



Crowdsourcing and Engaging Employees in Innovation: Three Field Studies

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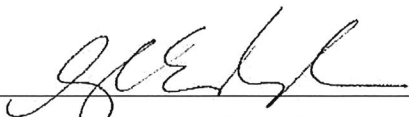
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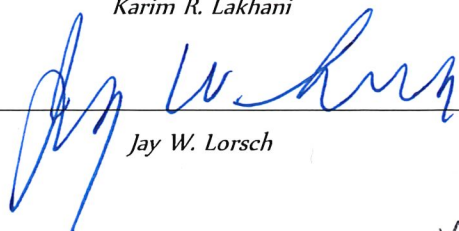
Olivia S. Jung

candidate for the degree of Doctor of Philosophy and hereby
certify that it is worthy of acceptance.

Signature 
Amy C. Edmondson, Chair

Signature 
Michaela J. Kerrissey

Signature 
Karim R. Lakhani

Signature 
Jay W. Lorsch

Date: May 13, 2021

CROWDSOURCING AND ENGAGING EMPLOYEES IN INNOVATION: THREE FIELD STUDIES

A dissertation presented

by

Olivia S. Jung

to

The Committee on Higher Degrees in Health Policy

in partial fulfillment of the requirements

for the degree of

Doctor of Philosophy

in the subject of

Health Policy (Management)

Harvard University

Cambridge, Massachusetts

May 2021

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**CROWDSOURCING AND ENGAGING EMPLOYEES IN INNOVATION:
THREE FIELD STUDIES**

ABSTRACT

This dissertation examines how crowdsourcing ideas, which opens up the opportunity to innovate, can engage employees to solve organizational problems. Across three field studies, I investigate: employees' responses to being invited to participate in idea generation and selection when such activities are not part of the day-to-day job, the impact of broadening the locus of innovation on existing organizational relationships and practices, and whether employees innovate more when crowdsourcing mechanisms are introduced.

In Study/Chapter 1, I posit that organization-wide innovation contests, a vehicle to crowdsource ideas, enable individual learning to become organizational learning. Contests allow employees to share knowledge and ideas for organizational improvement and to evaluate shared ideas through crowd voting. I find that a culture of learning plays a key role in facilitating employee participation in contests. In a cardiac center of an academic hospital (n=1,400) employees who perceived openness to new ideas and psychological safety were more likely to participate in ideation as well as voting. Innovation contests' potential to decentralize innovation and facilitate organizational learning may be greater in an environment that supports learning.

In Study/Chapter 2, I partnered with NASA for a qualitative study (n=53) and a field experiment (n=7,455) to understand employees' motivations to engage with a crowdsourcing platform and study the effectiveness of different recognition incentives. Qualitative findings

show that the perceived incongruence between crowdsourcing and organizational hierarchy disincentivized employees by creating concerns about the legitimacy of peer-based innovation. Experimental findings show that managerial recognition, the incentive that was congruent with the established hierarchy, significantly increased engagement, possibly by alleviating legitimacy concerns. These findings demonstrate the potential of recognition incentives—when they are aligned with prevalent organizational structure and culture—to assuage employees’ negative attitudes towards a new practice.

In Study/Chapter 3, I examined whether and how innovation contests could increase employees’ general engagement in innovation. In this multi-method study, I first conducted a field experiment with 53 community health centers (CHCs). Half of the randomly treated CHCs crowdsourced all employees for ideas to improve patient care. After the experiment, I interviewed 175 people spanning roles and levels from the same field sites to explore how and under what conditions this intervention works. My experimental findings evince that the intervention increased employees’ engagement in innovation by more than 35 percent, two months following the intervention. My qualitative findings suggest that the intervention (1) exposed managers to the usefulness of soliciting employee ideas, prompting them to keep soliciting ideas and (2) spurred employees to prioritize innovating on top of their day-to-day work. The intervention was particularly effective in organizations where employee ideas were not proactively sought prior to the intervention. This study illustrates that a crowdsourcing intervention that introduces an open and structured approach to innovation can motivate manager-employee communication in new ways.

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INTRODUCTION

Employees are well-positioned to innovate based on their firsthand knowledge of what is working and not working. Capturing their innovative solutions is critical for improving organizational functioning, learning, and performance (Argyris & Schön 1978; Bashshur and Oc 2015; Morrison & Milliken 2000).

However, employees' formal responsibilities seldom include tasks related to innovation, such as sharing suggestions or conceiving, designing, and implementing a new practice. Innovating is typically reserved for those in R&D or quality improvement roles, and not those on the frontline who are focused on executing customer- or patient-facing, operational tasks (Blasco et al. 2019). Consider a medical assistant who supports several physicians and patient care teams. His or her workdays comprise checking in patients, documenting their medical history, assisting the care team, and scheduling appointments. While immersed in these tasks, the medical assistant is likely to think of at least one idea about optimizing the care delivery process or improving the patient experience. But, in the absence of an appropriate outlet, reward, and training for sharing and acting on such ideas, the medical assistant will likely dismiss his or her idea, create a workaround to patch up the issue, then carry on with other, more core tasks (Tucker & Edmondson 2003). A potentially impactful idea becomes a missed opportunity for the organization.

In addition, while managers want employees to put in a hard day's work *and* engage in additional activities to better the organization, various workplace surveys consistently describe stressed and disengaged employees (Gallup 2017). Stress and burnout is prevalent among employees in the health care industry in particular, due to the intensity of clinical work, time pressure, and limited control over work processes (Friedberg et al. 2017; Mata et al. 2015;

Rotenstein et al. 2016; Shanafelt et al. 2015). According to a national study, more than half of U.S. physicians indicated at least one sign of burnout in 2014. Nurses also report a high degree of emotional exhaustion (McHugh et al. 2011). Moreover, there may be psychological, interpersonal barriers to participate in organizational improvement (Nembhard & Edmondson 2006). Expecting already stretched-thin employees to contribute time and effort beyond the job requirement may be unrealistic and even naïve.

This dissertation examines crowdsourcing, a distributed innovation mechanism that opens up the outlet and occasion to innovate (Jeppesen & Lakhani 2010; Majchrzak & Malhotra 2020), and how uses of crowdsourcing can engage employees in innovation. Crowdsourcing draws from widespread knowledge and skills through a broadcast call and search for ideas. A defining feature of crowdsourcing is its reliance on voluntary contributions. For example, open-source software developers write and share their code, revealing proprietary information and allowing strangers to benefit from their work at no cost (Lakhani & Wolf 2005). Similarly, in company-hosted user communities, users freely provide valuable ideas and feedback on companies' product platform. The company then adopts user input in its development of new products to sell to users (Jeppesen & Frederiksen 2006). Research on what motivates people to participate in crowdsourcing and freely contribute ideas attributes these seemingly irrational and altruistic behaviors to non-pecuniary motivations, such as the fun in problem-solving, intellectual stimulation, social acceptance, and recognition (Gallus 2017; Huberman et al. 2009; Lakhani & Wolf 2005; Jeppesen & Frederiksen 2006; Piezunka and Dahlander 2019).

Within an organization, then, crowdsourcing employees for ideas for new products, services, or ways of working may offer similar, non-conventional benefits, such as the opportunity to be heard by management, to contribute to organizational innovation, and to

participate in a fun activity outside of day-to-day work. Such opportunities, enabled by expanding the locus of innovation, may motivate discretionary, citizenship behaviors like solving organizational problems and speaking up about organizational issues. However, while a growing number of organizations are tapping employees for ideas using crowdsourcing mechanisms (Zuchowski et al. 2016; Malhotra et al. 2017; Williams 2019), we still know little about their impact on employee behaviors and organizational practices. How does broadening the locus of organizational innovation impact existing relationships and practices? How do people react to being invited to participate in idea generation and selection when such activities are not part of day-to-day tasks? Do people innovate more when crowdsourcing technology and platforms are introduced?

To answer these questions, I conducted three field studies in this dissertation. I used myriad research methods, such as field experiments, surveys, and interviews, as complexities of organizational life requires flexible approaches to study. I partnered with organizations to collect original data from the field to explore the social contexts of people and processes.

In Study/Chapter 1, co-authored with Karim Lakhani and Andrea Blasco, we posited that organization-wide innovation contests—a vehicle to crowdsource ideas—enable individual learning to become organizational learning. Contests allow employees to share knowledge and ideas for organizational improvement and all are invited to evaluate shared ideas through crowd voting. We hypothesized that whether employees participate in contests likely depends on their perceived organizational support for learning. We designed and implemented an innovation contest at a cardiac center (n=1,400) within an academic hospital and before the contest, surveyed employees about the learning-oriented culture, practices, and leadership in the center. Our findings indicate that a culture of learning plays a key role in facilitating participation;

employees who perceived openness to new ideas and psychological safety were more likely to participate in ideation as well as voting. We conclude that innovation contests' potential to decentralize innovation and facilitate organizational learning may be greater in an environment that supports learning.

In Study/Chapter 2, co-authored with Jana Gallus and Karim Lakhani, we partnered with NASA for a qualitative study and a field experiment (n=7,455) to understand employees' motivations to engage with a crowdsourcing platform and study the effectiveness of different recognition incentives. Our qualitative findings show that the perceived incongruence between crowdsourcing and organizational hierarchy disincentivizes employees by creating concerns about the legitimacy of peer-based innovation. Our experimental findings show that managerial recognition, the incentive that is congruent with the established hierarchy, significantly increases engagement, possibly by alleviating legitimacy concerns. We do not find support for the overall effectiveness of peer recognition, the incentive that is congruent with the peer-based approach to innovation. These findings demonstrate the potential of recognition incentives—when they are aligned with prevalent organizational structure and culture—to assuage employees' negative attitudes towards a new practice.

In Study/Chapter 3, I examined whether and how innovation contests could increase employees' general engagement in innovation. In this multi-method study, I first conducted a field experiment with 53 community health centers (CHCs). Half of the randomly treated CHCs crowdsourced all employees for ideas to improve patient care. After the experiment, I interviewed 175 people spanning roles and levels from the same field sites to explore how and under what conditions this intervention works. My experimental findings evince that the intervention increased employees' engagement in innovation by more than 35 percent, two

months following the intervention. My qualitative findings suggest that the intervention (1) exposed managers to the usefulness of soliciting employee ideas, prompting them to keep soliciting ideas and (2) spurred employees to prioritize innovating on top of their day-to-day work. The intervention was particularly effective in organizations where employee ideas were not proactively sought prior to the intervention. This study illustrates that a crowdsourcing intervention that introduces an open and structured approach to innovation can motivate manager-employee communication in new ways.

CHAPTER 1. A CULTURE OF LEARNING SUPPORTS INNOVATION CONTEST PARTICIPATION

1.1. Summary

Employees are well-positioned to conceive improvement opportunities based on firsthand knowledge of what works and what does not work. Innovation contests may be a useful vehicle to capture such knowledge and ideas. We posit that contests enable individual learning to become organizational learning as employees practice creativity and initiative to share ideas for improvement and all ideas are reviewed by organizational members through voting. Whether employees participate in contests likely depends on organizational support for learning. In this study, we examined how employees' perception of a learning-oriented culture, practices, and leadership affected contest participation.

We studied an innovation contest implemented in a cardiac center within an academic hospital ($n=1,400$). The contest invited all clinicians and support staff to participate in ideation and voting. We used the 27-item Learning Organization Survey to measure employee perception of a learning-oriented environment, practices and processes, and leadership. Our study sample consisted of 25% of the cardiac center employees that completed the LOS. Of those, 11% participated in ideation, 31% participated in voting, and 9% participated in both.

The intervention effectively decentralized the locus of innovation; employees who typically did not have the opportunity to share input or assess input by others (e.g., nurses, front desk staff) could do so through the contest platform. Perceptions of a learning-oriented culture predicted participation in ideation and voting. These findings indicate that contests may serve as a productive outlet through which employees can share ideas and learn from others' ideas. To promote such learning, it is important for managers to create an environment wherein employees feel safe to voice new ideas and differences are appreciated.

1.2. Background

Frontline employees are well-positioned to conceive improvement opportunities based on firsthand knowledge about what works and what does not work. From day-to-day work and interactions with customers (patients), employees are acutely aware of operational deficiencies (Tucker & Singer, 2015), motivated to make changes to improve their work environment (Tucker, Edmondson, & Spear, 2002), and bring multifaceted perspectives to problem-solving processes (MacDuffie, 1997). Growing economic pressures, demand for high-quality, patient-centered care, and need for rapid information processing compel managers to rely on bottom-up contribution of ideas to aid decision-making. In health care organizations, utilizing suggestions from employees is associated with improved processes (Frankel et al., 2008) and improved quality of care (Nembhard & Tucker, 2011).

Innovation contests, which draw on principles of open or distributed innovation (Boudreau, Guinan, Lakhani, & Reidl, 2016; Guinan, Boudreau, & Lakhani, 2013), may be a useful vehicle to gather ideas for improvement. Within organizational boundaries, the contest mechanism capitalizes on the creativity of a large and diverse employee population. This bottom-up approach to innovation contrasts from the top-down approach in which a few individuals, such as senior executives and administrators, steer the course of innovation. In this way, contests “democratize innovation” (von Hippel, 2005) by shifting the locus of idea generation and sharing to physicians, advanced practitioners, nurses, administrative and support staff, who possess intimate knowledge of patients and care delivery processes.

However, whether contests effectively generate innovation from frontline employees likely depends on employees’ view of their organization, such as the organization’s support for learning. Organizational support for learning manifests in a culture that appreciates differences

and welcomes new ideas, work practices that facilitate information flow, and leader behaviors that invite and attend to employee input (Garvin, Edmondson, & Gino, 2008). When employees perceive poor learning-oriented culture, practices, and leadership, they may be less willing or able to speak up about ways to improve the status quo. When employees recognize an adequate platform to share ideas and that sharing their ideas is not interpersonally risky, they may be more likely to participate in contests.

In this study, my co-authors and I examined the innovation contest conducted in a health care organization. The contest solicited clinicians and staff to share and evaluate ideas to improve patient care. Specifically, we studied how their perception of organizational support for learning affected contest participation. To formulate our hypotheses, we drew from the literature on innovation contests, employee creativity and initiative, and organizational learning. We show that contests that broadcast a search for improvement opportunities can elicit many ideas addressing wide-ranging issues. We also show that the extent to which contests enable employee participation in organizational improvement depends on their perceived support for learning; those who perceive a supportive learning culture were more likely to share and evaluate ideas than those that did not.

1.2.1. Innovation Contests Democratize Innovation

Contests are effective platforms for eliciting innovation (Terwiesch & Ulrich 2009; Terwiesch & Xu 2008). The contest host seeks to solve problems through an open call for solutions from the crowd. Invited contestants submit ideas. Following ideation, ideas are evaluated and a few emerge as winners.

One central feature of innovation contests is the decentralization of the creative process across large and diverse groups of contestants. The contest mechanism can draw participants

from a broad spectrum of backgrounds in terms of technical expertise as well as social status (Guinan et al., 2013; Jeppesen & Lakhani, 2010). This feature effectively expands the locus of innovation, captures knowledge that is localized and embedded in practice (Carlile, 2002), and enables generation of novel solutions. The size and diversity of the problem-solving population are positively associated with problem-solving success (Terwiesch & Xu 2008). Thus, innovation contests offer an idea-sharing platform to those previously unable to voice ideas, and contest organizers can benefit from these opportunities.

The concept of seeking employee input on organizational improvement is not new. Prior research documents examples of suggestion programs across industries (e.g., Frese, Teng, & Wijnen, 1999; Harlos, 2001). Like these programs, contests seek input from employees, but unlike them, contests also solicit participants to evaluate submitted ideas following ideation. Inviting employees to review and vote on coworkers' ideas that they deem as important allows participation in idea selection, an additional, important aspect of innovation (Keum & See, 2017) and a task typically reserved for managers and decision-makers.

1.2.2. Contest Participation Entails Creativity and Initiative

Making a suggestion entails at least two behavioral elements: creativity and initiative (Frese et al., 1999). First, the literature on creativity conceptualizes giving suggestions as producing novel and useful ideas (Amabile, 1996). Employees' domain-relevant skills, capacity to think creatively, cognitive abilities, personality, and social factors all influence their likelihood of engaging in creative acts such as developing a suggestion or an idea. Second, the literature on initiative characterizes a suggestion-giving employee as self-starting and proactive (Frese & Fay, 2001). Sharing an idea implies that one is sufficiently interested in work to think about improvement opportunities, motivated to act on an observed problem or inefficiency, and

committed to flesh out the idea. This conceptualization is similar to the concept of employee voice, or “discretionary communication of ideas, suggestions, concerns, or opinions about work-related issues” (Morrison, 2011, p.375) that challenges the status quo and seeks to enhance organizational functioning (LePine & Van Dyne 1998). Thus, we view innovation contests as a platform through which employees can practice creativity and initiative through ideation.

Participating in evaluation of ideas through voting aligns with this view. Reviewing and assessing ideas through voting implies organizational creativity, as individuals in a social system work together to develop a creative solution (Woodman, Sawyer, & Griffin, 1993). The voting process filters and ranks ideas according to the participants’ perspective. As for showing initiative, taking time to appraise ideas and select promising ones indicates interest and intention to contribute to organizational improvement. The voting mechanism enables participants to proactively convey opinions about which ideas are novel and useful.

1.2.3. Hypotheses Development

We hypothesize that employee perception of organizational support for learning predicts participation in contests, namely ideation and voting. Organizational learning refers to improving organizational processes and performance via integration of new experiences and knowledge (Argote & Miron-Spektor, 2011; Levitt & March, 1988). Employees play an essential role in organizational learning as the “carriers, interpreters, and appliers of knowledge” (Groysberg & Lee, 2009, p.741). Contests offer a channel through which employees can share their knowledge of problems and solutions encountered in daily work, facilitating organizational learning. In this way, contests enable individual learning to become organizational learning as employees develop and share ideas, and all submitted ideas are evaluated by colleagues and managers. Thus, the

perceived extent to which the organization promotes learning-oriented culture, practices, and leadership is likely to affect employees' likelihood to participate in contests.

We employ the framework developed by Garvin, Edmondson, and Gino (2008) to assess organizational support for learning. To aid concrete understanding and measurement of being a “learning organization”, Garvin et al. discuss three building blocks that are critical for organizational learning. The first building block, *supportive learning environment*, is characterized by psychological safety, appreciation of differences, openness to new ideas, and time for reflection. Second, *learning processes and practices* aid generation, collection, interpretation, and dissemination of information. Third, *leadership that reinforces learning* empowers employees to engage in learning. While each block and its subcomponents are conceptualized as discrete, independent, and measured separately, when present together, they synergize and reinforce one another.

Below, we present hypotheses on how each building block underlying organizational learning relates to contest participation, or an opportunity for employees to exercise creativity and initiative.

Supportive learning environment. Speaking up with suggestions can challenge the status quo and feel interpersonally risky. Detert and Edmondson (2011) show that individuals hold taken-for-granted beliefs about when and why speaking up at work feels risky or inappropriate. These beliefs include assuming those higher in the organizational hierarchy will receive suggestions as criticism or that speaking up will be interpreted as being disloyal. Such a sense of threat or risk etiolates employees' willingness to take initiative (Detert & Edmondson, 2011; Milliken, Morrison, & Hewlin, 2003). In contrast, an open and safe culture promotes personal engagement at work (Kahn, 1990). When people can trust that they will not suffer the negative

consequences of voicing opinions, they “employ and express themselves physically, cognitively, and emotionally” (Kahn, 1990, p.694). In general, norms that support open sharing of information and highly participative work systems are associated with organizational creativity (Woodman et al., 1993). Another aspect of learning environment is time for reflection. High work volume, pressure, and stress present obstacles for creativity (Amabile, 1996) and reduce efforts towards innovation that tend to conflict with production (Oliva, 2001). Without sufficient slack time to think about improving existing processes, employees cannot learn from, diagnose, and speak up about latent problems (Tucker et al., 2002). Thus, when employees discern that their input is welcome and have time to reflect on improvement opportunities, they are more likely to share ideas for improvement via contest participation.

Hypothesis 1. Employee perception of a supportive learning environment is positively associated with contest participation.

Learning practices and processes. Organizational learning occurs when new experiences and knowledge accumulate internally (e.g., by encouraging individuals to be observant) and externally (e.g., by adopting best practices from other organizations) (Argote & Miron-Spektor, 2011; Levitt & March 1988). Mechanisms that facilitate information flow include experimenting with new products, services, or ways of working; acquiring information from experts or customers; monitoring and analyzing performance data to diagnose and resolve areas of underperformance; and educating and training employees (Garvin et al., 2008). These mechanisms are designed to facilitate a continuous exchange of knowledge and ideas, which is linked to creativity (Woodman et al., 1993). Moreover, employees equipped with organizational knowledge are more likely to be committed to their organization and engage in citizenship behaviors, such as suggestion-giving (Podsakoff, Mackenzie, Paine, & Bachrach, 2000). Thus,

when concrete learning practices and processes provide opportunities for employees to gain experiences and develop knowledge, they are more likely to engage with critical thinking and problem solving via contest participation.

Hypothesis 2. Employee perception of learning practices and processes is positively associated with contest participation.

Leadership that reinforces learning. Through words and actions that signal invitation and appreciation for employee input, coupled with willingness to effectuate change based on that input, leaders can create an environment characterized by psychological safety and learning orientation (Milliken et al., 2003; Nembhard & Edmondson, 2006). Leaders at all levels—senior managers, middle managers, and direct supervisors—all play a crucial role in fostering a learning-oriented culture by being accessible and accepting failures as learning opportunities (Edmondson, 2012). These behaviors may diminish the salient power differential between leaders and subordinates and embolden employees to offer ideas. Empirical studies attest that supportive leader behaviors lead to improved creativity (Amabile, 1996), speaking up (Detert & Burris, 2007), suggestion-giving (Frese et al., 1999), and initiative (Podsakoff et al., 2000). Thus, when employees discern that their leaders appreciate and encourage feedback, they are more likely to contribute input via contest participation.

Hypothesis 3. Employee perception of leadership that reinforces learning is positively associated with contest participation.

1.3. Methods

1.3.1. Research Setting and Design

We conducted a cross-sectional study of an innovation contest implemented in a hospital-based cardiac center consisting of roughly 1,400 employees. All cardiac center employees,

including residents and fellows in internal medicine involved with cardiac care, were invited to participate. The publicized goals of the contest were broadly defined: improve patient care, improve workplace efficiency, and lower costs of care. The contest was collaboratively designed by the Healthcare Transformation Lab (HTL) at Massachusetts General Hospital and researchers at Harvard Business School (HBS). The contest began with a four-week long ideation phase. Ideation entailed describing a “pain point” faced at work and a solution that addresses it. Each response was limited to 300 words. One could submit more than one set of pain point and solution. Next was a two-week long crowd-voting phase, during which voters would log into a website, view all of the submissions presented in a random order, and rate each one on the scale of 1 (low quality) to 5 (high quality). All submissions presented on the website were copy-edited to ensure anonymity and clarity. Four contest participants who submitted ideas that received the highest average rating won an iPad Mini as a prize.

1.3.2. Data Collection

Both ideation and voting took place online, and an institutional email login was required to participate. We collected all submissions, each identifiable by the participant’s email address.

Prior to the start of the contest, we administered the short-form Learning Organization Survey (LOS), developed and validated by Singer, Moore, Meterko, and Williams (2012). The LOS measures the extent of learning occurring in an organization across units and levels of hierarchy (Garvin, et al., 2008). The original version of the LOS consists of 55 items in three domains corresponding to our three hypotheses: supportive learning environment, learning practices and processes, and leadership that reinforces learning. The short-form LOS, used in our study, consists of 27 items, retains the original conceptual model, and was condensed for use in over-surveyed health care settings. Singer et al. (2012) assessed the empirically derived factor

structure of the short-form LOS and found support for goodness of fit, internal consistency reliability, and robustness. The survey asked respondents to agree or disagree with 27 statements, presented in a random order, on the scale of 1 (strongly disagree) and 7 (strongly agree). At the end of the survey, respondents were asked to identify their gender, age, and years worked in the cardiac center. Through the hospital's human resource system, we identified respondents' role and involvement with direct patient care.

We deployed the short-form LOS to all cardiac center employees over email for three weeks. To encourage completion, unit leaders sent reminder emails and the HTL arranged lunch and snack breaks for people to stop by and take the survey. Upon completion, respondents received a \$5 gift card to redeem at a hospital café. To minimize bias from a possible suspicion that the contest and the LOS were related, announcements and advertisements occurred at different times by different sponsoring groups (i.e., the contest by HTL and LOS by HBS).

1.3.3. Data Analysis

We tested our hypotheses using analysis of variance, logistic regression, and predicted probabilities. We examined the significance and direction of the coefficient to ascertain whether our hypotheses were supported. All analyses were performed using Stata 13.0.

We summarized the means, standard deviations, and percentages of positive responses of all survey items. We determined the percentage of positive responses by combining the responses that agreed or strongly agreed with a given statement (or disagreed or strongly disagreed for negatively worded statements). To compare the LOS results between those that participated in ideation and voting and those that did not, we used the Wilcoxon rank-sum test, which seemed appropriate for our ordinal survey responses with a skewed-to-the-left distribution.

We used logistic regression models, as our dependent variables—participation in ideation and voting—were binary. As for independent variables, we used Singer et al. (2012)’s seven-factor model of a learning organization. This model includes two measures on learning culture, four measures on learning processes and practices, and one measure on leadership. Cultural factors comprised a *learning environment* that appreciates differences and allows employees to feel safe about speaking up and *time for reflection*. Learning processes and practices comprised *experimentation*, *training*, *knowledge acquisition*, and *performance monitoring*. *Leadership that reinforces learning* comprised items relating to whether managers invite employee input, listen attentively, and provide time and venue for reflection. We assessed the internal consistency of the scales by computing the Cronbach’s alpha (α) and discriminant validity by comparing the strength of each scale’s internal consistency to correlations with other scales. Reliability for all scales exceeded conventional standards ($\alpha > 0.70$). Correlations among scales (average of 0.56) were lower than intrascale correlations. We included gender and tenure as control variables as the male gender and those with a longer tenure are more likely to voice suggestions than the female gender and those with a shorter tenure (Detert & Burris, 2007; LePine & Van Dyne, 1998). In logistic regression models, odds ratios (ORs) show how variables are related. In our study, an OR of greater than one indicated a higher likelihood of contest participation given an increase in the level of a predictor (i.e., perceived support for learning). Conversely, an OR less than one indicated a lower likelihood of contest participation.

Lastly, we used predicted probabilities to estimate the marginal effects of organizational support for learning on contest participation. For each measure of learning included in the model, we computed the probability of participation for an individual. For example, the probability of ideation was compared between employees who indicated neutrality in their perception (i.e.,

selecting a 4 on the scale of 1 to 7) and employees who indicated moderate positivity in his or her perception (i.e., selecting a 5 on the scale of 1 to 7).

1.4. Results

1.4.1. Contest Results

Seventy-two clinicians and staff submitted 138 ideas. Of the participants, 26% were physicians, 8% were nurse practitioners or physician assistants, 38% were nurses, 14% were administrative or clerical staff, and 10% were researchers. A vetting process that screened out duplicative ideas determined that 125 ideas were fit for voting. In terms of voting, 245 employees participated. Forty-nine participated in both ideation and voting.

1.4.2. Hypothesis Test Results

Our study sample for hypothesis-testing consisted of 25% of the cardiac center employees that completed the LOS. Of the 354 survey respondents, 39 participated in ideation (11%), 110 participated in voting (31%), and 31 (9%) participated in both ideation and voting.

Hypothesis-testing results are shown in Tables 1.1 and 1.2. Hypothesis 1 predicted that supportive learning environment, as perceived by employees, would be positively associated with contest participation. Overall, employees that participated in ideation reacted more positively to the statements on learning environment than non-participants. In particular, items on appreciation for new ideas ($p<0.10$), welcoming differences in opinions ($p<0.05$), and allowing mistakes ($p<0.05$) showed significant differences between participants and non-participants. Our logistic regression analysis suggests that one standard deviation (SD) increase in the perception of there being a learning environment was associated with a 76% increase in the odds of ideating ($OR=1.76$, $CI=1.07-2.89$), and a 55% increase in the odds of voting ($OR=1.55$, $CI=1.13-2.12$). Predicted probabilities show that an employee who somewhat

perceived learning-oriented environment (i.e., selecting a 5 on the scale of 1 to 7) had a 33% likelihood of participating in voting, while an employee who strongly perceived a learning-oriented environment (i.e., selecting a 7 on the scale of 1 to 7) had a 54% likelihood of participating.

Table 1.1. Learning Organization Survey Results Overall and Comparison by Participation in Ideation

	Overall		Ideation		No Ideation		p [#]
	Avg. (SD)	Pos. %	Avg. (SD)	Pos. %	Avg. (SD)	Pos. %	
LEARNING ENVIRONMENT							
In this workgroup, people value new ideas [^]	4.87 (1.61)	44%	5.26 (1.53)	56%	4.82 (1.61)	42%	0.08
Differences in opinions are welcomed in this workgroup*	4.68 (1.58)	37%	5.18 (1.12)	54%	4.62 (1.61)	35%	0.03
In this workgroup, people are open to alternative ways of getting work done	4.65 (4.65)	37%	4.82 (1.50)	41%	4.63 (1.62)	36%	0.54
This workgroup engages in productive conflict and debate during discussions	4.50 (1.62)	32%	4.82 (1.35)	38%	4.46 (1.64)	32%	0.22
In this workgroup, we frequently identify and discuss underlying assumptions that might affect key decisions	4.60 (1.57)	35%	4.79 (1.28)	36%	4.58 (1.60)	35%	0.60
People in this workgroup are eager to share information about what doesn't work and what does work	5.10 (1.53)	49%	5.10 (1.57)	56%	5.10 (1.53)	49%	0.81
If you make a mistake in this workgroup, it is often (not) held against you*	4.66 (1.60)	38%	5.28 (1.39)	51%	4.58 (1.61)	37%	0.01
There is (simply no) time for reflection in this workgroup	4.32 (1.65)	31%	4.67 (1.63)	41%	4.28 (1.65)	30%	0.14
In this workgroup, people are (not) too busy to invest time in improvement	4.18 (1.73)	31%	4.33 (1.71)	36%	4.17 (1.74)	30%	0.59
LEARNING PRACTICES AND PROCESSES: EXPERIMENTATION							
This workgroup experiments frequently with new product/ service offerings*	4.66 (1.52)	37%	4.18 (1.64)	28%	4.72 (1.50)	38%	0.04
This workgroup experiments frequently with new ways of working	4.24 (1.59)	26%	4.41 (1.50)	26%	4.22 (1.60)	26%	0.51
This workgroup frequently employs pilot projects or simulations when trying out new ideas	4.66 (1.60)	35%	4.67 (1.63)	33%	4.65 (1.59)	35%	0.97
This workgroup has a formal process for conducting and evaluating experiments or new ideas	4.24 (1.59)	25%	4.49 (1.65)	28%	4.21 (1.59)	25%	0.23

Table 1.1. Learning Organization Survey Results Overall and Comparison by Participation in Ideation (continued)

LEARNING PRACTICES AND PROCESSES: TRAINING							
Experienced employees in this workgroup receive training when shifting to a new position	4.93 (1.31)	42%	4.77 (1.37)	38%	4.95 (1.31)	42%	0.39
Experienced employees in this workgroup receive training when new initiatives are launched	5.30 (1.36)	57%	5.46 (1.33)	64%	5.28 (1.37)	56%	0.37
Newly hired employees in this workgroup receive adequate training	5.22 (1.48)	55%	5.31 (1.38)	56%	5.21 (1.50)	55%	0.81
LEARNING PRACTICES AND PROCESSES: KNOWLEDGE ACQUISITION							
This workgroup has forums for meeting with and learning from: Experts from outside the organization	4.47 (1.63)	33%	4.59 (1.46)	28%	4.45 (1.65)	34%	0.78
This workgroup has forums for meeting with and learning from: Experts from other departments/ teams/divisions	4.52 (1.56)	34%	4.64 (1.48)	36%	4.50 (1.57)	34%	0.65
This workgroup has forums for meeting with and learning from: Customers/clients	3.98 (1.59)	22%	4.13 (1.56)	23%	3.96 (1.60)	22%	0.55
This workgroup regularly conducts post audits, after- action reviews, and debriefings	4.08 (1.55)	22%	3.92 (1.42)	13%	4.10 (1.57)	23%	0.49
LEARNING PRACTICES AND PROCESSES: PERFORMANCE MONITORING							
This workgroup frequently compares its performance to: Best- in-class organizations	4.49 (1.63)	33%	4.64 (1.66)	15%	4.47 (1.62)	32%	0.47
This workgroup frequently compares its performance to: Other similar workgroups	4.25 (1.49)	23%	4.15 (1.33)	15%	4.26 (1.51)	24%	0.72
This workgroup consistently collects information on technological trends	4.46 (1.46)	29%	4.41 (1.57)	31%	4.47 (1.45)	29%	0.74
LEADERSHIP THAT REINFORCES LEARNING							
My manager(s) establish(es) forums for and provide(s) time and resources for identifying problems and organizational challenges	4.76 (1.64)	42%	4.79 (1.49)	41%	4.76 (1.66)	42%	0.93
My manager(s) establish(es) forums for and provide(s) time and resources for reflecting and improving on past performance	4.69 (1.65)	39%	4.79 (1.51)	33%	4.67 (1.67)	40%	0.89
My manager(s) listen(s) attentively	5.45 (1.57)	66%	5.67 (1.53)	72%	5.43 (1.58)	66%	0.24
My manager(s) invite(s) input from others in discussions	5.32 (1.53)	60%	5.49 (1.32)	64%	5.30 (1.56)	59%	0.62

Notes. Responses are on the scale of 1 (strongly agree) and 7 (strongly disagree). Avg.: average. SD: standard deviation. Pos. %: agree or strongly agree. #Based on a two-sample Wilcoxon rank-sum test (Mann-Whitney test). ^ $p < 0.10$, * $p < 0.05$.

Hypothesis 2 predicted that learning practices and processes would be positively associated with contest participation. Our results provide a mixed support for this hypothesis.

Ideation participants' perception of experimentation was lower compared to non-participants'; the less a frontline staff perceived that experimentation was taking place, the more he or she was likely to participate in ideation and voting. According to adjusted predictions, an employee that indicated neutrality in perceiving organizational support for experimentation (i.e., selecting a 4 on the scale of 1 to 7) had a 11% likelihood of ideating; an employee that indicated moderate positivity in perception (i.e., selecting a 5 on the scale of 1 to 7) had a 8.5% likelihood of ideating; and an employee that indicated strong positivity in his or her perception (i.e., selecting a 7 on the scale of 1 to 7) had a 4.7% likelihood of ideating. We did not detect significant association between participation and other learning practices.

Table 1.2. Logistic Regression Analysis Results

	Cronbach's alpha & correlation coefficients							Participated in ideation (n=39)		Participated in voting (n=110)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	OR ^a	CI ^b	OR ^a	CI ^b
(1) Learning environment	<i>0.91</i>							1.76*	1.07-2.89	1.55**	1.13-2.12
(2) Time for reflection	0.55	<i>0.76</i>						1.08	0.81-1.44	0.94	0.77-1.14
(3) Experimentation	0.71	0.47	<i>0.85</i>					0.73	0.47-1.13	0.69*	0.51-0.93
(4) Training	0.64	0.46	0.58	<i>0.77</i>				0.79	0.51-1.22	1.16	0.87-1.55
(5) Knowledge acquisition	0.59	0.48	0.72	0.61	<i>0.82</i>			1.12	0.72-1.74	0.95	0.70-1.27
(6) Performance monitoring	0.52	0.41	0.56	0.47	0.63	<i>0.73</i>		0.90	0.62-1.30	0.96	0.75-1.24
(7) Leadership	0.65	0.45	0.66	0.57	0.59	0.50	<i>0.90</i>	1.04	0.73-1.50	0.94	0.74-1.19
(8) Gender ^c								0.73	0.32-1.68	0.63	0.36-1.12
(9) Tenure								1.01	0.99-1.04	0.99	0.97-1.01
Constant								0.92*	0.01-0.98	0.94	0.19-4.67

Notes. Cronbach's alpha coefficients are presented on the diagonal in italics. The model with nine predictors and ideation as the dependent variable had the likelihood ratio chi-square of 8.90 and a p-value of 0.45. The model with nine predictors and voting as the dependent variable had the likelihood ratio chi-square of 16.75 and p-value of 0.05. When we adjust p-values using the Bonferroni method, learning environment and experimentation coefficients predicting voting become significant at 10%. Other predictors lose their statistical significance. ^aOR: odds ratio. ^bCI: confidence interval. ^c1 = male. * $p < 0.05$, ** $p < 0.01$.

Our results provided no support for hypothesis 3. Although the direction of the coefficient was positive for ideation (one standard deviation increase in perceived leadership support for learning was associated with 4% increase in the odds of ideation (CI=0.73-1.50)) the magnitude of the effect was small.

1.5. Discussion

The innovation contest implemented at the hospital-based cardiac center in this study generated solutions addressing a wide-range of issues, including patient experience, cost of care, workflow, and access. Our results show a positive relationship between contest participation and a supportive learning environment as perceived by employees.

1.5.1. Theoretical Implications

Our findings have several theoretical implications for research on innovation contests and employee creativity and initiative. First, to our knowledge, this is one of the first studies examining an innovation contest implemented within an organization. In line with prior work on contests (e.g., Jeppesen & Lakhani, 2010) and the only other paper that discusses innovation contests in the health care context (Terwiesch, Mehta, & Volpp, 2013), the contest in our setting decentralized innovation. Employees who typically did not have the opportunity to share input or assess input by others could do so through the contest platform. Winning ideas, determined as winners via voting, came from an administrative staff, physician fellows, and nurses.

Second, we show that a supportive learning environment encouraged participation in both ideation and voting. Our results are in line with prior research that evinces the relationship of psychological safety (an important component of a learning-oriented environment) to voice (Detert & Burris, 2007) and engagement with quality improvement (Nembhard & Edmondson, 2006). The results concerning voting are interesting, as it represents employees' interest in

learning about the improvement ideas raised by their coworkers and offer perspective on idea quality and importance—rather than voicing an idea of their own. We show that employees’ perception of organizational openness to differences and psychological safety predicts participation in voting.

Lastly, a limited experience with organizational experimentation motivated participation. Employees perceiving insufficient consideration of new products or services were more likely to contribute ideas, or take advantage of the platform through which one could suggest new ways of working. Research on employee initiative describes individual and organizational predictors such as perceived efficacy and safety of involvement (Morrison, 2011; Podsakoff et al., 2000) but is largely silent on the role of existing organizational practices such as experimentation. Our findings suggest that contests may serve as an outlet through which employees can share and learn new ideas, especially for those who believe that new ideas are not tried and tested frequently enough.

1.5.2. Practice Implications

A highly visible organizational intervention like innovation contests has both benefits and risks. Potential benefits include increasing employees’ engagement with work. In conversations with contest participants, several used the word “fun” when discussing their experience. One administrative staff shared being “really excited” to go through all of the submitted ideas for voting. Similarly, a physician fellow described her favorite part of the contest as reading through the ideas to find out “how lots of people from different spheres actually have same issues” and that she is “not alone in complaining about something”. Another participant, a physician fellow, shared that he enjoys computer programming, and leaned on this hobby to propose writing a computer code that would extract information from the scheduling database to display patients’

wait time in the waiting area. These findings suggest that in health care organizations where work is predominantly procedure-based and task-oriented, innovation contests could prompt a different pace and type of thinking that may be refreshing and enjoyable for employees.

Potential risks include frustration and discontent if there is no desired change after the contest takes place. While contests convey management's interest in employee input, a return to the status quo after an intervention like the contest that widely solicits employee input can cause and reinforce any negative attitudes towards management (Harlos, 2001). In our case, managers did not always select the ideas that were highly rated by employees for implementation. One nurse whose idea did not get chosen said he felt a "sense of loss" and wondered how his idea "fell short". To avoid such scenarios, contest organizers could articulate the criteria that management will use to evaluate ideas prior to start and more importantly, frame and use the contest as an opportunity to connect with employees. One purpose of implementing innovation contests is to allow employees to voice ideas based on their experiences and point of view. While employee suggestions may not always align with organizational priorities and resources may not be available to address all of the submitted ideas, managers could regard contests as an opportunity to learn what concerns employees in their day-to-day work and communicate such aim to employees.

1.5.3. Limitations

Several limitations to this study should be acknowledged. First, our sample included about one fourth of the cardiac center, or just those that completed the Learning Organization Survey (LOS). We noted a low response particularly among physicians (less than 20%). To adjust for the different rates of non-response by job type, we conducted an additional analysis where we weighted the responses by the inverse of the non-response rate for the respondent's job

type. For example, if the response rates for physicians, nurses, and administrative staff were 25%, 40%, and 50%, respectively, then we weighted the relevant responses by factors of 4, 2.5, and 2 to account for non-responders (Dillman, Eltinge, Groves, & Little, 2001). The results of this analysis did not differ much from the non-weighted analysis (reported in Table 1.2), suggesting that our overall results would not be strongly affected by non-response bias. Second, self-reported survey data may be subject to social desirability bias. While we assured confidentiality of responses, it is unclear how much our efforts or respondents' social desirability affected our LOS data. Third, we suspect that our lack of significant results for the third hypothesis on leadership support and ideation is due to difficulties in defining the "manager". In the cardiac center where our study was conducted, the managerial behaviors that the LOS inquires about could be fulfilled by a supervisor, senior manager, or whomever the employee might regard as their manager (e.g., attending physician to residents). Although we included the instruction, "For questions related to 'your manager', please consider this your direct report manager," in the instruction, specifying the managerial level (e.g., middle manager, senior manager) and type (e.g., clinical, administrative) could have been helpful. Lastly, our study is limited to a single unit within an organization. Conducting innovation contests in multiple units and/or organizations would add generalizability to our results and allow exploration of whether contest participation relates to organizational factors such as quality improvement needs and patient volume.

CHAPTER 2. RECOGNITION INCENTIVES FOR INTERNAL CROWDSOURCING: A QUALITATIVE STUDY AND FIELD EXPERIMENT AT NASA

2.1. Summary

How can organizations motivate employees to engage in crowdsourcing? Should they use incentives that are congruent with their established hierarchical structures, or incentives that are aligned with the aspirational, peer-based approach to innovation that crowdsourcing represents? We partnered with NASA for a qualitative study and a field experiment ($n=7,455$) to understand employees' motivations to engage in crowdsourcing, and to study the effectiveness of different recognition incentives. First, we find that the perceived incongruence between crowdsourcing and organizational hierarchy disincentivizes employees by creating concerns about the legitimacy of peer-based innovation. Second, we find that managerial recognition, the incentive that is congruent with the established hierarchy, significantly increases engagement. We do not find support for the overall effectiveness of peer recognition, the incentive that is congruent with the peer-based approach to innovation. But this result masks an interesting heterogeneity by job function: Employees in support functions, who are otherwise less visible, report being highly motivated by it. Our study contributes to the literatures on crowdsourcing and incentives, and it yields direct implications for organizations seeking to adopt peer-based innovation.

2.2. Background

Internal crowdsourcing platforms offer great potential to organizations (Erickson et al. 2012; Malhotra et al. 2017). They promise to leverage the collective knowledge of the entire workforce by breaking down functional and geographic silos and giving everyone within the organization the possibility to broadcast and contribute to solving problems (Jeppesen & Lakhani 2010). Getting employees to visit the platform, even without making posts, is crucial; the greater the number of employees who follow the discussions on the platform, the wider the pool of

potential problem solvers, and hence the greater the motivation to post problems (Kane & Ransbotham 2016). Within firms, such platform engagement moreover promotes employees' acquisition of firm-specific knowledge, and it may raise employees' overall motivation by promoting transparency and a sense of agency (Stieger et al. 2012; Turco 2016). Yet building the platform does not mean that employees will come.

Prior research has highlighted important challenges in the adoption of outward-facing collective innovation mechanisms (Lifshitz-Assaf 2018). These challenges are compounded when organizations try to adopt crowdsourcing mechanisms within their organizational boundaries: Organizations need to overcome the initial “chicken-and-egg” problem at the platform inception stage and attract enough people on both sides of the platform, problem identifiers and problem solvers; but they need to do so with a pre-determined pool of potential contributors, their employees.

We partnered with the U.S. National Aeronautics and Space Administration (NASA) for a qualitative study and a large-scale field experiment involving 7,455 employees to study the motivations of employees to engage in crowdsourcing. NASA established an internal platform in 2010, but its adoption was stalling. Our qualitative study highlights an important context contingency behind such underuse: When organizations seek to adopt peer-based innovation, the structural incongruence between the established hierarchy and the novel crowdsourcing approach can disincentivize employee engagement by sowing doubts about the legitimacy of investing time in the novel approach.

Organizations and platform designers resort to incentives to overcome such motivational barriers. Recognition incentives play a central role on platforms and in the knowledge economy more broadly (e.g., Gallus 2017). They are particularly relevant where money is of limited use,

for instance due to budget constraints or concerns about motivational crowding-out (e.g., Gneezy et al. 2011). Yet the literature on the causal effects of recognition is still in its beginnings, with a rising but still limited number of experimental work that cleanly identifies causality in the field (see Frey and Gallus 2017 for a review). It is unclear which type of recognition incentives work best, and under what organizational conditions.

There are many types of recognition incentives, such as pins, badges, certificates, and induction into halls of fame (Frey and Gallus 2017). In general, recognition incentives draw their motivational value from three dimensions (Gallus et al. 2020): self-signaling, signaling to others (social signaling), and tangibility (if money or other economically valuable items are involved). One important and vastly under-researched dimension that distinguishes the different forms of recognition is the target audience of the social signal. In the context of hierarchical organizations seeking to adopt peer-based crowdsourcing processes, the distinction between recognition in front of management (‘managerial recognition’) and recognition in front of peers (‘peer recognition’) is particularly important.

Should such organizations deploy managerial recognition incentives, which fit the established structures, practices, and culture? Or should they focus on peer recognition incentives, which reflect the aspirational, peer-based approach to innovation, thus signaling the intended shift? Do these different types of recognition incentives work similarly for all employees? Or does the response to those incentives vary, such that the optimal recognition type would depend on which employees one seeks to motivate. This is a question particularly relevant for crowdsourcing, which seeks to involve wide and diverse swaths of employees, not just scientists and engineers.

Our field experiment with NASA studies whether and how the two basic forms of recognition, managerial and peer recognition, can motivate platform engagement. It is difficult to study the causal effects of recognition in the field, let alone test different types of recognition in the same context, holding all else constant. We managed to do so by using a messaging study design that allowed us to exogenously vary the expected audience of recognition: managers or peers. To account for the different peer groups that exist in modern work contexts, we further differentiated between local peers (offline) and peers on the innovation platform (online). To the best of our knowledge, this is the first field experiment testing managerial and peer recognition within the same context, as well as the first (social science) field experiment conducted at NASA.

The field experiment shows that the prospect of formal recognition in front of management had a significant positive effect: Managerial recognition increased the odds of engaging with the platform by 44 percent (p -value=0.005). The incentive offered a scarce resource: attention from management; and it signaled that crowdsourcing was not incongruent with the traditional organizational hierarchy after all, thus mitigating employees' concerns about the legitimacy of platform engagement. In contrast, peer recognition was not found to significantly increase platform engagement on average. But as we will discuss, this result may mask an important heterogeneity by job function: Employees in support functions, who are otherwise less visible, indicated that they were highly motivated by the prospect of recognition – even by the informal forms of peer recognition that engineers and scientists in more visible functions disregarded.

Our paper contributes to two bodies of literature: crowdsourcing and recognition incentives. While several studies have analyzed incentives on competitive, outward-facing

crowdsourcing platforms (e.g., Lifshitz-Assaf for the case of NASA), we still have a limited understanding of motivations and incentives for collaborative crowdsourcing within organizations. Our paper illuminates the frictions arising from the structural incongruence between hierarchy and crowdsourcing. Prior work has not examined whether and how hierarchy can inhibit engagement with internal crowdsourcing. This is an important gap because hierarchy remains a prevalent organizational form (Mintzberg 1979; Zhou 2013), and it is increasingly supplemented by internal, peer-based crowdsourcing processes (Majchrzak & Malhotra 2020). We show that the incongruence between hierarchy and crowdsourcing creates legitimacy concerns that disincentivize employees from engaging in peer-based innovation.

Based on the discourse in the rapidly growing literature on crowdsourcing, which highlights the benefits of decentralizing and democratizing innovation, one may believe that the most effective way of incentivizing engagement is to leverage peer-based incentives, as opposed to top-down incentives. Our field experiment tests this presumption. We experimentally study managerial and peer recognition in the same organizational context and thus add to the literature on recognition incentives by showing when and why different forms of recognition work. We integrate the experimental approach with rich qualitative data to study and introduce the notion that incentives for engaging with internal crowdsourcing platforms may work better if they are aligned with what is considered legitimate within an organization (or any other relevant context in which the incentivized person is embedded). This integration of qualitative and quantitative data moreover allows us to uncover important heterogeneities by job functions in response to incentives to engage in crowdsourcing (see Edmondson and McManus 2007 for a methodological discussion of such integrative designs).

Our findings have direct managerial implications. Indeed, the insight from the present research about the importance of managerial recognition has already been applied by NASA when the organization sought to promptly motivate as many employees as possible to use the platform to contribute ideas towards COVID-19 response efforts (NASA 2020). More broadly, our research provides guidance for the many hierarchical organizations that are seeking greater employee engagement in peer-based innovation (e.g., Williams 2019), by highlighting pitfalls and ways to address them.

2.2.1. Hierarchy as a Potential Barrier to Internal Crowdsourcing

Hierarchy is a ubiquitous means of organizing. It generally refers to the arrangement of authority (reporting relationships) and roles in an organization (Mintzberg 1979; Zhou 2013). Hierarchy establishes and formalizes differences among members that translate into a ranking and distribution of resources, control, status, and power (Adler & Borys 1996; Gruenfeld & Tiedens 2010, Magee & Galinsky 2008). It is intended to increase coordination and control of employees (Chandler 1962; March & Simon 1958; Mintzberg 1979) by establishing a social order (Magee & Galinsky 2008), and ensuring that employees pursue the goals decreed by managers (Cardinal 2001).

In practice, hierarchy manifests as layers of sequential authority and formalized work procedures. A hierarchy of authority implies supervisory presence and oversight. Supervisors observe and direct activities of subordinates (Mintzberg 1979). In terms of knowledge flow, they act as gatekeepers who decide whether to pass on any information and proposals from lower levels of the organization up the ladder of hierarchy (Seshadri & Shapira 2003). Members who are lower in the hierarchy internalize and comply with decisions of their superiors, as compliance can help them evade sanction or attain approval (Gruenfeld & Tiedens 2010). In terms of

formalized work procedures, written standards codify roles, routines, and workflows (Adler and Borys 1996, Cardinal 2001, Marsden et al. 1994). With these established procedures, hierarchy distinguishes departments responsible for different functions and shapes members' understanding of who does what, when, and how (e.g., film production organizations in Bechky 2006; emergency department employees in Valentine & Edmondson 2015). A clear hierarchy, enabled by formalized rules and norms, specifies collective expectations of members' roles, expertise, and decision-making capacity.

The evidence of how hierarchy shapes innovation is mixed (for a review, see Damanpour & Aravind 2012). Some organizational characteristics associated with hierarchy are shown to hamper knowledge transfer and experimentation (Bunderson & Reagans 2011; Teece 1996). Yet properly designed forms of hierarchy can positively impact problem-solving efforts (Adler and Borys 1996; Cardinal 2001; Keum & See 2017). Cardinal (2001) finds that formalized roles and procedures are associated with greater numbers of radical innovations (i.e., new drug developments) and reasons that the positive role of hierarchy is due to the nature of scientific work. New drug development necessitates correct and meticulous scientific procedures, and thus, is enhanced by clear structure and prescribed roles. Looking at broader idea generation and selection processes, Keum and See (2017) find that while hierarchy negatively impacts the number of ideas generated, it can aid in the selection phase of innovation. Thus, whether hierarchy serves innovation depends on dimensions such as the type and phase of innovation.

Crowdsourcing opens up the innovation process by increasing transparency, facilitating a quick and informal exchange of ideas, and decentralizing the locus by involving the crowd in search of exceptional opportunities (Guinan et al. 2013; Jeppesen & Lakhani 2010; Majchrzak & Malhotra 2020). We posit that this mechanism, when implemented within an organization, can

challenge the existing hierarchical structures, practices, and culture in several ways. Soliciting ideas from all parts of the organization bypasses lines of reporting relationships and roles. In contrast, hierarchy is built on layers of bureaucracy that information must otherwise travel through (“red tape”), and members may be hesitant to pass on information due to a lack of control and evaluation apprehension (Reitzig & Maciejovsky 2015; Seshadri & Shapira 2003). Moreover, hierarchically organizing departments allows for a clear delineation of specialty and responsibility based on function, but broadcasting a problem statement diminishes these departmental and professional boundaries (Lifshitz-Assaf 2018). For internal crowdsourcing to work in the context of a marked organizational hierarchy, members must take initiative to contribute ideas and expertise, beyond their prescribed roles and responsibilities. Participating in crowdsourcing, a peer-based innovation mechanism, may even mean defying the hierarchy. This can create friction if supervisors’ support for crowd-based innovation is uncertain.

How might the tension between such a peer-based approach to innovation and hierarchical structures, practices, and culture affect employees’ views of and motivations for platform engagement? We hypothesize that such contexts of discord lead employees to question the legitimacy of platform engagement. Legitimacy refers to a social judgment about whether an organizational practice is appropriate, suitable, or deserving given existing norms and contexts (Ashforth & Gibbs 1990). It results from a process of normative evaluation, questioning, and justification.

In our qualitative study, we explore how members of an organization that is characterized by a high degree of hierarchy perceive internal crowdsourcing. We establish that legitimacy concerns create important disincentives for engagement with internal crowdsourcing, and shed light on the specific tensions that accompany these legitimacy concerns. As internal

crowdsourcing is a relatively novel phenomenon, we are only beginning to understand what motivates employee engagement with platforms that facilitate it (Erickson et al. 2012; Jung et al. 2020; Malhotra et al. 2020). To add to the burgeoning body of literature on this topic, we consider how specific organizational context, namely the presence of a marked hierarchy, affects employee perceptions of and motivations for platform engagement. This analysis is important for understanding the effects of different incentives that organizations can use to increase platform engagement.

2.2.2. Recognition Incentives for Internal Crowdsourcing

Recognition incentives such as corporate award programs belong to the most common forms of nonmonetary incentives used in organizations (Frey 2007; Gubler et al. 2016). They play a particularly prominent role in the knowledge economy, where the complexity of tasks and motivations complicates the use of standard monetary incentives. While monetary incentives can undermine people's intrinsic, prosocial, and image motivations (Frey 1997; Gneezy et al. 2011), social recognition has the potential to bolster them (Frey & Gallus 2017). This is especially important in the context of crowdsourcing, where motivations have been found to be highly multi-faceted and evolving. These motivations include intrinsic enjoyment of problem solving and 'tinkering', being part of a community one identifies with, improving one's career prospects, helping others, learning, and finding solutions to one's own problem (Lakhani & Wolf 2005; Leimeister et al. 2009). Recognition can be designed to reinforce several of these motivations, as it usually draws on three main dimensions (Gallus et al. 2020): self-signaling (e.g., reinforcing identification as a 'tinkerer' or sense of belonging to a community), social signaling (yielding pro-social or career-related reputational benefits), and tangibility (providing means for learning or problem solving).

Which combination of underlying motivations prevails depends on the given context. This makes it important to gather context-specific information on the views and motivations of present and potential future users of a given platform. At the most basic level, we can expect significant differences based on whether the platform draws on contributors from within or from beyond the organization's boundaries (internal vs. external or "open" crowdsourcing), and whether the platform is premised on competition or on collaboration (contest- vs. community-based platforms) (Lakhani 2015). The combination of existing motivations determines which incentives work, and which ones do not yield their intended effects (Leimeister et al. 2009).

The literature testing causal effects of recognition incentives in the field is still in its beginning (Frey & Gallus 2017). Recent research suggests that recognition can be highly effective in motivating different forms of peer-based innovation. But to advance towards a more general framework of when and why recognition incentives work, it is important to take into account the existing motivations and organizational context, and to distinguish between the different forms of recognition. One fundamental difference is the audience involved (Leimeister et al. 2009).

In a field experiment run within the Wikipedia community, Gallus (2017) found that a purely symbolic award scheme backed by senior community members causally increased the retention rate among new contributors by 20% in the month after the award was posted on contributors' personal profile pages. The treatment effect was long-lasting; it continued to be significant for an entire year after the intervention. Being seen and appreciated by senior peers was an important mechanism driving these results. Similarly, appreciation and attention by the community of users more generally (Huberman et al. 2009; Zhang & Zhu 2011), by lower- or

equal-status peers (Restivo & Rijt 2012, 2014), or by the platform-hosting firm (Leimeister et al. 2009; Piezunka & Dahlander 2019) have been found to be important sources of motivation.

While these studies suggest that recognition and attention by peers and by managers might both have positive effects, few studies study these two fundamentally different forms of recognition in the same field context while holding everything else constant. Moreover, most of the research has focused on external and/or contest-based crowdsourcing. Since the effects of incentives depend on the underlying motivations of platform participants, we cannot readily assume that similar results obtain for collaboration-based crowdsourcing within organizations.

In the context of internal crowdsourcing, the existing organizational structures, practices, and culture likely play a major role in determining the effectiveness of incentives; these contextual factors reflect and moreover shape participants' expectations and beliefs. This creates a conundrum for hierarchical organizations that seek to adopt collaborative, peer-based innovation mechanisms within their organizational boundaries. Should they implement recognition incentives that reflect the established hierarchical structures, practices, and culture, or should they use recognition incentives that are in line with the aspirational approach to innovation to signal the intended shift towards peer-based, informal problem identification and problem solving? In hierarchical organizations, it is possible that attention from managers and their judgments triumph. It is also possible, however, that emphasis on peer-based recognition is needed as this signals the intended shift. Moreover, to the extent that employees have concerns about management's negative judgments about engagement with novel practices, an audience of like-minded peers might be preferred over managers' attention.

These questions also speak to the fundamental distinction between different types of recognition incentives based on who is the audience. What are the incentive effects of formal

recognition in front of management (which we call managerial recognition), and of informal recognition in front of peers (peer recognition)? Moreover, as organizations increasingly rely on virtual collaboration tools: Does it matter whether peer recognition is provided in person in front of immediate co-workers (offline peer recognition) or digitally in front of a virtual audience (online peer recognition)? Answering these questions is important for advancing our understanding of when and why recognition works. It also allows us to gain deeper insights into the fundamental motivations underlying internal crowdsourcing within hierarchical organizations.

2.3. Study Setting: NASA@WORK

NASA@WORK is an inner-organizational, collaborative platform set up for employees to draw from each other's expertise and ideas. This is in contrast to the agency's outward-facing and competitive crowdsourcing programs (Jeppesen & Lakhani 2010; Richard et al. 2019). Anybody working for NASA (civil servants, whom we refer to as "employees", and contractors) can contribute to NASA@WORK. To engage with the platform, people create a user profile with their real name and center affiliation. All posts are publicly visible and tied to that username. The platform is akin to an online forum in which users can post questions or problems (i.e., become a "challenge owner"), post answers or solutions (i.e., become a "challenge solver"), respond to other people's submissions, or browse and learn about initiatives and projects across the agency. The challenge owner determines the length of the submission period and selects up to two winners from the pool of contributors. The "challenges" posted on the NASA@WORK platform range from broad questions seeking to initiate collective brainstorming to highly technical and well-defined problems. To illustrate, one challenge owner asked for ideas as her work group sought to expand targets monitored (e.g., analytes, biomarkers, compounds) on the International

Space Station during long-duration missions. In a more specific challenge, another challenge owner asked for vendors and technology applications to develop a helmet that could quickly and seamlessly change its tint to protect the astronaut's eyes from solar radiation without having to carry a second visor material. Not all challenges asked for technical or scientific input. For example, one challenge crowdsourced design ideas for a crosswalk at the Johnson Space Center.

When NASA@WORK was first introduced at NASA, winners could receive small monetary prizes, but these had to be discontinued in the wake of the government funding sequestration (NASA 2013). This made the search for non-financial incentives a priority and motivated the research collaboration. We worked closely with the managers of the federal Center of Excellence for Collaborative Innovation (CoECI) at the NASA Johnson Space Center, which manages the platform. The CoECI team sought to introduce non-financial incentives and had already identified several options. We further refined and tied these incentives to theory and then worked out an experimental strategy to evaluate their effectiveness in motivating employees to become active on the platform.

Our sample consisted of 7,455 NASA@WORK users, evenly split among employees (51.2%) and contractors (48.7%). Many of the accounts were dormant and the main goal was to motivate users to become active again. Less than 40% of users had logged in at least once on the platform during the six months before the experiment. From platform inception to the time of our experiment, 48 users, or 0.6% of our sample, had posted and managed a challenge on the platform. 76 users (1.0%) had “solved” a challenge (were chosen as a winner by the challenge owner). Platform posting was low overall, for both solution seekers and contributors. We used our field collaboration to develop a deeper understanding of the reasons for this low usage.

2.4. Qualitative Study

It is important to consider the organizational context when adopting information technology like a crowdsourcing platform. We sought to understand how employees (users and potential users of the platform) perceived and experienced internal crowdsourcing in the presence of organizational hierarchy. Prior research has made great strides in advancing our understanding of other forms of information technology, like emails, wikis, enterprise blogs, and outward-facing knowledge sharing communities (e.g., Ceccagnoli et al. 2014; Kane & Alavi 2007). But the phenomenon of internal crowdsourcing remains under-researched (Malhotra et al. 2017).

2.4.1. Data Collection

We conducted 53 semi-structured interviews of NASA employees and contractors. Informants were purposively sampled (Berg 2001) from the population of NASA@WORK users (i.e., those with a registered account on the platform). We used attributes such as users' prior activities on the platform (posted a challenge, posted solutions, both, or none), whether s/he was an employee or a contractor, and center affiliation, to obtain a broad range of perspectives. We also used snowball sampling (Berg 2001) to reach those without a registered account on the platform and those with a dormant account (no activity since registration). At the end of each interview, we asked informants for names and contact information of colleagues who might not be familiar with NASA@WORK. We continued our interviews until it appeared that we had reached theoretical saturation, such that additional interviews did not reveal any new information (Glaser & Strauss 1967).

The informant sample comprised 37 employees and 16 contractors. In terms of platform engagement, 6 informants did not have a registered account, 7 had a dormant account, 10 had logged in on NASA@WORK over the past 6 months but had not posted anything, and 30 had

logged in over the past 6 months and had made at least one post. More than half (56.6%) of the interview sample had contributed a post and were therefore familiar with the platform, but none were “prolific” users: none of the informants had posted more than one challenge, and they had solved on average 1.3 challenges (with a maximum of 3 challenges). All interviews were conducted using Zoom, a video conferencing software. The interviews averaged 34 minutes each and ranged from 19 to 54 minutes.

At the beginning of each interview, informants were given a general statement about the purpose of research (“to learn how employees perceive the internal crowdsourcing platform in terms of its purpose, benefit, cost”). Each interview began with a question about the informant’s extent of engagement with NASA@WORK. Then, we asked customized open-ended questions depending on whether the informant had made a post on the platform or not. For those who had made a post, our questions sought to understand their motivations for participation, any challenges underlying their participation, and reasons for (not) participating again. For those who had not made a post, we asked about any perceived barriers to platform usage and what might motivate them to use the platform. We asked all informants how they would characterize the purpose of using NASA@WORK, what might motivate more people to use the platform, to what extent one’s role (e.g., scientist, engineer, support function) and employment status (employee or contractor) might affect one’s platform engagement, and whether and how NASA employees would get compensated or recognized for participating in activities like NASA@WORK.

2.4.2. Analytic Approach

We used thematic analysis (Attride-Stirling 2001; Braun & Clarke 2006) to analyze the interview data. We chose this qualitative analytic approach because it allows a detailed and nuanced account of a particular theme that relates to a specific question (Braun & Clark 2006).

In our case, we were interested in exploring a thematic range and illustrating a distribution of views relating to barriers to engaging with internal crowdsourcing. Thematic analysis entails three classes of themes (Attride-Sterling 2001): (1) empirical themes, which are the most basic or lowest-level order themes derived from data, (2) organizing themes, which group empirical themes into abstract clusters of similar issues, and (3) global themes, which assemble organizing themes that together allow interpretation of data as a whole and present an argument, proposition, or assertion about a given issue.

The analytic procedure involved coding and identifying themes through careful reading and re-reading of the data (Rice & Ezzy 1999). We followed the analytic steps outlined in Braun and Clark (2006) and Attride-Sterling (2001). We began with initial coding of the entire data without a preconceived coding frame. Braun and Clark (2006) characterize this phase as coding “interesting features of the data in a systematic fashion”. Next, we collated the codes and drew “basic”, empirical themes from the coded text segments (Attride-Sterling 2001). This inductive analysis lets the data drive the identification of empirical themes. Table 2.1 summarizes the progression of coding. Based on this analysis, we constructed a thematic map by arranging empirical themes into organizing themes. We deduced a global theme by iterating between data analysis and theory. We present the qualitative data using labels indicating employment type (employee or contractor), extent of platform engagement (no account, dormant account, browse only, or post and browse), and interview number.

Table 2.1. Coding Progression of Discrete Data Segments about Platform Engagement

Coded data segment	Empirical theme	Organizing theme
Each center acts as their own fiefdom. (CP24) We are so bad about having these silos of knowledge at each center. (CB43) There's a lot of cases where people in one part of the organization have no idea what another part is doing. (ED17)	Knowledge work happens in silos	Inconsistent with existing approach to innovation

Table 2.1. Coding Progression of Discrete Data Segments about Platform Engagement
(continued)

NASA@WORK tries to spur cross-pollination, something that's orthogonal to the normal structure of projects and mission directorates. (EP31) With the exception of that [platform], I can't think of another way in which we communicate between the different centers. (CP3) NASA@WORK is an attempt to create a centralized location where people can query the whole knowledge base of NASA. (CP12) It's kind of like people at the bar over a beer and making sketches on a napkin. But taking that into the work setting and having those conversations with people across NASA, rather than just having the people directly around you at your disposal. (EP23)	NASA@WORK broadens the innovation process
It's not something that people in the dominant culture here understand. [That culture is] more hierarchical and process-oriented. This [process] goes against that [culture] because you can ask anybody anything. (EP26) It comes down to adapting the culture to the idea of, "we can put out a challenge and get input." NASA centers still have this culture of being cloistered and not interacting with each other. It gets tricky even on an electronic platform to collaborate. (EP19) The gatekeepers have been there forever, who technically know most of what's going on. Breaking them out of their world of thinking that they know things will help. (CP24) It's a benefit to break down the not-invented-here mentality to look for ideas from others across the agency. (ED28)	
In our field, a lot of our challenges require very detailed knowledge, and we know pretty much everyone who has that knowledge. (CP3) Traditionally that's all been done through knowing somebody. You know somebody who knows somebody who knows something about it. (CP12) Say, I'd like to know how to do X. The natural tendency would be to figure out which organization is responsible for X, and ask them the question. (EB37) I've usually been able to find answers from people here. (EP47) I probably would exercise other options first before doing that. If I am wondering if other departments have input on something, I usually will go directly to the department. (ED41) I know who the subject matter experts are. I don't need a tool to go to a non-subject matter expert community. (ED38)	Reliance on designated experts and established networks
We work beyond 40 hours. Frankly, I don't see how anybody can expect any of us to go on [NASA@WORK] during our "free time". (EN30) All of us have tons of assignments and work that isn't probably related to the NASA@WORK platform. (EP14) I lost interest in trying to follow all the challenges, especially with all the other work going on. This is like on the side. Most of the time, NASA employees are already oversubscribed with work. (ED45) I have other responsibilities. It's not going to be a first responsibility to anyone. (EB42) I don't have a lot of time, and I have a ton of work. (CD36)	
	Not a resource for core tasks
	Core tasks leave no bandwidth for extracurricular activities

Table 2.1. Coding Progression of Discrete Data Segments about Platform Engagement (continued)

Because it is a new mechanism to do work, you want that encouraged [by managers]. (EP26)		
If it's not tied to someone's main line work, it really depends on their supervisor. (EB27)		
When you want people to take notice and invest and be involved, the fastest way to do that is to have the chain of management's buy-in on that. Approval for it and even advocacy for it. (EP51)	Top-down approval crucial	
A lot of it depends on if management is on board with technical teams and encourages them to submit challenges, maybe recognize them for submitting challenges in addition to responding (CP5)		
Our center directors and our engineering director will be like, "We have this platform, it's awesome. Everyone should use it." Then our branch managers are like, "No, do your work. Don't work on other people's problems." (EP14)		
I've seen more managerial support from higher levels of management, but not necessarily the direct supervisor. So when you did stuff, like, "wow, you won this crowdsourcing challenge!" that was more beamed about from the top. (EP35)	Disconnect between top and middle management	
Supervisors would have to decide what they think is the most appropriate amount of time for that kind of an activity. (ED38)		Not clearly supported by management
Contractors have to document every single minute of the day to different job numbers. We have time sheets to enter every day. (CP16)		
We're slaves to charge codes here. People are not supposed to be doing any work that we don't have a specific charge code for. (CP3)	Unable to formally account for time on the platform	
We don't charge our time [spent on NASA@WORK]. (EP52)		
We're not supposed to be doing those things. It's one of those things where it's much easier for accounting-wise if everybody just pretends they don't happen. So if anybody acknowledged it, I don't think it would be in a positive way. If I could just have like a couple hours a week to just do my own thing [like contributing to NASA@WORK] without feeling guilty about it at all, that would be awesome. (CN40)		
During the short period I was involved, I became aware of a situation where a supervisor took disciplinary action against one of their employees who he felt was spending way too much time on NASA@WORK. (ED38)	Fear of possible reprimand for use	
There's a perception if you're spending time doing that, then you should have time to be doing real work, too. (EB2)		

Notes. Labels identify whether the informant is an employee (E) or contractor (C); whether the informant has no account (N), a dormant account (D), has an account but browses only (B), or posts and browses on the platform (P); and the interview number.

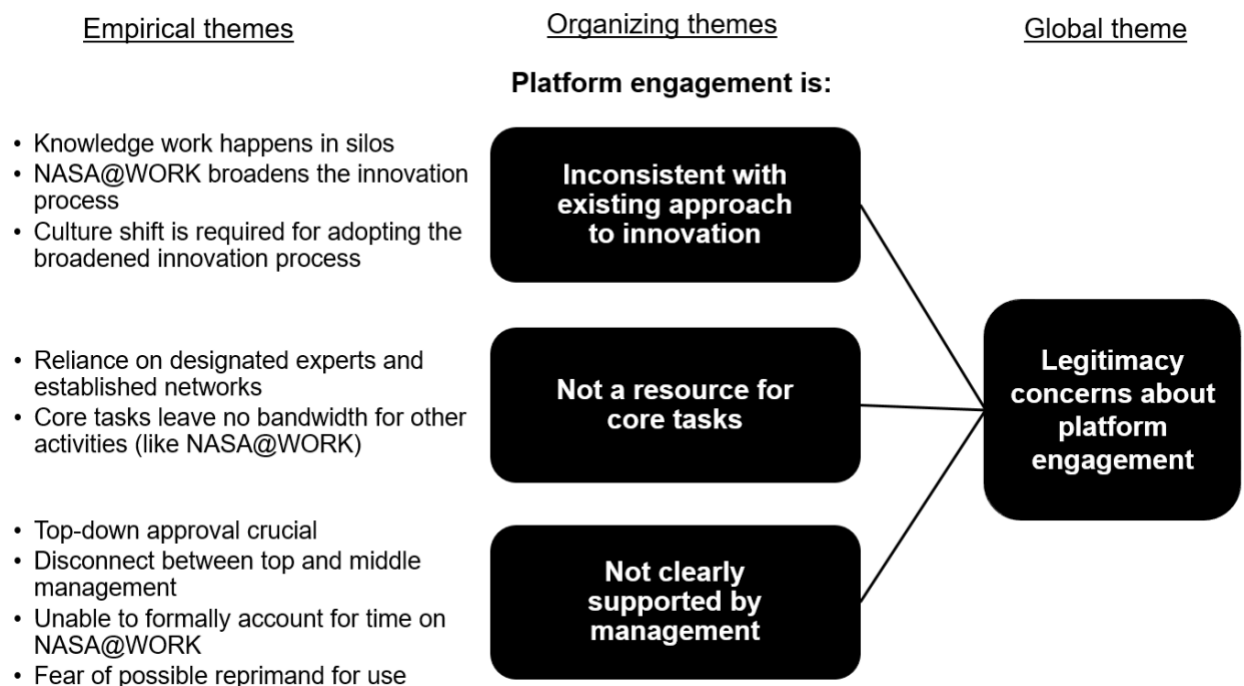
2.4.3. Findings

The interview data brought several important barriers for engagement to the fore. These barriers were largely rooted in the context of hierarchy, manifesting as established innovation processes that are facilitated by networks based on designated expertise and roles, formalized

procedures for core work, and layers of authority. In summary, we find that (1) informants perceived platform engagement as inconsistent with the existing hierarchical and formal approach to innovation, (2) they did not consider it a resource for making progress on their ‘core’ tasks, and (3) they did not see it as being clearly supported by management. Together, these beliefs and perceptions led to significant concerns about the legitimacy of platform engagement, which were fundamentally rooted in the incongruence between hierarchy and crowdsourcing.

Figure 2.1 illustrates the structure of the qualitative data.

Figure 2.1. Qualitative Data Structure



Inconsistent with NASA’s existing approach to innovation. NASA has centers and facilities spread across the United States. Each houses different areas of knowledge and supports different elements of missions (Seitzen 2008). Our informants shared that clear knowledge boundaries and coordination protocols existed within centers. One said that each location “acts as their own fiefdom” (CP24), and knowledge sharing did not routinely take place across the entire organization. Another informant (CB43) explained,

We are so bad about having these silos of knowledge at each center and not utilizing knowledge bases across centers. We end up duplicating work and effort because there's not a good understanding of what knowledge is available to other centers.

Even when centers face similar technical problems (despite supporting different aspects of NASA missions), collaborating and reaching out beyond the center for solutions did not seem to be a standard practice and was limited by a dearth of facilitating structures.

In contrast, NASA@WORK introduced a crowdsourcing structure that opened the problem identification and solving process to all NASA employees across the agency, regardless of one's expertise, tenure, role, position, and center affiliation. Informants shared that before NASA@WORK, there had been no other platform that enabled communication and collaboration beyond established knowledge networks. NASA@WORK introduced a broadened innovation process that was unfamiliar to many. Some considered this process inappropriate as they were accustomed to having clear problem-solving boundaries and protocols. One informant described the platform as “something that is orthogonal to the normal structure of projects and mission directorates” (EP31). Broadcasting a question beyond existing work groups and networks of contacts to seek ideas was not the norm. In fact, some NASA employees and contractors appeared to evaluate NASA@WORK as unfitting given these existing information sharing practices.

Whereas the existing practices promoted innovation that takes place within circles of designated experts, NASA@WORK promoted “finding expertise across the agency”, which is “not part of the culture” (EP19). Informants explained that a culture shift would be necessary for the adoption of a broadened, more transparent, and more informal peer-to-peer innovation process such as the one introduced by NASA@WORK. One informant (EP26) said,

It's not something that people in the dominant culture here understand. [That culture is] more hierarchical and process-oriented. This [platform] goes against that [culture] because you can ask anybody anything.

Not a resource for core tasks. NASA@WORK was viewed as being separate from core work, rather than as a tool that could serve as a resource. NASA scientists and engineers, whose jobs entail solving technical problems, relied on designated experts and established networks for help when challenging problems surfaced. One informant (CP3) explained,

In our field, a lot of our challenges require very detailed knowledge, and we know pretty much everyone who has that knowledge. You already know the experts. You already have people to go to. You don't need to broadcast your search on the platform.

As in this quote, several informants expressed beliefs that the specific and technical nature of their work would not be accessible or relevant for the NASA community at large. Informants shared that the “traditional” (CP12) or “natural tendency” (EB37) to problem solving was to reach out to designated experts, often judged by titles and positions. One informant (ED38) said,

If I have a complicated intellectual property question, I'm gonna go to the appropriate expert at NASA, which is our patent council. I'm not going to put that out to people who likely know nothing about it and are not qualified nor hired to comment on such a thing.

Given this existing practice of knowledge search based on established titles and positions, NASA@WORK did not come to mind as a useful tool for solving problems related to informants' core tasks.

Informants also shared that they were at maximum capacity with carrying out their assigned tasks, leaving no bandwidth for activities like engaging with NASA@WORK. Being on the platform and contributing solutions was perceived as a “sidebar activity”, distinct from the “primary job function”, “main project”, or “real work”. One informant said, “We work beyond 40 hours. Frankly, I don't see how anybody can expect any of us to go on it during our ‘free time’. People simply don't have the time or the energy left over” (EN30). Some informants

expressed concern that spending time on NASA@WORK interfered with their official job assignments. One informant said, “All of us have tons of assignments and work that isn't probably related to the NASA@WORK platform. You're expected to do your work and work on the issues and problems that you have” (EP14). Overall, informants expressed skepticism as to whether being on the platform was a productive use of work time.

Not clearly supported by management. Informants emphasized the importance of top-down approval for any novel initiative or project. With “a new mechanism to do work” (EP26) like NASA@WORK, which is “not tied to the main line of work” (EB27), one informant explained, “When you want people to take notice and invest and be involved, the fastest way to do that is to have the chain of management’s buy-in on that. Approval for it and even advocacy for it” (EP51). Another informant said, “If employees are using it but their boss doesn't understand, you almost want to incentivize the managers to figure out how to use it” (EP26).

However, our data indicates a disconnect between top managers and middle managers and supervisors in terms of their support for employees’ platform engagement. One informant (EP14) shared,

Our center directors and our engineering director will be like, “We have this platform, it’s awesome. Everyone should use it.” Then our branch managers are like, “No, do your work. Don't work on other people's problems”.

Although top managers were seen to approve and support platform engagement, indicated by their decision to organizationally adopt and maintain NASA@WORK, whether mid-level managers and supervisors saw platform engagement as a valuable activity was unclear or even doubtful for employees. Supervisors’ support carried more weight for employees as they more closely oversaw employees’ day-to-day performance and more frequently interacted with them compared to upper-level managers. One informant explained, “Supervisors would have to decide

what they think is the most appropriate amount of time for that kind of an activity and whether they think it's a valuable activity" (ED38). These data suggest that there was significant uncertainty about managers' beliefs and judgments about platform engagement.

To add to this uncertainty, informants shared that the time spent on NASA@WORK, whether posting a challenge and managing the responses or devising a solution and crafting a written response to a challenge, could not be formally accounted for. For project management purposes, NASA relies on "charge codes" wherein all employees document "every single minute of the day to different job numbers" (CP16) on a timesheet. One informant shared, "We're slaves to charge codes here. People are not supposed to be doing any work that we don't have a specific charge code for" (CP3). Yet, there was no charge code to account for work done on NASA@WORK. Another informant explained, "We essentially don't get paid for [contributing to NASA@WORK]. We don't charge our time. It has to be something we have to fit into our normal work, put on top of our normal work, or do it on our own time" (EP52). This absence of formal structures (charge codes) that would have officially sanctioned platform engagement seems to have further cast doubt on management's positive judgments of platform engagement.

Consequently, informants expressed concerns about managerial approval and even fear of possible reprimand for platform engagement. There seemed to be a sense that platform engagement was not an authorized activity and that it needed to take place discreetly. One informant said, "We're not supposed to be doing those things. It's one of those things where it's much easier for accounting-wise if everybody just pretends they don't happen. So if anybody acknowledged it, I don't think it would be in a positive way" (CN40). Another informant shared an anecdote of a supervisor who took disciplinary action against an employee "who he felt was spending way too much time on NASA@WORK" (ED38). Thus, according to our data,

endorsement for platform engagement from those immediately higher in the hierarchy seemed to be key. The lack of clear and visible support from supervisors and management seems to have further discouraged employees from using the platform.

Legitimacy concerns about platform engagement. The factors identified above gave rise to and reflect significant concerns about the legitimacy of platform engagement. The legitimacy concerns were rooted in a perception that crowdsourcing – a peer-based, informal, and more transparent approach to innovation – was at odds with existing innovation processes, which were based on a hierarchical, formal, and cloistered approach. Platform engagement was considered separate from ‘core’ work. And it was not clearly sanctioned by management.

2.4.4. Discussion

Our interpretation of the relationship between these themes is that the clash between the novel crowdsourcing mechanism and the existing hierarchical structures, practices, and culture created doubts about the actual value of NASA@WORK for advancing critical work. When employees looked to management to determine whether the incongruent approach would be accepted and valuable, they encountered conflicting signals: although upper management endorsed platform engagement, no structures had been put in place to officially sanction the time spent on the platform. At the same time, middle managers and supervisors exhibited skepticism and at times actively discouraged platform engagement. The resulting legitimacy concerns created important disincentives for platform engagement. In this context, we asked: what can overcome these barriers and motivate engagement?

2.5. Field Experiment

2.5.1. Interventions

The design of the managerial and peer recognition treatments were informed by data from a survey that the platform managers conducted on the NASA@WORK platform. After the 2013 government sequestration, the use of financial incentives to encourage platform participation had to be discontinued (NASA 2013). Subsequently, the Center of Excellence for Collaborative Innovation (CoECI) conducted a survey on the platform to crowdsource alternative incentives (“As Good as Dollars: Incentives for NASA@WORK that Count!”). Fifty individual participants proposed ideas. We received access to this data and used it as a basis for selecting and refining the recognition incentives to be studied in the experiment.

Several submissions pertained to managerial recognition. One suggestion was to have the Center Director send the solver a “brief note” that expresses gratitude, with a copy of the note sent to “their Official in Charge”. Another post suggested a lunch meeting with the program manager and the center director as a potential award. The submitter wrote, “I suspect most of the people that ‘put it out there’ and respond to a NASA@WORK challenge are also the kind of people that would appreciate some face time with their Program and Center management (and we know how limited and valuable their time is).” In line with our theoretical interest, the suggestions were based on the motivational value of managerial attention, as well as clear, formal acknowledgement of the value of platform engagement in front of management, thus alleviating legitimacy concerns by signaling that the two approaches, hierarchy and crowdsourcing, were not incongruous after all.

Other suggestions drew on rewards to facilitate offline peer recognition, notably through official pins and certificates. One submission recommending the use of such small, tangible tokens reasoned that, “Many people participate in sports for trophies, awards, plaques. This is longer lasting than \$200”. Another participant who had responded to NASA@WORK challenges

in the past wrote, “All I ever hoped for was a certificate of appreciation to put on my cube wall. It doesn’t cost anything, and they could be emailed to the Honorable mention participant’s NASA email address”. These suggestions were in line with our theoretical interest in awards that facilitate informal offline peer recognition, and served as a template for the design of the offline peer recognition incentive that we tested.

Another category of suggestions was centered on virtual peer recognition via websites and newsletter spotlights. One participant suggested “recognizing awardees with a challenge synopsis and solution accompanied by their picture on a NASA public website”, and commented that “CoECI would be a natural place for this permanent recognition.” Another participant proposed using each center’s news publication: “On the last page of the Spaceport News are the employee of the month winners. Perhaps you could have a short blurb there as well. All about recognition and the higher the distribution, the better (usually).” These suggestions informed the design of the online peer recognition incentive.

Based on these suggestions and our theoretical interest in studying managerial and peer recognition as incentives, we worked jointly with the CoECI team to design three incentive messages and experimentally test their motivational effects. These messages partly leveraged materials that had already been commissioned by the CoECI managers, such as the official NASA@WORK pin. The messages were sent via email, which was the main channel of communication about the platform. This approach of basing the incentive design on crowdsourced suggestions, and closely collaborating with practitioners to draw on existing resources has the important advantage that the results have direct managerial relevance: they illuminate approaches that the organization would (and did) use.

The three experimental arms were compared to a control group that received a reminder about NASA@WORK. The text for the control group read:

Greetings, [Name]!

Thanks for being part of the NASA@WORK community. The NASA@WORK ideation platform allows us to draw on the creative minds across the entire Agency to make wonderful things happen! Challenge Owners who identify issues and bring the Challenge process to fruition are crucial since the best solutions can only be as good as the underlying problems they address.

[Specific statements pertaining to each treatment inserted here.]

Come explore some of our latest Challenges [[hyperlink to NASA@WORK](#)]. Or maybe you want to become a Challenge Owner yourself! If this piques your interest, here are 5 simple steps [[hyperlinked](#)] to make the most out of Owning your Challenge.

Please don't hesitate to ask if you have any questions. We are happy to have you as part of the NASA@WORK community.

The email was sent and signed by the manager of the NASA Center of Excellence for Collaborative Innovation. Note that the text in the baseline (control) condition provides a conservative benchmark to test the recognition treatments against. Our field partners hoped to motivate as many users as possible to return to the platform. Therefore, even the email sent to the control group was designed to maximize the number of returns to the platform.

Specific statements pertaining to each treatment were not visible without opening the email. Employees in the managerial recognition condition read that their managers would receive "official letters that highlight their leadership and the other skills they demonstrate". The text was accompanied by a photo of a sample letter sent to managers. Employees in the offline peer recognition condition were informed that they would receive a NASA@WORK pin (which the CoECI managers had previously commissioned) and a letter of appreciation from the NASA@WORK team. A photo of the pin and certificate were shown together with this text. In the online peer recognition treatment arm, employees were informed that they would "be

inducted in the newly created NASA@WORK Wall of Fame and recognized in the NASA@WORK Monthly Bulletin and in our tweets”. This was accompanied by a photo of the NASA@WORK Bulletin. Figure A2.1 in the Appendix shows screenshots of the control and treatment emails.

2.5.2. Experimental Design

We conducted a field experiment to evaluate the effectiveness of the different recognition incentives. From the pool of employees and contractors who had a registered NASA@WORK account, 7,455 users were randomized into one of the three treatment arms or the control group. We used a stratified randomization procedure, blocking on (1) recent platform engagement (whether the user had been active in the six months prior to the randomization) and (2) employment status (employee or contractor).

Table A2.1 in the Appendix presents a randomization check for the observable user characteristics (employment status, past activity, center affiliation). As expected, before the intervention the differences are all negligible in magnitude and not statistically significant.

2.5.3. Analysis and Main Results

In line with our field partners’ goal, our primary outcome of interest was platform engagement. This reflects a key metric used by many platforms, such as Facebook or YouTube, which focus on “Daily Active Users” by tracking how many people log into the platform. We used a binary variable indicating whether a user logged into the platform in the week following treatment delivery. Results are robust to limiting the analysis to the first day after treatment delivery, as well as to using click-through data as an alternate dependent variable.

This dependent variable is a meaningful measure of engagement for several reasons. First, in online communities, members differ in their interaction patterns, with some interacting

frequently and others reading messages but rarely posting content on their own. Yet, the greater the pool of users who read the content, the greater the likelihood that someone will have the requisite knowledge and contribute a solution, and thus the greater the motivation to broadcast a problem in the first place (see Kokkodis et al. 2020 for the importance of “lurkers”). For intra-organizational platforms, even lurking on the platform without posting anything is valuable as it can promote organization-specific knowledge acquisition, motivate employees through greater transparency, and increase the likelihood of discovering potential collaborators and new knowledge networks (Stieger et al. 2012; Turco 2016). Second, platform log-in is a good proxy for costly effort, because security protocols mean that logging back in takes time. Online platform firms such as Facebook invest heavily in making logging in as easy as possible because of its importance for subsequent content provision and consumption. However, security protocols within public sector organizations prevent such seamless integration. Thus, logging in requires effort and is a prerequisite for addressing the content contribution and consumption chicken-and-egg problem afflicting platforms at their inception (Kane & Ransbotham 2016). Third, the content populated on the platform at the time of the experiment does not confound the log-in measure. In contrast, postings to the platform depend on there being a challenge for which a given user has the relevant expertise, which makes estimation noisier. Our outcome variable allows us to directly pick up on motivational differences. And it is not driven by manipulation or gaming of the incentive system, as users knew that their contributions would be comprehensively evaluated by the CoECI team, who would facilitate the dispensing of the recognition incentives at its discretion.

Since the baseline level of posting on the platform was extremely low, we limit the quantitative analysis to this extensive margin analysis of who engages with the platform. This

lays the ground for future research that can exploit data from more active platforms. We use an intent-to-treat analysis to be conservative and because reliable data on who opened the treatment emails was not available.

We estimate a conditional logistic regression model with center-level fixed effects to predict platform engagement from the experimental treatments. We add controls for the four strata used in the experimental design, crossing employment status with whether or not the user had logged in during the six months before the experiment. We also control for the number of challenges the user had previously owned and solved. Standard errors are clustered by center affiliation.

In the week after treatment delivery, 323 users, or about 4.3% of our sample, engaged with the NASA@WORK platform. The rate in the control group (without incentives) was 3.7%. Table 2.2 shows the number and the percentage of log-ins for each of the four experimental arms. A 4% engagement rate is not surprising given that platform participation is not part of employees' 'core' tasks and activities. It is also consistent with research on internal innovation contests. Blasco et al. (2019) find a 5% participation rate in a health care setting with several additional reminders and a four-week window to participate.

Table 2.2. Platform Engagement by Treatment

	N log-in	% log-in	<i>p</i> -value
Managerial recognition	98	5.27%	0.014
Peer recognition (offline)	91	4.89%	
Peer recognition (online)	64	3.43%	
Control	70	3.74%	

Notes. The last column shows the *p*-values from a Chi-square test of independence comparing platform engagement across the four experimental arms.

The regression results are reported in Table 2.3. As can be seen, the managerial recognition incentive had a significant positive effect on subsequent platform engagement.

Compared to the baseline condition, the prospect of managerial recognition increased the odds of

returning to the platform by about 45% (OR=1.453, RSE=0.194, p -value=0.005), controlling for other factors such as prior platform engagement. The results for the other treatments are statistically insignificant. These findings hold also in the most basic model without any controls. As can be seen, the point estimate of offline peer recognition is comparable to that from managerial recognition, but its standard errors are bigger and so the difference is not statistically significant (OR=1.341, RSE=0.274, p -value=0.151). Nevertheless it is an interesting observation that we will explore further below.

Table 2.3. Logistic Regression Models Predicting Platform Engagement

	Model 1		Model 2		Model 3	
	Dependent variable = log-in within one week of intervention					
	OR	RSE	OR	RSE	OR	RSE
Treatments						
Managerial recognition	1.433*	0.205	1.440**	0.200	1.453**	0.194
Peer recognition (offline)	1.322	0.266	1.329	0.275	1.341	0.274
Peer recognition (online)	0.915	0.161	0.901	0.157	0.912	0.151
Center-level fixed effects	Not included		Included		Included	
Stratification variables	Not included		Included		Included	
Control variables	Not included		Not included		Included	
Log likelihood	-1,324		-1,257		-1,253	
Observations	7,455		7,386		7,386	

Notes. Standard errors are clustered by center affiliation. Stratification variables are employment status (employee or contractor) and prior activity (logged in within the 6 months before the experiment). In models 2 and 3, 69 observations are dropped because of all positive or negative outcomes within a center. The main specification (model 3) adds control variables for the numbers of previously owned and solved challenges. * p <0.05; ** p <0.01

Correcting for multiple hypothesis testing using the Bonferroni method does not meaningfully change our results. The p -value on the managerial recognition coefficient in the main specification becomes 0.016 when using the Bonferroni method. We also analyze the data using randomization inference (RI). In lieu of the traditional sampling-based approach, RI is an increasingly recommended approach for analyzing data from randomized controlled trials (Heß 2017; Young 2019). Our results remain. The p -value on the managerial recognition coefficient becomes 0.033 when using RI.

2.5.4. Exploratory Analysis of Heterogeneities in the Response to Recognition Incentives

The experiment shows that the managerial recognition incentive significantly increased platform engagement compared to the baseline condition. In contrast, neither offline nor online peer recognition had significant effects on platform engagement. The prospect of offline peer recognition, however, had a similar magnitude of impact on platform engagement as managerial recognition, albeit with larger standard errors.

Interviews conducted following the experiment suggest an important heterogeneity in the response to offline peer recognition: They indicate that the prospect of being recognized by their local peers was indeed motivating for employees in support functions, who were otherwise less visible and of lower perceived status. One administrative staff (CP32) shared,

I'm on the bottom of the totem pole. So I get excited. For almost every project you get a pin or a patch or a sticker. We don't normally get that because we're not really associated with any.

On the other hand, an engineer employee (EB53), whose work visibly contributes to NASA's organizational mission, noted,

I feel like for most employees, if they see someone wearing a pin that says, "I served a NASA@WORK challenge", if that is your top accomplishment that you want to wear a pin over, that's probably not a good sign. I think people are conscious of that.

This contrast between more and less visible employees may explain why our quantitative estimates show greater variance in the response to offline peer recognition as opposed to managerial recognition. Some employees, namely those in support functions who are otherwise less visible, indicated to be highly motivated by the prospect of being seen and recognized by their offline peers. This provides further support for the attention mechanism that explains part of the motivational effects of the recognition incentives observed above. Less visible employees, who otherwise receive less attention, appear to be motivated by the prospect of getting others' attention, even if it does not come from management.

Organizations often focus their attention on a small proportion of employees who are already visible as they are perceived as central to the organization's mission. At NASA, various awards celebrate innovation, but these prestigious honors are largely only accessible to employees whose job function already puts them into a visible position that is considered 'central' to the mission – namely, the NASA scientists and engineers. Compared to most others, these employees accrue more recognition, both in terms of quantity and importance of the awards. They are therefore likely to respond only to what they consider to be an important form of recognition in the established hierarchical culture. Yet there is a non-trivial proportion of employees who otherwise receive little recognition (at NASA, about 35% of the jobs are in support functions, notably administration, accounting, legal, transportation, information technology, and others; NASA 2019). It appears that these employees are highly motivated even by smaller, more informal forms of recognition, which the more focal employees disregard.

This argument about a differential response to recognition by employees who are otherwise more or less visible, who are on top or at the bottom of the “totem pole”, can be extended to an analysis of differential effects by employment types: employees versus contractors. Our informants shared that in several centers and contexts, there can be a noticeable status difference between employees and contractors. As one employee explained, “I've worked on projects where they try very hard to keep everybody as a team and trying to not pay attention to the badge [that designates who is and is not an employee]. In general, at least the projects I work on, we try to forget about that and work as a team” (EP23). Another employee noted, “There are a lot of training courses that are offered. On some of them there are restrictions where contractors can only sit in on them if there's room. Civil servants, I think, have preferential treatment” (EB42). One of the contractor informants shared that, “Usually NASA's pretty

inclusive of their contractor staff, but that [distinction]’s always a small little thing in the back of my head” (CN40).

We therefore analyze heterogeneity in the response to the recognition incentives by employment type (contractor or employee). We would expect that, at least directionally, contractors respond even more positively to the recognition incentives than employees. We had stratified the experimental design on employment type as we had planned to test for such heterogeneity. In our analysis, we include an interaction term for employment type and incentive treatment in the main model.

Table 2.4. Logistic Regression Testing Heterogeneous Treatment Effect by Employee vs. Contractor Status

	Dependent variable: log-in within one week of intervention	
	OR	RSE
Treatments		
Managerial recognition	1.186	0.205
Peer recognition (offline)	1.152	0.278
Peer recognition (online)	0.735	0.192
Contractor	0.934	0.163
Treatment x Contractor		
Contractor x Managerial recognition	1.492 [^]	0.307
Contractor x Peer recognition (offline)	1.357	0.409
Contractor x Peer recognition (online)	1.526	0.483
Center-level fixed effects	Included	
Control variables	Included	
Log likelihood	-1,253	
Observations	7,386	

Notes. The model includes fixed effects at the center-level. Standard errors are clustered by center affiliation. Control variables include prior activity (logged in within the 6 months before the experiment) and numbers of previously owned and solved challenges. These results remain when we limit our analysis to just employees (n=3,765) or to just contractors (n=3,554). [^] $p < 0.10$

The results in Table 2.4 suggest that on average, contractors may have indeed been even more strongly motivated by the recognition incentives than employees. Across treatment arms, the coefficients on the interaction terms are positive and thus point into the expected direction, but they do not reach significance. The interaction with managerial recognition is positive and marginally significant (p -value=0.052 in the conditional logistic regression model; p -value=0.042 when using ordinary least squares regression). While these results should be

interpreted with caution, they provide an intriguing basis for future research into the heterogeneities in the response to recognition incentives.

2.6. Discussion

2.6.1. Theoretical Contributions

In this paper, we addressed the following questions: What are the barriers for employees' engagement with internal crowdsourcing? When and how do recognition incentives overcome those barriers and increase platform engagement? Specifically, what is the potential of managerial and peer recognition in promoting engagement with internal crowdsourcing?

By addressing those questions, our paper contributes to two important bodies of literature. First, it adds to the literature on organizational adoption and management of crowdsourcing as an innovation mechanism (Dahlander et al. 2019; Guinan et al. 2013; Leimeister et al. 2009; Lifshitz-Assaf 2018) – and internal crowdsourcing in particular (Blasco et al. 2019, Malhotra et al. 2017). We extend prior research on the challenges that organizations face in increasing engagement with crowdsourcing. Prior research has considered perceived support for organizational learning (Jung et al. 2020), frontline employees' agency to innovate (Malhotra et al. 2020), and the role of proactive senior leadership (Erickson et al. 2012). We introduce incongruence between hierarchy and crowdsourcing and the resulting legitimacy concerns as important concepts. In hierarchical organizations, informal, peer-based crowdsourcing is at odds with existing innovation processes. This creates uncertainty for employees, who look to management for guidance and approval. Absent clear support from all levels of management, however, employees perceive mixed signals. In our context, although top management seemed to approve of and endorse the platform, no official structures had been put in place to officially sanction working on the platform, and employees were moreover concerned

about middle-managers' and direct supervisors' lacking support. These factors sowed doubts about the legitimacy of platform engagement, which created disincentives for employees to engage with crowdsourcing.

We also extend prior work on the motivations to contribute to crowd-based knowledge platforms (Gallus 2017; Lakhani & Wolf 2005, Piezunka & Dahlander 2019). While much of this prior work has focused on incentives to increase motivation, we add to this line of work by beginning our study with an analysis of the disincentives (notably, legitimacy concerns) that act as restraining forces against engagement.

A second body of literature we contribute to is the research on recognition and its motivational effects in organizations (Gallus & Frey 2016). The research on recognition has long grappled with the difficulty of establishing clear causal effects. We contribute to a recent line of work testing the causal effects of recognition incentives through randomization in the field. We still know fairly little about the effectiveness of recognition incentives in established hierarchical organizations, and about the role of different forms of recognition incentives. One fundamental and vastly under-researched distinction is between recognition in front of management and recognition in front of peers. This is highly relevant in the context of hierarchical organizations seeking to adopt peer-based innovation, as formal managerial recognition is congruent with the established structure, practices, and culture, while peer recognition is congruent with the aspirational approach to innovation. We exogenously varied the type of recognition incentive and are, to our knowledge, the first to study the effects of both managerial recognition and peer recognition in the same organizational context (i.e., holding all else constant).

Our findings show strong positive effects from managerial recognition incentives. This builds on and extends prior literature that shows that managerial actions provide important cues

for employee behavior (e.g., Detert & Burris, 2007; Liu, Zhu, & Yang, 2010; Tangirala & Ramanujam, 2012). Much of this prior work is based on observational studies that use surveys to capture perceptions and behavior. Using a clean and rigorous experimental procedure in the field, we were able to measure causal effects on actual behavior. We find that the prospect of managerial recognition can causally motivate employees to engage in crowdsourcing, by offering positive attention and reducing the perceived incongruence between hierarchy and crowdsourcing. We do not find support for the overall effectiveness of peer recognition, but these results appear to mask an important heterogeneity by job function. Employees in support functions, who otherwise receive less attention and rank lower in the status hierarchy, seemed to be highly motivated by the prospect of being seen and recognized – even if not by management. Similarly, a heterogeneity analysis of our experimental data by employment type suggests that contractors, who tend to have lower status than employees, may have been even more strongly motivated by the prospect of recognition than civil servants.

This adds to the literature on recognition by advancing our knowledge of when what type of recognition works: In hierarchical organizations, formal managerial recognition appears to be highly effective because it promises attention from higher-ups and alleviates legitimacy concerns; under these conditions, informal peer recognition may be motivating, but only for employees who otherwise receive less attention. We thus emphasize the importance of alignment between recognition incentives and organizational context. Our results indicate that the incentive that is congruent with the established organizational context may be needed to blaze the trail towards the aspirational approach to innovation. These findings provide fertile ground for future research, such as studies on the interaction between organizational context and incentives.

2.6.2. Practical Implications

Our study yields several implications for practice. First, our findings inform the design of incentives when seeking to adopt novel, peer-based approaches to innovation. It is important to understand whether and how the prevalent structure, practices, and culture within an organization correspond to the aspirational approach to innovation on crowdsourcing platforms. If there is incongruence between the organizational hierarchy and the peer-based approach to innovation, organizations may benefit from starting with incentives that are still in line with the established, hierarchical culture. This means acknowledging and leveraging the important motivational role played by managers, even if that may seem to be at odds with the intended aim of shifting towards ‘flatter’, peer-based innovation.

This implication has already informed platform management practices at NASA. For instance, when the organization used NASA@WORK to seek innovative solutions to address the COVID-19 pandemic, our analysis showing the causal effects of managerial recognition was cited in upper-level management meetings and became a basis for the development of incentives to motivate broad engagement in the COVID-19 challenge.

In line with these findings, a recent survey conducted by Gallup found that employees identified the source of their “most memorable recognition” as that from their direct manager, followed by senior leaders, customers, and peers (Mann & Dvorak 2016). This may be an indication that hierarchy is still a prevalent means of governing organizations. If this is the case, many organizations will benefit from recognition based on their established formal hierarchies (top-down) and they should be weary of rushing the change by changing too many variables (incentives in addition to the approach to innovation) at the same time. Instead of stopping at surveys, our study showcases how organizations can leverage experimentation to evaluate the motivational effects of different incentives in their context.

Lastly, our findings suggest the importance of looking beyond “star employees” and designing recognition incentives that are in reach for the broader workforce. We found that employees who were otherwise less visible, who considered themselves to be at the lower end of the “totem pole”, were highly motivated by the prospect of recognition, even by the smaller, less formal forms of peer recognition that others in more visible functions disregarded or even ridiculed. This suggests that organizations may be wasting resources by focusing mostly on employees whose functions already put them into more visible positions, and for whom the marginal effect of an additional token of recognition may be much lower than for employees who otherwise receive little attention for their efforts to contribute. As one interviewee (EP22) commented, while there are many high-caliber awards at NASA, “maybe just the average Joe at NASA would like to be recognized more”.

CHAPTER 3. CROWDSOURCING INCREASES EMPLOYEE INNOVATION: FIELD EXPERIMENTAL AND QUALITATIVE EVIDENCE FROM COMMUNITY HEALTH CENTERS

3.1. Summary

Are there long-term, spillover outcomes to crowdsourcing ideas from employees, beyond the innovations generated from it? This paper examines whether and how innovation contests, a crowdsourcing intervention that opens up a channel and opportunity to innovate, could increase employees' general engagement in innovation. In a multi-method study, I first conducted a field experiment with 53 community health centers (CHCs). Half of the randomly treated CHCs crowdsourced all employees for ideas to improve patient care. After the experiment, I interviewed 175 people spanning roles and levels from the same field sites to explore how and under what conditions this intervention works. My experimental findings evince that the intervention increased employees' engagement in innovation by more than 35 percent, two months following the intervention. My qualitative findings suggest that the intervention (1) exposed managers to the usefulness of soliciting employee ideas, prompting them to keep soliciting ideas and (2) spurred employees to prioritize innovating on top of their day-to-day work. The intervention was particularly effective in organizations where employee ideas were not proactively sought prior to the intervention. This study illustrates that a crowdsourcing intervention that introduces an open and structured approach to innovation can motivate manager-employee communication in new ways.

3.2. Introduction

Organizations are increasingly crowdsourcing employees for ideas (Zuchowski et al., 2016; Malhotra et al., 2017). Crowdsourcing refers to broadcasting a question or a problem statement to a crowd, or a large pool of people across knowledge domains who can self-select to

contribute solutions (Jeppesen and Lakhani, 2010; Poetz and Schreier, 2012; Lifshitz-Assaf, 2018; Majchrzak & Malhotra, 2020). Immediate, direct outcomes of crowdsourcing employees, or opening up the organizational brainstorming and problem-solving to all employees, are clearly documented in the prior literature. They include developing a new product or service (Bjelland & Wood, 2008; Soukhoroukova, Spann, & Skiera, 2012; Malhotra & Majchrzak, 2014), improving customer service (Standing & Kiniti, 2011; Malhotra et al., 2020), identifying organizational improvement opportunities (Blasco et al., 2019), and co-creating an organizational strategy (Stieger et al., 2012; Mack & Szulanski, 2017).

There may be long-term, spillover outcomes to crowdsourcing employees for ideas, such as increasing their general engagement in organizational innovation. Such outcomes that are not immediately tied to the crowdsourcing activity are underexplored in the literature, but can have important long-term implications for employee behavior. Crowdsourcing enables employees to participate in organizational innovation beyond their job description and the formal chain of command (Turco, 2016; Blasco et al., 2019), as innovating tends to be reserved for professionals in R&D. Other employees, such as those on the frontlines, focus on customer-facing, operational tasks. Prior research has shown that crowdsourcing, an “open” or “distributed” approach to innovation, can lead to a shift in the locus of innovation (Lifshitz-Assaf, 2018), facilitate a dialogue between employees and managers across the hierarchy (Andriole, 2010; Turco, 2016), and increase employees’ awareness of organizational issues (Soukhoroukova, Spann, & Skiera, 2012; Rohrbeck, Thom, & Arnold, 2015).

This study explores whether and how crowdsourcing employees for ideas increases their engagement in discretionary innovation. I define discretionary innovation as the generation and implementation of novel and useful ideas (Scott & Bruce, 1994; Amabile, 1996) that are not part

of the job description. It is closely related to employee voice, a discretionary, improvement-oriented, upward expression of suggestions (Detert & Burris, 2007). When primary responsibilities center on day-to-day tasks, innovating can be pushed aside (Edmondson, 2008); studies conducted in health care (Tucker, Edmondson, & Spear, 2001), manufacturing (Bernstein, 2012), and restaurants (Detert & Burris, 2007) have shown that for most employees, innovation is often not a priority compared to adherence to protocol and efficient production and delivery of goods and services. Still, capturing the input of employees—who are well-positioned to think critically about established practices, identify problems, generate solutions, and make suggestions—is critical for enhancing organizational functioning, learning, and performance (Argyris & Schön, 1978; Bashshur & Oc, 2015).

The impact of a crowdsourcing intervention on employees' engagement in discretionary innovation likely depends on the existing organizational context. Existing organizational structures, practices, and culture can influence how crowdsourcing is implemented and used (Erickson, Trauth, & Petrick, 2012; Mack & Szulanski, 2017; Gallus, Jung, & Lakhani, 2020; Malhotra et al., 2020). Gallus et al. (2020) found that in a hierarchical organization, wherein innovation processes were based on established roles and expertise, formalized work procedures, and layers of authority, employees questioned the legitimacy of engaging with the crowdsourcing platform. In this context, the prospect of managerial recognition for making contributions to the platform increased platform engagement as it signaled that crowdsourcing was not incongruent with the traditional organizational hierarchy after all. Similarly, Mack and Szulanski (2017) found that in organizations where the decision-making authority was concentrated at the topmost level, uses of crowdsourcing practices for strategy-making were limited to one-off information gathering routines. In contrast, in organizations where the

decision-making authority was shared with middle management and employees, ongoing outreach and communities were used to identify and resolve organizational issues.

In this multi-method study, I quantitatively tested whether crowdsourcing ideas from employees via innovation contests causally increases their engagement in discretionary innovation and qualitatively investigated mechanisms and boundary conditions—such as the organizational context—underlying the effect of the intervention. I first conducted a field experiment with 53 community health centers (CHCs), where employees' primary job is to deliver high-quality patient care rather than innovating, or thinking of a new product, service, or way of working. I randomly assigned each of the recruited CHC to the treatment or control group. Treated CHCs conducted an innovation contest, which crowdsourced all employees, regardless of position or tenure, for ideas to improve patient care. Following the field experiment, I interviewed 175 people spanning various levels and roles from the same field sites, to explore how and under what conditions this intervention works at the organizational level.

I used these two methods as they are complementary. On the one hand, a field experiment lets us examine the causal effects of an intervention. However, it does not generate in-depth information about contexts and experiences of participants like a qualitative study does. On the other hand, a qualitative study does not allow us to test for causal relationships between constructs like a field experiment does. So by integrating the two, this study produces findings that are rigorous as well as insightful.

3.2.1. Crowdsourcing to Increase Engagement in Innovation

The potential of crowdsourcing to generate novel and impactful ideas from widespread sources has attracted scholars from various disciplines, including organizational theory (Afuah & Tucci, 2012; Lifshitz-Assaf, 2018; Piezunka & Dahlander, 2019), economics (Jeppesen &

Lakhani, 2010; Morgan & Wang, 2010; Boudreau, Lacetera, & Lakhani, 2011; Gallus, 2017), strategy (Chesbrough, 2003; Mack & Szulanski, 2017), marketing (Toubia, 2006; Bayus, 2013), and information systems (Majchrzak & Malhotra, 2013, 2020; Kane & Ransbotham, 2016). Of particular interest from this research is the *openness* underlying crowdsourcing. I posit that crowdsourcing employees for ideas increases their engagement in discretionary innovation because of its open approach to seeking ideas.

Crowdsourcing opens up the idea search process by broadcasting a question or problem statement and inviting broad participation. Innovation contests, a form of crowdsourcing, elicit many ideas to select a few exceptional ones (Boudreau, Lacetera, & Lakhani, 2011). “Anyone who deems themselves qualified to solve the problem” (Jeppesen & Lakhani, 2010: 1016) can make contributions; contributors self-select based on their interest and ability. As a result, contributors are not bound by professional, technical, or social boundaries (Jeppesen & Lakhani, 2010; Poetz & Schreier, 2012; Guinan, Boudreau, & Lakhani, 2013; Lifshitz-Assaf, 2018). Jeppesen and Lakhani (2010) found that in science contests covering fields traditionally dominated by male scientists, winning solutions were more likely to come from women. The authors reason that opening up the idea search process allowed inclusion of individuals in marginal positions (e.g., socially distant from the core establishment) who are likely to have novel perspectives. Similarly, Guinan et al. (2013) found that in an idea challenge for research ideas about Type I diabetes, winning ideas came from participants without relevant professional or technical expertise, including a college senior and a retired dentist.

Within an organization, this openness implies that any employee can participate in innovation, even if it is not stipulated in their formal job description (Soukhoroukova, Spann, & Skiera, 2012; Turco, 2016; Malhotra et al., 2017; Blasco et al., 2019). A crowdsourcing

intervention like an innovation contest represents an explicit managerial invitation to share ideas and gives the right to all employees to voice and participate in an organization-wide conversation. It may signal—especially to those who are not typically involved in organizational problem-solving and whose voice is not usually solicited—that managers respect and value their opinions and knowledge beyond their specific role (Turco, 2016). Studies have shown that employees are more likely to share ideas when they perceive their superiors to be inclusive in their invitation for input and listen to suggestions (Nembhard & Edmondson, 2006; Tangirala & Ramanujam, 2012). Thus, a crowdsourcing intervention that opens up the innovating opportunity for any interested employees may spur them to keep ideating and speaking up afterwards.

In addition, crowdsourcing introduces a channel for the sponsoring organization to openly interact with contributors. Such interactions can cultivate relationships between the crowdsourcing sponsor and contributors, leading to repeated interactions (Bayus, 2013; Piezunka & Dahlander, 2019). These interactions include contributors submitting ideas in response to the sponsor's call and the sponsor giving recognition and feedback for the ideas shared, which can resolve the contributor's uncertainty about the sponsor's interest in their ideas (Jeppesen & Frederiksen, 2006; Piezunka & Dahlander, 2019). Relationships formed through these sponsor-contributor interactions can grow contributors' interest and sustain their idea contribution (Dahlander & Piezunka, 2014).

Within an organization, crowdsourcing opens up a channel for senior managers—who typically sponsor and broadcast the question or problem statement—and employees to connect (e.g., Turco, 2016; Malhotra et al., 2017; Blasco et al., 2019). In a ten-month long ethnography, Turco (2016) observed an organization that used multiple open channels, including a wiki, enterprise chat systems, and large meetings where employees volunteered ideas and solved

organizational problems with senior managers. Employees freely used these channels to share ideas and critique others' ideas while senior managers reciprocated. These open channels promoted and sustained ongoing dialogues about organizational challenges, motivating employees to be more engaged at work. In general, crowdsourcing offers a platform for employees to articulate and discuss ideas with a broad audience, including managers as well as other employees beyond their immediate working groups and departments (Soukhoroukova, Spann, & Skiera, 2012; Stieger et al., 2012). An activity that facilitates such interactions may help build norms that encourage upward and lateral knowledge sharing (Quigley et al., 2007). Thus, a crowdsourcing intervention may give rise to new formal and informal channels for employees to keep brainstorming and innovating alongside senior managers.

One potential mechanism through which crowdsourcing increases employees' engagement in innovation entails building the climate of psychological safety—that is, the perception that it is safe to take interpersonal risks to experiment and innovate (Edmondson, 2019). Psychological safety has been reliably identified as a mediator between managers' leadership styles and employees' suggestion-giving behaviors (Ashford et al., 1998; Detert & Burris, 2007; Walumbwa & Schaubroeck, 2009). Because managers are the usual recipients of employee voice and managerial actions provide salient cues for behavior, how they ask for input is likely to affect employees' perceptions of whether it is safe to innovate, particularly when it is outside of one's job scope. Indeed, managerial actions such as asking for employee input, showing appreciation for their suggestions, and creating forums for feedback have been shown to improve psychological safety (Edmondson, 2019).

I therefore hypothesize that (a) crowdsourcing ideas from employees via innovation contests causally increase their engagement in innovation and (b) the impact of the intervention is explained by increased psychological safety.

3.3. Research Design and Setting

I conducted two studies, involving 12 months of data collection. Study 1 was a field experiment with an intervention (“ideation challenge”) and aimed to examine the causal impact of administering a crowdsourcing intervention on employees’ engagement in discretionary innovation eight to ten weeks following the intervention. Study 2 was a qualitative study with post-intervention interviews of senior managers and employees and aimed to explore the mechanisms and boundary conditions underlying the impact of the intervention.

I recruited 53 community health centers (CHCs) for this research. CHCs receive federal funding under Section 330 of the Public Health Service Act and to qualify for this funding, they must fulfill requirements such as: serving an underserved area or population; providing primary care and supportive services (e.g., dental, preventive health, mental health services, transportation); having a governing board of community members and patients, and; meeting administrative, clinical, and operational standards (HRSA, 2018).

I chose to partner with CHCs for several reasons. First, although CHCs vary in size and location, they are largely alike in administrative, operational, and clinical dimensions due to the requirements they have to meet for federal funding. These similarities allowed for comparable implementation of innovation contests and evaluation of their impact across organizations. Second, as CHCs strive to improve quality and patient experience, crowdsourcing ideas from employees helped to identify areas of improvement. CHCs have been integral to health care delivery system reform as the principal primary care providers in poor and underserved

communities. Many have achieved clinical integration as patient-centered medical homes (PCMHs) and increasing numbers of health centers are participating in pay-for-performance programs (Shi et al., 2017; Lewis, Abrams, & Doty, 2019). Third, motivating employees to be engaged at work is a prominent issue in CHCs due to difficulties with recruitment and retention. Understaffed clinics, patients with complex socioeconomic and health needs, and limited access to specialists contribute to employee stress and turnover (Hayashi, Selia, & McDonnell, 2009). Practice transformations and quality improvement initiatives have had mixed effects on professional satisfaction and morale (Friedberg et al., 2017).

3.4. Field Experiment

3.4.1. Experiment Procedures and Sample Characteristics

Recruitment. I emailed 1,367 CHCs funded by the Health Resources and Services Administration Health Center Program. The directors of 203 accepted my invitation to attend an informational webinar during which I described the benefits of crowdsourcing, the experience of other healthcare organizations with crowdsourcing, what would be provided to participating CHCs at no cost (e.g., promotion materials, crowdsourcing infrastructure, prizes), and what would be asked of the participating CHCs. In particular, I asked for (a) permission to determine the timing of the intervention, (b) permission to administer two to three all-employee surveys, and (c) senior management's commitment to promote and support the intervention. Fifty-four directors signed the participation agreement, a number comparable to or higher than that for other intervention studies in the health care setting (e.g., Thomas et al., 2005; Tucker & Singer, 2015; Curry et al., 2018). Participating clinics (n=54) are similar to nonparticipating clinics (n=1,313) in organizational characteristics (e.g., number of patients served, percentage of

uninsured patients) and clinical quality (e.g., diabetes management, tobacco use assessment).

Table A3.1 in the Appendix reports the comparison results.

Randomization. I used a stratification randomization procedure (Deaton & Cartwright, 2018), blocking on whether or not the CHC is a PCMH and serves a rural population. These variables have been shown to affect patient outcomes and care delivery processes in CHCs (Shi et al., 2017; Timbie et al., 2017). Other CHC characteristics, such as patient volume, number of patients best served by a language other than English, and number of providers, were all significantly correlated with the health center’s rural context. Half the enrolled CHCs were randomly assigned to the treatment group (n=27) and the rest to the control group (n=27). The randomization produced two balanced groups (Table 3.1).

Table 3.1. Baseline Characteristics and Balance Check (26 treatment vs. 27 control CHCs)

	All		Treated vs. control	
	(1) Mean	(2) SD	(3) T-C difference	(4) RI p-value
A: Outcome variables (baseline)				
(1) Psychological safety on 1–7 scale	4.56	0.33	-0.05	0.56
(2) % employees who express psychological safety	57.4	8.54	-1.11	0.60
B: Organizational characteristics				
(1) % located in a rural area	43.4	50.1	13.0	1.00
(2) % achieved PCMH recognition	73.6	44.5	-1.00	1.00
(3) N employees	206.6	355.4	67.6	0.75
(4) N clinic/office locations	8.96	9.63	2.87	0.30
(5) N patients served	22,779	32,447	2,660	0.82
(6) % patients best served in a non-English language	16.0	17.4	0.32	0.95
(7) % uninsured patients	23.2	15.7	-1.56	0.75
(8) Region				0.89
N in the Midwest	13			
N in the Northeast	14			
N in the South	14			
N in the West	12			
C. Clinical quality measures from 2016				
(1) Adult BMI screening & follow-up	65.7	17.6	3.37	0.48
(2) Children/adolescent weight assessment	56.9	23.2	3.74	0.54
(3) Ischemic vascular disease treatment	75.8	15.8	6.31	0.19
(4) Asthma treatment	86.4	12.7	5.56	0.13
(5) Colorectal cancer screening	35.8	16.3	3.26	0.49
(6) Cervical cancer screening	48.1	14.0	-1.67	0.67
(7) Children vaccination	32.2	23.4	-4.49	0.48
(8) Diabetes management	53.9	8.20	-0.86	0.70
(9) Blood pressure control	61.9	8.59	0.04	0.99
(10) Low birthweight delivery	9.42	6.27	0.61	0.74

Table 3.1. Baseline Characteristics and Balance Check (26 treatment vs. 27 control CHCs)
(continued)

(11) Lipid-lowering therapy	78.5	9.64	0.92	0.73
(12) Tobacco use assessment	85.2	13.1	-0.52	0.88
(13) HIV treatment	77.9	36.2	-5.58	0.64
(14) Clinical depression screening	61.9	20.2	0.53	0.92
(15) Dental sealants for children	44.3	23.8	10.31	0.18
D: Survey respondent characteristics				
(1) Gender (% female)	87.2	5.15	-0.17	0.92
Tenure				
(2) Less than one year (%)	24.9	9.98	0.25	0.92
(3) One to three years (%)	31.4	7.39	0.56	0.77
(4) Three to five years (%)	15.6	4.70	-0.24	0.86
(5) Five to ten years (%)	12.8	6.15	-0.36	0.81
(6) More than ten years (%)	15.2	10.1	-0.21	0.94
Hours at work				
(7) Less than 40 hours (%)	16.0	13.3	5.79	0.12
(8) 40 hours (%)	56.1	8.58	-3.59	0.14
(9) More than 40 hours (%)	27.8	9.22	-2.20	0.41

Notes. Columns (1) and (2) report mean and SD of all variables for all participating health centers. Column (3) reports the difference between treatment and control groups, or the estimated coefficient for the treatment indicator from a regression of the variable on the treatment indicator and stratum indicators. Column (4) reports the randomization inference (RI) *p*-values for the coefficient, based on 1,000 draws. For variable (8) in Panel B, the difference between treatment and control groups was determined using the chi-squared test.

Sample characteristics. One CHC assigned to the treatment group dropped out after completing the intervention. Data from 53 CHCs were included in the analysis. Table 3.1 provides information on them. Twenty-three (43%) were in rural areas and 39 (74%) achieved the PCMH certification. At the time of the study, participating health centers employed 207 people on average, ranging from 18 to 2,573. Employees included physicians/dentists, nurse practitioners, physician assistants, nurses, medical/dental assistants, case managers, social workers, front desk staff, technicians, billing specialists, and other support staff.

3.4.2. Intervention

I coordinated with a point person, typically a senior manager (e.g., chief executive officer), from each health center to implement the intervention. Days prior to launching, I asked senior managers to introduce the concept of innovation contests to employees. The intervention broadly sought ideas to improve patient care. All promotional materials contained language that

explicitly encouraged employees to contribute ideas. To standardize the information shared with all organizations, I asked managers to use the materials and language that I created to promote the ideation challenge, at time points that I specified. Figure A3.1 in the Appendix presents screenshots of the promotional materials and the crowdsourcing platform.

I asked senior managers to present the intervention as an organizational initiative rather than a research study to minimize its linkage to the pre- and post-intervention surveys. I also asked that the surveys be introduced to employees as a way to assess—in partnership with external researchers—employee engagement, separate from intervention. All participating CHCs completed the intervention and its timing was staggered to distinguish the treatment and control groups; that is, the control group CHCs conducted the intervention only once all post-intervention surveys had been completed in the treatment group.

All employees were invited to participate in the intervention—a crowdsourcing activity called the “ideation challenge”. An institutional email was required to log onto the platform. The challenge began with a three-week ideation phase. Ideation entailed describing a work issue and proposing a solution, with each response limited to 250 characters (comparable to Twitter’s character limit). Next came a three-week voting phase. Voters were asked to indicate the extent, on a scale of 1 to 5, to which they would like to see each idea (presented in a random order) implemented. All submissions were copy edited prior to voting to ensure anonymity and clarity. The average of all ratings determined the winners. One winner and one runner-up per contest won \$100 and \$35 gift cards, respectively. Larger CHCs were encouraged to divide their employee pool by role or location and host a contest for each pool. On average, health centers hosted 2.25 contests, ranging from 1 to 7.

Across all health centers, the crowdsourcing intervention generated 2,138 ideas from 1,341 employees; 4,167 people voted. On average, 17% of the employees of a given CHC participated in ideation and 46% in voting. Ideas addressed new service opportunities, community needs, and workflow improvement. One idea asked to “create a special team of provider, nurse, community health worker, and medical assistant to take the medical bus once a month to severely underserved areas (e.g., subsidized housing towers).” Another called for a “Community Wellness Day in the parking lot [to] showcase all services and offer screenings.”

3.4.3. Data and Analysis

Survey data. A baseline survey was administered in all CHCs, asking employees to indicate their perceived psychological safety (Garvin, Edmondson, & Gino, 2008) on a seven-point Likert scale. About eight to ten weeks after the intervention in the treatment CHCs, a second survey was conducted in all CHCs. It asked the same questions as the first and also included a section soliciting supervisor assessments. For this assessment, I borrowed five-point Likert scale items on innovative and voice behaviors (Scott & Bruce, 1994; van Dyne & LePine, 1998). Supervisors rated multiple employees, raising the issue of nonindependence. However, comparing the relative power of ordinary least squares (OLS) models to random coefficient modeling—a multilevel modeling technique—suggests that nonindependence is not a big concern in my data (Bliese & Hanges, 2004). For example, 116 supervisors each assessed three employees and the intraclass correlation (ICC) value is 0.28. These values indicate that nonindependence of the nested data would have led to an approximately 1% drop in power, a relatively modest drop.

On average, 62% of the employees across 53 CHCs completed the first survey and 52% completed the second survey. Supervisors assessed behaviors of 54% of the employees in the

second survey. The response rates in treatment and control group CHCs did not differ significantly for both surveys.

Outcome measures. I examined the impact of the intervention on five measures. The first four were supervisor assessments of individual employees (1) making suggestions to improve patient care, (2) generating creative ideas, (3) promoting and championing ideas to others, and (4) developing plans and schedules to implement new ideas in the last two weeks. The fifth measure was an index of items (Cronbach's $\alpha = 0.89$) on psychological safety (e.g., "People in this organization are eager to share information about what does and does not work") as indicated by employees (including supervisors).

As each CHC was a unit of analysis, and for ease of presentation, I aggregated each measure collected at the individual level (e.g., employee X voices suggestions) to the organizational level (e.g., percentage of employees who voice suggestions at CHC Y). I created binary variables where 1=extremely or very characteristic and 0=moderately, slightly, or not at all characteristic of the employee to engage in a given behavior. I then calculated the percentage of employees who engage in that behavior at each CHC. I also conducted the analysis using pre-aggregated, individual-level data and included the results in Table A3.2 in the Appendix. In these models, I clustered standard errors by CHC and included CHC random effects. The direction and significance of the results remain the same as in the organizational-level analysis.

Analysis. I estimated the intervention's average treatment effects using a simple regression model:

$$Y_j = \beta T_j + \gamma_j + X_j + \varepsilon_j \quad (1)$$

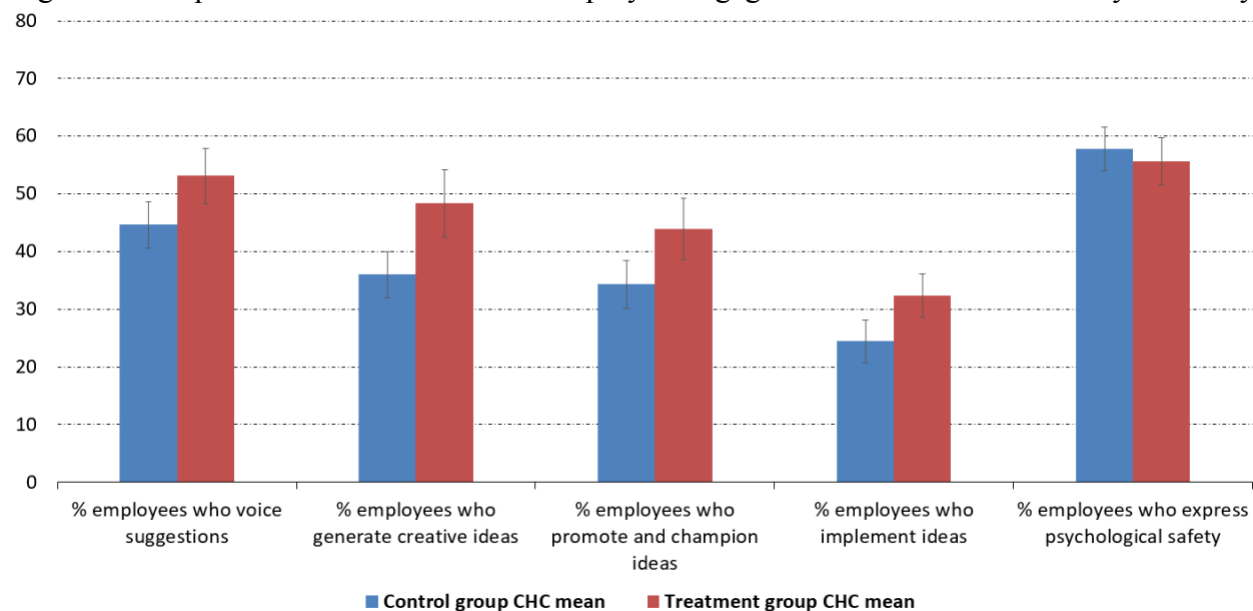
where Y_j is the outcome of interest for health center j , T_j is the treatment indicator, γ_j is the stratum indicator, and X_j controls for psychological safety at baseline, the number of employees,

and percentage of uninsured patients; the last two variables have been shown to affect CHCs' clinical performance and employee burnout (Shi et al., 2017). For statistical inference, I used randomization inference, which considers uncertainty in estimates arising from random assignments rather than from sampling and is the increasingly recommended method for analyzing RCT data, especially for small samples (Heß, 2017; Young, 2019). To adjust for multiple hypothesis testing, I controlled for the familywise error rate, the probability of even one false rejection of the null hypotheses (List, Shaikh, & Xu, 2019).

3.4.4. Experiment Findings

Figure 3.1 gives a first impression of the main treatment effects. The percentages of employees engaging in discretionary innovation are higher in the treatment group CHCs than in the control group CHCs. For example, the percentage of employees voicing suggestions is about eight points higher in CHCs that conducted the crowdsourcing intervention than in those that did not. The error bars indicate that the increases are statistically significant. The percentages of employees expressing psychological safety appear to be similar across groups.

Figure 3.1. Impact of the Intervention on Employee Engagement in Innovation and Psych. Safety



Notes. Error bars indicate 95% confidence intervals.

Table 3.2 shows results without and with controlling for select organizational characteristics. The results of both specifications are similar across outcomes. As observed in the bar chart, the intervention has a positive and significant effect on employees' engagement in innovation, increasing them by as much as 35%. In contrast, I do not find evidence that the intervention affects psychological safety. Psychological safety does not seem to mediate the relationship between the crowdsourcing intervention and the increased engagement in innovation; results remain largely the same when the psychological safety indicator is entered into regression models (shown in Table A3.3 in the Appendix).

Table 3.2. Treatment Effects

	Outcome variables									
	Voicing suggestions		Generating creative ideas		Championing & promoting ideas		Implementing ideas		Psychological safety (at post-intervention)	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Treatment effect	8.84** (2.95) [0.005]	9.48** (3.08) [0.006]	12.9*** (3.18) [0.001]	13.7*** (3.29) [0.001]	9.98** (3.20) [0.003]	11.1** (3.31) [0.002]	8.09** (2.57) [0.002]	7.73** (2.70) [0.006]	-2.31 (2.70) [0.401]	-0.64 (1.84) [0.747]
Size		-0.003 (0.004)		-0.005 (0.005)		-0.002 (0.005)		-0.001 (0.004)		-0.001 (0.003)
Uninsured pts %		0.11 (0.10)		0.06 (0.11)		0.15 (0.11)		0.04 (0.09)		0.06 (0.06)
Psych. safety		0.07 (0.19)		-0.07 (0.20)		0.12 (0.20)		0.12 (0.17)		0.85*** (0.11)
Constant	54.0*** (4.95)	46.5*** (12.9)	50.2*** (5.33)	52.3*** (13.8)	43.5*** (5.35)	31.8* (13.9)	29.3*** (4.30)	21.5 (11.4)	53.2*** (4.52)	1.58 (7.71)
N. obs	53	51	53	51	53	51	53	51	53	51

Notes. OLS estimates of the treatment effects. All models include stratum indicators. Standard errors are reported in parentheses. Randomization inference p -values based on 1,000 draws are reported in square brackets. Adjustments for multiple comparisons using the procedure developed by List et al. (2019) do not change the statistical significance of any of the tests. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

I conducted several exploratory robustness checks. First, to see if the impact of the intervention persists for employees who observed but did not participate, I repeated the analysis after excluding the treatment CHC employees who participated in ideation ($n=827$). Results

remain largely the same, other than that the coefficient on voicing suggestions becomes marginally significant (Table A3.4 in the Appendix). Second, I repeated the analysis using the sample of employees who took both pre- and post-surveys ($n=3,297$); the direction and significance of the results remain the same (Table A3.5). Third, I conducted two tests to address a concern that supervisors' experience of the crowdsourcing intervention in the treatment group positively biases their assessment of employee behaviors. I first checked if responses of supervisors hired after the intervention ($n=12$) are different from those of supervisors who were part of the organization from the onset of the study ($n=461$). If the above concern is valid, then supervisors who experienced the intervention would assess their subordinates' behaviors more favorably than the new supervisors who did not. However, I find that for all four variables capturing employee innovation, responses of new supervisors are more positive than those of existing supervisors. I also checked to see if responses of supervisors who participated in the intervention ($n=337$) are different from those of supervisors who did not ($n=136$) but find no statistical difference. These findings rule out the possibility that knowledge of the innovation intervention inflated supervisory assessment of employee behaviors in the treatment CHCs.

3.4.5. Discussion of Experiment Results

Testing my hypothesis on a field sample of 53 health centers demonstrates that a crowdsourcing intervention can increase employees' engagement in discretionary innovation. My findings show that eight to ten weeks following the intervention, employees in the treatment group CHCs continued to innovate. Importantly, this was the case not only for those who contributed an idea but also for those who opted to observe and did not contribute ideas. However, psychological safety was not found to be a mechanism; I did not find support that it mediates the effect of a crowdsourcing intervention on employee innovation. With these findings

remain a few questions: How does a crowdsourcing intervention affect employees' engagement in innovation? How did it cause employees to innovate more? And under what conditions does this intervention work? Might it work across all organizations or does it work better in some organizations but not in others?

3.5. Qualitative Research

To gain deeper insights on how the crowdsourcing intervention increased employees' engagement in innovation and under what conditions it works, I interviewed senior managers and employees from the same field sites. This research phase was structured inductively because I sought to answer open-ended questions (Pratt, 2008). The treatment and control group distinction no longer mattered in this phase because the interviews took place after the post-intervention survey.

3.5.1. Data and Analysis

I interviewed 89 senior managers from 48 CHCs. To understand how they experienced intervention and what they did to implement it, I asked a mix of open-ended and closed-ended questions. On average, these conversations lasted about 48 minutes. I also interviewed 86 employees from 21 CHCs. Of those, 25 were supervisors. All interviewees participated in ideation or voting and were randomly selected for an interview. I asked open-ended questions to gain a broad understanding of how they experienced the intervention. On average, these conversations lasted about 16 minutes. All interviews except one were conducted using Zoom, a videoconferencing software. I visited one health center and conducted that interview in person. Appendix 1 lists the interview questions that guided these conversations.

I analyzed the interview transcripts using an inductive approach: an iterative process of coding, comparing, and contrasting themes from the data and integrating patterns and

relationships into a theoretical framework (Glaser & Strauss, 1967; Strauss, 1987). I used NVivo to keep track of thematic salience and for writing and sorting memos. My analytic thought process was refined through discussions with colleagues and informants.

Reviewing the data, I observed that while the specific mechanics of crowdsourcing (e.g., voting, prizes) were new to all participating CHCs, the general practice of soliciting ideas from employees was not. Senior managers varied in how they solicit employee ideas. In some CHCs, explicit and structured practices that engage employees in innovation were already in place prior to the intervention. Senior managers established formal practices to seek ideas from employees and they allowed employees to openly communicate their ideas. This observation prompted me to classify the various employee innovation solicitation approaches as either passive or proactive at the organization level. I elaborate on this classification in the next section and Table A3.6 in the Appendix shows the extant practices and coding results for each CHC. I observed that in 24 of the 48 CHCs where I conducted interviews, senior managers passively sought employee innovation prior to the intervention. Based on this classification, I analyzed the differences in the two subgroups' perceptions and experiences of the intervention. I present the qualitative data below using labels for interviewees indicating their health center, interview number, and role.

3.5.2. Two Innovation Solicitation Approaches: Passive versus Proactive

In CHCs where what I call *passive* innovation solicitation practices were in place, managers relied on employees to decide when and how to share ideas. Managers in these CHCs instituted an open door policy and expected employees to speak to their supervisor about ideas as they emerged. One senior manager said that in her organization, when employees have a suggestion, they “let their supervisors know. Or it can be brought to our clinical quality improvement committee. It can be brought to the CFO, COO, or even the CEO” (#1-0).

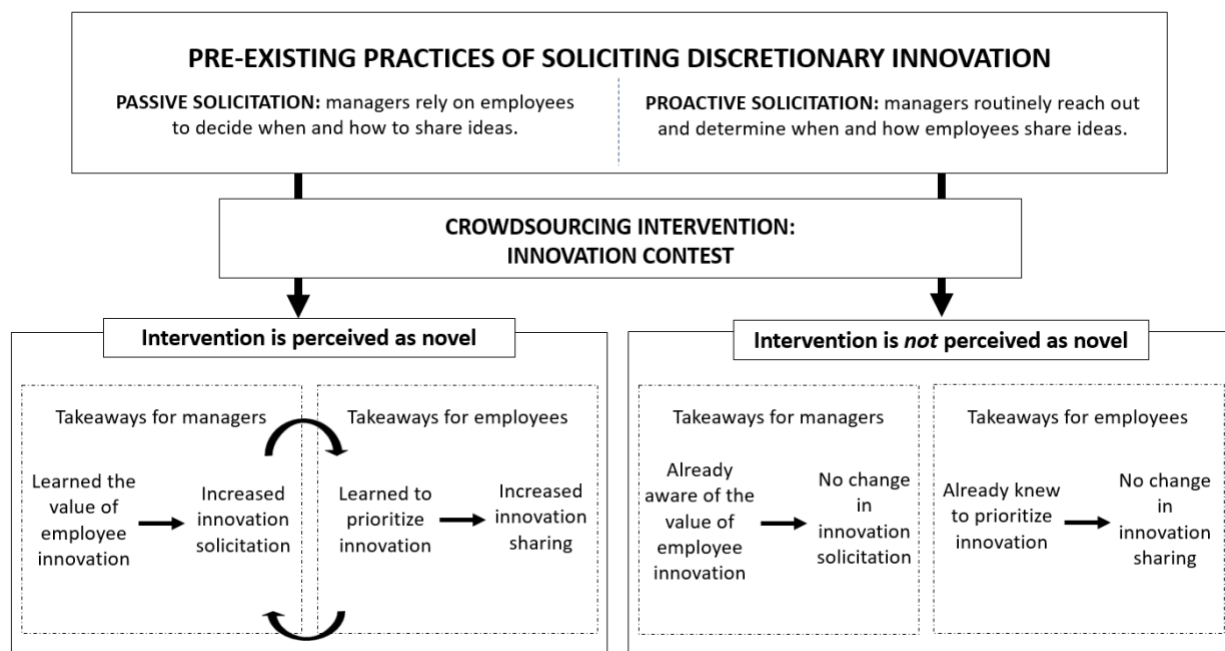
However, employees' initiative alone was not always sufficient to elevate their voice to the appropriate audience. A senior manager observed that people in her CHC do speak up but she was "not sure that it always comes up to my level" (#32-0). In general, in CHCs where managers passively solicited employee ideas, informants described the existing means of capturing employee ideas as "informal" and as not "organized" or "structured."

In CHCs that use what I call *proactive* innovation solicitation practices, managers regularly reached out to employees and determined when and how employees should share ideas. Managers in these CHCs used feedback surveys, suggestion boxes with a clear follow-up process, and meetings specifically designed to brainstorming and ideation. Senior managers of one CHC (#24-0) told me about a biannual survey that asked for suggestions to improve morale and job satisfaction; the aggregate results were shared in an all-staff meeting and managers selected three issues to address in the upcoming year. In another CHC (#17-0), employees used a virtual suggestion box to voice ideas. Each submission would describe a suggestion, its potential impact, and how much it would cost to implement. All submissions were discussed during weekly administrative meetings. If any part of the idea was implemented, paid time-off hours were awarded to the employee who suggested it. Overall, in CHCs where managers proactively solicited employee ideas, informants referred to a formal "process" or "mechanism" that prescribed the occasion and outlet to collect ideas.

The main difference between the passive and proactive innovation solicitation practices was the extent to which employees had to use discretion to innovate and share ideas. When there was no official channel or occasion for such input, the onus was on the employees to discern when and how to innovate. When managers proactively sought employee ideas via an open invitation and structure, less employee discretion was required.

Whether managers passively or proactively solicited employee ideas prior to the intervention turned out to be an important context for managers' and employees' experience of the crowdsourcing intervention. Drawing on rich qualitative data, I show that this context determined whether the intervention was perceived as novel or not. In CHCs with passive innovation solicitation practices, the intervention was perceived to be novel and introduced takeaways for both managers and employees, resulting in increased innovation solicitation and sharing behaviors. In CHCs with proactive practices, the intervention was not perceived to be novel and neither introduced new takeaways nor changed behaviors. These differences are illustrated in an emergent framework (Figure 2). Table A7 offers illustrative quotes.

Figure 3.2. Impact of the Intervention Based On Passive vs. Proactive Innovation Solicitation Practices in Place Prior to the Intervention



3.5.3. Crowdsourcing Intervention Experience in CHCs with *Passive* Solicitation Practices

Perceived as novel. In CHCs where employee ideas were passively sought, senior managers and employees both described the crowdsourcing intervention as novel. One senior manager said, “We haven’t implemented a formal program like [the ideation challenge], not

since I've been here. We would tell people at staff meetings, sometimes, to share ideas” (#37-0). Another senior manager noted that, “[t]here hasn’t been an easy way for staff to be able to be involved” and that crowdsourcing “gave people the opportunity to give their ideas if they aren't in middle management” (#4-0).

Employees described the intervention as “shockingly new” (#36-1, medical assistant) and a “huge opportunity to share ideas” (#26-1, social worker). A front desk staff said, “I participated because we don’t have a way or form to give ideas on things that we could better handle” (#42-1). Employees appreciated the chance to contribute ideas more than the chance to win a prize; one said, “This was the first large opportunity that we could actually help create a change. I didn’t do it for the gift card. I did it to help. I would be happy to give back the gift card” (#35-4, community health worker). These data suggest that in CHCs where employee input was sought passively, the crowdsourcing intervention offered an untried method for both managers and employees to openly solicit and share innovation.

Managers’ takeaways. Prior to the intervention, managers in these CHCs learned of employee perspectives from the few who were willing and able to take advantage of the open door policy. For these managers, the crowdsourcing intervention presented ideas from employees in a systematic manner for the first time. One senior manager (#33-0) said, “What I took away [from running the ideation challenge] was that staff have fabulous ideas. Their ideas are able to elevate us but we don’t have formal mechanisms to capture them.” Another (#43-0) said:

[The ideation challenge] opened my eyes to be like, so what do you think might help the situation? When we hear complaints and aggravations, we could ask [the employees]: what could help, or are you just venting? It’s reaffirming that we could be more, “Hey what do you think might fix it?” instead of being, “Okay, I’ll fix it for you.”

These experiences suggest that the intervention taught managers to recognize that employees could be innovative and contribute useful ideas when asked.

As a result, managers in these health centers started to solicit ideas from employees more proactively after the intervention. One senior manager (#15-0) said she has heard more ideas from a diverse group of employees since the intervention and attributed this change to the shift in her approach:

I've been spending a lot more time sitting with providers and medical assistants asking, what do you think about this process, do you have some ideas on how you would improve it, or what are you doing that you feel like is redundant?

Other senior managers described plans to implement a suggestion box (#27-0), morning huddles (#41-0), and even ideation challenges to crowdsource ideas on focused topics such as employee benefits and cost-saving strategies (#35-0, #6-0).

Employees noticed their managers' sustained efforts to involve them in innovation. One observed that there have been "more conversations around ideas" as the intervention initiated such conversations and that managers "push people to continue to share their ideas" (#43-1, medical assistant). Another noted, "In a recent quarterly meeting, managers said they will do more outreach to collect employee feedback. I've never heard them offer that before. It seems like they saw the benefit of doing this" (#23-5, marketing assistant).

Employees' takeaways. The open request for ideas energized employees to prioritize innovation, even if it was not part of their day-to-day work. One nurse observed, "Our feelers are up. Business is still as usual but the ideation challenge made your antennas go up to say, hey, this needs to be changed or we could do this better here" (#44-1). In a setting in which employees are under constant pressure to deliver, the need to innovate and to speak up with ideas might not have been at the forefront of their minds. One explained, "It feels like . . . there are constant fires to put out. We're trying to get our patients' needs met. Ideas and anything innovative get pushed to the side" (#40-3, behavioral health therapist). In this context, the crowdsourcing intervention

offered an excuse for employees to engage with their work environment beyond prescribed tasks and thus “sparked creativity” to explore “what they want to see different” (#42-5, billing manager). One volunteer engagement specialist (#23-2) said:

I started to look more globally at how things work in this position and how we can better assist patients. It’s gotten me to think more critically. Before, you just work day to day, but the ideation challenge got me thinking like, “what else can I think of to improve my workplace” instead of going from day to day to day to day.

Being asked to innovate on behalf the organization seems to have conveyed to employees that they can and should innovate and speak up with ideas.

As a result of this takeaway, employees started to innovate and voice more ideas following the intervention—as evinced in my experimental findings. Senior managers received more ideas; one CEO said, “Since the ideation challenge, we are getting more suggestions about pretty much anything. They’re not all incredibly innovative, but I think our staff used the process to learn to make suggestions” (#44-0). An outreach worker similarly reported that she and her coworkers became more likely to innovate and speak up after the intervention, even about seemingly pedestrian issues: “Now, even if it isn’t something that needs a big policy change, we go to our practice manager now and say, hey, what about this, and we start doing it” (#46-2).

3.5.4. Crowdsourcing Intervention Experience in CHCs with *Proactive Solicitation Practices*

Not perceived as novel. In CHCs where employee ideas were proactively sought, managers and employees both described the intervention as being similar to existing solicitation practices. Senior managers in these CHCs shared that they already had idea generation and feedback loops in place prior to the intervention. One director of human resources (#17-0) commented that employees were confused as to how the intervention differed from other idea solicitation practices and managers had to keep clarifying it. A mid-level contracts manager (#34-1) said that the intervention felt “not any different” from the regular feedback surveys; the

only thing new was the chance to win a prize. Employees, too, reported prior experience with practices that explicitly solicited their ideas. One dietician said, “They did something similar before. We wrote down our ideas on paper and turned them in. ... Based on that experience, this didn’t seem like a foreign thing” (#2-2). These data suggest that in these CHCs, the intervention was not a new opportunity for managers to solicit employee ideas or for employees to contribute their input.

Managers’ takeaways. Even before the intervention, managers in these CHCs understood the importance of soliciting ideas from those “on the ground.” One senior manager said, “My sense is that I can't know everything from my office and I love to hear from someone who's working with patients on a day-to-day basis” (#20-0). Another said, “We always work to understand the voice of the staff and people who do the work. They often have the best ideas” (#31-0). There were no new takeaways about the value of soliciting employee innovation for managers in these CHCs. As one front office supervisor noted, “Even before the ideation challenge, many were already giving ideas away. We try to ask, as managers, whatever is on your mind, let us know and we can talk about it” (#45-1).

There were, in turn, no changes made to existing employee innovation solicitation practices. One senior manager said: “We do encourage people to speak truth to power and come up with ideas. Sometimes they do. Sometimes they don't. But there's a culture here. I don't know whether it's been strengthened by the ideation challenge” (#7-0). In short, managers who proactively sought employee ideas did so because they already appreciated them. The intervention did not prompt new lessons or changes regarding soliciting employee innovation.

Employees’ takeaways. In these CHCs, employees were already aware of the importance of identifying and speaking up about improvement opportunities. One nurse shared that in her

clinic, “people already pipe up with ideas” (#45-2). A nurse practitioner in another CHC also said, “People who are on the ground already constantly identify problems and offer solutions. So the ideation challenge was another way of what's already being done on a very consistent basis” (#47-1). These data suggest that the intervention did not provide new takeaways for employees about prioritizing innovation. The intervention was perceived to be aligned with the existing culture around innovating. One marketing and communications manager (#12-5) explained:

It’s already an innovative environment. It’s an open environment where people can share ideas. I wouldn’t say there have been any drastic changes, since the innovative spirit is already instilled in the organization. It just supported that and reminded folks that that’s part of our culture.

Thus, the intervention did not cause any behavioral changes related to innovating in these CHCs.

These qualitative findings suggest that the impact of the crowdsourcing intervention on employees’ engagement in discretionary innovation depends on whether or not there are proactive innovation solicitation practices already in place. In Table A3.7 in the Appendix, I describe a quantitative test with which I show that in CHCs with proactive innovation solicitation practices prior to the intervention, the intervention effects on employee innovation are fairly small and not statistically significant. In contrast, in CHCs with passive solicitation practices, the estimated effect is more than ten times as large. Thus, pre-existing innovation solicitation practices may act as a boundary condition for this intervention. In particular, the intervention seems to be very effective when managers and employees are not used to the open approach to innovating, but not so effective when such an approach is already in use.

3.6. Discussion

I set out to explore whether there are long-term, spillover outcomes to crowdsourcing ideas from employees, beyond immediate outcomes like the innovations generated from the crowdsourcing activity. Specifically, I examined whether and how innovation contests, a

crowdsourcing intervention that opens up a channel and opportunity for all employees to innovate, could increase their engagement in discretionary innovation. My experimental findings evince that eight to ten weeks following the intervention, it increased employees' engagement in innovation by more than 35 percent. Although psychological safety was not found as a mechanism, my qualitative findings suggest alternative ones as well as boundary conditions. The intervention increased employees' engagement in innovation by (1) exposing managers to the value of soliciting employee ideas, thereby prompting them to increase their solicitation behaviors and (2) spurring employees to prioritize innovating on top of their day-to-day work. The intervention was particularly effective in organizations where employee ideas were not proactively sought prior to the intervention. This paper makes contributions to theory and research on crowdsourcing and motivating employees to innovate and speak up.

3.6.1. Impact of Opening the Innovation Opportunity and Channel

While much of the crowdsourcing literature has focused on its short-term effects, several scholars have noted long-term effects of opening the innovation process on participants, including changes to their professional identity, locus of innovation, and engagement at work (Soukhoroukova, Spann, & Skiera, 2012; Turco, 2016; Malhotra et al., 2017; Lifshitz-Assaf, 2018). The present paper adds to this research stream by showing that a crowdsourcing intervention can shape behavioral norms and create new organizational processes pertaining to innovating beyond one's job description. The intervention, which represented an open approach to innovation, allowed senior managers as well as employees to experience and learn the importance and relevance of manager-employee communication and interactions in organizational problem-solving. The open channel allowed managers to confront and learn from employees and develop an appreciation for their knowledge and wisdom. As a result, this one-

time opportunity and channel for all employees to innovate opened up new formal and informal communication channels that managers could use to continue soliciting ideas from employees. Employees, too, began to prioritize innovating after learning that their input is valued by management, leading to more sharing of ideas. This finding is in line with our theoretical understanding that introducing a new practice can engender new beliefs, values, and assumptions about interpersonal processes and organizational communication (Roethlisberger & Dickson, 1939; Barley, 1986; Schein, 2010).

I find that the impact of the crowdsourcing intervention depends on existing organizational practices, similar to prior research that shows the role of organizational context on how crowdsourcing is implemented and used (Mack & Szulanski, 2017; Gallus, Jung, & Lakhani, 2020; Malhotra et al., 2020). The crowdsourcing intervention had little impact on employees' engagement in discretionary innovation in organizations where managers were already proactively seeking employee ideas prior to the intervention. In those organizations, the open opportunity and channel for all employees to innovate was not perceived to be novel and did not expose managers or employees to new experiences or takeaways, leading to no change in behavior. Thus, the existence of employee idea solicitation practices may be a boundary condition for the impact of crowdsourcing intervention on employees' engagement in innovation. When managers are already familiar with the usefulness of openly soliciting employee ideas and employees are used to having open channels to communicate their input, a crowdsourcing intervention that merely asks for ideas may not be sufficient to increase innovative behaviors. A more robust communication channel that offers explicit and structured feedback, in addition to the ask, may be needed. Future research should examine whether and how provision of

meaningful responses to ideas (e.g., Piezunka & Dahlander, 2019), combined with a crowdsourcing intervention, motivates and sustains employees' engagement in innovation.

Findings from this study carry practical implications for employee engagement. It is important that opening up the innovation process seems to have energized employees' interest in solving organizational problems, as many organizations grapple with disengaged employees (Gallup, 2017). This study demonstrates that a crowdsourcing intervention is a relatively easy, low-cost effort that can increase employees' interest in workplace issues and putting forth discretionary effort to benefit the organization. Future research should look at how varying elements of the crowdsourcing intervention—such as the scope of the problem statement, competition versus collaborative framing of the intervention, and allowing iterative ideation among employees—affects employee behaviors and their attitudes towards work and organization.

3.6.2. Activating and Sustaining Employee Voice

This study sheds light on the broader question of prompting employees to speak up when they have useful information and ideas (Morrison, 2011). Prior research on employee voice has largely focused on how managers can convince employees that voice is welcomed and enable them to speak up (e.g., Edmondson, 2003; Detert & Burris, 2007; Walumbwa & Schaubroeck, 2009; Tangirala & Ramanujam, 2012; Li & Tangirala, 2020). It has also discussed channels such as the suggestion box and the open door policy (Frese, Teng, & Wijnen, 1999; Harlos, 2001). I advance these insights by showing that managers can be more direct in soliciting employee input and characterizing managerial solicitation as ranging from proactive to passive. Managers who engage in proactive solicitation are more likely to use formal voice systems and determine when and how employees share input, while managers who engage in passive solicitation are more

likely to leave employees to bring up ideas as they see fit rather than organizing a structure for ideas.

My results also suggest that specifying the occasion and outlet for employee ideas reduces the extent to which employees must use discretion to innovate and speak up. This can explain why psychological safety was not found to be a mechanism underlying the intervention's effect on employee innovation. Psychological safety is the shared belief that it is safe to take an interpersonal risk to experiment and speak up (Edmondson, 2019). This may have become an unimportant factor once managers—who are generally the intended audience for ideas—extended the invitation themselves. The open invitation for ideas may have eliminated the need to weigh the relative costs and benefits of speaking up typically highlighted in the literature (Ashford et al., 1998; Morrison, 2011). A recent study also found that psychological safety is more strongly related to employees' tendency to withhold information than to speaking up (Sherf, Parke, & Isaakyan, 2020). Instead, my qualitative findings suggest that the crowdsourcing intervention energized employees—especially those who are more focused on execution of daily tasks and less on quality improvement and innovation—to prioritize and speak up about improvement opportunities. The open invitation to voice ideas may have lowered the psychological barriers and encouraged all employees, regardless of role or position in the hierarchy, to share ideas.

Lastly, this study makes methodological contributions to the literature on employee voice. Using a variety of research methods can make our understanding of engaging employees more complete. Existing research on voice has been dominated by survey methods that measure its antecedents and frequency. There have also been qualitative field studies that elucidate important constructs like the content of voice (Burris, Rockmann, & Kimmons, 2017) and

reasons for self-censorship at work (Detert and Edmondson, 2011). I add to the existing arsenal of survey and qualitative methods by implementing an intervention specifically designed to solicit employee ideas in the field and measuring its impact using experimental and qualitative methods. This study generates rigorous and insightful results; the experimental analysis demonstrates the intervention's causal impact on employees' engagement in discretionary innovation, which includes speaking up, and the qualitative data illuminates how and under what conditions beliefs of employees and managers were altered by the intervention.

APPENDICES

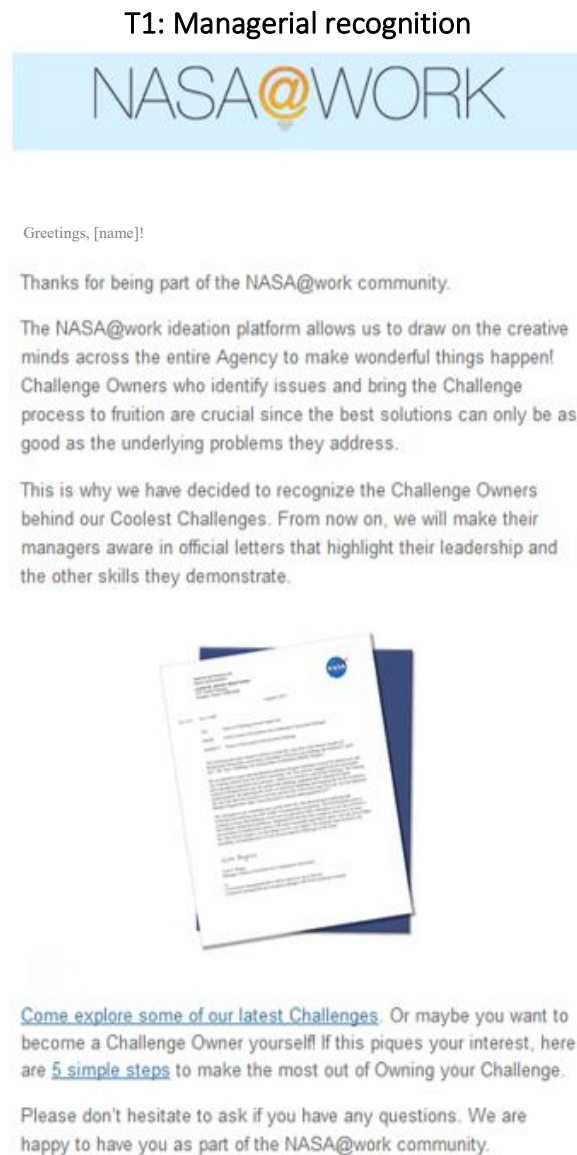
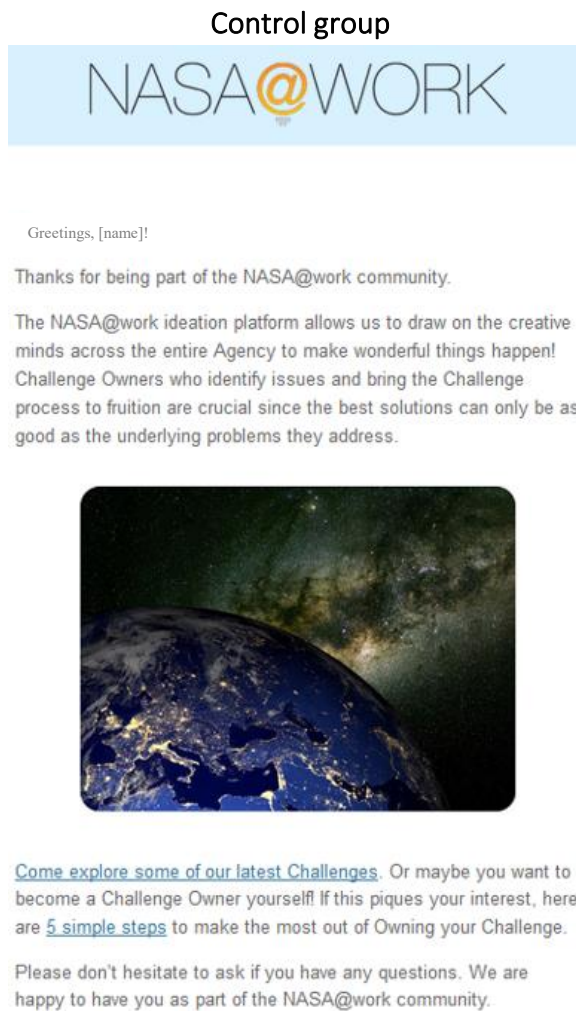
Supplementary Materials for Chapter Two

Table A2.1. Balance Table of User Characteristics by Treatment Assignment (N=7,455)

	Control	Man. R.	Peer R. (offline)	Peer R. (online)	<i>p</i> - value
A. Stratification variables					
Employment Status					
Employee (civil servant)	51.0%	51.2%	51.2%	51.5%	0.994
Contractor	49.0%	48.8%	48.8%	48.5%	
Last log-in within 6 months at the time of study	39.6%	39.9%	40.1%	40.1%	0.987
B. Prior activity on NASA@WORK					
Owned a challenge	0.59%	0.54%	0.75%	0.70%	0.840
Won a challenge	1.12%	1.02%	1.13%	0.80%	0.737
Days since last log-in at the time of study	545	581	551	553	0.212
C. Center affiliation					
Armstrong Flight Research Center	1.12%	1.72%	1.43%	1.45%	0.147
Ames Research Center	3.47%	4.14%	3.97%	3.70%	
Dryden Flight Research Center	0.27%	0.27%	0.43%	0.38%	
Glenn Research Center	9.41%	8.34%	7.95%	9.12%	
Goddard Space Flight Center	10.6%	9.10%	8.70%	9.12%	
Headquarters	3.69%	3.66%	3.44%	3.06%	
Independent Verification & Validation	0.48%	0.65%	0.64%	0.38%	
Jet Propulsion Laboratory	3.37%	2.31%	2.36%	2.58%	
Johnson Space Center	28.6%	27.0%	28.2%	28.1%	
Kennedy Space Center	15.2%	14.8%	16.3%	16.0%	
Langley Research Center	7.38%	9.10%	7.20%	7.83%	
Michoud Assembly Facility	0.16%	0.22%	0.48%	0.11%	
Marshall Space Flight Center	11.0%	12.9%	13.8%	12.1%	
NASA Shared Services Center	1.44%	1.94%	1.61%	1.93%	
Stennis Space Center	1.76%	1.56%	2.15%	2.31%	
Wallops Flight Facility	1.39%	1.61%	1.13%	0.97%	
White Sands Complex	0.00%	0.16%	0.05%	0.00%	
White Sands Test Facility	0.69%	0.59%	0.27%	0.86%	
Number of observations	1,871	1,858	1,862	1,864	

Notes. The last column shows the *p*-values from a Chi-square test of independence and analysis of variance (ANOVA) between platform user characteristics and treatment assignments.

Figure A2.1. Treatment Email Screenshots



T2: Peer recognition (offline)

NASA@WORK

Greetings, [name]!

Thanks for being part of the NASA@work community.

The NASA@work ideation platform allows us to draw on the creative minds across the entire Agency to make wonderful things happen! Challenge Owners who identify issues and bring the Challenge process to fruition are crucial since the best solutions can only be as good as the underlying problems they address.

This is why we have decided to recognize the Challenge Owners behind our Coolest Challenges. From now on, they will receive our NASA@work pin together with a personal letter of appreciation from the NASA@work team.



[Come explore some of our latest Challenges](#). Or maybe you want to become a Challenge Owner yourself! If this piques your interest, here are [5 simple steps](#) to make the most out of Owning your Challenge.

Please don't hesitate to ask if you have any questions. We are happy to have you as part of the NASA@work community.

T3: Peer recognition (online)

NASA@WORK

Greetings, [name]!

Thanks for being part of the NASA@work community.

The NASA@work ideation platform allows us to draw on the creative minds across the entire Agency to make wonderful things happen! Challenge Owners who identify issues and bring the Challenge process to fruition are crucial since the best solutions can only be as good as the underlying problems they address.

This is why we have decided to shine a light on the Challenge Owners behind our Coolest Challenges. From now on, they will be inducted in the newly created [NASA@work Wall of Fame](#) and recognized in the NASA@work Monthly Bulletin and in our tweets.



[Come explore some of our latest Challenges](#). Or maybe you want to become a Challenge Owner yourself! If this piques your interest, here are [5 simple steps](#) to make the most out of Owning your Challenge.

Please don't hesitate to ask if you have any questions. We are happy to have you as part of the NASA@work community.

Supplementary Materials for Chapter Two

Appendix 3.1. Interview guides

For interviews of senior managers

- How was your experience with the ideation challenge?
- Thinking back to the decision to run the ideation challenge in your health center, do you recall what you were looking to get out of this experience? Any goals, aims, or expectations that you might have had?
- Has your organization implemented a project like the ideation challenge in the past (i.e., asking all employees to be involved with thinking of ideas and selecting which ideas are best)?
 - Probe: Would you say that being asked for ideas and suggestions felt familiar for your employees? Or more foreign? Can you say more?
 - Probe: How do your employees bring up ideas or suggestions if they have one?
- To what extent did running the ideation challenge in your organization meet your expectations?
- Did anything surprise you? Can you give me an example?
- Do you have anything else about your experience to add that I didn't ask about?

For interviews of employees

Introductions

- What is your role/job at work?
- Can you tell me about your typical day?
- How long have you worked at this clinic?

Experience with the ideation challenge

- What did you think about the ideation challenge?
- What made you participate?
- To what extent has the ideation challenge impacted the way you (or your colleagues) notice improvement opportunities? Come up with ideas? Speak up about them?
- Prior to the ideation challenge, when you had an idea for an improvement or a suggestion, what would you do? If you were to share about it, how would you bring it up?
 - Probe: Has this changed after the ideation challenge?
- Overall, how was your experience? Do you have any other thoughts that I didn't ask about?

Table A3.1. Comparison of Participating (N=54) Vs. Nonparticipating CHCs

	Participating CHCs	Nonparticipating CHCs	<i>p</i> - value	Number of CHCs
A. Organizational characteristics				
(1) Located in a rural area (%)	44.4	44.3	0.99	1,367
(2) Achieved PCMH recognition (%)	72.2	69.7	0.69	1,333
(3) No. of clinic locations (mean N)	8.98	7.57	0.23	1,365
(4) Patients served (mean N)	22,947	18,829	0.20	1,357
(5) Patients best served in a language other than English (%)	16.0	19.0	0.35	1,357
(6) Uninsured patients (%)	22.9	25.9	0.26	1,357
B. Clinical quality measures (% achieved)				
	Mean	Mean		
(1) Adult BMI screening & follow-up	65.8	59.9	0.06	1,367
(2) Children/adolescent weight assessment	56.8	56.4	0.92	1,353
(3) Ischemic vascular disease treatment	75.8	76.7	0.72	1,367
(4) Asthma treatment	86.3	85.2	0.60	1,354
(5) Colorectal cancer screening	35.4	37.0	0.56	1,364
(6) Cervical cancer screening	47.8	49.2	0.58	1,367
(7) Children vaccination	33.2	37.8	0.20	1,319
(8) Diabetes management	53.8	53.4	0.84	1,367
(9) Blood pressure control	61.9	61.8	0.94	1,364
(10) Low birthweight delivery	9.48	9.73	0.90	1,202
(11) Lipid-lowering therapy	78.8	77.7	0.68	1,357
(12) Tobacco use assessment	85.1	82.7	0.31	1,367
(13) HIV treatment	77.9	82.3	0.39	762
(14) Clinical depression screening	61.7	59.3	0.49	1,366
(15) Dental sealants for children	45.0	48.0	0.44	1,015

Notes. In Panel A, *p*-values are results of chi-square tests for variables (1) and (2). For the remaining variables in Panel A and all variables in Panel B, *p*-values are results of equal variance *t*-test.

Table A3.2. Treatment Effect Analysis Using Individual-Level Data

	Outcome variables								Psychological safety (at post-intervention)	
	Voicing suggestions		Generating creative ideas		Championing & promoting ideas		Implementing ideas			
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)		
Trtmt. effect	0.255*** (0.067)	0.278*** (0.068)	0.330*** (0.077)	0.349*** (0.078)	0.304*** (0.083)	0.323*** (0.083)	0.301** (0.103)	0.305** (0.106)	-0.166 (0.092)	-0.130 (0.089)
Strat. vars	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control vars	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
N. obs	5,412	5,346	5,398	5,332	5,397	5,331	5,376	5,310	4,833	4,763

Notes. OLS estimates of the treatment effects at the individual level. All models include CHC random effects with standard errors clustered by CHC. The survey scales for outcome variables in models (1), (2), (3), and (4) are on a 1–5 Likert scale and those in model (5) are on a 1–7 Likert scale. The number of employees and percentage of uninsured patients are included in all models as control variables. Robust standard errors are reported in parentheses. ** $p < 0.01$, *** $p < 0.001$.

Table A3.3. Psychological Safety as a Non-Mediator

	Outcome variables							
	Voicing suggestions		Generating creative ideas		Championing & promoting ideas		Implementing ideas	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Treatment effect	9.48** (3.08) [0.006]	9.65** (3.09) [0.007]	13.7*** (3.29) [<0.001]	13.7*** (3.33) [<0.001]	11.1** (3.31) [0.002]	11.3** (3.28) [0.003]	7.73** (2.70) [0.006]	7.87** (2.71) [0.007]
Psych. safety (at post-intervention)		0.262 (0.250)		0.057 (0.270)		0.371 (0.266)		0.211 (0.220)
Size	-0.003 (0.004)	-0.003 (0.004)	-0.005 (0.005)	-0.005 (0.005)	-0.002 (0.005)	-0.002 (0.005)	-0.001 (0.004)	-0.0008 (0.004)
% uninsured pts	0.110 (0.100)	0.094 (0.102)	0.064 (0.107)	0.061 (0.109)	0.148 (0.108)	0.125 (0.108)	0.039 (0.088)	0.026 (0.089)
Psych. safety	0.073 (0.190)	-0.150 (0.285)	-0.068 (0.203)	-0.116 (0.307)	0.118 (0.204)	-0.197 (0.303)	0.123 (0.167)	-0.056 (0.250)
Constant	46.5*** (12.9)	46.1*** (12.9)	52.3*** (13.8)	52.2*** (13.9)	31.8* (13.9)	31.2* (13.7)	21.5 (11.3)	21.2 (11.4)
N. observations	51	51	51	51	51	51	51	51

Notes. OLS estimates of the treatment effects. All models include stratum indicators. Standard errors are reported in parentheses. Randomization inference p -values based on 1,000 draws are reported in square brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A3.4. Treatment Effects after Excluding Treatment CHC Employees Who Participated In Ideation

	Outcome variables									
	Voicing suggestions		Generating creative ideas		Championing & promoting ideas		Implementing ideas		Psychological safety (at post-intervention)	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Trtment effect	5.73 [^] (3.20) [0.091]	6.24 [^] (3.33) [0.079]	9.52 ^{**} (3.38) [0.008]	10.1 ^{**} (3.46) [0.004]	6.78 [*] (3.27) [0.041]	7.66 [*] (3.39) [0.032]	5.32 [*] (2.59) [0.046]	4.80 (2.72) [0.105]	-1.45 (2.69) [0.598]	0.143 (1.84) [0.944]
Size		-0.003 (0.005)		-0.004 (0.005)		-0.002 (0.005)		- 0.0006 (0.004)		-0.002 (0.003)
Uninsured pts %		0.152 (0.108)		0.125 (0.113)		0.148 (0.110)		0.076 (0.089)		0.023 (0.060)
Psych. safety		-0.019 (0.205)		-0.186 (0.214)		- 0.0006 (0.210)		-0.035 (0.168)		0.837 ^{***} (0.114)
Constant	52.0 ^{***} (5.36)	48.5 ^{***} (13.9)	46.6 ^{***} (5.66)	53.7 ^{***} (14.4)	43.0 ^{***} (5.47)	38.1 ^{***} (6.49)	25.7 ^{***} (4.34)	25.9 [*] (11.4)	55.8 ^{***} (4.50)	6.23 (7.67)
N. obs	53	51	53	51	53	51	53	51	53	51

Notes. After excluding 827 employees, 9,892 remained. This table reports OLS estimates of the treatment effects at the organization level. All models include stratum indicators. Standard errors are reported in parentheses. Randomization inference p -values based on 1,000 draws are reported in square brackets. [^] $p < 0.10$, ^{*} $p < 0.05$, ^{**} $p < 0.01$, ^{***} $p < 0.001$.

Table A3.5. Treatment Effects among Employees Who Took both Pre- and Post-Intervention Surveys

	Outcome variables								Psychological safety (at post-intervention)	
	Voicing suggestions		Generating creative ideas		Championing & promoting ideas		Implementing ideas			
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)		
Trtmnt effect	11.3*** (3.09) [<0.001]	11.6** (3.24) [0.002]	15.3*** (3.49) [<0.001]	16.1*** (3.69) [<0.001]	13.2** (3.95) [0.002]	13.7** (4.14) [0.003]	13.2*** (3.49) [<0.001]	13.0*** (3.63) [0.001]	-2.92 (2.78) [0.288]	-0.260 (1.87) [0.895]
Size		0.003 (0.023)		-0.017 (0.026)		0.009 (0.029)		0.014 (0.026)		0.0006 (0.013)
Uninsured pts %		-0.137 (0.105)		-0.022 (0.119)		-0.010 (0.134)		0.028 (0.117)		0.077 (0.060)
Psych. safety		0.146 (0.205)		-0.036 (0.233)		0.312 (0.261)		0.333 (0.229)		0.927*** (0.118)
Constant	61.3*** (5.18)	56.9*** (13.8)	54.2*** (5.85)	57.0*** (15.8)	47.6*** (6.62)	29.6 (17.7)	30.6*** (5.85)	10.6 (15.5)	51.5*** (4.66)	-5.16 (7.98)
N. obs	53	51	53	51	53	51	53	51	53	51

Notes. 3,297 employees took both pre- and post-contest surveys. This table reports OLS estimates of the treatment effects at the organization level. All models include stratum indicators. Standard errors are reported in parentheses. Randomization inference p -values based on 1,000 draws are reported in square brackets. ** $p < 0.01$, *** $p < 0.001$.

Table A3.6. Passages Indicating Passive vs. Proactive Innovation Solicitation Practices

CHCs with <i>passive</i> innovation solicitation practices (coded as 1)	
ID	Relevant sample passage from conversations with senior managers
1	Submitting their ideas for change was all new for them. Our employees let their supervisors know [if they have suggestions]. It can be brought to our clinical quality improvement committee. It can be brought to the CFO, COO, or even the CEO.
4	There was never an easy way for other staff to be able to be involved. This ideation challenge gave people the opportunity to submit their ideas if they aren't in middle management.
5	I try to have an open door policy. I try to meet with staff and have one-on-ones with them. But I still think that there might be some resistance to that or maybe some uncomfortable feeling.
6	I would say this [the ideation challenge] was brand new to them. We ask them to go through their supervisor. The supervisors bring suggestions from staff to admin meeting.
15	We haven't done something where they could just come up with any idea and we would vet it to see if it would work. [The ideation challenge] gave us a new opportunity for us to speak differently about sharing good ideas.
18	We've [asked employees for suggestions] on an informal basis. We've always encouraged an open door policy. We haven't had a structured event around that.
22	Not all the sites were not having site meetings. Sometimes there'll be staff that will raise [a suggestion].
23	Nothing official like [the ideation challenge]. There's an open door policy. You could bring your idea to a supervisor.
26	This was new. There's a code of silence under certain things. I personally would like to see it happen again.
27	We haven't implemented a project like this formally. Our staff have open relationships with their supervisor. But not everyone is comfortable doing that, even though I tell people that my door is open. There are staff who would never go to your office to tell you something.
32	This was the first formal time that this [asking staff for input] has ever come up. Informally I would say [that people speak up], but I'm not sure that it always comes up to my level.
33	I have an open door policy. Staff are encouraged, regardless of the method, to bring forward their ideas.
35	I know people are very free to give me their ideas. I get those a lot, just informally. I've also heard some really negative things about they don't feel free.
36	Something like this has never done before. What we did was unfamiliar for our staff.
37	We say at staff meetings sometimes, to send ideas. But we didn't really get a lot of response.
38	We used to do employee surveys. But we haven't done one in a while. We did a survey about 8, 9 years ago.
39	There is something within the state that you can use to submit an idea. <i>[Note from the author: This CHC is part of a state government.]</i> I don't think anyone from our organization has participated.
40	We have not done anything as structured as the ideation challenge.
41	People are encouraged to speak up during staff meetings. They're reminded that they can share their ideas.
42	I don't think we've done anything like this before. Ideas usually come from quality committees when we see incidents.
43	I think the challenge was different for our staff. They can bring ideas forward in meetings.
44	This was the first time we had really ever done anything like that in a big organized fashion. We ask for staff feedback but it had never been in such a large organized push.
46	It's been informal. This is a more formal process to collect ideas. And it seems that we got good bang for our buck and it's something that we should certainly consider enacting again.
48	We have areas that are better than others [in terms of people speaking up]. I think it's a supervisory issue.

Table A3.6. Passages Indicating Passive vs. Proactive Innovation Solicitation Practices
(continued)

CHCs with <i>proactive</i> innovation solicitation practices (coded as 0)	
ID	Relevant sample passage from conversations with senior managers
2	We periodically do employee surveys. It's similar [to the ideation challenge] in getting feedback and then picking up the action items.
3	We have engaged staff through an employee engagement survey. It has questions like, do you have any suggestions for improving your workplace?
7	We ask people to email in suggestions and we look at them and then communicate back to the staff. We have a process for that.
8	[Asking for ideas was] not foreign, but the process of doing it online and voting electronically was new. Our staff are accustomed [to thinking of and sharing ideas].
9	I'd say [the ideation challenge was] familiar in terms of engaging them for information. We did some scenario planning activities with staff to help us brainstorm around particular areas. We created case studies and allowed them to think about ways to solve a problem and make recommendations.
10	We tried to generate ideas on how to improve patient satisfaction, how to improve patient cycle time, how to increase patient numbers. We've done a number of things. We've offered incentives. We've done this through our website.
11	We do surveys that help to identify goals for the organization and what employees want to see.
12	I don't know if [the ideation challenge] was new. This format and putting it up for everyone to see was new.
13	This project was familiar to our staff except the rewards and getting to vote on people's ideas and selecting the winner.
14	People can submit suggestions using an online suggestion box. We do get back to the person who suggests one. It might be disappointing if something cannot be implemented, but we try to explain why it can't be implemented. We've implemented 75% of the suggestions that we got.
16	There's been a lot of transparency and listening to that kind of input. Staff are always asked that all the time. Calling it the ideation challenge was new. But asking for their help in quality or improving things was not new.
17	We have what we call an idea form. Employees at any point can submit ideas. They have to fill out a form and describe what it entails, what it'd cost, and who would be affected by it.
19	Staff will often come up with a solution to whatever the problem is. We had a thing where we asked people to email in their ideas. We received 15–20 suggestions.
20	We've had a mechanism for staff to propose ideas. It's online. They can go in and offer what the problem is and the solution that they recommend. Then we have a group of staff who evaluate those ideas, whether or not they fit the criteria for a workable solution. If they do, that gets elevated and shared with management staff to make a change.
21	We never called it the ideation challenge but we've mirrored a similar format in the past on topics like, what kind of training would you like.
24	Twice a year, we do a staff satisfaction survey. It's pretty much the same thing [as the ideation challenge]. We ask for suggestions for improvement. They become a focus on the management agenda. We'll look closely at the results of the survey and then we'll pick the top three and look at what can we do about it at the management level.
25	We've done something like the employee satisfaction survey. A part of that asks for ideas and feedback for improving the organization.
28	We do an annual employee engagement survey and ask for their feedback on what we could improve on.
29	They're used to us coming up with the questions, what we want answers on. [This was different in that it asked] an open-ended question versus what are your thoughts on X is a very specific thing that the management is asking for.
30	I think the design was a bit foreign. But the idea of asking them to think of solutions was not.
31	We have an annual employee survey that we've done in the past.
34	We usually do a staff satisfaction survey where they can voice concerns.

Table A3.6. Passages Indicating Passive vs. Proactive Innovation Solicitation Practices
(continued)

45	We've done something like this before. We have meetings. That's when we normally ask people. Everybody has a seat at the table. We have group-type activities.
47	We've had get-togethers, where we've picked a topic to say we know our system really needs to engage in this differently and we want your feedback. And so, we'd collect ideas around a specific topic.

Table A3.7. Qualitative Impact of the Intervention: Dimensions and Illustrative Quotes

	CHCs with <i>passive</i> solicitation practices	CHCs with <i>proactive</i> solicitation practices
Perceived novelty of the crowdsourcing intervention	Novel <i>Managers' perspective</i> • There hasn't been an easy way for staff to be able to be involved. This ideation challenge gave people the opportunity to give their ideas if they aren't in middle management. (#4-0, senior manager) • We haven't implemented a formal program like [the ideation challenge], not since I've been here. We would tell people at staff meetings, sometimes, to share ideas. But we didn't really get a lot of response. (#37-0, senior manager) • This was the first formal time that something like [the ideation challenge] has ever come up. Informally, I would say [that people innovate and speak up] but I'm not sure that it always comes up to my level. (#32-0, senior manager) • I've only been here for two years, but from what I can gather, I know that something like this has never been done before. (#36-0, senior manager) • I would say this [the ideation challenge] was something brand new to [the staff]. We ask them to go through their supervisor, and the supervisors bring suggestions from staff to admin meeting. (#6-0, senior manager) • We have not done anything like the ideation challenge in the past. This was our first time of doing a challenge like this. (#41-0, senior manager)	Not novel <i>Managers' perspective</i> • The last round [of another ideation activity] was probably six months before this challenge. So some people were actually confused, asking whether the ideation challenge was for winning paid time off. I had to explain that they were separate. (#17-0, senior manager) • Staff are asked for input all the time. Calling it the ideation challenge was new. But asking for their help in quality or improving things was not new. (#16-0, senior manager) • We got a few comments about how similar the questions were from the questionnaire we've done. Before we started the ideation challenge, we already had ideation generation and feedback loops in place. (#3-0, senior manager) • I'd say it didn't shock any of them. It was the first time we've done something like an online contest. But I wouldn't say the concept was foreign. We've had challenges where we asked for suggestions or where teams compete to improve performance on a metric. (#14-0, senior manager) • We've done a lot of things like the ideation challenge. Lots of surveys. When this one came along, it wasn't a big deal. I really don't see the ideation challenge as any different from the other surveys that were offered to us. The only difference was the money part. (#34-1, contracts manager) • When people were given the opportunity to participate, there wasn't a buzz like, "oh my gosh I gotta do this". Our culture is so used to it, accustomed to giving feedback. (#21-0, senior manager)

Table A3.7. Qualitative Impact of the Intervention: Dimensions and Illustrative Quotes
(continued)

<i>Employees' perspective</i>	<i>Employees' perspective</i>
• The concept of the ideation challenge was shockingly new for us. It's not what we're used to. There's no [other] chance to speak up and feel like we're going to be heard. (#36-1, medical assistant supervisor) • I looked at it as a huge opportunity to share thoughts and ideas for those who don't have the opportunity to share or don't belong to a leadership group. (#26-1, social worker) • I participated because we don't have a way or form to give ideas on things that we could better handle. (#42-1, front desk staff) • This offered a channel for the first time to share your ideas directly with managers. People have talked about listening sessions and in-person meetings before, but they haven't been done yet. (#32-1, social services manager) • This was the first large opportunity that we could actually help create a change. I didn't do it for the gift card. I did it to help. I would be happy to give back the gift card. (#35-4, community health worker)	• They did something similar before. We wrote down our ideas on paper and turned them in. It was during a time of transition for our company. It seemed to be a positive experience. Based on that experience, this didn't seem like a foreign thing. (#2-2, dietitian) • I thought we had a mechanism in place that was very similar. There are several avenues open for staff to make suggestions or report incidents. (#14-2, human resources staff) • As far as putting out ideas, they [managers] are always open and I've given multiple ideas outside of the ideation challenge before it happened. (#7-1, medical assistant) • We've done this kind of a thing off and on. We have a suggestion box in the break rooms. They've done a few things online before. (#25-1, optician) • There are always requests for feedback and ideas. We have an online idea or feedback submission forum. (#20-2, clinical services coordinator) • We've had to do a survey to tell them how we felt and stuff. (#14-4, billing specialist)

Table A3.7. Qualitative Impact of the Intervention: Dimensions and Illustrative Quotes
(continued)

Takeaways for managers	Exposure to the value of employee ideas	No new takeaways related to the value of employee ideas
	• For me what I took away [from running the ideation challenge] was that staff have fabulous ideas. Their ideas are able to elevate us but we don't have formal mechanisms to capture them. (#33-0, senior manager) • [The ideation challenge] opened my eyes to be like, so what do you think might help the situation? When we hear complaints and aggravations, we could ask [the employees]: what could help, or are you just venting? It's reaffirming that we could be more, "hey what do you think might fix it?" instead of being, "okay, I'll fix it for you." (#43-0, senior manager) • The ideation challenge was a great way to get information from people. We have so many things on our plate that we forget to ask that simple question: how can we improve, give me your idea. (#44-2, quality manager) • As we went through the process, it got our wheels turning. I was like, oh, we could do this, we can use that [idea]. It was a great way to learn from frontline staff. (#4-0, senior manager) • As I read through some of the projects out there, I thought they were pretty brilliant. I'm not in the clinical area so it was nice to see what some of their pain points were and things frontline employees would like to change. When I saw the responses, I'd go, oh, that's a good one! I thought a lot of them had merit. I'd back a lot of what I saw. (#42-5, billing manager) • We got 61 ideas and there were some really good ideas. I want us to try and work on how we can make as many of them happen as possible. (#38-0, senior manager) • It was a good self-check to review whether we have identified all the areas that need improvement throughout the organization. Seeing many that we were aware of was a good indicator that we're doing the right thing. (#40-0, senior manager)	• My sense is that I can't know everything from my office and I love to hear from someone who's working with patients on a day-to-day basis if they see an opportunity. (#20-0, senior manager) • I really believe that the people who are doing the work often come up with the best solutions. Or at least identify the problems or roadblocks. So I thought [the ideation challenge] would be a good avenue for our organization to make improvements. (#2-0, senior manager) • We always work to understand the voice of the staff and people who do the work. They often have the best ideas. (#31-0, senior manager) • I was happy to hear that we would be involved with something like [the ideation challenge] to hear the voices of the folks who work on the ground. We try really hard to make informed decisions and that includes having input from people, not only have their voices heard but have them come up with ideas themselves. (#12-5, marketing communications manager) • When I first heard about [the ideation challenge], it wasn't a surprise to me. One of the reasons why I wanted to work here is because they do really listen to their employees. We make a valid attempt to ask what's going on in this clinic or what's going on with this position. We go to the people who are doing the job or part of the task. (#28-1, clinic manager)

Table A3.7. Qualitative Impact of the Intervention: Dimensions and Illustrative Quotes
(continued)

Resulting change: increased solicitation of employee ideas	Resulting change: none related to increasing idea solicitation
• Since [the ideation challenge], it feels like we've been more able to get ideas out of different people and I think it's that we sit with them and ask them. I know I've been spending a lot more time sitting with providers and medical assistants asking, what do you think about this process, do you have some ideas on how you would improve it, or what are you doing that you feel is redundant. (#15-0, senior manager) • In a recent quarterly meeting, managers said they will do more outreach to collect employee feedback. I've never heard them offer that before. It seems like they saw the benefit of doing [the ideation challenge]. (#23-5, marketing assistant) • There's more conversation around ideas. The management team is pushing people to continue to share their ideas. I think [the ideation challenge] has helped to open up that conversation. (#43-1, medical assistant) • Since the ideation challenge, the clinic manager has started or re-started one-on-one meetings with every staff. They started to do that to make sure we're satisfied and so we can share what we can do to increase our energy and what the supervisor can do to make our work better. (#39-1, dental assistant) • We set up a suggestion box for staff after the ideation challenge. (#27-0, senior manager) • One thing that came out of it is that the leadership team started to lead morning huddle. As leaders, we learned that it's good to know what everybody is doing because we are growing in leaps and bounds as an organization and we all have a lot going on. (#41-0, senior manager) • We plan to run another ideation challenge around employee benefits soon. It will be a more guided ideation, with specific areas that we need to have accomplished and having employees submit ideas specific to those areas. (#35-0, senior manager)	• Even before the ideation challenge, many were already giving ideas away. We try to ask, as managers, whatever is on your mind, let us know and we can talk about it. (#45-1, front office supervisor) • We do encourage people to speak truth to power and come up with ideas. Sometimes they do. Sometimes they don't. But there's a culture here. I don't know whether it's been strengthened by the ideation challenge. I haven't noticed anything yet. But that's part of our culture here to do that. (#7-0, senior manager) • We've always had a suggestion box at each site, where if there are any concerns or anything they want us to change. The box is checked routinely and if there is something in the box, that's shared at the PI meeting. Staff know the management is looking at their ideas. There's always a lot of communications open. (#24-0, senior manager)

Table A3.7. Qualitative Impact of the Intervention: Dimensions and Illustrative Quotes
(continued)

Takeaways for employees	Learned to prioritize innovation	No new takeaways related to prioritizing innovation
	• Our feelers are up. Business is still as usual but the ideation challenge made your antennas go up to say, hey, this needs to be changed or we could do this better here. (#44-1, nurse) • The ideation challenge made us stop and think. After the ideation challenge, I started to look more globally at how things work in this position and how we can better assist patients. It's gotten me to think more critically. Before, you just work day to day, but the ideation challenge got me thinking like, "what else can I think of to improve my workplace," instead of going from day to day to day to day. (#23-2, volunteer engagement specialist) • The ideation challenge gave me a better understanding of what can be tweaked here and there, how we could raise the bar and improve quality as an organization. Now, even if it isn't something that needs a big policy change, we go to our practice manager and say, hey, what about this, and we start doing it. (#46-2, outreach worker) • Just a couple of weeks ago, I was like, man, why isn't that challenge going on now, I could have submitted this. (#5-2, patient service representative) • [The ideation challenge] suggested to staff to get involved, to be part of the solution, to be creative, to think outside the box and not be complacent with the status quo. You know, like, it's working, so why do we need to change anything—to get them to not think that way. (#42-3, program supervisor) • If they hadn't thought about what they want to see different, before, it sparked that creativity—hey, we could do this differently, this would make our lives easier, this would be better for our patients. It sparked that energy for all of them to think, well, what would I want to see different? (#42-5, billing manager) • Since the ideation challenge, we are getting more suggestions about pretty much anything. They're not all incredibly innovative, but I think our staff used the process to learn to make suggestions. (#44-0, senior manager)	• At my site, people already pipe up with ideas. It's not people just complaining about things. It's identifying a solution. (#45-2, nurse) • People who are on the ground already constantly identify problems and offer solutions. So the ideation challenge was another way of what's already being done on a very consistent basis. (#47-1, nurse practitioner) • One thing that was surprising to me was how many of our staff really do understand the concept of innovation. (#14-0, senior manager) • It's already an innovative environment. It's an open environment where people can share ideas. I wouldn't say there have been any drastic changes, since the innovative spirit is already instilled in the organization. It just supported that and reminded folks that that's part of our culture. (#12-5, marketing and communications manager) • I don't usually wait for challenges. I'm proactive. If I see something that's gonna benefit me, I start marketing. I don't wait for things. I go ahead and go after it. (#25-1, optician) • I don't think anything surprised me. It was around topics that we talk about and brainstorm about within our staff already. (#12-4, nurse)

Table A3.8. Differential Treatment Effect By Proactive vs. Passive Solicitation (N=48 CHCs)

Dependent variable	Voice solicitation practice prior to the contest		Difference <i>p</i> -value
	Passive (1)	Proactive (0)	
(1) % employees who voice suggestions for improvement	15.6** (4.36)	1.35 (3.97)	0.014
(2) % employees who generate creative ideas	22.1*** (5.16)	5.97 (4.70)	0.019
(3) % employees who promote and champion ideas	18.0*** (4.77)	8.18 (5.13)	0.105
(4) % employees who implement ideas	14.4*** (3.08)	3.25 (5.22)	0.052
(5) % employees who express psychological safety	2.08 (3.68)	-5.03* (2.24)	0.105

Notes. For this quantitative test, I used the following OLS regression model, $Y_j = \beta_1 T_j + \beta_2 P_j + \beta_3 T_j * P_j + \gamma_j + X_j + \varepsilon_j$ where P_j is an indicator for passive (1) or proactive (0) solicitation practices in place. This equation is analogous to equation (1). β_1 is the estimated treatment effect in CHCs with proactive solicitation practices prior to the intervention. The sum of β_1 and β_3 is the estimated treatment effect in CHCs with passive solicitation practices. β_3 is the estimated difference between these two treatment effects. This table reports β_1 and $\beta_1 + \beta_3$ as well as the *p*-value for β_3 . Standard errors are reported in parentheses. **p*<0.05, ***p*<0.01, ****p*<0.001.

Figure A3.1. Screenshots of the Promotional Materials and the Contest Platform

INTRODUCING THE

IDEATION CHALLENGE

AN OPEN INNOVATION CONTEST AT COMMUNITY HEALTH CENTERS, INC.

What is Ideation Challenge? The Ideation Challenge is a contest of Ideas that solicits innovative solutions from frontline staff – anyone working in the health center, including physicians, nurses, medical assistants, case managers, administrative staff, billing/finance staff, nurse practitioners, physician assistants, any and all staff – to improve patient care and work processes. We are excited to hear your ideas!

Submission opens on March 25.

Here is how it works:

Round 1: Ideation
All CHC staff are invited to submit pain points and solutions to real challenges they face in their work day. We will hold four Ideation challenges.

Round 2: Crowd voting
Submissions are posted anonymously on an online platform and all staff are invited to vote on which Idea they would like to see implemented.*

Round 3: Awards
Winners are announced and celebrated. Each group will determine its own winner!
PRIZE: \$100 gift card for the crowd voting winner
\$35 gift card for the runner-up

Learn more and submit your ideas:
www.ideationchallenge.com/chc

(1) Website

IDEATION CHALLENGE AT COMMUNITY HEALTH CENTERS

Our health care centers are going through a lot of changes.

We believe great solutions often come from those on the front lines.

We want to hear your ideas! You never know, your idea could be the next big thing!

[CLICK HERE TO VOTE ON IDEAS](#)

TIMELINE OF EVENTS

IDEATION

Ideation will launch on March 25 and close on April 12.

[CLICK HERE TO SUBMIT IDEAS](#)

VOTING

Crowd voting will launch on May 20 and close on June 7.

AWARDS

Crowd voting winners will be announced on June 25.

FREQUENTLY ASKED QUESTIONS

Who can participate?
Anyone working at CHC – whether you are a physician, nurse, advanced practitioner, administrator, or support staff, you're welcome to share your idea(s) and vote on submitted ideas.

Why should I participate?
We believe that frontline staff have the most intimate understanding of and access to patient care, and thus the best ideas to improve care delivery processes. Get your voice heard, help to improve patient care, and win a prize!

How do I participate?
To share your idea(s), please click on the button below. All ideas must be submitted through this link. At a later time, the link for voting will be available.

[CLICK HERE TO VOTE ON IDEAS](#)

What will happen to my ideas?
Your ideas will be shared with your colleagues for review and voting. All ideas will be presented anonymously, meaning others will not be able to identify who submitted which idea. Some of the ideas may get selected for implementation!

What kinds of ideas are you looking for?
Any and all ideas! Areas of focus include but are not limited to: (1) new models of care delivery (2) enhancing patient experience, (3) improving the workplace, (4) improving efficiency, quality, and safety, and (5) lowering the cost of care.

(2) Ideation page

Briefly describe the **problem** you're planning to solve with your idea (250 character limit)

Characters remaining: 250

Briefly describe **your idea** to address this problem (250 character limit)

Characters remaining: 250

(3) Voting page

Welcome to the Voting Phase of the Ideation Challenge!

Please give a star rating for as many ideas as you would like. (Five stars: I definitely want to see this idea implemented. One star: I definitely do not want to see this idea implemented)

Any progress you make will be saved. Please feel free to exit the screen and come back later to finish voting. (Don't press the **>>>** button at the end unless you are finished. If you'd like to take a break, simply exit out of the screen.)

Onsite Manet gym or partnership with local gyms for patients to go to at a discounted rate. Physical activity can help with many chronic diseases. Maybe in the future employees could use this benefit.

Employee recognition program! Have staff nominate Employee of the Month. Recognize this staff member (i.e., showcase on Idea Board, give small token of appreciation or certificate).

★★★★☆ 4

★★★★★ 5

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