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Working Paper 20-059



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Funding for this research was provided in part by Harvard Business School and NASA Open Innovation Research, award #NNX16AC77A.

Managerial recognition as an incentive for innovation platform engagement:

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Last updated: November 12, 2019

ABSTRACT

Incentivizing employees to engage with novel innovation mechanisms and contribute to collective problem-solving can be difficult. We run a field experiment with NASA (N=11,192) to study two widely used classes of non-financial incentives: recognition (of managers, peers, online platform participants), and the prospect of advancing the organizational mission. Our analysis shows that managerial recognition has a significant positive effect on employees' engagement with the problem-solving platform. The other incentives are not found to be effective. A follow-up interview study suggests that (1) managerial recognition works through signaling the platform's legitimacy in a context of uncertainty, as well as through offering managerial attention and appreciation; (2) recognition interacts with workers' job proximity to the organization's mission and can be particularly motivating for workers with distant job functions; (3) organizations where the appeal of the organizational mission is already strong may face difficulties in using the mission as an instrumental incentive.

INTRODUCTION

Consider a request from the chair of your department to join a new standing committee to deal with an emerging issue at your institution. Faculty at most schools are already at full capacity for teaching and research (McKenna 2018, Newport 2019), and this additional request creates extra work and demands more effort above and beyond the existing formal and relational contracts. This hypothetical scenario is not uncommon in modern organizational life (Garton 2017, Thompson et al. 2013). Workers, as part of their membership in organizations, are expected to go the extra mile, above and beyond their job responsibilities, for the benefit of the organization. In effect, workers are asked to solve problems and generate solutions that are beneficial for the rest of the organization's members. Indeed, there is an expectation in most organizations that employees will both complete their own work and simultaneously contribute to collective goods within the organization that benefit others (Blasco et al. 2019).

Workers in organizations, beyond being specifically asked by a manager to contribute to non-core activities, are increasingly solicited to participate in online platforms that engender innovation and collective problem-solving (Dahlander and Piezunka 2014, Erickson et al. 2012, Malhotra et al. 2017, 2019, Myler 2013, Williams 2019). Yet, motivating employees to engage with extracurricular innovation and problem-solving mechanisms is challenging (Lifshitz-Assaf 2018). A central question faced in theory and in practice is what might motivate workers to participate in creative problem solving activities? Monetary incentives are not the sole, and often not even the primary motivation behind people's creative and innovative work (Amabile 1996, von Hippel 2017). What alternative incentives do organizations have at their disposal for motivating engagement with novel innovation practices? The literature points to two specific non-pecuniary incentives that executives in organizations can offer to motivate effort in extra-organizational creative problem solving. First, managers can offer symbolic organizational recognition awards to encourage workers to engage in creative problem solving outside of their current job scope (Frey 2007, Frey and Gallus 2017a, Gubler et al. 2016). A second prevalent class of non-financial incentives seeks to motivate workers through highlighting how their work contributes to the mission of the organization (Cassar and Meier 2018).

In this paper, we seek to understand the non-pecuniary motivators for workers to engage in extracurricular work. We accomplish this through two studies: 1) a field experiment where we causally manipulate incentives for workers in a high-profile science and technology organization, and 2) an interview study with the same population of workers to understand the underlying mechanisms for their actions (or lack thereof). We run the field experiment (Study 1) with the U.S. National Aeronautics and Space Administration (NASA) to study these two widely-used classes of non-financial incentives: recognition and mission. There is a wide variety of recognition awards, ranging from titles (such as the IBM Fellows), to trophies, plaques, and online recognition boards. One important dimension that distinguishes different types of organizational awards is the audience involved. We exogenously vary the expected audience of recognition in the same organizational context in the field: managers, immediate peers, or online platform participants. We compare the effectiveness of these recognition awards to the effectiveness of using mission as an explicit incentive to motivate platform engagement. Running a field experiment with NASA allows us to cleanly identify causal effects of those different incentives. The incentives are announced in emails sent to 11,192 employees, and motivation and effort to solve organizational innovation problems is measured as the share of employees returning to the platform in the week following treatment administration.

Our analysis shows that the prospect of managerial recognition has a significant positive effect on subsequent platform engagement. We do not find support for the effectiveness of the other incentives. An interview study (Study 2) with 53 NASA employees sheds light on the mechanisms. It highlights the importance of signaling about the platform's legitimacy. In a context of uncertainty around the new innovation platform, managerial recognition signaled that platform engagement was legitimate and important. In contrast, recognition in front of immediate peers and among online platform participants was ineffective or even demotivating since the signal-worthiness of the underlying task was questionable. A second mechanism behind the effects of managerial recognition was managerial attention and appreciation, which seemed to have been particularly motivating for employees whose jobs were relatively removed from the organizational mission. The prospect of recognition exhibited an opportunity

to be seen as supporting the organization's new innovation initiative. Lastly, employing the organization's mission to motivate task engagement was met with skepticism because employees were already highly mission motivated, such that highlighting mission did not further increase motivation on the intensive margin.

Our multi-method research design combines the experimental approach with qualitative data (Fine and Elsbach 2000). The multi-method design allows us to develop richer explanations of relationships among novel and existing constructs. This is particularly useful for research on emerging topics, such as incentivizing engagement with new innovation mechanisms within organizations (Edmondson and McManus 2007). Our findings contribute to the literatures on non-financial incentives— notably recognition and mission motivation—innovation platform engagement, and change management.

The remainder of this paper is structured as follows: As a backdrop for the current research, we provide a review of relevant studies on non-financial incentives relating to innovation. We then describe the empirical context of our study, including the innovation platform implemented at NASA. Next, we describe our field experimental design and then present and briefly discuss the results. This is followed by the interview study setup, analysis, and results. We conclude with theoretical and practical implications of our findings and avenues for future research.

Non-financial Incentives and Innovation Platform Engagement

Organizations are increasingly adopting online platforms that facilitate the exchange of ideas and expertise among employees within the organization (Erickson et al. 2012, Jung et al. 2018, Malhotra et al. 2017, Malhotra and Majchrzak 2014). However, despite the promise of such platforms, overcoming skepticism and motivating platform engagement can be difficult if there are no network effects to begin with and if the platform's horizontal nature is at odds with a predominantly hierarchical organizational structure. Paying employees to support the organizational change and adoption of the platform is of limited use. It may not be possible and even backfire. There is by now ample research showing the ineffectiveness and potentially deleterious effects of using money in domains ranging from citizenship

behaviors (Frey 1997, Gneezy et al. 2011) to creativity and innovation (Amabile 1996). The use of incentives is particularly difficult where individuals have pro-social and intrinsic motivations that risk being undermined. This begs the question of what alternatives organizations have for increasing or sustaining people's motivations.

Recognition is a particularly promising incentive because it has the potential to bolster people's intrinsic and pro-social motivations by providing appreciation in public (Gallus and Frey 2016). We contribute to the emerging literature on awards and recognition incentives (Bradler et al. 2016, Gallus 2017, Gubler et al. 2016, Kosfeld and Neckermann 2011, Rossman and Schilke 2014). Studying the causal effects of different types of recognition incentives within the same field context is challenging. We do so by studying the ex-ante effects of promised recognition and experimentally vary the expected audience. We focus on recognition in the context of newly adopted, peer-based innovation mechanisms, which are marked by uncertainty around the signal-worthiness of the underlying task.

Recent research suggests that recognition can be highly effective in motivating peer-based and new innovation initiatives. These studies have looked at different audiences in isolation. In a field experiment run within the Wikipedia community, Gallus (2017) finds that a purely symbolic award scheme backed by senior contributors causally increases 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 appreciated by senior peers and not feeling "lost in the crowd" (Latané et al. 1979) was an important mechanism driving these results. This is in line with theoretical research suggesting the importance of managerial attention (Dur 2009, Halac and Prat 2016), as well as with experiments (albeit not in the context of innovation) that found positive effects of recognition given by the managing director (Kosfeld and Neckermann 2011) or the head of the research institute (Bradler et al. 2016). Similarly, appreciation and attention by the community of users more generally (Huberman et al. 2009, Zhang and Zhu 2011), by lower- or equal-status peers (Restivo and van de Rijt 2012, 2014), or by the platform-hosting firm

(Dahlander and Piezunka 2014, Jeppesen and Frederiksen 2006, Piezunka and Dahlander 2019) have been found to be important sources of motivation.

It is still an open question which form of audience is the most effective, and under what conditions. For instance, peer recognition may be generally motivating in a largely open and peer-based innovation community, but it may also be limited in a context of uncertainty around the signal-worthiness of platform engagement inside an organization. Managerial recognition, on the other hand, may be at odds with the peer-based nature of many platforms, but it could be an important source for signaling and legitimacy.

A second class of non-financial incentives seeks to motivate workers through the meaning of work (Carton 2018, Cassar and Meier 2018). The mission of an organization can give an important sense of meaning and purpose and can thus increase motivation and performance (Cassar & Meier, 2018). Unlike lower-order organizational goals that tend to be specific, discrete, and measurable, an organization's mission represents abstract aims and abiding ambitions (e.g., "advance science") (Bateman et al. 2002). It is often argued that employees find these broad, timeless aspirations compelling as they epitomize the organization's shared purpose and values (Shamir et al. 1993). Recent research suggests that how the organization's mission is conveyed and perceived may determine the effectiveness of using mission as an incentive. In an inductive analysis of President John F. Kennedy and other leaders of NASA communicating NASA's ultimate aspirations to employees in the 1960's, Carton (2018) finds that leaders' sensegiving actions allowed employees to make connections between NASA's mission and everyday work. Leaders' written and verbal messages outlining the relationship between day-to-day work and organizational aims positioned employees to view their work ("mopping the floors") as enacting the higher organizational mission ("putting a man on the moon").

Relatedly, there is a burgeoning literature showing, for instance, that a firm's pro-social initiatives and social mission can lower wage demands (Burbano 2016) and increase the size and quality of the applicant pool (Hedblom et al. 2019). One interesting and relevant question is whether and how instrumentally highlighting the organization's mission can motivate workers who have already self-

selected into an organization based in large part on their affinity to the organizational mission, such as is the case for NASA (Carton, 2018).

Another option for motivating workers to engage in problem solving on a new innovation platform is to provide information about the platform's effectiveness. We will include it as an additional experimental arm, knowing that it alone is often of limited use in motivating behavior change (Thaler and Sunstein 2008).

STUDY SETTING: NASA AND NASA@WORK

Studying non-financial incentives within the U.S. National Aeronautics and Space Administration (NASA) has several major advantages. First, NASA established an organization-wide online innovation platform, called NASA@WORK, in 2012. Its implementation aimed to inspire innovation through knowledge sharing, facilitate crowdsourcing, and break down silos across the agency. In contrast to the agency's outward-facing and competitive open innovation programs (Boudreau et al. 2011, Jeppesen and Lakhani 2010, Richard et al. 2019), NASA@WORK is an inner-organizational platform set up for workers to draw from each other's expertise and ideas. While several studies analyze incentives on competitive open innovation platforms, we still have a limited understanding of incentives in collaborative, inner-organizational contexts. Second, given the important role played by NASA, the agency has been the subject of a rich body of research, which has examined factors affecting innovation including the agency's culture (Vaughn 1996, 2006), knowledge management processes (Lifshitz-Assaf 2018, Majchrzak et al. 2004), and the meaning of work (Carton, 2018). The insights from this literature allow us to delve into whether and how anticipated recognition and organizational mission motivate collaborative innovation. Third, we deliberately chose an organization where the appeal of the mission is an important component in the self-selection of individuals into the organization. This makes it particularly interesting to study non-financial incentives, and the role of mission in particular, at NASA.

Any NASA employees (civil servants, contractors) can contribute to NASA@WORK. To engage with the platform, employees create a user profile using 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 (e.g., Dahlander & Piezunka, 2014; Jeppesen & Frederiksen, 2006). The latter was an important goal behind setting up the platform, which was intended to break down inner-organizational silos. The challenge owner determines the length of the submission period and selects up to two winners from the pool of contributors. Winners initially received monetary prizes, but these had to be discontinued due to the government funding sequestration (NASA 2013). This made the search for non-financial incentives a priority and motivated the research collaboration. We worked closely together with the Center of Excellence for Collaborative Innovation (CoECI) at the NASA Johnson Space Center, which manages the platform.

NASA’s primary interest was increasing the share of employees who would return to the platform as a result of the treatments. Any subsequent postings would depend on the content populating the platform, which was sparse. The platform engagement variable was considered the most important first step at this early stage of the platform, where there were no network effects to benefit from. The variable is moreover meaningful because logging back in is costly in terms of time, as there are multiple alternative uses of what is mostly employees’ spare 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, but security protocols within organizations prevent such seamless integrations. Thus, logging in requires effort on the part of employees and is prerequisite for addressing the chicken-and-egg problem of content contribution and consumption afflicting platforms at their inception (Kane and Ransbotham 2016). Lastly, in online communities, members differ in their interaction patterns, with some interacting frequently and others reading messages but rarely posting content on their own (Hammond 2000). For inner-organizational platforms, employees’ perusing the content can be highly valuable. It furthers employees’ acquisition of firm-specific knowledge and learning

about innovation efforts across the organization, with the potential that they encounter problems they may have solutions for.

The challenges on the platform can range from broad questions seeking to initiate a collective brainstorm to highly technical and well-defined problems. For example, 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 instance, one challenge asked for design ideas for a crosswalk in front of the Johnson Space Center.

In Table 1, we describe the population of NASA@WORK users; i.e., NASA employees who had a registered account on the platform at the time of the experiment. The population is evenly split among civil servants (51.2%) and contractors (48.8%). The centers with the strongest representation are Johnson Space Center (28.2%), Kennedy Space Center (15.9%), and Marshall Space Flight Center (12%). From its inception to the time of our experiment, 101 users (0.6% of the platform population) had posted and managed a challenge on the platform (only 11 users had owned more than one challenge). More than half of the challenge owners were affiliated with JSC, although users from JSC constituted only 28% of the platform population. 174 users (1.04%) had ever won a challenge (only 27 users had won more than one challenge, and 12 users had both owned and solved a challenge). While the group of challenge solvers differs somewhat less from the overall population of registered users than does the group of challenge owners, civil servants were disproportionately represented among challenge solvers (63%).

As few employees make any postings and platform engagement is very low, we also display statistics for the group of employees (less than 40% of user accounts) who had logged in at least once on NASA@WORK during the six months before the experiment. We used this variable for the randomized stratification. Overall, employee type does not differ systematically between the general population of

platform users and the subset of more recently active ones. Recent activity does differ somewhat by center affiliation. We control for center affiliation in the analysis.

[Insert Table 1 here]

STUDY 1: FIELD EXPERIMENT

Experimental Design

We use a natural field experiment (Harrison and List 2004) to evaluate the effectiveness of non-financial incentives. Subjects were randomly exposed to different interventions and their behavior was not affected by an awareness of the research project. With our field partners, we identified two main classes of non-financial incentives that are theoretically interesting and practically important to study: three forms of recognition, which vary the audience of recognition (manages, peers, or online platform participants), and a message of how platform engagement contributes to the organizational mission. As is often done in studies on behavioral interventions, we also tested the effect of merely providing information about the platform's effectiveness. These five experimental arms were compared to a control group that received a generic reminder email 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 were 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 [hyperlink] 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.”

This text provides a conservative benchmark as our field partners hoped to motivate as many users as possible to engage with the platform; even the email sent to the control group was designed to maximize the number of returns. 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 peer recognition condition were informed that they would receive a NASA@WORK pin and a letter of appreciation from the NASA@WORK team. A photo of the pin and certificate were shown together with this text. In what we call the platform recognition arm, employees were informed that they would “be inducted in the newly created [hyperlinked] 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. As for the message about the organizational mission, which we developed jointly with our field partners, we borrowed language from NASA’s most recent Strategic Plan. Employees in the mission condition read:

“Contributing to the platform enables all of us to reaffirm NASA's vision to reach for new heights and reveal the unknown so that what we do and learn will benefit all humankind. It allows us to accomplish our mission to drive advances in science, technology, aeronautics, and space exploration to enhance knowledge, education, innovation, economic vitality, and stewardship of Earth.”

For exploratory purposes, we also combined statements concerning mission and each of the three recognition treatments, knowing that the increase in length of the email would dilute the recognition component and limit their comparability to the other treatments and control.

Finally, subjects receiving information about the platform’s effectiveness read that: “About 80% of the Challenges run on this platform have been or are about to be implemented, leading to significant advances and savings for NASA.” Figure A1 in the online appendix shows the screenshots of treatment and control emails.

From the overall pool of 16,806 employees who had a registered NASA@WORK account, 11,192 users were randomized into the five main treatment arms and control group, and 5,674 users were randomly allocated into the three exploratory conditions.¹ Our analysis focuses on the five main treatment arms, but including all eight treatment arms does not change the results (see Table A2 in the online appendix). As stated in the pre-registration (AEARCTR-0002314), 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 (civil servant or contractor). The CoECI manager delivered the interventions via email, the main channel of communication about the platform. The emails were sent on October 11, 2017.

Analysis and Results

Table A1 in the online 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, point into different directions, and are not statistically significant.

In line with our field partners' goal of increasing NASA@WORK use, our primary outcome of interest, *platform engagement*, is a binary variable indicating whether a user logged into the platform in the week following treatment delivery. Importantly, the content populated on the platform (e.g., whether there is a challenge for which a given user has the interest or relevant expertise) at the time of the experiment does not confound this measure. The one-week horizon afforded subjects sufficient flexibility in allocating their time across the different days of the week. Since the baseline level of posting on the platform is extremely low, we limit the quantitative analysis to this extensive margin analysis. Study 2

¹ As specified in the pre-registration (AEARCTR-0002314), we excluded some groups of users before the randomization: "Data management rules have been set up to drop certain user groups from the list before the randomization: duplicate accounts (the ones with the lower ID# are dropped as lower ID#s indicate older accounts), users with InnoCentive domains [employees of the platform operator who merely test the platform], users who are part of the NASA@WORK/CoECI team (list was provided by field partner) [who operate and manage the platform from within NASA], users without name fields, users lacking name and center affiliation information, users who are identified as interns (as these are transitory accounts)."

explores implications on the intensive margin, such as users' perceptions of posting challenges and ideas. We use an intent-to-treat analysis to be conservative and because reliable data on who opened the treatment emails was not available.

We use 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 (*challenges owned*) and solved (*challenges resolved*). Standard errors are clustered by center (*affiliation*).

In the week after treatment delivery, 682 users, or about 4% of all users, engaged with the NASA@WORK platform. On average, 77 users logged in across the eight treatments, ranging from 98 (managerial recognition) to 59 (mission and platform recognition). A 4% participation rate within a week of the initial treatment is unsurprising given that workers at NASA already have mission-critical tasks and activities. This result is consistent with other research on internal innovation contests (e.g., 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).

The regression results are reported in Table 2. The incentive of receiving managerial recognition had a significant positive effect on subsequent platform engagement. Compared to the baseline condition, the message about potential managerial recognition increased the odds of returning to the platform by about 44% (OR = 1.443, RSE = 0.197, p -value = 0.007), 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.

Correcting for multiple hypothesis testing using the Bonferroni method does not meaningfully change our results. As an additional robustness check, we analyze the data using randomization inference (RI) instead of using the traditional sampling-based approach. RI is increasingly recommended to analyze data from randomized controlled trials (Athey and Imbens 2017, Heß 2017, Young 2019). Our results

remain when using RI. The p-value on the managerial recognition coefficient in the main specification becomes 0.036 and 0.037, respectively, when using the Bonferroni method and RI.

[Insert Table 2 here]

Discussion of Experimental Findings

Our field experiment finds that the prospect of managerial recognition had a significant and positive effect on subsequent platform engagement. Study 2 explores the mechanisms behind this effect. The field experiment does not find support for the effectiveness of the other incentives, which may be due to the generally very low platform engagement that made robust quantitative analyses difficult. This relates to a point made by Kane & Ransbotham (2016) about researching innovation communities: the importance of accounting for a community's "life stage" when studying and intervening in its collaboration (p. 1259). It also suggests that there are important restraining forces that would first need to be addressed before positive but relatively subtle incentives can work (Lewin 1951). We therefore conducted a second study, which uses a large number of interviews with NASA employees to explore perceptions of platform engagement, and how these views interact with incentives.

STUDY 2: INTERVIEWS

Combining quantitative results with qualitative data allows for a more robust analysis and deeper understanding of meaning and context than when using a single method (Fine and Elsbach 2000, Ivankova et al. 2006). We conducted follow-on interviews to build on our quantitative findings that illuminated causal effects of incentives for platform engagement and to capture relevant and rich mechanisms of social processes.

Study Design

To obtain a representative range of reactions, we purposively sampled (Berg 2001) the initial list of potential informants based on their prior activities on NASA@WORK (posted a challenge, posted solutions, both, or none), employment status (civil servant or contractor), and center affiliation. This

method ensured inclusion of individuals displaying diverse characteristics. We invited sampled individuals to participate in a semi-structured interview via email and conducted interviews using Zoom, a video conferencing software. We then used snowball sampling (Berg, 2001) to increase our sample. At the end of each interview, we asked the informant for names and contact information of other possible informants. This method warranted us a good introduction, especially to those who are otherwise difficult to reach (e.g., people who have a log-in but haven't posted anything).

In the initial round of interviews, we focused on understanding the results of the field experiment by eliciting interviewees' perceptions of and experiences with the platform. Why was managerial recognition as effective in inducing platform engagement? Why hadn't other incentives produced similar effects? What did they perceive to be the costs and benefits of engaging with NASA@WORK? In hearing responses to these questions, we noticed that informants' experiences relating to NASA@WORK varied by whether their job was directly or indirectly tied to the organizational mission. To analyze whether these were important factors in understanding incentives for engagement with new innovation mechanisms, we updated the interview protocol with specific questions about distinctions concerning job proximity to mission. With the updated protocol, we intentionally included more employees in administrative roles in our outreach sample for the second round of interviews. (See Appendix 1 for the Interview Guide.) We continued our interviews until it appeared that we reached the point of theoretical saturation, or when additional interviews did not reveal any new information (Glaser and Strauss 1967). We reanalyzed all of the interview transcripts and notes after completing the second round of data collection.

Our final interview sample comprised a total of 53 NASA employees. We conducted 26 interviews in the first round and 27 interviews in the second round. The interviews averaged 34 minutes each and ranged from 19 to 54 minutes. All interviews were digitally recorded (with permission) and subsequently transcribed, resulting in more than 500 pages of interview transcripts and notes. Table 3 shows the summary of interviewee characteristics.

[Insert Table 3 here]

Data Analysis

The formal analysis of the interview transcripts comprised three main stages of coding (Chamaz 2010, Lofland et al. 2005). We began with open coding, perusing the transcripts and identifying codes based on language used by informants. We coded informants' statements about their perceptions of NASA@WORK and reactions to the experimental findings. Examples of open codes included "opportunity to step outside your normal daily activities" (a benefit of engagement) and "have to document every single minute of the day" (a perceived barrier). Next, we grouped open codes into more abstract bundles in the second step of axial coding. These categories evolved as we iterated among the data, emerging themes, and existing literature. Examples of axial codes included "extracurricular" (how NASA@WORK is perceived) and "justification of platform use" (an explanation for effectiveness of the managerial recognition incentive). The third stage entailed exploring and integrating the relationship of the abstract codes into a conceptual framework, summarizing how the data fit together and fit with existing theory. The framework was further refined through discussions with colleagues, informants, and CoECI field partners. All forms of coding were conducted within and across the two rounds of data collection. We used NVivo software to store, organize, and analyze the data. Table 4 summarizes the data structure resulting from the analytic process.

[Insert Table 4 here]

Results

In what follows, we first address the question of how NASA employees perceive engaging with NASA@WORK. While internal, peer-based innovation mechanisms are increasingly being implemented in organizations, employees' perceived benefits and barriers of participating remain unclear. Based on this context, we then present data about the role of the recognition incentives studied in the field experiment and how employees' job proximity to mission may interact with these incentives. Lastly, we

present data that may explain the potential ineffectiveness of using organizational mission as an instrumental incentive. Figure 1 depicts the conceptual framework that organizes the findings.

[Insert Figure 1 here]

Perceptions of NASA@WORK engagement

Based on informants' observations and experiences with NASA@WORK, we conceptualize engaging in this newly adopted innovation mechanism as an extracurricular activity that involves an unconventional approach to problem solving for NASA employees. The interviews reveal a high degree of uncertainty around the legitimacy of platform engagement and its support from management.

Extracurricular. Our informants described engaging with NASA@WORK as an extracurricular task, an addition to the “day job” or the “normal workload”. Browsing challenges and contributing solutions were perceived as a “sidebar activity”, distinct from “primary job function”, “main project”, or “real work”. Some informants even expressed concerns that spending time on NASA@WORK would interfere with their required job assignments. One informant said, “It’s kind of a side thing. Like, we’ll be doing our normal daily job, and a question will come in. If we have extra time at the end of the day, we might participate.” Others shared that although engaging with NASA@WORK is not part of their daily routine, they are willing to make time for it in order to help solve technical problems that their peers are facing. One informant described the activity as “community service”, and another informant explained, “If there’s something that I can do in ten minutes that would take somebody else a day of work, of course I’m gonna do it.”

Uncertainty around new, unconventional approach to problem-solving. Informants indicated that NASA@WORK introduces a new, unconventional approach to problem solving. These informants expressed skepticism about the newly adopted platform and about publicizing problems and broadly searching for solutions more generally. One informant said,

“It's quite a foreign thing to a lot of people here, and maybe not something that people in the dominant culture here understand as much. [That culture is]...more hierarchical and more process-oriented. This [NASA@WORK] goes against that dominant culture, because you can ask anybody anything.”

Similar to Lifshitz-Assaf (2018)'s account of tension and fragmentation towards adopting open innovation, our data also illustrate that problem-solving across silos and finding expertise across the agency is unfamiliar and unaccepted for some. Persisting silos among units and centers and reliance on existing knowledge-transfer networks seem to pose a barrier to platform engagement that enables broad, collective problem-solving.

In addition, informants shared that whether participating in such novel and unfamiliar mechanisms is permitted or not depends on one's direct manager. Supervisors that consider platform engagement as productive and beneficial support its use, while others that question the value of the platform discourage use and deem engagement as “wasting time”. There often seemed to be significant uncertainty about supervisors' attitude towards the new platform.

Against this background of uncertainty, platform engagement was seen as supporting the adoption of the novel problem solving process:

“I think it does come down to changing the culture at NASA as a whole, to understand the idea of, ‘We can just throw out a question 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. There are pockets that do collaborate between the centers, but as a whole, it's not part of the culture to just say, ‘Let's just work all together and find expertise from across the agency.’”

Mechanisms behind recognition

Understanding employees' perception of platform engagement as extracurricular and of uncertain legitimacy helped us interpret our field experimental findings. The experimental results showed that the prospect of managerial recognition induced greater platform engagement than other types of incentives.

We specify the relevant level of management as one's immediate supervisor (Detert and Treviño 2010). Our qualitative data suggests that managerial recognition encourages participation in two ways: (1) managerial recognition signals legitimacy for spending time on a task (often) unrelated to the prescribed work; (2) managerial attention is highly valued and offers a sense of appreciation for engaging with the new approach to innovation and problem-solving.

Legitimacy of platform engagement. Informants reported that managerial recognition for contributing to NASA@WORK indicates justification for platform engagement, or time spent on an extracurricular activity. One informant suggested that managerial recognition signals legitimacy of platform use:

“There is the feeling that if you're doing NASA@WORK, then you're not doing real work. If you're playing with their challenges as opposed to doing your real job, when everyone's super busy. Why are you making time for that? So if you have management recognition, then it kind of justifies spending your time that way.”

Another informant explained that managers' acknowledging NASA@WORK activities offers “at the very least, a tacit approval to participate” and with that permission, engaging on NASA@WORK “is not the same as reading the CNN webpage...not like taking a break. You're actually doing something that management sees as valuable.” Thus, managerial recognition appears to validate and encourage platform engagement.

Our qualitative data suggests that the prospect of recognition is attractive only if the underlying achievement is signal-worthy. The chance to be recognized for contributing to NASA@WORK, an activity that is largely alien among the workforce and not clearly endorsed by managers, may not have been sufficiently appealing for employees. With regard to the anticipation of receiving peer recognition by wearing a NASA@WORK pin, one informant explained that because NASA@WORK is not a well-known, regularly used platform, “if [wearing a NASA@WORK pin] 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.” In parallel, informants also pointed to the unfamiliarity of NASA@WORK in explaining the ineffectiveness of the

platform recognition incentive. One informant described the hall-of-fame webpage as a “dark corner of the Internet” that does not draw much traffic. Another informant shared that he’d be worried about being presented on a public webpage for engaging in tasks that are “not backed by management”.

Sense of appreciation. Our data suggests that managerial attention offers a visceral sense of appreciation and validation that motivates discretionary and collaborative behavior. NASA@WORK presents an avenue for employees to volunteer time and effort for tasks beyond the job requirement, and to demonstrate enthusiasm and support for colleagues’ work and the community at large. Our informants expressed appreciation for immediate supervisors’ affirming words and actions that acknowledge going the extra mile. One informant said,

“You can recognize someone, like, ‘Oh, hey, here's a piece of paper. Thanks for your work.’ But to have your boss come up to you, shake your hand, and go, ‘Look, thank you for all that you do.’ It's a really big difference.”

Our data supports the overall notion that employees appreciate recognition that acknowledges adoption of and engagement with the newly introduced problem-solving practices. One informant said, “Just a little bit of recognition goes a long way. ... It provides those people who have that orientation [to brainstorm across discipline lines] a chance to, if you will, raise their hand in a way that demonstrates that commitment, or that interest.”

In addition, our data indicates that while various awards at NASA celebrate innovation and prosocial conduct, these are infrequent and involve formal nominations and a lengthy selection process. Importantly, they do not seem accessible to many in the organization. Although these awards are prestigious and highly coveted, informants also conveyed desire for managers’ words of praise and encouragement. One informant explained,

“It may be like a supply and demand problem. We do have awards that are given out periodically for teams that do great work and we do have annual performance reviews, but maybe just the average Joe at NASA would like to be recognized more.”

Employees' desire for attention and commendation from their supervisors, which are more personal compared to the organizational awards, provides a second explanation for the effectiveness of the managerial recognition incentive.

Job proximity to mission as a mediator for the effect of recognition

Although NASA's mission centers on science, technology, aeronautics, and space exploration, less than 65% of NASA employees are astronauts, scientists, or engineers. The remaining 35% of the jobs are in administration, accounting, legal, transportation, information technology, and others (NASA 2019). These jobs indirectly contribute to NASA missions. Our interview data suggests that the sense of appreciation and attention by management may be particularly motivating for employees whose job functions are more distant from the mission. Informants with jobs that are only indirectly related to mission shared that contributing to NASA@WORK can demonstrate to the manager that "you're really like an all-star across the entire job description and NASA in general" and that managerial attention offers a "feeling that you're actually playing a role in the organization". One office secretary informant 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." For employees whose routine work is not explicitly tied to the organizational mission but who want to participate in it, NASA@WORK appeared to fulfill that want and to provide a way to be recognized for their commitment.

Using mission as an instrumental incentive

Using NASA's mission as an explicit instrumental incentive was not seen to be positively motivating. For employees who are already drawn to and motivated by the organizational mission, the message seems to have been redundant or even provocative. One informant said, "Some percentage of the NASA population may have rolled its eyes and said, 'I'm already pursuing the future in my day job, why do I need to do this other thing?'" Another informant further elaborated, "You don't need to remind me of

that [the mission]. That's why we're not in the industry making three times our salaries. It's because we want to do the scientific breakthrough, that's what's exciting to us.”

As before, the uncertainty around the value and legitimacy of platform engagement seems to have contributed to the ineffectiveness of the mission treatment. As one informant stated, “When I think of NASA’s mission, I think outer space, humans, and science missions way out in the universe. That doesn't really fit with this online platform for problem solving.” Thus, using mission as an instrumental incentive on the intensive margin seemed to be of limited use in a workforce that had selected into the organization based on a strong mission appeal, and for a task whose connection to the overarching mission was not clear.

IMPLICATIONS FOR THEORY AND RESEARCH

Our findings contribute to the literatures on non-financial incentives, in particular the literatures on awards (Frey & Gallus 2017a,b) and mission incentives (Cassar & Meier, 2018), and motivations on peer-based innovation platforms (Jeppesen and Frederiksen 2006, Lakhani et al. 2005). We were able to partner with NASA for this study and are, to the best of our knowledge, the first to run a field experiment in this important context. It is a challenge to study the causal effects of awards in the field, and even more difficult to study different types of recognition at the same time. We do so by focusing on the ex-ante effects of recognition and experimentally vary the expected audience: management, immediate peers, or other platform participants.

Our experimental results showed that the prospect of receiving managerial recognition incentivized platform engagement. We did not find support for the effectiveness of the other non-financial incentives. Our interview findings suggest important and novel mechanisms behind recognition: positive signaling about the task’s legitimacy in a context of change and uncertainty, as well as being noticed and appreciated by management in a way that is personal and timely compared to the formal and infrequently awarded organizational honors. While it has been posited that awards can be used to signal organizational and managerial priorities and goals (Gallus and Frey 2017), such signaling has so far received only little

attention in the empirical literature on organizational awards (Robinson et al. 2019). As our findings suggest, for recognition to work, the underlying task needs to be considered signal-worthy.

We also observe potential heterogeneity in employees' responsiveness to recognition based on their job proximity to the organization's mission. Managerial recognition seems to be particularly motivating for employees whose day-to-day work is only indirectly tied to the organizational mission (e.g., secretaries). Interestingly, the demand for acknowledgment was not related to the display of superior ability and performance, but rather to the individual's desire to be recognized as a good citizen who seeks to support organizational change.

In a context of uncertainty around the signal-worthiness of platform engagement, peer recognition and platform recognition were ineffective. While peer recognition would have been in line with the newly aspired-to culture of peer-based problem solving, managerial recognition was in line with the established, hierarchy-based organizational culture. Our findings suggest that an incentive scheme that is aligned with the established culture may be needed to blaze the trail towards the new culture and facilitate the desired change process.

We compare recognition to the use of organizational mission as an incentive. Invoking mission as an incentive is theoretically interesting (Carton, 2018; Cassar & Meier, 2018; Shamir et al., 1993) as well as practically relevant. We chose and designed our non-financial incentives in collaboration with our field partners, who no longer had financial incentives at their disposal and had to seek alternative ways of motivating platform engagement. Our results suggest that using mission as an instrumental incentive may be difficult if workers are already highly mission-motivated. A mere textual reminder produced little behavioral change. This result is in line with Blasco et al. (2019), who found that a mission-oriented incentive did not effectively motivate hospital employees to contribute ideas towards improving patient care. These results may imply that in organizations such as NASA, hospitals, schools, and others where one presumes mission to provide an important meaning for work, using mission as an explicit and instrumental incentive to further motivate workers on the intensive margin can be limited or even counterproductive when it risks being perceived as disingenuous. Moreover, it is possible that without a

proper explanation, employees in our context struggled to see the connection between the specific task of platform engagement and the high-level, organizational aspirations (Carton, 2018).

Future work could usefully draw on experiments on more active innovation platforms to analyze these mechanisms as well as the effects of recognition and mission incentives on the frequency and quality of postings. It should moreover explore the boundary conditions to our findings. For instance, we believe that our findings about the importance of managerial appreciation would extend to other organizations adopting inner-organizational innovation platforms. On the other hand, managerial recognition may be less effective to foster engagement with established peer innovation platforms that are already legitimate in the views of employees. Instead, in these cases we would expect peer recognition to be more effective.

IMPLICATIONS FOR PRACTICE

This study suggests several steps from which organizations may benefit when trying to encourage use of new and peer-based innovation platforms. First, our analysis of non-financial incentives points to the importance of managerial recognition for employees. In line with our findings, a recent Gallup workplace survey 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 and Dvorak 2016). Our data indicate that employees appreciate managerial attention and appreciation—a low-cost activity that can have significant positive effects. Accordingly, signaling organizational support and training supervisors and middle managers to validate and recognize the contributions of their staff may be critical.

The main mechanism driving our findings is that for recognition incentives to be effective, the underlying task needs to be signal-worthy. This is particularly important in contexts where organizations seek to implement novel initiatives. We expect our results about the importance of managerial recognition in providing appreciation and signaling legitimacy to generalize to contexts of change management and engagement with intra-organizational online platforms more broadly. Paying employees to support such new initiatives is most likely ineffective, infeasible, and can even be counterproductive. Instead, offering

appreciation by management seems to be a promising avenue. Such appreciation need not be focused on outstanding ability, creativity or performance, but instead may be particularly motivating for employees who make an effort to engage with novel initiatives and support the organization's change.

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TABLES & FIGURES

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Table 2. Logistic Regression Models Predicting Platform Engagement

Table 3. Interview Sample Characteristics

Table 4. Overview of Qualitative Data Structure

Figure 1. Conceptual Framework

Appendix 1. Interview Protocol for Semi-Structured Interviews

Table A1. Balance Table of User Characteristics by Treatment Assignment

Table A2. Logistic Regression Models Predicting Platform Engagement Including Exploratory Arms

Table A3. Logistic Regression Models Exploring Treatment Effects on Contractors

Figure A1. Screenshots of treatment emails

Table 1. Description of NASA@WORK Population and Engagement

	NASA@WORK population N (%)	Challenge Owner ¹ N (%)	Challenge winner N (%)	Logged in at least once 6 months prior to the experiment N (%)
Employment status				
Civil servant	8,609 (51)	95 (94)	110 (63)	3,422 (51)
Contractor	8,197 (49)	6 (6)	64 (37)	3,263 (49)
Center affiliation				
AFRC	264 (1.6)	0 (0)	5 (2.9)	109 (1.6)
ARC	634 (3.8)	2 (2.0)	10 (5.7)	248 (3.7)
GRC	1,455 (8.7)	3 (3.0)	13 (7.5)	519 (7.8)
GSFC	1,572 (9.3)	7 (6.9)	12 (6.9)	517 (7.7)
HQ	577 (3.4)	6 (5.9)	6 (3.4)	174 (2.6)
JSC	4,734 (28)	53 (52)	74 (43)	2,085 (31)
KSC	2,666 (16)	9 (8.9)	15 (8.6)	1,137 (17)
LARC	1,324 (7.9)	6 (5.9)	10 (5.7)	609 (9.1)
MSFC	2,019 (12)	8 (7.9)	13 (7.5)	746 (11)
SSC	331 (2.0)	3 (3.0)	4 (2.3)	134 (2.0)
WSTF	123 (0.7)	1 (1.0)	2 (1.1)	47 (0.7)
Other ²	1,107 (6.6)	3 (3.0)	10 (5.7)	360 (5.4)
Total	16,806	101 (0.6)	174 (1.0)	6,685 (40)

Note. AFRC: Armstrong Flight Research Center; ARC: Ames Research Center; GRC: Glenn Research Center; GSFC: Goddard Space Flight Center; HQ: Headquarters; JSC: Johnson Space Center; KSC: Kennedy Space Center; LARC: Langley Research Center; MSFC: Marshall Space Flight Center; SSC: Stennis Space Center; WSTF: White Sands Complex/Test Facility

¹To be a challenge owner, one must be a civil servant; contractors can co-own challenges with a civil servant partner.

²Other includes Brad, Dale, Dryden Flight Research Center, Goddard Institute for Space Studies, Independent Verification and Validation, Jet Propulsion Laboratory, Michoud Assembly Facility, NASA Shared Services Center, and Wallops Flight Facility.

Table 2. 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	1.433**	0.201	1.443**	0.197
Peer recognition	1.322	0.265	1.319	0.275	1.331	0.274
Platform recognition	0.915	0.160	0.900	0.157	0.911	0.150
Mission	0.900	0.215	0.891	0.215	0.900	0.213
Information	1.134	0.126	1.121	0.126	1.134	0.121
Center-level fixed effects	Not included		Included		Included	
Stratification variables	Not included		Included		Included	
Control variables	Not included		Not included		Included	
Log likelihood	-1,927		-1,849		-1,845	
Observations	11,192		11,147		11,147	

Notes. An odds ratio (OR) less than 1 indicates lower platform engagement than in the control group, which received the baseline email with no treatment; conversely, an OR greater than 1 indicates higher platform engagement than in the control group. Standard errors are clustered by center affiliation. Stratification variables are employment status (civil servant or contractor) and prior activity (logged in within the 6 months before the experiment). In models 2 and 3, 45 observations (i.e., users in 4 centers) are dropped because of all positive or negative outcomes within a center. The main specification (model 3) adds control variables for the number of previously owned and solved challenges. Correcting for multiple hypothesis testing using the Bonferroni method does not meaningfully change the results. Using randomization inference (RI) instead of the traditional sampling-based approach does not change the results. The p-value on the managerial recognition coefficient in the main specification becomes 0.036 and 0.037, respectively, when using the Bonferroni method and RI. The p-value on the managerial recognition coefficient in the main specification becomes 0.036.

* $p < 0.05$; ** $p < 0.01$

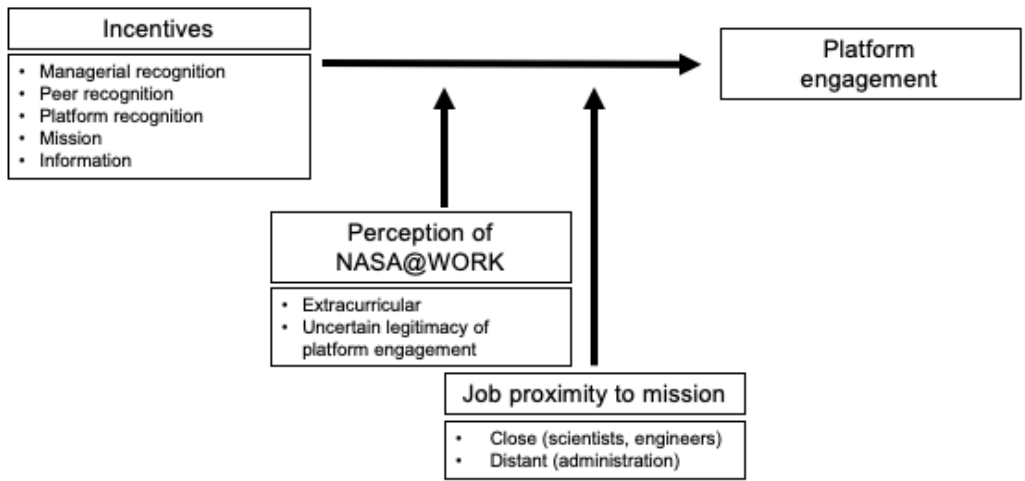
Table 3. Interview Sample Characteristics

	Engagement with NASA@WORK				Total
	Owned a challenge	Contributed to a challenge	Owned & contributed a challenge	None	
No. of Interviews	10	21	10	12	53
Civil servant/contractor	10/0	12/9	7/3	8/4	37/16
Job proximity to mission					
Close (e.g., engineer, scientist)	9	12	7	10	38
Distant (e.g., administration)	1	9	3	2	15
Female/male	6/4	4/17	2/8	4/8	16/37
Organizational tenure					
Less than 5 years	2	2	1	2	7
5-10 years	4	7	2	2	15
10-20 years	3	6	2	3	14
20+ years	1	6	5	5	17
Center affiliation					
Ames Research Center	1	1	0	2	4
Armstrong Flight Research Center	0	2	0	0	2
Glenn Research Center	0	1	0	0	1
Goddard Space Flight Center	1	2	1	2	6
Headquarters	1	1	1	0	3
Johnson Space Center	5	6	4	6	21
Kennedy Space Center	1	2	3	1	7
Langley Research Center	0	1	0	0	1
Marshall Space Flight Center	1	2	0	1	4
NASA Shared Services Center	0	1	0	0	1
Stennis Space Center	0	1	1	0	2
White Sands Test Facility	0	1	0	0	1

Table 4. Overview of Qualitative Data Structure

Topics	Axial code	Open code examples
Perception of NASA@WORK engagement	Extracurricular (For workers with jobs distant from mission)	<p>“No one really recognizes that as real work” “A side thing” “I think of it as sort of community service”</p> <p>“An opportunity to step outside your normal daily activities” “A fun opportunity to get more engaged with NASA missions”</p>
	Unconventional	<p>“This [NASA@WORK] goes against that dominant culture, because you can ask anybody anything” “It's not part of the culture to just say, ‘Let's just work all together, and find expertise from across the agency.’” “I probably would exercise other options first before doing that.”</p>
Mechanisms of recognition incentives	Legitimacy of platform engagement	<p>“Top-down approval would probably help people feel like that it's permissible” “Credibility that it's something important” “You probably would wear the NASA pin... rather than the NASA@WORK pin” “If you post my name in the dark corner of the Internet, I do not necessarily feel very recognized” “Getting your picture posted on a website... looks like you're not doing work that's backed by management”</p>
	Sense of appreciation (For workers with jobs distant from mission)	<p>“Want to feel valued” “The average Joe at NASA would like to be recognized more” “If I'm doing great things, unless I'm waving my own flag, there's no recognition for it”</p> <p>“Feeling that you’re actually playing a role in the organization” “Provides ... a chance to raise their hand in a way that demonstrates that commitment, or that interest”</p>
Mechanisms of mission incentive	Redundant reminder	<p>“I'm already pursuing the mission in my day job; why do I need to do this other thing?” “Don’t need to remind me of that. That's why we're not in the industry making three times our salaries”</p>
	Unclear relationship to platform	<p>“How is NASA@WORK going to really influence any sort of mission?” “Outer space, humans, and science missions...doesn't really fit with this online platform for problem solving.”</p>

Figure 1. Conceptual Framework



Appendix 1. Interview Guide for Semi-Structured Interviews

Introductions

- Can you tell me about your role/job at NASA?
- How long have you worked at NASA?
- Which center are you a part of?

Experience with NASA@WORK

- Can you describe the extent of your engagement with NASA@WORK?
- How often do you visit the platform in a given week or month?
- What prompts you to visit the platform?

[If posted a challenge and/or a solution]

- What motivated you to post?
- How much time did you spend on the platform?
- To what extent did you connect with people about the question you posted outside of the platform? Could you tell me more about this experience?

[If posted a challenge but not a solution]

- To what extent did you find submitted ideas to be helpful? Did anything surprise you?
- What would you describe as the main barrier(s) for not posting a solution?

[If posted a solution but not a challenge]

- Have you ever considered owning a challenge? Why or why not?

[If haven't posted a challenge or a solution]

- What would you describe as the main barrier(s) for your limited engagement?
- What would motivate you to use the platform?

General impressions of NASA@WORK

- What do you see as the main purpose of NASA@WORK?
- What would motivate more people to use the NASA@WORK platform?
- (Added in the updated protocol) To what extent do you think one's role or job at NASA affects the way one approaches and engages with NASA@WORK?

Other activities similar to NASA@WORK at NASA (added in the updated protocol)

- Are there other activities at NASA that are, like NASA@WORK, "pro-social", as in beneficial for the organization but not immediately beneficial for the person doing it? Can you give me an example?
- How do employees at NASA get recognized for participating in these types of activities?
- What about for leadership and participation in organizational improvement, more broadly? To what extent do employees at NASA get recognized for participating in these types of activities?
- Can you tell me an example of someone, yourself or a colleague, getting recognized for going above and beyond one's job?

Reactions to experimental findings

We emailed all 17,000+ NASA employees registered on NASA@WORK. Each person received one of nine emails, each highlighting a different potential motivator. We wanted to see if highlighting the mission of NASA, effectiveness of the platform, the prospect of getting recognized by managers, getting recognized in front of one's peers/coworkers with a lapel pin, or getting publicly recognized on the NASA@WORK hall of fame webpage would affect people's engagement with NASA@WORK.

- We found that people who received the email highlighting managerial recognition were most likely to visit NASA@WORK afterwards. Do you have any thoughts about why this might have been the case?
- What about getting a lapel pin that you can wear in front of peers/coworkers?
- What about getting recognized on the NASA@WORK "hall of fame" webpage?
- What about highlighting NASA's mission?
- Would getting an email that highlights the impact of NASA@WORK, saying that "80% of the Challenges run on this platform have been or are about to be implemented, leading to significant advances and savings for NASA" impact your engagement with the platform? Why or why not?

Table A1. Balance Table of User Characteristics by Treatment Assignment

	Control	Treatment assignment								p-value
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
A. Stratification variables										
Employment Status										
Civil servant	51.0%	51.2%	51.2%	51.5%	51.4%	50.9%	51.0%	51.6%	51.1%	1.000
Contractor	49.0%	48.8%	48.8%	48.5%	48.6%	49.1%	49.0%	48.4%	48.9%	
Last log-in within 6 months before the Experiment	39.6%	39.9%	40.1%	40.1%	39.8%	39.6%	39.7%	39.5%	39.7%	1.000
B. Prior activity on NASA@WORK										
Owned a challenge	0.59%	0.54%	0.75%	0.70%	0.75%	0.43%	0.69%	0.48%	0.48%	0.862
Won a challenge	1.12%	1.02%	1.13%	0.80%	1.13%	1.07%	0.96%	1.07%	1.01%	0.992
Days since last log-in at the time of Experiment	545	581	551	553	561	564	556	572	563	0.679
C. Center affiliation										
Armstrong Flight Research Center	1.12%	1.72%	1.34%	1.45%	1.61%	1.76%	1.82%	1.50%	1.81%	0.705
Ames Research Center	3.47%	4.14%	3.97%	3.70%	4.56%	3.42%	3.95%	3.43%	3.31%	
Brad	0.00%	0.00%	0.00%	0.00%	0.00%	0.05%	0.00%	0.00%	0.00%	
Dryden Flight Research Center	0.27%	0.27%	0.43%	0.38%	0.43%	0.27%	0.11%	0.37%	0.32%	
Dale	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.05%	0.00%	0.00%	
Goddard Institute for Space Studies	0.00%	0.00%	0.00%	0.00%	0.00%	0.05%	0.00%	0.05%	0.05%	
Glenn Research Center	9.41%	8.34%	7.95%	9.12%	9.17%	9.35%	8.12%	8.46%	8.00%	
Goddard Space Flight Center	10.6%	9.10%	8.70%	9.12%	8.90%	9.67%	9.83%	9.43%	8.85%	
Headquarters	3.69%	3.66%	3.44%	3.06%	3.16%	3.10%	3.85%	3.05%	3.89%	
Independent Verification & Validation	0.48%	0.65%	0.64%	0.38%	0.21%	0.37%	0.37%	0.48%	0.80%	
Jet Propulsion Laboratory	3.37%	2.31%	2.36%	2.58%	2.52%	2.40%	2.35%	2.57%	2.19%	
Johnson Space Center	28.6%	27.0%	28.2%	28.1%	28.1%	27.4%	27.9%	30.2%	28.1%	
Kennedy Space Center	15.2%	14.8%	16.3%	16.0%	15.2%	16.4%	17.0%	15.9%	15.9%	
Langley Research Center	7.38%	9.10%	7.20%	7.83%	7.94%	7.85%	7.37%	7.45%	8.80%	
Michoud Assembly Facility	0.16%	0.22%	0.48%	0.11%	0.21%	0.27%	0.53%	0.27%	0.32%	
Marshall Space Flight Center	11.0%	12.9%	13.8%	12.1%	11.5%	12.0%	11.1%	11.6%	12.2%	
NASA Shared Services Center	1.44%	1.94%	1.61%	1.93%	1.77%	1.87%	1.50%	1.29%	1.55%	

Stennis Space Center	1.76%	1.56%	2.15%	2.31%	2.41%	1.60%	1.71%	1.93%	2.29%
Wallops Flight Facility	1.39%	1.61%	1.13%	0.97%	1.50%	1.39%	1.71%	1.23%	0.75%
White Sands Complex	0.00%	0.16%	0.05%	0.00%	0.00%	0.05%	0.11%	0.05%	0.05%
White Sands Test Facility	0.69%	0.59%	0.27%	0.86%	0.80%	0.80%	0.59%	0.75%	0.75%
Sample size	1,871	1,858	1,862	1,864	1,865	1,872	1,872	1,867	1,875

Note. 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. The control group received a reminder email about engaging with NASA@WORK without information about incentives. Main treatments: (1): managerial recognition; (2): peer recognition; (3): platform recognition; (4): mission; (5): information about platform effectiveness. Three exploratory arms: (6): mission & managerial recognition; (7): mission & peer recognition; (8): mission & platform recognition.

Table A2. Logistic Regression Models Predicting Platform Engagement Including Exploratory Arms

	Model 1		Model 2		Model 3	
	Dependent variable = log-in within one week of intervention					
	OR	RSE	OR	RSE	OR	RSE
Treatments						
Managerial recognition	1.443**	0.197			1.445**	0.197
Peer recognition	1.331	0.274			1.340	0.273
Platform recognition	0.911	0.150			0.912	0.150
Mission	0.900	0.213			0.900	0.212
Information	1.134	0.121			1.134	0.121
Mission & managerial recognition			1.123	0.143	1.116	0.147
Mission & peer recognition			1.171	0.209	1.165	0.210
Mission & platform recognition			0.830	0.157	0.835	0.161
Center-level fixed effects	Included		Included		Included	
Stratification variables	Included		Included		Included	
Control variables	Included		Included		Included	
Log likelihood	-1,845		-1,139		-2,730	
Observations	11,147		7,420		16,742	

Notes. An odds ratio (OR) less than 1 indicates lower platform engagement than in the control group, which received the baseline email; conversely, an OR greater than 1 indicates higher platform engagement than in the control group. Standard errors are clustered by center affiliation. Stratification variables are employment status (civil servant or contractor) and prior activity (logged in within the 6 months before the experiment).

* $p < 0.05$; ** $p < 0.01$

Table A3. Logistic Regression Models Exploring Treatment Effects on Contractors

	Model 1		Model 2	
	Dependent variable = log-in within one week of intervention			
	OR	RSE	OR	RSE
Treatments				
Managerial recognition	1.443**	0.197	1.170	0.205
Peer recognition	1.331	0.274	1.144	0.279
Public recognition	0.911	0.150	0.733	0.190
Mission	0.900	0.213	0.703	0.151
Information on platform impact	1.134	0.121	0.820	0.224
Treatment x Contractor				
Managerial recognition x Contractor			1.511*	0.307
Peer recognition x Contractor			1.355	0.405
Public recognition x Contractor			1.532	0.481
Mission x Contractor			1.614*	0.329
Information on platform impact x Contractor			1.840	0.689
Center-level fixed effects	Included		Included	
Stratification variables	Included		Included	
Control variables	Included		Included	
Log likelihood	-1,845		-1,843	
Observations	11,147		11,147	

Notes. An odds ratio (OR) less than 1 indicates lower platform engagement than in the control group, which received the baseline email; conversely, an OR greater than 1 indicates higher platform engagement than in the control group. Standard errors are clustered by center affiliation. Stratification variables are employment status (civil servant or contractor) and prior activity (logged in within the 6 months before the experiment).

* $p < 0.05$; ** $p < 0.01$

Figure A1. Screenshots of the Treatment Emails

Control group

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.



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T1: Platform effectiveness

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T2: Mission

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T3: Peer recognition (i.e., pin)

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T4: Managerial recognition

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T5: Platform recognition

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T6: Mission & peer recognition

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T7: Mission & managerial recognition

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T8: Mission & platform recognition

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