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Driven by Social Comparisons: How Feedback about Coworkers' Effort Influences Individual Productivity

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Running Head: RESPONDING TO PERFORMANCE FEEDBACK

Driven by Social Comparisons:

How Feedback about Coworkers' Effort Influences Individual Productivity

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Abstract

Drawing on theoretical insights from research on social comparison processes, this article explores how managers can use performance feedback to sustain employees' motivation and performance in organizations. Using a field experiment at a Japanese bank, we investigate the effects of valence (positive versus negative), type (direct versus indirect), and timing of feedback (one-shot versus persistent) on employee productivity. Our results show that direct negative feedback (e.g., an employee learns her performance falls in the bottom of her group) leads to improvements in employees' performance, while direct positive feedback does not significantly impact performance. Furthermore, indirect negative feedback (i.e., the employee learns she is *not* in the bottom of her group) worsens productivity while indirect positive feedback (i.e., the employee learns she is *not* in the top of her group) does not affect it. Finally, both persistently positive and persistently negative feedback lead to improvements in employees' performance. Together, our findings offer insight into the role of performance feedback in motivating productivity in repetitive tasks.

Key Words: Feedback, Framing, Learning, Motivation, Persistence, Productivity, Social comparison

Driven by Social Comparisons:

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In organizations across industries, managers face the task of assuring that employees are motivated and devote consistent effort to their jobs. As the marketplace becomes increasingly competitive, enhancing employee productivity is critical to staying ahead of the competition. One tool for keeping employees engaged in their jobs, including jobs that involve the repetition of the same tasks over time, is performance feedback (Murphy and Cleveland 1995). Performance feedback provides employees with information about the effectiveness of their own work behavior. Although performance feedback is widely used in organizations, and the design and maintenance of feedback systems are essential for both individual and organizational performance (Fedor 1991; Taylor, Fisher, and Ilgen 1984), when and what type of feedback influences employee motivation and performance is, to date, still unclear. In fact, as Latham and Locke (1991, p. 224) noted, "few concepts in psychology have been written about more uncritically and incorrectly than that of feedback."

In this paper, we address calls for critically executed research on the effects of feedback on employees' performance by exploring how the *valence* (positive versus negative), *type* (direct versus indirect), and *timing* (one-shot versus persistent feedback) of performance feedback impact employees' productivity in organizations. Using a field experiment, we examine how these dimensions of feedback affect employee productivity in a context where performance is not linked to pay, and where there are no specific, difficult goals set for workers. We propose that performance feedback has direct psychological consequences that stimulate or decrease employee motivation depending on one's own standing relative to coworkers.

Several field and laboratory studies have examined the relationship between performance feedback and employee productivity over the last few decades (Murphy and Cleveland 1995) and have consistently demonstrated that feedback enhances performance on single-criterion tasks when the feedback is specific to the performance criterion and when clear, specific goals for workers are in place

(e.g., Becker 1978, Komaki, Barwick, and Scott 1978, see also Locke et al. 1981 for a thorough review). Across these studies, feedback produced beneficial effects on individual productivity because it was accompanied by the positive motivational effects of setting specific and difficult but attainable goals (e.g., Erez 1977). Although empirical evidence suggests that the combination of feedback plus clear goals is beneficial for workers' performance, the evidence regarding the use of *feedback only* (without specifying performance goals) is mixed (Kluger and DeNisi 1996). As noted by Kluger and DeNisi (1996, p. 277), the lack of a unified theory makes it impossible to interpret such findings: "Without a comprehensive theory, there is no way to integrate the vast and inconsistent empirical findings."

Drawing on social comparison theory (Festinger 1954), we propose that employees respond to performance feedback differently depending on the saliency of the comparisons they make between themselves and their coworkers regarding their productivity. The performance feedback we focus on in our investigation is, by nature, feedback that promotes *social comparison processes*, as workers learn about their performance standing compared to that of coworkers. Social comparison processes allow people to self-evaluate and improve by comparing their performance to that of others (Festinger 1954). Although people prefer to evaluate themselves and their standing using objective standards, these are rarely available in organizational settings. Under such circumstances, people compare themselves to others in order to assess how they are performing (see Suls and Wheeler 2000, and Suls, Martin, and Wheeler 2002). Thus, social comparison processes are useful not only for evaluating oneself accurately by viewing the performance of other employees completing the same tasks, but also to improve one's own productivity through direct comparisons with more or less productive workers (e.g., Monteil and Huguet 1999).

The empirical setting of our field experiment is the processing operation for APLUS, the consumer finance subsidiary of Shinsei Bank, a mid-sized bank based in Japan. APLUS offers credit cards, shopping credit (i.e., credit for large purchases such as furniture), and car loans to Japanese consumers. Processing employees at APLUS sit at individual desktop computers and enter data from loan applications. APLUS employees complete the same set of tasks repetitively throughout the course of the

day, and their individual performance is precisely tracked by the company's advanced information technology system. Traditionally, APLUS employees did not receive performance feedback, and their pay did not vary based on their productivity. With our field study, we introduced different variations on the type of feedback APLUS employees received on a daily basis for an entire month. In this way, we could examine the effects this feedback had on their individual productivity in a controlled manner.

This paper makes several contributions to the literature. First, we contribute to the existing literature on the effects of feedback on individual motivation by examining how the type, valence, and timing of feedback influence employees' performance in a functioning organization. Different from prior work, we consider a setting in which performance feedback is independent from goals set for employees and is also independent from pay. Second, our predictions are fundamentally different from the typical hypotheses found in between-individual investigations of the effects of feedback valence (i.e., whether the performance feedback individuals receive is negative or positive) on performance (e.g., Nease, Mudgett, and Quinones 1999; Podsakoff and Farh 1989). In previous research, feedback valence is manipulated by providing study participants in different experimental conditions with either general positive or negative feedback. By contrast, our predictions refer to a within-individual relationship, indicating how different types of feedback influence worker productivity across time (i.e., feedback types vary within each individual). In addition, our predictions refer not only to the valence of feedback but also to the type and timing of it, thus extending prior investigations that employed only a manipulation for feedback valence.

Third, our research contributes to prior work on the relationship between performance feedback and employee motivation by focusing on feedback that promotes social comparison processes. Prior research has primarily focused on how performance feedback can impact individuals' goal regulation process. For instance, when an employee learns that she has performed 10% below a set goal, she can adjust the goal accordingly or work harder to reach it. However, in many organizational settings, specific productivity goals are not communicated to workers, who are only asked to perform at their best over time. Our research examines the conditions under which the use of performance feedback that informs workers of their standing compared to the standing of other workers completing the same tasks enhances

productivity.

Finally, we also extend prior work on the impact of feedback on workers' motivation in operations management contexts. The relationship between feedback and workers' motivation has been examined in many ways (e.g., Kluger and DeNisi 1996; Nadler 1979; Sansone 1986; Schultz et al. 1998). The operations management literature commonly assumes that how fast workers complete their work and how motivated they are is independent of the way the system is designed. However, research has started to question this basic assumption (e.g., Schultz et al. 1999). Here, we focused on performance feedback and its effects on workers' motivation and productivity over time. Thus, our results contribute to the emerging research in behavioral operations (Boudreau et al. 2003; Bendoly, Donohue and Schultz 2006; Gino and Pisano 2008), whose main tenet is that operations management can make more accurate predictions when considering the psychology of workers. Consistent with this view, our research examines how an effective tool for improving workers' productivity can be best optimized to produce high levels of performance by considering the effects different forms of performance feedback have on workers' self-image and motivation. As a result, our theoretical framework integrates research in operations management and social psychology to offer a fine-grained understanding of the relationship between performance feedback and workers' productivity. With such understanding, managers can design better operating systems.

Feedback Effects on Performance

Several studies in the psychology and management literatures have demonstrated the beneficial effects of feedback on individual performance in organizations (e.g., Dockstader, Nebeker, and Shumate 1977; Ilgen et al. 1979; Ivancevich and McMahon 1982; Pritchard, Bigby, Beiting, Coverdale, and Morgan 1981). Yet, these studies have been primarily conducted in controlled, laboratory settings and have generally examined the effects of performance feedback in relation to specific goals participants were asked to reach. For example, Locke et al. (1981) reviewed a number of laboratory and field studies in which performance improved when goals were set and feedback was provided to individuals. In a field experiment with Air Force personnel, Pritchard, Jones, Roth, Stuebing, and Ekeberg (1988) demonstrated

how a program of goal setting and feedback can favorably impact productivity and employees' attitudes, such as job satisfaction and morale at work. In addition, prior research has compared the effects of positive and negative feedback when goals were clearly set. For instance, in a longitudinal study of athletic performance, Williams et al. (2000) examined goal and performance regulation in 25 track and field athletes. These authors demonstrated that negative feedback (i.e., learning that one's performance was lower than one's goal) produced downward goal revision, whereas positive feedback led to positive discrepancy production. That is, athletes responded to negative feedback by revising their goals to make them easier and responded to positive feedback by raising their goals. In a related study with varsity-level college track and field athletes, Donovan and Williams (2003) found that the magnitude of the discrepancy between current performance and goal influenced the extent to which athletes revised their goals. In particular, athletes were found to be more likely to lower their goals when they failed to meet their previous goal and the discrepancy between performance and goal was large. Similar to these studies, most of the research on performance feedback has focused on understanding the goal-regulation process and on whether feedback motivates people to revise their goals and achieve them. For instance, study participants might receive negative feedback indicating they performed 20% below the goal or positive feedback indicating they performed 20% above the goal. However, in many organizational settings, workers do not have specific goals to reach but are simply asked to sustain high levels of productivity over time. Our work focuses on this type of settings and examines the effects of valence, type, and timing of performance feedback on employee motivation and productivity.

This paper differs from prior research on the effects of performance feedback in three other important ways. First, we manipulate different dimensions of feedback in a context in which better performance does not directly translate to greater pay or greater incentives. The majority of previous studies manipulated feedback valence in contexts in which higher levels of performance translated into higher bonuses or higher pay for workers. Second, in our field experiment, feedback is provided to employees on a daily basis for an extended period of time. By contrast, prior work has focused mainly on situations in which individuals received feedback one time only after performing a task. Finally, our work

manipulates social comparison feedback—that is, performance feedback expressed in terms of an employee's productivity level as compared to the productivity level of workers completing similar tasks within the same organization.

Kluger and DeNisi (1996) suggested that feedback interventions influence employees' locus of attention, which, in turn, impacts their performance. These authors identified three levels of processes involved in performance regulation: the self (or meta-task processes), the focal task (or task motivation processes) and the details of the focal task (or task learning processes). In a meta-analysis, Kluger and DeNisi (1996) found that the benefits of feedback are stronger when the focus is on task learning processes rather than processes that involve the self (e.g., considering the consequences of task failure, including criticism from supervisors), and concluded that feedback interventions that contain cues that support learning can greatly affect performance. For these reasons, in our research, we used performance feedback that informs workers about their standing compared to other workers completing the same series of tasks.

Consequences of Positive or Negative Feedback

Feedback is commonly examined only in terms of its cognitive, informational value and overlooks the fact that individuals experience specific emotions when they receive feedback that varies depending on where they stand relative to coworkers. Consistent with this argument, prior work has found that when individuals fail to reach a goal or meet a performance standard, they experience changes in their affective state (Alliger and Williams 1993; Ilies, DePater, and Judge 2007). Similarly, research has shown that people experience different emotions as a result of social comparison processes on dimensions that are salient to the individual engaging in them (e.g., wealth or income level, see Gino and Pierce 2009, 2010). In turn, this affective state (e.g., joy, disappointment, or tension) can impact goal-directed behavior and performance on subsequent tasks (Ilies and Judge 2005). We propose that performance feedback that provides information about where a worker stands relative to coworkers completing the same set of tasks influences her affective states by increasing her confidence in her ability to perform well (a positive affective state) and by reducing the possibility of feeling shameful because of bad performance (an

aversive affective state). These affective states are triggered by the fact that information about one's own performance is provided in relative terms, thus promoting social comparisons.

Social comparison theory suggests that individuals have a drive to evaluate themselves by examining their opinions and abilities in comparison to others (Festinger 1954). People regularly make ability comparisons, in particular with "similar others" – like-minded people who work on the same set of tasks. Festinger (1954) refers to this individual tendency and basic motivation to improve one's standing on self-relevant dimensions relative to that of others as "unidirectional drive upward." Prior work on social comparison has demonstrated that, when people have the possibility to choose comparison targets and shape their social comparison contexts, they prefer targets who make them shine. For instance, in competitive situations, they prefer being around people who perform worse than they do. Using data from the television game show "The Weakest Link," Pillutla and Ronson (2005) demonstrated that players prefer to eliminate top performers when they have the chance to do so, especially when the reward pool is large. Similarly, Garcia, Song, and Tesser (2010) found that individuals who have high standing on a relevant dimension (e.g., the number of papers they published) protect their social comparison context and their own self-esteem by giving biased recommendations to others who may surpass them on that dimension (e.g. they tell them not to apply for a job in their department). These findings suggest that once people reach a high standing on a relevant dimension, they care about keeping their standing over time. Related research has also demonstrated that social comparison concerns on relevant dimensions are heightened in the proximity of a standard (Garcia and Tor 2007; Garcia, Tor, and Gonzalez 2006).

We predict that in a context in which employees do not have the opportunity to influence the actions of others through recommendations, they will be motivated to keep their standing over time by devoting effort to their jobs or tasks. Thus, we suggest that direct, positively framed feedback (e.g., a worker learns her performance falls in the top of her group) is likely to lead to improvements in employee performance over time. This reasoning led us to the following hypothesis:[1]

[1] Note than in the development of all our hypotheses, we compare the effect of feedback on a chosen category of workers to the control condition, in which workers were unaware of their performance.

Hypothesis 1: Workers who receive direct, positively framed feedback about their performance (i.e., a worker learns he is in the top 10 of his group) respond by improving their performance as compared to workers who perform similarly but receive no feedback.

Upward comparison processes generally serve as an incentive for self-improvement (e.g., Helgeson and Mickelson 1995; Wood 1989). Indeed, viewing others performing better than themselves can lead people to set higher personal standards, which, in turn, can motivate subsequent efforts and positively impact performance (Blanton, Buunk, Gibbons, and Kuyper, 1999; Seta, 1982). When performance improvements are perceived to be possible, individuals performing worse than others tend to increase their efforts as compared to their usual performance levels in order to match or even exceed those standards (Major, Testa, and Bylsma 1991; Seta 1982). In addition, learning that others are performing well can endow individuals with a sense of their own potential (e.g., Lockwood and Kunda 1997) and, as a result, increase their motivation to work harder. Empirical evidence consistent with these arguments comes from studies conducted in educational contexts. For example, Blanton et al. (1999) found that the academic performance feedback of Dutch schoolchildren tended to improve if they compared their examination grades to those of high-performing students. Similarly, Vrugt and Koenis (2002) demonstrated that upward comparison produced higher personal goals and increased the subsequent scientific productivity of academic staff members. The results of these studies demonstrate that upward comparisons do not lower self-evaluations but, rather, increase individuals' belief in their capabilities to perform at high levels.

Building on this research, we suggest that when performance feedback triggers upward social comparisons, these comparisons are likely to serve as a motivator for improving productivity across time. Indirect positive feedback (e.g., a worker learns she is not in the top 10 of her group) is likely to promote upward social comparisons, as it makes the category of top performers very salient to workers. This reasoning led us to the following hypothesis:

Hypothesis 2: Workers receiving indirect, positive feedback (i.e., a worker learns he is not in the top 10 of his group) respond by increasing their performance, as compared to workers who

perform similarly but receive no feedback.

Numerous studies have demonstrated the motivating effects of social comparison in various interpersonal tasks (for a review, see Collins 2000). Yet social comparisons may also result in aversive affective states if a person compares unfavorably to others. This is likely to happen when workers receive direct, negatively framed feedback (e.g., a worker learns her performance falls in the bottom of her group). Unfavorable social comparisons often result in negative self-perceptions (i.e., a person sees himself as inferior to others) and feelings of shame (Tangney 1995; Gilbert et al. 1996). Shame is a painful emotion, often associated with perceptions that one has personal characteristics (e.g., unproductive) or has engaged in behaviors (e.g., low effort) that others will find unattractive and that result in some form of rejection (Kaufman 1989). Since shame is an aversive state, individuals are motivated to avoid experiencing this emotion. This motivation, we suggest, is likely to result in higher levels of performance following negatively-framed performance feedback. Although not tested directly, some work alludes to the possibility that people seek to reduce aversive affective states when they experience them. For example, when individuals feel that their freedom is threatened, they often exhibit psychological reactance (Brehm 1966), and when they feel uncertain, they behave in ways that signal their attempt to reduce uncertainty (Tiedens and Linton 2001). By a similar logic, when individuals receive negative feedback on their standing compared to others, they are likely to feel motivated to devote more effort to their job so that they can avoid feeling ashamed and gain confidence in their ability to work effectively. This reasoning led us to the following hypothesis:

Hypothesis 3: Workers receiving direct, negatively-framed feedback about their performance (i.e., a worker learns he is in the bottom 10 of his group) respond by improving their performance as compared to workers who perform similarly but receive no feedback.

Yet, when negative feedback is indirect (i.e., a worker learns her performance does not fall in the bottom of her group), we expect employees' performance to worsen over time. In general, people are motivated to move as close as possible to the desired outcome (such as being part of the group of top performers) and as far as possible from the undesired end-state (such as being part of the group of bottom

performers) (see Carver and Scheier 1990, 1992, 1999). When they receive feedback, people experience different emotions. In particular, they experience agitation-related emotion after receiving negative feedback and dejection related emotion after receiving positive feedback (Carver, Lawrence, and Scheier 1999). Negative agitation-related emotions (e.g., fear) have been proposed to be more energizing than negative dejection-related emotions (e.g., sadness), while positive dejection-related emotions (e.g., excitement and joy) have been suggested to be more motivating than positive agitation-related emotion (e.g., relief and contentment) (Carver 2001). Negative indirect feedback is communicated to employees by letting them know they are not part of the group of workers who is performing the worse, and employees are thus likely to feel relief or contentment rather than shame or joy. In turn, we expect that this emotional state of contentment and relief will lead people to feel less motivated to keep their levels of performance high and may in fact lead to decrements in their productivity. Thus, we hypothesize the following:

> Hypothesis 4: Workers receiving indirect, negative feedback (i.e., a worker learns he is not in the bottom 10 of his group) respond by decreasing their performance, as compared to workers who perform similarly, but receive no feedback.

Consequences of Persistent Feedback

We hypothesized that both positively-framed and negatively-framed feedback are likely to improve employees' motivation and performance. In fact, in both cases, the social comparison targets (the group of top performers) in the upward social comparisons employees make are very salient, and lead employees to work harder to stay in or become part of that group. But what happens when the feedback is persistently positive or negative over time?

We propose that the effects of both positively-framed and negatively-framed feedback are likely to be exacerbated when the feedback is received persistently, for a certain amount of time. If a worker persistently learns she is in either the top or the bottom ten of her group in terms of performance, this persistent feedback is a constant reminder that other coworkers are executing the same set of tasks effectively with high levels of performance. In the case of persistent feedback, the effects of social

comparisons are likely to be heightened. In fact, in general, the effects of social comparisons are strongest when the need for self-related information (e.g., "How am I doing on my job?") is particularly salient, as it is the case in situations that highlight comparative evaluations (e.g., Gilbert, Giesler, and Morris 1995, Mussweiler and Strack 2000, Taylor and Lobel 1989). Receiving persistent feedback about one's own performance relative to the performance of coworkers engaging in the same type of tasks is one such situation. The salient reminder persistent feedback provides is thus likely to be motivating, and to result in increased performance.

In addition, this reminder is likely to make workers experience a heightened sense of personal control, which is an important antecedent of intrinsic motivation (Deci, 1975). Personal control refers to a person's feeling that he or she has chosen freely to engage in a particular behavior (e.g., a certain level of performance). By receiving information about their own standing, workers are reminded of the fact that they can increase or decrease their effort on their jobs, and, as a result, move up in the performance ranking. The heightened motivation due to feelings of personal control and the recurrent upward social comparisons triggered by persistent feedback are thus expected to promote productivity improvements. This reasoning led us to the following hypothesis:

> Hypothesis 5: As compared to workers who perform similarly but receive no feedback, workers who receive consistently negative feedback respond by improving their performance.
>
> Hypothesis 6: As compared to workers who perform similarly but receive no feedback, workers who receive consistently positive feedback respond by improving their performance.

A Field Experiment

To test these hypotheses, we implemented a field experiment at APLUS, the consumer finance subsidiary of Shinsei Bank, a mid-sized bank based in Japan. APLUS offers credit cards, shopping credit (i.e., credit for large purchases such as furniture) and car loans to Japanese consumers. Using its capability in enterprise system development and deployment (Citation Withheld), Shinsei developed an IT-based system for processing and approving applications. Applications for different products were broken into constituent steps, ranging from entering the application data (such as an applicant's name and

address) to requesting credit reports to approving the application if all necessary steps had been completed successfully. APLUS workers sat at desktop computers with two monitors. On one monitor, the work to be completed would appear (e.g., an image from a scanned application form to be entered); on the other monitor, the worker would complete the task (e.g., enter the data into the system). Workers stayed at one computer throughout the day and, through the enterprise system, new work appeared when the prior task was finished.

It is for this process that we implemented our field experiment. Historically, workers were not provided with quantitative performance feedback. Workers were paid on an hourly basis with no incentive-based pay. On average, workers had completed a high school education, and their average age was 30. All workers were Japanese citizens living in Japan. Workers were divided between full-time APLUS employees and employees from staffing agencies (36% and 64%, respectively). Both sets of workers enjoyed an implicit guarantee of lifetime employment, as management reported that APLUS had not involuntarily separated workers from the firm for performance reasons.

As part of a broader research program examining the maintenance of worker productivity on repetitive tasks, we approached Shinsei management about implementing a field experiment to examine the effects of performance feedback. Workers were divided into three groups of (initially) 24 workers each. As workers were primarily allocated to the different product lines on the job (credit cards, shopping credit, and auto), we first divided them by product line and then randomly assigned them to each experimental group in order to balance the design. Prior to the launch of the experiment, two workers, both in the positive feedback condition, left the firm voluntarily, and there was no time to replace them in the experiment (given the IT programming involved in setting up the manipulation).

We implemented two feedback conditions and kept the third group as a control group. The first condition, *negative feedback*, informed workers whether they were in the bottom 10 of the group in terms of performance. In the second condition, *positive feedback*, workers were told whether they were in the top 10 of their experimental group.

Worker performance was calculated on a daily basis. The feedback screen was accessible from

the worker's desktop computer, and she was asked to examine it each morning prior to the start of the day. Given that workers completed tasks for different stages, it was necessary to compile a normalized measure for comparison purposes. To do this, the company first calculated the expected completion time for a stage based on the thirty days of performance by all workers assigned to the given stage (where a stage was the particular task on a particular line, e.g., application capture for credit cards), prior to the focal day. Next, for each worker, the company calculated the worker's normalized completion time as expected completion time minus actual completion time divided by expected completion time. Once all tasks were normalized, the workers' performance across all tasks for the prior thirty days was used to create an ordered ranking that served as the basis for feedback. Employees in the negative feedback condition were told that they were in the bottom ten of their group (i.e., they received *direct*, negative feedback), or alternatively that they were *not* in the bottom ten (i.e., they received *indirect*, negative feedback). Employees in the positive feedback condition were told that they were in the top ten of the group (i.e., they received *direct*, positive feedback), or alternatively that they were *not* in the top ten (i.e., they received *indirect*, positive feedback).

Data

Our sample includes all transactions completed by workers from June 1, 2010 to July 31, 2010. Performance feedback began on July 1, so we use a difference-in-differences design to compare worker performance in groups both before and after the feedback conditions were implemented (see the next section for more detail on the identification strategy). Our data consists of information on 70 workers across the three groups, completing a total of 480,082 individual steps. The information technology system at APLUS provides detailed information on each step completed in the process. This includes start and finish times for the task as well as information about the task (which line and which step) and also which worker completed the task. This archival information permits us to construct the study's variables for analysis.

Dependent variable. To measure worker performance, we analyze the *completion time*, or the length of time it takes a worker to finish a task. This is a commonly used measure of worker productivity

(e.g., Reagans, Argote and Brooks 2005). We construct the variable by subtracting the start time from the finish time, yielding a number of seconds. The mean of completion time is 50.4 seconds, and its standard deviation is 70.1. As we use a learning curve structure for our models, we take the natural log of the variable for our analyses. In addition to completion time, one could also examine quality in order to evaluate performance. The company has two workers complete each step and compares output in order to detect defects (sometimes known as "double-keying"). The observed rate of defects in the data is 3.3%; thus, while we do not use this as a dependent variable, we do control for quality as a robustness check.

Independent and control variables. We use a number of variables to test our hypotheses. First, we construct an indicator, *july*, that equals one if a transaction was completed on or after July 1st and otherwise equals zero. We also create indicators for each of the two experimental conditions, *positive and negative*, for the positive and negative feedback conditions, respectively. The missing or comparison category in each of the models is the control group. To examine the effect of top 10 and bottom 10 ranking on performance, we construct two variables, *lag top 10* and *lag bottom 10*. The variable is set to one if a worker's ranking was in the top 10 or bottom 10 for her group from the prior day. This allows us to examine how a worker responds to feedback on the focal day. We construct the measure for all groups even though only members of the positive feedback condition actually know if they were in the top 10 in the group and only members of the negative feedback condition know if they were in the bottom 10 in the group.

Control variables. We include several additional control variables in the model. To control for learning effects, we construct a measure of cumulative experience, which is equal to the total number of transactions, prior to the current transaction, that an individual has completed since June 1. We do not take the log of the cumulative experience variable, as we wish to use the exponential form of the learning curve (Levy 1965; Lapré, Mukherjee and Wassenhove 2000). Since individuals have experience prior to the start of our data (on June 1), as Lapré and Tsikriktsis (2006) note, the exponential form is preferable to the log-log model, as the estimate from the log-log model will be biased and the exponential form estimate will not. Additionally, the exponential form is derived from theory and empirical observation,

while the log-log form is derived from empirical observation (Levy 1965; Lapré and Tsikriktsis 2006).

As prior work highlights that the variety of transactions a worker completes may impact performance (Boh, Slaughter and Espinosa 2007; Narayanan, Balasubramanian and Swaminathan 2009), we include a Herfindahl-based measure of variety. This measure is constructed by summing the square of the percentage of total transactions an individual completes across each line-station combination. We then subtract this value from one, generating the Blau Index (Harrison and Klein 2007), where a higher value corresponds to more variety. We also include indicators for each product line and station. Since we wish to examine a worker's total performance in response to feedback, we wish to examine all of a worker's transactions as opposed to only those at a given station. By including line and station indicators, we control for differences across lines and stations. Additionally, to control for within-day temporal effects, we include a control variable set to one if a transaction takes place during the second half of a worker's day and set to zero otherwise. Finally, we include worker fixed effects in each model in order to account for any time-invariant effects of workers, such as a worker's prior experience or innate skill.

Table 1 provides summary statistics for this study's independent variables.

**********Insert Table 1 about here **********

Empirical Approach

To examine the effects of our experimental manipulations, we use a difference-in-differences estimation model. This approach permits us to estimate the causal effect of our intervention by comparing the difference in performance of different experimental groups before and after the intervention. While the approach offers the opportunity to accurately identify treatment effects, prior work notes that serial correlation must be corrected for in order to avoid understating standard errors and thus overstating the significance of effects (Bertrand, Duflo and Mullainathan 2004). Following the recommended approach of Bertrand et al. (2004), we run fixed effects regression models with block-bootstrapped standard errors with 1,000 repetitions (Stata command xtreg). As a baseline, we first examine whether there is an overall positive or negative group effect by running the following model for person *j* completing task *i* of stage *k*:

$$\ln(\text{Completion Time})_{ijk} =$$

$$\beta 0 + \beta 1\text{July}_{ij} + \beta 2\text{July}_{ij}\, x\, \text{Positive Group}_i + \beta 3\text{July}_{ij}\, x\, \text{Negative Group}_i + j\beta 4\text{Ind}_j + k\beta 5\text{Stage}_k + \beta 6X_{ij} + u_{ijk} \quad (1)$$

In this model we include the indicator for the month of July as well as the interaction of *July* with each of the group indicator variables. By itself, the indicator for July controls for any temporal changes in the month that might affect all workers. The interaction of *July* with each of the group indicator variables permits us to estimate any overall effects from the experimental manipulations, relative to the control group. Also, we include X_{ij}, a vector of individual-task characteristics that includes the individual's prior cumulative volume and its quadratic term, the individual's prior variety of experience and its quadratic term, as well as whether it occurred during the second half of the day. Finally, we control for differences in individuals and stages by including indicators for the different workers (Ind_j) and the different stages in the data ($Stage_i$).

In model two, in order to examine Hypotheses 1 through 4, the effect of top 10 and bottom 10 rankings on performance, we enter the *lag top 10* and *lag bottom 10* variables and their interactions with *July* and *group* to the model:

$$\ln(\text{Completion Time})_{ijk} = \beta_0 + \beta_1\text{July}_{ij} + \beta_2\text{July}_{ij}\, x\, \text{Positive Group}_i + \beta_3\text{July}_{ij}\, x\, \text{Negative Group}_i + \beta_4\text{July}_{ij}\, x\, \text{Positive Group}_i\, x\, \text{Lag Top Ten}_{ij} + \beta_5\text{July}_{ij}\, x\, \text{Negative Group}_i\, x\, \text{Lag Top Ten}_{ij} + \beta_6\text{July}_{ij}\, x\, \text{Positive Group}_i\, x\, \text{Lag Bottom Ten}_{ij} + \beta_7\text{July}_{ij}\, x\, \text{Negative Group}_i\, x\, \text{Lag Bottom Ten}_{ij} + \beta_8\text{Lag Top Ten}_{ij} + \beta_9\text{Lag Bottom Ten}_{ij} + \sum_j \beta_{10j}\text{Ind}_j + \sum_k \beta_{11k}\text{Stage}_k + \beta_{12}X_{ij} + u_{ijk} \quad (2)$$

The individual terms for top 10 and bottom 10 rankings permit us to control for any regression to the mean. The interaction of top 10 and bottom 10 performance with *july* and the positive feedback group variable allows us to test Hypothesis 1 and 2, respectively. Hypothesis 1 predicts that $\beta_4 < 0$, or that workers receiving direct, positive feedback respond by improving their performance, as compared to workers who perform similarly but receive no feedback. Hypothesis 2 predicts that $\beta_6 < 0$, or that workers receiving indirect, positive feedback respond by increasing their performance as compared to workers

who perform similarly but receive no feedback. The interaction of *july* with bottom 10 and top 10 performance and the negative feedback group variable allows us to test Hypotheses 3 and 4 with the two hypotheses predicting $\beta_7 < 0$ and $\beta_5 > 0$, respectively.

Finally, in our third model, we examine the persistence of performance. To do this, we create two indicators for the month of July: *fjuly*, which is equal to one for the first 10 days of July and zero otherwise, and *sjuly*, which is equal to one for the remainder of July and zero otherwise. We then define two additional indicators: *pg* and *pb* (for persistently good and persistently bad), where each variable equals one if an individual's ranking is in the top 10 or bottom 10, respectively, for all ten of the first 10 days of the month, and is zero otherwise.[2] We then interact *sjuly* with the group variables and *pg* as well as *pb* in order to examine the persistence of feedback:

$$\ln(\text{Completion Time})_{ijk} =$$

$$\beta 0 + \beta 1\text{Fjuly}_{ij} + \beta 2\text{Sjuly}_{ij} + \beta 3\text{Sjuly}_{ij}\ x\ \text{Positive Group}_i + \beta 4\text{Sjuly}_{ij}\ x\ \text{Negative Group}_i + \beta 5\text{Sjuly}_{ij}\ x\ \text{Positive Group}_i\ x\ \text{pg}_{ij} + \beta_6\text{Sjuly}_{ij}\ x\ \text{Negative Group}_i\ x\ \text{pg}_{ij} + \beta_7\text{Sjuly}_{ij}\ x\ \text{Positive Group}_i\ x\ \text{pb}_{ij} + \beta_8\text{Sjuly}_{ij}\ x\ \text{Negative Group}_i\ x\ \text{pb}_{ij} + \beta_9\text{Sjuly}_{ij}\ x\ \text{pg}_{ij} + \beta_{10}\text{Sjuly}_{ij}\ x\ \text{pb}_{ij} + \sum_j \beta_{11j}\text{Ind}_j + \sum_k \beta_{12k}\text{Stage}_k + \beta_{13}X_{ij} + u_{ijk} \qquad (3)$$

Hypothesis 5 predicts that $\beta_5 < 0$, or that workers who receive consistently positive feedback respond by improving their performance as compared to workers who perform similarly but receive no feedback. Hypothesis 6 predicts that $\beta_8 < 0$, or that workers who receive consistently negative feedback respond by improving their performance as compared to workers who perform similarly but receive no feedback.

Results

Table 2 provides the regression results for models 1 and 2. Examining Column 1, we see that the

[2] We conducted further analyses where we relaxed our definition of persistently positive and persistently negative performance to include individuals who performed in the top ten or bottom ten for eight or more of the first ten days. Using this definition the support for our hypotheses does not change.

interaction coefficients for the feedback experimental group variables and the July indicator are both negative, but not significant at conventional levels. Thus, the feedback manipulation does not have an overall, average effect for everyone in the feedback group on performance in our data.

**********Insert Table 2 about here **********

Moving to Column 3, we add the top 10 and bottom 10 variables with their interactions to examine the effect of feedback on sub-groups. First, neither the coefficient for positive, direct feedback (July × positive × lag top 10) nor the coefficient for positive, indirect feedback (July × positive × lag bottom 10) are statistically significant. Thus, Hypotheses 1 and 2 are not supported. Examining the coefficient for negative, direct feedback (July × negative × lag bottom ten) we see that, consistent with Hypothesis 3, the coefficient is negative and statistically significant. Thus, workers receiving feedback that they are in the bottom 10 of their group on the prior day respond by improving their performance, on average, by approximately 13.6% the following day, as compared to equivalent workers in the control group. The coefficient for negative, indirect feedback (July × negative × lag top 10) is positive and statistically significant, supporting Hypothesis 4. This reveals that workers who were in the top 10 on the prior day in the negative feedback condition (and thus were told that they were *not* in the bottom 10 of their group) experienced an average decrease in performance of approximately 17.1%, as compared to similar workers in the control group. An F-test also confirms that the top 10 and bottom 10 interaction coefficients are significantly different from one another ($p<0.001$).

We present our results on the effect of persistent negatively-framed or positively-framed feedback on individual performance in Table 3. In Column 1 we examine the interaction coefficients to explore whether persistence in the different conditions affects performance. Hypothesis 5 predicts that individuals in the positive feedback condition who consistently receive positive feedback (i.e., who are told they are in the top 10) will exhibit better performance than equivalent workers in the control group. The coefficient on the interaction of Sjuly × positive × pg is negative and statistically significant, supporting this hypothesis. Finally, the coefficient on the interaction of Sjuly × negative × pb is also negative and statistically significant, providing support for Hypothesis 6, which predicted that individuals in the

negative feedback condition who consistently receive negative feedback would exhibit better performance than equivalent workers in the control group..

**********Insert Table 3 about here **********

Finally, to examine the robustness of our reported results, we control for the quality of the transaction. To do this we repeat the models including a variable, *error*, which is set to one if a transaction was incorrect and set to zero otherwise (Columns 3 and 2 in Tables 2 and 3, respectively). The addition of this variable does not change the support for our hypotheses.

General Discussion

In this paper we examined the effect of feedback on worker performance by exploring how the *valence*, *type,* and *timing* of performance feedback influence employees' productivity in a field setting. We looked at these relationships in a context where performance is not linked to pay and where there are no specific, difficult goals set for workers. We conducted a field experiment to precisely identify the causal relationships we study. In our main models, we do not see a statistically significant relationship for either direct or indirect positive feedback on a daily basis. However, we find that both direct and indirect negative feedback have statistically and organizationally significant consequences on employee productivity. Employees receiving direct negative feedback respond by improving their performance the next day. Alternatively, employees receiving indirect negative feedback respond by worsening their performance. In addition to identifying a daily effect from feedback, we also investigated the effect of feedback over time – that is, persistence. We find that individuals receiving persistent positive *or* persistent negative feedback respond by improving their performance as compared to the control group.

Overall, our results indicate that negatively-framed performance feedback may provide a heightened motivation for working harder when compared to positively-framed performance feedback. This finding is consistent with prior research in psychology on the negativity bias, namely the tendency of individuals to pay more attention to and give more weight to negative rather than positive experiences or other types of information (for reviews, see Baumeister, Bratslavsky, Finkenauer, and Vohs 2001, Kanouse and Hanson 1971, Rozin and Royzman 2001). Skowronski and Carlston (1987, 1989) proposed

that this negativity bias by which negative information commonly receives greater weight than equivalent positive information occurs because individuals believe negative information is more diagnostic. Although we did not assess how employees interpreted performance feedback, our findings are consistent with this prior research and suggest that communicating performance feedback using negatively-framed wording may prove effective in influencing employee motivation and productivity.

Theoretical and Practical Contributions

Our study makes four main contributions to the literature. First, we investigated within-individual rather than between-individual effects of feedback. Using a field experiment, we were able to identify precisely the effects we study in a functioning organization. We not only studied the valence of feedback, but also extended prior work by examining the type and timing of feedback.

Second, we focused on feedback that promotes social comparison processes and, in so doing, contributed to work on the relationship between performance feedback and employee motivation. Employee motivation is critical in organizations since it is a driver of many beneficial processes such as knowledge sharing (Quigley, Tesluk, Locke, and Bartol 2007) and creativity (Elsbach and Hargadon 2006). Here, we examined how it can be fostered by varying the type, valence and timing of performance feedback. In many organizational settings, specific productivity goals are not communicated to workers, and workers are merely asked to perform at their best over time. Our research examines how informing workers of their standing compared to the standing of other workers completing the same tasks can both enhance or decrease productivity.

Third, our research contributes to existing management literature on the effects of social comparison processes on organizationally relevant factors (e.g., Belliveau 2005, Gibson and Lawrence 2010, Gino and Pierce 2010). Feedback managers provide to employees often triggers social comparison processes among employees. By examining different dimensions of feedback, we advanced our understanding of the consequences of these social comparison processes on employees' motivation and work productivity.

Finally, we extend prior work on the impact of feedback on employees' motivation in operations

management contexts. Holding the system design constant, we examined how an effective tool for improving workers' productivity can be best optimized to produce high levels of performance by considering the effects different forms of performance feedback have on employees' self-image and motivation. As a result, our theoretical framework integrates research in operations management and in social psychology and offers a fine-grained understanding of the relationship between performance feedback and employees' productivity.

In addition to the theoretical contribution, our work also provides advice for practicing managers in understanding how to design better operating systems. Namely, our results suggest that feedback can improve worker performance, even without specific goals, and that such feedback should be direct rather than indirect. Altogether, thoughtful performance feedback regimes may provide managers with a powerful lever for improving operational performance. In addition, our findings caution managers on the important social comparisons employees regularly engage in when interpreting feedback on their performance, and how such comparisons may be a key driver in their productivity.

Limitations and Directions for Future Research

There are several limitations of our study that bear discussion. The first concerns the fact that we examined a Japanese company staffed with Japanese workers. Do our results generalize to other settings? There are two competing forces at play. First, Japan is a culture where face is quite important, such that performing poorly with respect to others *may* have additional negative connotations as compared to other cultures. The feedback provided did not include others' rankings, but it is possible that employees might have discussed their feedback, resulting in an increased desire to avoid the bottom 10 group. The second force is that employees were functioning under an implicit guarantee of employment. Management reported that they had not laid off employees for inadequate performance, outside of an initial two-week probationary period (which all employees in the experiment had already passed). Arguably, employees did not have a reason to respond to the feedback because prior history indicated that performance and employment were not linked (though perhaps the launch of the experiment may have changed an employee's view of this contract). While we believe that these competing forces suggest that the reported

results would hold in contexts outside of Japan, future research should explore this contention.

The second concern has to do with a Hawthorne effect (Roethlisberger and Dickson 1934). Whenever working conditions are changed, it is necessary to examine whether the resulting performance improvement is due to the presence of *any* change as opposed to the particular change. The pattern of our observed results increases our confidence that they are not solely a result of a Hawthorne effect. Namely, we did not see a universal increase in performance in all experimental conditions.

An additional question concerns the fact that our study only observes the effects of feedback on performance over one month. The observed effects might change over longer time periods. For example, it is possible that negative feedback could increase employee stress and increase the likelihood that a worker would depart the firm. Similarly, if persistence was defined over a longer window (e.g., several months), then employees might eventually give up if they consistently received negatively-framed performance feedback. While we were restricted to a total of two months in our experiment, future work should seek to examine longer time periods.

A final concern is that we do not know whether workers actually looked at the feedback. In our discussion with the managers at Shinsei Bank, we learned that employees regarded the feedback as important and did in fact look at it, but we do not have specific data capturing whether this was in fact the case. The null hypothesis research testing approach indicates that employees in the negative feedback condition did change their performance in significant ways. This suggests that the reported results may be a lower bound. Nevertheless, future work should explore whether employees examine feedback when they receive it on a regular basis, and how this may alter their performance.

Conclusion

One key managerial challenge in today's organizations is to sustain workers' motivation and performance across time, even when workers' jobs are repetitive in nature. In this paper, we examined one possible strategy to improve employees' productivity: providing performance feedback. Using a field experiment at a Japanese bank, we investigated the differential effects of both positive and negative feedback on workers' productivity and how these effects vary over time when feedback is persistently

positive or negative. We also distinguished between direct feedback (e.g., a worker learns she is in the bottom or top 10 of her group in terms of performance) and indirect feedback (e.g., the worker learns she is not in the bottom or top 10 of her group). We found that direct negative feedback leads to improvement in employees' performance over time, while direct positive feedback has no significant effect on performance. Furthermore, we demonstrated that indirect negative feedback worsens productivity, while indirect positive feedback has no significant effect on performance. Finally, we found that both persistently positive and persistently negative feedback lead to improvements in workers' performance. Together, our findings suggest new ways to improve performance through the effective use of information about workers' behavior.

Tables

Table 1. Summary Statistics (n = 480,082).

Variable	Mean	σ	1	2	3	4	5	6	7	8	9	10	11	12
1. Log completion time	3.132	1.331												
2. July	0.493	0.500	**-0.004**											
3. Fjuly	0.175	0.380	**-0.003**	**0.468**										
4. Sjuly	0.317	0.465	-0.002	**0.692**	**-0.314**									
5. Positive group	0.201	0.401	**-0.039**	**0.014**	**0.046**	**-0.022**								
6. Negative group	0.285	0.452	**0.047**	**-0.049**	**-0.045**	**-0.016**	**-0.317**							
7. Lag top ten	0.169	0.375	**0.077**	**0.458**	**0.156**	**0.364**	**-0.040**	0.001						
8. Lag bottom ten	0.217	0.412	**-0.081**	**0.534**	**0.267**	**0.356**	**0.127**	**-0.070**	**-0.237**					
9. Persistently good (pg)	0.098	0.297	**0.145**	**-0.035**	**-0.051**	**0.004**	**-0.074**	**0.185**	**0.329**	**-0.227**				
10. Persistently bad (pb)	0.135	0.342	**-0.114**	**0.048**	**0.028**	**0.029**	**-0.254**	**0.133**	**-0.191**	**0.281**	**-0.268**			
11. Second half of day	0.611	0.488	**0.016**	**-0.024**	**-0.004**	**-0.023**	**-0.032**	0.001	**-0.015**	**-0.027**	**0.003**	-0.002		
12. Cumulative volume	5,066.3	3,871.3	**-0.176**	**0.667**	**0.142**	**0.601**	**0.050**	**-0.047**	**0.249**	**0.428**	**-0.155**	**0.079**	**-0.011**	
13. Variety	0.337	0.406	**0.225**	**0.217**	**0.015**	**0.221**	**0.008**	**0.033**	**0.094**	**0.108**	**-0.003**	**-0.031**	0.002	**0.217**

Note. Bold denotes significance of less than 5%.

Table 2. Regression results on completion time of feedback variables (*n* =480,082).

	(1)	(2)	(3)
July	0.07937	0.09394*	0.09336*
	(0.05058)	(0.04664)	(0.04126)
July × positive group	-0.002612	0.06327	0.06379
	(0.06275)	(0.09081)	(0.1293)
July × negative group	-0.01468	-0.02870	-0.02828
	(0.06292)	(0.03949)	(0.05858)
July × positive × lag top ten		-0.1492	-0.1494
		(0.1869)	(0.2207)
July × negative × lag top ten		0.1710*	0.1713***
		(0.08042)	(0.04336)
July × positive × lag bottom ten		-0.04484	-0.04514
		(0.1156)	(0.1121)
July × negative × lag bottom ten		-0.1356**	-0.1362**
		(0.04930)	(0.04449)
Lag top ten		-0.04163	-0.04183
		(0.04830)	(0.03350)
Lag bottom ten		0.005628	0.005810
		(0.03665)	(0.02875)
Cumulative volume	-2.148e-05	-2.120e-05	-2.115e-05*
	(1.167e-05)	(1.233e-05)	(8.898e-06)
Variety	-0.5389***	-0.5047***	-0.5040***
	(0.1087)	(0.1284)	(0.1009)
Variety^2	0.5581***	0.5179**	0.5185***
	(0.1493)	(0.1631)	(0.1144)
Second Half of Day	0.07986**	0.07802***	0.07802***
	(0.02944)	(0.01478)	(0.02355)
Error			0.04478
			(0.04586)
Constant	2.4891**	2.4302**	2.4281***
	(0.8379)	(0.8109)	(0.7101)
Observations	480,082	480,082	480,082
Number of Individuals	71	71	71
R-Squared	0.6072	0.6128	0.6127

Notes. *, ** and *** denote signficance at the 5%, 1% and 0.1% levels, respectively. Models are fixed-effects, OLS regression regression models with block bootstrapped standard errors. All models include, but results are not shown for the indicators for stage and worker.

Table 3. Regressions to examine persistence of rankings (*n*=480,082).

	Dependent Variable: Log Completion Time	
	(1)	(2)
Fjuly	0.08811**	0.1100***
	(0.03175)	(0.02888)
Sjuly	0.06149	0.07998
	(0.03614)	(0.04200)
SJuly × positive group	0.04387	0.04751
	(0.06145)	(0.09770)
SJuly × negative group	0.008576	0.01801
	(0.03553)	(0.04057)
Sjuly × positive × pg	-0.2415***	-0.2371***
	(0.03757)	(0.06783)
Sjuly × negative × pg	0.1107	0.09819
	(0.06908)	(0.06700)
Sjuly × positive × pb	0.08052	-0.05672
	(0.06731)	(0.1592)
Sjuly × negative × pb	-0.3068**	-0.3093*
	(0.1162)	(0.1217)
Sjuly × pg	0.05121	0.06454
	(0.04693)	(0.07470)
Sjuly × pb	0.1201**	0.09305*
	(0.03655)	(0.04098)
Cumulative volume	-2.439e-05*	-2.432e-05***
	(1.108e-05)	(3.274e-06)
Variety	-0.5470**	-0.5123**
	(0.1786)	(0.1692)
Variety^2	0.5544*	0.5263*
	(0.2609)	(0.2177)
Second Half of Day	0.07953***	0.08055*
	(0.02234)	(0.03363)
Error		0.04383
		(0.02845)
Constant	2.4312*	2.4706***
	(1.0001)	(0.6881)
Observations	480,082	480,082
Number of Individuals	71	71
R-Squared	0.6133	0.6123

Notes. *, ** and *** denote signficance at the 5%, 1% and 0.1% levels, respectively. Models are fixed-effects, OLS regression regression models with block bootstrapped standard errors. All models include, but results are not shown for the indicators for stage and worker.

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