# WORKPLACE KNOWLEDGE FLOWS*

Jason J. Sandvik
Richard E. Saouma
Nathan T. Seegert
Christopher T. Stanton

We conducted a field experiment in a sales firm to test whether improving knowledge flows between coworkers affects productivity. Our design allows us to compare different management practices and to isolate whether frictions to knowledge transmission primarily reside with knowledge seekers, knowledge providers, or both. We find large productivity gains from treatments that reduced frictions for knowledge seekers. Workers who were encouraged to seek advice from a randomly chosen partner during structured meetings had average sales gains exceeding 15%. These effects lasted at least 20 weeks after the experiment ended. Treatments intended to change knowledge providers' willingness to share information, in the form of incentives tied to partners' joint output, led to positive—but transitory—sales gains. Directing coworkers to share knowledge raised average productivity and reduced output dispersion between workers, highlighting the role that management practices play in generating spillovers inside the firm. *JEL* Codes: D8, J3, L2, M5.

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# I. Introduction

The best workers in many firms substantially outperform others (Lazear, 2000; Bandiera, Barankay, and Rasul, 2007; Mas and Moretti, 2009; Lazear, Shaw, and Stanton, 2015; Lo et al., 2016). Is this due to variation in natural abilities, or differences in knowledge about how to perform a job? To the extent that knowledge differences matter, what slows the diffusion of knowledge among coworkers? The literature on peer effects suggests that spillovers operate powerfully inside firms (Mas and Moretti, 2009; Bandiera, Barankay, and Rasul, 2010), but the conditions for knowledge spillovers and the management practices that facilitate them are less clear.[1] Few controlled experiments assess knowledge spillovers under different management practices, and observational approaches can be challenging due to omitted variable bias (Manski, 1993; Glaeser, Sacerdote, and Scheinkman, 2003; Guryan, Kroft, and Notowidigdo, 2009). To overcome these challenges, we worked with a sales firm to conduct a field experiment.

The experiment occurred in an inbound sales call center where workers ("agents" in the firm's terminology) sell television, phone, and internet services to customers calling from across the United States. Calls are allocated to agents randomly, meaning that everyone within a division faces the same distribution of sales opportunities, and agent compensation depends on individual performance. Using the firm's focal performance measure, revenue-per-call (RPC), sales productivity across agents varied dramatically prior to the experiment. Those at the 75th percentile of the distribution brought in approximately 48% more revenue on a given call than those at the 25th percentile, even after adjusting for sampling variation. Manager interviews and agent surveys cite varying knowledge of sales techniques as contributing to this dispersion, consistent with the importance of task-specific human capital (Gibbons and Waldman, 2004). For example, the most successful agents understand when and how to ask about customer needs; they know which products to bundle; they incorporate add-ons that increase revenue; and they redirect callers to feasible alternatives whenever they fail to qualify for specific products or promotions.

What limits the diffusion of this knowledge between coworkers? Knowledge seekers may face initiation costs that prevent them from gathering information. These costs may include social concerns (e.g., reluctance to approach unfamiliar coworkers or a fear of signaling incompetence (Edmondson and Lei, 2014; Chandrasekhar, Golub, and Yang, 2016)), coordination difficulties (e.g., setting up meetings), and search frictions (e.g., knowing whom to ask (Boudreau et al., 2017)). On the other hand, knowledge providers may lack the incentive to share knowledge, due to contracting costs. In many sales firms, including this one, a portion of compensation depends on (coarse) performance relative to other employees, potentially increasing the opportunity costs of helping others. Contracting costs limit the ability of knowledge seekers to sufficiently compensate knowledge providers for exchanging information, consistent with frictions in many models of person-to-person knowledge transfer (Morrison and Wilhelm Jr., 2004; Garicano and Rayo, 2017; Fudenberg and Rayo, 2017).[2]

The experiment was designed to assess the effectiveness of management practices that target initiation costs, contracting costs, and the combination of both. In the firm's two main offices, 653 agents were assigned to four treatment cells using a clustered design based on the identity of their sales manager. Treatments

1. Spillovers have been shown to drive productivity growth (Marshall, 1890; Jacobs, 1969; Romer, 1990; Barro, 1991; Glaeser et al., 1992), and there is a long history of work connecting the transfer of knowledge to physical proximity.

2. Relatedly, Becker (1962) discusses the contracting costs associated with a firm that shares knowledge with employees. Specifically, trainees disproportionately benefit in the long run, while firms pay an upfront cost, leading to an under-provision of general skills training in firms.

occurred during a four-week period, labeled the intervention period. At the onset, agents were all paired with a randomly assigned partner from the same treatment, with some pairs rotating to new partners at the beginning of each subsequent week. Agents in the Internal Control group were paired and had their joint revenue-per-call gains (relative to the two weeks prior to the intervention period) displayed publicly, but they were given no additional incentives or instructions to take further actions, making them "passive pairs." Three "active" treatments added additional layers on top of the partner pairings. The first active treatment, labeled Structured-Meetings, targeted initiation costs by encouraging worker-pairs to meet early in the week. Worksheets guided these agents to reflect on their own sales strengths and challenges and to seek and record advice from their partner.[3] Pairs completing worksheets were encouraged to meet again over a catered lunch near the end of the week. The second active treatment, labeled Pair-Incentives, targeted contracting costs by providing paired agents with explicit incentives to increase their joint revenue-per-call. The third active treatment, labeled Combined, included all elements of both the Structured-Meetings and Pair-Incentives treatments. An additional 83 salespeople, located in a third office, 600 miles away from the two main offices, provided an External Control group that was unaware of the experiment.

We estimate how the treatments affect output using four weeks of pre-intervention data, the four-week intervention period itself, and 20 additional weeks of data after the interventions ended. Data from the post-intervention period allows us to distinguish between short-term effort changes and long-term sales gains due to knowledge acquisition from peers.

We find that certain management practices that encourage knowledge sharing between coworkers can raise long-term productivity. The Structured-Meetings treatment was particularly effective, suggesting the constraint on knowledge flows is initiation costs on the part of knowledge seekers, as opposed to knowledge providers' lack of willingness to help. The following results are identified by the experiment.

1. Relative to both the Internal Control and External Control groups, the Structured-Meetings treatment yielded a 24% increase in revenue-per-call during the four-week intervention period, compared to a 13% increase in the Pair-Incentives treatment. Net revenue gains significantly exceeded implementation costs for both treatments.
2. Revenue-per-call gains in the Combined treatment were similar to those of the Structured-Meetings treatment during the intervention period.
3. Treatments targeting initiation costs induced knowledge transfers between peers, while treatments targeting contracting costs alone did not.
   (a) The Structured-Meetings and Combined treatments yielded persistent performance increases through the post-intervention period. Twenty weeks after the interventions formally ended, average sales in the Structured-Meetings and Combined treatments remained between 18% and 21% higher than their expected level in the absence of the interventions.
   (b) Agents in the Pair-Incentives treatment had post-intervention average sales changes that were statistically indistinguishable from either control group, pointing to effort changes, rather than knowledge acquisition, as the source of gains during the four-week intervention period.
   (c) Agents in the Structured-Meetings and Combined treatments performed better across the intervention and post-intervention periods when paired with high-performers—agents with above median sales

3. One side of the worksheet asked agents to reflect on their performance that week (e.g., their most difficult call and how, in hindsight, it could have been improved). The other side had agents solicit the same responses from their partner and then asked them to write down the advice they received.

prior to the intervention. The largest gains occurred for low-performers who were paired with high-performers. High-performers' own sales improved when paired with other high-performers, while their sales remained stable when paired with low-performers. These heterogeneous effects by partner ability distinguish knowledge transfers from explanations around each agent solving his or her own problems through self-reflection or agents increasing effort due to an improved work environment.

(d) Productivity dispersion fell in the Structured-Meetings and Combined treatments, largely due to the increased performance of agents in the lower tail of the performance distribution.

4. Results are similar for every sales measure tracked by the firm, including revenue-per-hour (RPH) and total revenue-per-week. The Structured-Meetings protocol did not detract from agents' ability to answer calls.
5. Although sales and call center jobs have high baseline turnover rates, the sales increases are not due to retention differences across treatments.

Content from participants' worksheet entries, survey responses, and interviews further support knowledge flows as the mechanism behind the persistent sales gains observed in the Structured-Meetings and Combined treatment groups. These sources indicate that the Structured-Meetings and Combined treatments induced partners to share knowledge, while the Pair-Incentives treatment did not. Furthermore, management believed that knowledge sharing occurred during the intervention period and continued afterward.

Over 80% of the worksheets used to document what transpired between partners in the Structured-Meetings and Combined treatments contain examples of contextual knowledge on improving sales. Partners' suggestions on these worksheets included new content to use when pitching service bundles, strategies to handle difficulties with customer credit checks (which occur for sales involving hardware installations), and tactics to offer selective discounts. Other worksheets contained only supportive statements, like "stay positive" or "be confident," rather than knowledge. In regressions of sales performance on measures of different worksheet content, agents with recorded knowledge on their worksheets had the largest persistent sales gains.

We infer that initiation costs, rather than contracting costs, most constrain workplace knowledge flows because agents in the Structured-Meetings treatment had similar long-term gains to those in the Combined treatment. Several additional results provide insight into what types of initiation costs are most likely in this setting. Survey evidence suggests search costs are relatively unimportant because agents report that: (1) they can identify high-performers and (2) they believe help from high-performers would improve their sales and, consequently, their compensation. We also find that sales changes are similar for agents regardless of their proximity to—and hence likely familiarity with—their assigned partner, which is inconsistent with search costs. In contrast, interview evidence is consistent with social costs limiting knowledge flows. For example, one interviewee said an "intimidation factor" had previously prevented her from asking coworkers for help, and that the structured meetings had given her an excuse to talk to one of the best sales agents in the company. The worksheet prompts and the Structured-Meetings protocol may have enabled agents to ask others for help (Edmondson, 1999; Edmondson and Lei, 2014). While the research design cannot pinpoint the exact form of social costs, these pieces of evidence suggest that lowering these costs likely had a substantial effect on performance.

By reducing initiation costs, the Structured-Meetings and Combined treatments increased individual workers' weekly earnings by $35 to $43 per week and firm revenues by $580 to $720 per agent-week during the intervention period. Given these effect sizes, one may question why the practices were not attempted earlier. First, the outcomes were not obvious to management (nor to the authors). In planning conversations,

sales team leaders believed that joint incentives would drive knowledge sharing and revenue. Such beliefs are consistent with several studies on the efficacy of group incentives (Friebel et al., 2017; Englmaier et al., 2018). Human resource managers, instead, believed that a more directed approach was needed to encourage peer spillovers. Second, experimentation was necessary to uncover these findings (Carpenter, Harrison, and List, 2005), and controlled experiments had not been attempted within this firm. Based on the outcome of the experiment, the firm's management has augmented its traditional onboarding with a process that closely follows the Structured-Meetings protocol.

Our work links the literature on management practices with the determinants of "social learning" (Conley and Udry, 2010; Bloom and Van Reenen, 2011; Hanna, Mullainathan, and Schwartzstein, 2014; Bloom, Sadun, and Van Reenen, 2016; Bloom et al., 2017). Specifically, we demonstrate that organizational policies may overcome widespread social costs that have been shown to limit the diffusion of information (Bursztyn and Jensen, 2017). These results have obvious connections to the substantial literature on peer effects and mentoring in the workplace (Lyle and Smith, 2014; Lazear, Shaw, and Stanton, 2015) while also relating to the challenges of implementing practices that facilitate peer spillovers (Carrell, Sacerdote, and West, 2013; Garlick, 2014).[4]

Our findings show that individuals stand to gain significantly from talking about productivity limitations with coworkers, but they often fail to do so because of frictions preventing them from seeking help. Similar frictions are likely important in many settings, and the gains from understanding and addressing them have the potential to be quite large (Battiston, Blanes i Vidal, and Kirchmaier, 2017; Catalini, 2017; Cai and Szeidl, 2017; Hasan and Koning, 2017; Boudreau et al., 2017). For organizations, these results may help explain the relatively limited takeup of remote hiring or other forms of alternative work arrangements (Katz and Krueger, 2019), as spillovers from coworkers are important, even for individual work.

We conclude that management practices within firms are important levers for unlocking individual interactions, the benefits of which have been documented in cities and other contexts. Specifically, we provide micro-level empirical evidence of the macro-level benefits from knowledge spillovers first described by Marshall (1890). Furthermore, our within-firm analysis adds to a growing literature that considers agglomeration benefits at different scales and distances (Charlot and Duranton, 2004, 2006; Arzaghi and Henderson, 2008; Liu, Rosenthal, and Strange, 2018). Rosenthal and Strange (2019) provide both an overview of what we know about agglomeration benefits at different scales and motivation for more research, like ours, to unpack the mechanisms for agglomeration benefits at the micro-level.

# II. Experimental Setting

## *II.A. The Study Firm, Performance Metrics, and Agent Compensation*

The experiment occurred in an inbound-sales call center from July to August of 2017, with data collection continuing after the conclusion of the interventions. At the time of the experiment, the firm employed over 730 salespeople in three geographically separate offices. The two offices involved in the experiment are within

4. Most of the literature on peer effects largely focuses on settings with significant group-level components, including effort externalities (Mas and Moretti, 2009), effort complementarities (Friebel et al., 2017), internal competition (Chan, Li, and Pierce, 2014), and social spillovers associated with choosing one's coworkers (Bandiera, Barankay, and Rasul, 2005, 2013). The peer knowledge flows that we induced yielded measurable value, despite the lack of production interdependencies (workers sell autonomously in this firm).

50 miles of one another, whereas the third office, containing the External Control group, is located over 600 miles away. The firm contracts with television, phone, and internet providers to market and sell their services. Similar third-party sales arrangements are common in the United States. Sales agents are tasked with answering inbound calls from potential customers, accommodating customer needs, and explaining the benefits of premium service packages (upselling) when appropriate. The sales department contains six large divisions that were included in the experiment, along with a small number of agents (that were not part of the analysis) who operate outside of these divisions. The six large divisions can span multiple offices, are headed by one or two division presidents, and are uniquely characterized by the bundles of products, services, and brands offered for sale. Divisions themselves contain smaller teams of agents, led by a single manager. During the intervention, the average team size was 12.69 agents, with a standard deviation of 4.07.

Summary information about agent demographics, work patterns, and sales productivity is contained in Table I, column (1). The sales floor is predominately male, 68%, with an average age of 26. Agents spend, on average, about 33 hours per week logged into the phone system (about 80% of their shift time), and 87% of agents work more than 32 hours per week. Agents also participate in weekly team meetings and one-on-one discussions with their manager. Summary measures in the table capture further details about agent's work time. For example, adherence is the fraction of an agent's logged-in time either spent on calls or waiting in the queue to receive an incoming call. In a given week, the average agent takes 62 calls, approximately two calls for every hour available to answer the phone. The firm records revenue from each call, where revenue is a transfer price that approximates the firm's share of the total sale. (The remainder goes to the upstream provider.)[5]

Within a division, calls are allocated to agents based on their waiting time in the call queue. Importantly, because of this waiting time property, sales opportunities are allocated at random to agents. Calls are not routed based on customer characteristics, agent characteristics, or agent selling productivity. This allows us to use realized sales revenue to measure the effects of treatments on individual sales productivity. The firm primarily focuses on revenue-per-call to filter variation in the number of calls. The firm also shared data with us on revenue-per-hour (RPH), total calls-per-week (total calls), and total revenue-per-week (revenue). Each week, agents receive reports on their own revenue-per-call, revenue-per-hour, and how their numbers compare with the rest of their division.

Revenue metrics also enter agents' pay, which has three main components. (1) They receive an hourly wage. The base wage starts at approximately 150% of the minimum wage, with small hourly raises for every three months of tenure. Hourly wages are capped at approximately 200% of minimum wage. (2) They receive a weekly commission, where the fraction of total sales paid out to agents is a function of their relative efficiency, based on quintiles of revenue-per-call, quintiles of revenue-per-hour, and call quality, as captured by mandatory call audits each week. As reported in Table I, the average (median) sales agent earns \$217.78 (\$185.45) per week in commissions. (3) They may receive small, occasional bonuses from temporary promotional activities.

5. Upstream service providers pay the firm for every sale in accordance with pre-negotiated schedules—some of which vary with the total number of products or services sold by the firm. To insulate the sales agents from the uncertainty surrounding aggregate sales and periodic contractual negotiations, the firm posts relatively fixed "transfer prices" that form the base revenue upon which agents are paid commissions. All use of the term "revenues" in this paper refers to sales priced in accordance with the internal transfer price schedule. These transfer prices remained constant during the entire data period. Management told us the transfer prices are conservative, meaning that the actual revenue figures that the firm receives either equal or exceed the numbers used for internal tracking purposes.

We investigated how two features of the incentive environment could potentially limit knowledge flows. First, time away from the phone may result in fewer revenue-generating opportunities for an agent. However, there is usually downtime between calls, so helping others would rarely affect selling opportunities. Second, agent commission rates—that is, the fraction of their earned revenue paid out as commissions—are a weakly decreasing function of their coworkers' success. Despite this, the probability that helping a coworker would meaningfully shift one's own compensation is small.[6] Pre-experiment interviews suggested that agents are aware of the incentive structure, but they would still be willing to help others. These interviews and the experimental results suggest that agents face other constraints.

## *II.B. Training, Development Practices, and Productivity Dispersion*

When hired, agents are enrolled in a sales training class that lasts two weeks. Throughout training, they receive information largely through lectures and by listening in on other agents' calls. Trainees then spend up to four weeks in a hands-on training program, taking calls under the supervision of a temporary training manager. The temporary training manager familiarizes agents with the process of selling and educates them on the services being sold. Once trainees reach a threshold level of revenues, they graduate to a permanent team on the sales floor. Agents who fail to reach the threshold level of performance within a designated number of weeks are usually let go. For agents on regular teams, surveys indicate that their primary point of contact for guidance or solving problems is their direct sales manager.

There is substantial dispersion in sales productivity among the agents. Using data from the eight weeks preceding the interventions, Figure I displays the overall dispersion in log revenue-per-call for agents in the firm's two main offices. We decompose this variation to extract agent fixed effects, representing expected productivity differences across workers, after removing time-by-division fixed effects. As shown in the density plot labeled "Agent Fixed Effects" in Figure I, these agent fixed effects have substantial variability.[7] The interquartile range of log revenue-per-call due to agent effects is 0.39, meaning that, on a random call, an agent at the 75th percentile of the fixed effects distribution generates about 48% more expected revenue than an agent at the 25th percentile. The agent fixed effects capture baseline knowledge differences and gains from job-specific experience. However, tenure differences alone do not explain the wide variation in agent performance. While highly tenured agents are more productive on average, their performance also exhibits substantial variability: the interquartile range of log revenue-per-call fixed effects for agents with above median tenure is also 0.39.

This variation motivates exploration of whether practices that encourage agents to exchange knowledge alter the mean and variance of the distribution of sales productivity. Agents themselves point to knowledge-based explanations for differences in performance. When surveyed about the determinants of top sellers' success: 32% of agents credit top sellers' superior ability to determine and respond to customers' needs,

6. Commission rates are bucketed into coarse categories that depend on relative performance on revenue-per-call and revenue-per-hour. In interviews, agents describe their commission rate category as relatively fixed, reflecting that the likelihood that helping others influences one's own compensation is very small. Changing one's own compensation through helping others requires the agent providing assistance to be at the precipice of the performance threshold. In particular, helping another agent must either: (1) sufficiently detract from one's own work such that performance falls from one quintile to another, or (2) deliver so much value to one's partner that the latter leapfrogs the former and simultaneously bumps the focal agent into the lower performance quintile. In all cases, the agent's take-home pay will drop by less than 10%.

7. We shrink the fixed effects to reduce the influence of sampling error using the procedure of Lazear, Shaw, and Stanton (2015).

29% believe the most important factor is a better sales process—knowing when to suggest products, how to overcome objections, and how to use the computer system to support the sale, and another 29% cite superior product knowledge as the reason for top sellers' success.

# III. Experimental Design

We develop an illustrative model in Appendix A, in which agents combine effort and knowledge to generate revenue. (All appendices are contained in the Online Appendix). The model allows for knowledge to flow freely between paired agents, provided the two have made sufficiently large, relationship-specific investments. Hindering such flows are initiation and contracting costs, though the magnitude of these costs and who bears them are empirical questions that the experimental design seeks to uncover.

All agents in the six largest sales divisions working in the firm's two largest offices were eligible for treatment, resulting in 653 workers assigned to a treatment cell. Agents in the third location, 83, were not eligible for assignment to a treatment group, constituting a hold out External Control group. Agents at the third location (600 miles away) were unaware of the experiment, as there is minimal interaction between workers in different offices. The design was pre-registered before treatments began.[8]

All agents who were assigned to a treatment cell experienced four common changes associated with the experiment. First, agents were told, via posters around the office and announcements from support personnel, that the company was partnering with university researchers to study pairing agents together in a "Sales Sprint" that would last four weeks. Agents were directed to view a website for more information. (The text of the website is displayed in Appendix B.) Second, each agent was paired with a single, randomly chosen partner from his or her own treatment group, division, and office. Partner identities were announced at the beginning of the week. Half of the agents were assigned to rotate partners weekly, but whether an agent would rotate or remain in a fixed pairing was not announced ex-ante. On Day 1 of Week 2, new partner pairings were announced.[9] (Repeat assignments were permitted for rotating agents). Third, agents were notified that their own and their partners' individual sales data was being shared with the university team. Fourth, all pairs had their joint performance scores published daily on TV monitors and on the firm's internal messaging platform. These joint performance scores normalized the percentage change (relative to a base of 100) in the pair's average revenue-per-call, relative to their total revenue-per-call in the two weeks immediately preceding the interventions.

Beyond these components common across all treatment-eligible agents, we term three treatment cells "active." Each active treatment was designed to target different sets of knowledge transfer frictions: initiation costs, contracting costs, or both. In particular, the Structured-Meetings treatment targeted the initiation costs facing knowledge seekers, the Pair-Incentives treatment targeted knowledge providers' potential contracting costs, and the Combined treatment explored whether both frictions jointly limit knowledge transfers.

8. The RCT registry number is AEARCTR-0002332. The IRB approval at the University of Utah is IRB 00098156. Appendix B provides additional detail about minor differences between the pre-registration sample size and the final numbers reported in the text.

9. Some pairs were dissolved when one or both agents left the sample (e.g., termination of employment, taking a leave of absence, etc.); the partners of these departing agents were paired with a new, randomly chosen partner.

## *III.A. Structured-Meetings Treatment*

The Structured-Meetings treatment was designed to test the hypothesis that encouraging agents to seek help from their partners would result in knowledge exchange. Agents in the treatment were prompted to talk through issues holding back their sales and to seek advice from their assigned partners. To facilitate these conversations, agents were encouraged to complete the following tasks: (1) fill out an individual self-reflective worksheet to prompt discussion prior to meeting with their partner; (2) converse with their partner and record their partner's feedback on the self-reflective responses and any advice received on their own worksheet; and (3) return completed worksheets to management by Wednesday of each week. Points of emphasis on the worksheets were sourced/designed in collaboration with the firm's leadership. Documentation of the worksheet and other instructions can be found in Appendix B. Completion of these tasks was optional, but agents largely complied. Over 80% of the agents completed the worksheets used to direct conversations with their partner (see Appendix Table A.1). Those who turned in the worksheets could receive a free catered lunch on Wednesday or Thursday of the same week. During this lunch, agent-pairs were provided with local sandwiches (costing approximately $7 each) and were prompted to discuss several additional talking points related to their prior interactions, though these conversations were not recorded or documented formally.

While the meetings between agents did not have fixed content (like a training manual) and were largely self-guided, agents were provided with directions to meet with their partners and focus their conversations on recent sales calls. In this way, the Structured-Meetings treatment directly targeted initiation costs via nontrivial managerial practices, namely: creating the worksheets prompting specific conversations, formally asking workers to discuss their calls in a structured way, and rewarding participants with sponsored lunches.

## *III.B. Pair-Incentives Treatment*

The Pair-Incentives treatment was designed to provide evidence on two hypotheses. The first hypothesis is that incentives for knowledge providers would be necessary for them to share information. The second hypothesis is that explicit, joint output incentives would suffice for partners to organize and exchange knowledge. Agent-pairs in the Pair-Incentives treatment could earn rewards for increasing their joint production. Specifically, at the end of each week, agent-pairs were bracketed with two other randomly chosen pairs, and the pair with the highest percentage increase in joint revenue-per-call was awarded the weekly prize. To prevent agents from feeling discouraged or adjusting their effort based on the real-time performance of a known set of other agent-pairs, no one was told which other pairs they would be competing against until a random drawing occurred at the end of each week (see Appendix B). Basing the reward probability on percentage increases of revenue-per-call relative to baseline performance was intended to prevent feelings of being disadvantaged if an agent was paired with a less productive partner. To increase the salience and immediacy of the incentive, management suggested using prizes, such as golf vouchers, onsite massages, and tickets to activities—with delivery of the prize to each partner at the end of every week. The cash-equivalent of each prize was approximately $50. In surveys, agents reported an average valuation for the prizes of $40, which equates to an 18% (22%) increase in weekly commission pay for the average (median) agent, or equivalently, approximately 8% of the median agent's total take-home pay. Earlier work documents that smaller, team-based incentives generate meaningful productivity increases, albeit in a setting with worker interdependence in production (Friebel et al., 2017).

While agents in the Pair-Incentives treatment were not given a protocol to transfer knowledge with their partners, they were free to do so. Nothing prevented them from engaging their partner in conversations like

those in the Structured-Meetings treatment. In fact, the website copy for all active treatments read: "We want to encourage you to talk about your calls with colleagues, and possibly meet some new people along the way" (see Appendix B). The Pair-Incentives treatment thus offers a test of whether workers with aligned incentives will self-organize to share knowledge without managerial intervention.

## *III.C. Combined Treatment*

The Combined treatment was designed to test the hypothesis that addressing both initiation costs and contracting costs would have a different joint effect than treatments addressing either initiation costs or contracting costs in isolation. Agent-pairs in the Combined treatment were given both the Structured-Meetings and Pair-Incentives treatments. Prizes were only based on comparisons with other pairs in the Combined treatment.

## *III.D. Control Groups*

Agents in the Internal Control group received the common treatments. That is, they were made aware that data was being shared with university researchers, they were assigned a partner, and their joint performance scores were publicized. Like the active treatments above, they were told that the experiment's objective was to encourage discussion of their calls with their partners; however, they were not provided with a protocol to do so, nor were they provided with incentives to boost their joint sales. When designing the experiment, we expected any response to the revelation of information about joint performance to be minimal, but the design does allow us to use the External Control group to test for performance changes resulting from information revelation (Bandiera, Barankay, and Rasul, 2013).

The External Control group, which was never exposed to the experiment, allows for a comparison against each of the three active treatments and the Internal Control group. If Hawthorne effects or responses to new information were important, we would expect performance in the Internal Control group to diverge from the External Control group.

## *III.E. Treatment Assignment and Implementation Details*

Figure II illustrates the allocation of agents to the different treatment and control groups. Agents were assigned to treatments based on the identity of their sales manager. The 653 agents in the two offices with active treatments were managed by 52 distinct sales managers during the intervention period (i.e., the four weeks when the treatments were in place). Among these managers, 13 were randomly designated to the Internal Control, along with their 186 sales agents. Similarly, 13 managers (158 agents) were allocated to the Structured-Meetings treatment, 12 managers (135 agents) were allocated to the Pair-Incentives treatment, and 14 managers (174 agents) were allocated to the Combined treatment. Across the treatment-eligible agents, the probability that an agent was assigned a partner reporting to his or her own manager was 0.40 each week, which ranged from 0.36 in the Pair-Incentives treatment to 0.47 in the Combined treatment. The External Control group in the distant office contained 83 agents supervised by six managers. As part of the design, movement between managers was restricted during the intervention period, and no agents switched managers during these four weeks.[10]

10. Agents typically switch managers on average between one to two times per year. After the intervention period, there was some reallocation of agents to other managers. Ninety-six agents had a different manager

Table I splits demographics and performance information by treatment assignment. The agents in the three active treatment groups and the Internal Control group do not differ based on pre-intervention sales productivity or demographic characteristics. That is, treatment assignment is balanced across observables for treatment-eligible agents. P-values of randomization tests of mean differences in the Internal Control and active treatment groups are reported in the last column.[11] Although the External Control group had lower average sales per agent, sales trends in the External Control tracked those in the Internal Control and the three active treatments prior to the experiment. Section IV.A. discusses parallel trends tests prior to the intervention. We also test for balance across managers in Table A.2. Across treatment arms, managers are similar in age, tenure, gender, the average sales productivity of the agents they oversee, and the number of agents on their team during the intervention period.

To communicate treatment assignment and intervention guidelines, senior executives shared the details of the appropriate treatment with sales managers and support personnel, as they would be agents' first resource if they had questions. Managers and support personnel were told that the research staff would be allocating agents to different treatments in order "to better understand and improve [agent] motivation, [agent] retention, and ultimately, [agent] satisfaction." Staff were told to communicate this to agents, if asked. When agents arrived at the website detailing their treatment, they were provided with a specific login key such that agents could only review the details of their own assigned treatment. Email and phone hotlines were established to answer questions that were not directed to sales managers. Finally, a subset of the authors were on-site at least three days a week during the intervention period. Appendix B provides details about the sequence of steps used to implement the intervention.

# IV. Results Identified by the Experiment

This section presents evidence on treatment effects during the four weeks with active interventions and then analyzes the persistence of these effects in the post-intervention period. Figure III shows average revenue-per-call gains during the intervention period in all three active treatment groups. Beginning with a normalized baseline of $61 over the pre-intervention period, revenue-per-call increased by $11 for agents in the Pair-Incentives treatment, whereas the Structured-Meetings and Combined treatments yielded a revenue-per-call increase of approximately $15 relative to the pre-intervention mean. Revenue-per-call did not change for agents in the Internal and External control groups. Figure IV shows revenue-per-call by week for each treatment group. Positive effects were present for all three active treatments in week one (the first week of the intervention) and remained positive for the rest of the intervention period. Beyond week four, when interventions ended, revenue-per-call remained elevated for agents in the Structured-Meetings and Combined treatments. In contrast, average revenue-per-call immediately collapsed to the control mean for agents in the Pair-Incentives treatment.

The sales increases during the intervention period were likely achieved through different channels. If knowledge was exchanged, then any associated productivity gains should persist. The experiment was intentionally designed to measure such persistence in the post-intervention period. Agents in the Structured-

during at least one week between weeks 5 and 10 (the six weeks following intervention), and 277 agents were observed with a different manager during at least one week in the 20 weeks following the interventions.

11. These tests are computed from a regression of the variable of interest on treatment-assignment dummies after clustering standard errors by manager (the level of assignment). P-values are for the joint test on these treatment-assignment dummies.

Meetings and Combined treatments had persistent sales gains that likely resulted from applying newly acquired knowledge on their calls. Supporting this interpretation, we show that treatment effects are largest where knowledge exchange is most likely: for agents paired with high-performing partners and agents who document contextual knowledge on their worksheets. The Pair-Incentives treatment, on the other hand, induced only transitory sales gains, consistent with temporary increases in effort.

## *IV.A. Estimation and Inference with Difference-in-Differences*

Our empirical strategy uses difference-in-differences, which 1) enables comparisons relative to the External Control, an office with lower levels of pre-experiment sales productivity than the treatment-eligible agents, and 2) increases power for analysis of heterogeneous responses by reducing the influence of between-subject or between-manager variability. Figure IV provides support for this approach by showing similar pre-intervention trends across groups.[12] The main estimating equation is:

$$
\begin{aligned}
(1) \qquad \mathrm{Y}_{it} =& \beta_0 + \beta_1 \text{Structured-Meetings}_i \text{ x } \mathrm{T}_t + \beta_2 \text{Pair-Incentives}_i \text{ x } \mathrm{T}_t \\
&+ \beta_3 \text{Combined}_i \text{ x } \mathrm{T}_t + \beta_4 \text{Internal-Control}_i \text{ x } \mathrm{T}_t + \lambda_t + \theta_g + \varepsilon_{i,t},
\end{aligned}
$$

where $Y_{i,t}$ is a dependent variable of interest, $i$ represents an agent, $t$ represents a week, $g$ represents a sales manager group, $\lambda_t$ and $\theta_g$ are week and sales manager fixed effects, respectively, and $\varepsilon_{i,t}$ is an idiosyncratic error term. The indicator $\mathrm{T}_t$ is a placeholder for either the intervention period or the post-intervention period, indicating that interventions were either occurring or had occurred in the past. For example, when the sample includes the pre-intervention period (weeks -3 to 0) and the intervention period (weeks 1 to 4), the variable Structured-Meetings$_i$ x $\mathrm{T}_t$ is set to one during weeks 1 to 4 for those agents randomly assigned to the Structured-Meetings treatment and to zero otherwise. When the sample consists of the pre-intervention period and the post-intervention period (weeks 5 to 24), the variable Structured-Meetings$_i$ x $\mathrm{T}_t$ is set to one during weeks 5 to 24. The level effects of each treatment are subsumed by the sales manager fixed effects because all agents under a sales manager are assigned to the same treatment. Week fixed effects remove common time shocks that affect all workers.

Standard errors are clustered at the manager level, the unit of treatment assignment. We also use randomization inference to compute exact p-values for the null of no treatment effects, as described by Young (2018). Subsequent tables present p-values of joint hypothesis tests of no significant treatment effects after accounting for clustered treatment assignment by manager and re-randomizing treatments across managers.

## *IV.B. Treatment Effects During the Intervention Period*

The first four columns of Table II present treatment effects for log revenue-per-call during the intervention period.[13] For this analysis, the sample contains the four weeks of data in the pre-intervention period and the four weeks of data during the intervention period. Consistent with the graphical evidence, the active

12. To formally test for pre-trend differences, we interact time indicators and treatment indicators in the pre-intervention period. We test for pre-trends using both four and eight weeks of pre-intervention data. After regressing log revenue-per-call on these time-by-treatment indicators in the pre-intervention period, we fail to reject that any are statistically different from zero at the 10% level (the smallest p-value is 0.48).

13. We focus on log revenue-per-call and total revenue to ease interpretation, but the results are not sensitive to the choice of performance measure, as we report in Appendix Table A.3.

treatments resulted in large, statistically significant increases in sales. Point estimates on log revenue-per-call range from 0.22 to 0.25 for the Structured-Meetings treatment. While group incentives did increase individual output, the Pair-Incentives point estimates are smaller than those for the Structured-Meetings treatment, and range between 0.13 and 0.14. Wald tests at the bottom of the table reject equality of sales gains in the Structured-Meetings and Pair-Incentives treatments.[14] Agent satiation or discouragement after failing to win a prize has minimal influence on the week-to-week variation in the Pair-Incentives treatment. (See Table A.4 in the Appendix).

Treatment effects for the Combined group are very similar to those for agents with Structured-Meetings alone, indicating that the additional benefit of addressing contracting costs in addition to initiation costs was relatively small. Randomization tests reject the joint null of no treatment effects for the three active treatments at the 1% level in all columns. In the final row, most specifications reject the hypothesis that the Combined treatment effect is greater than the sum of the individual Structured-Meetings and Pair-Incentives effects. That the incremental effect of adding the Pair-Incentives in addition to Structured-Meetings is smaller than the baseline effect of Pair-Incentives alone may indicate crowding out of monetary incentives (Frey and Oberholzer-Gee, 1997; Bénabou and Tirole, 2006; Gneezy, Meier, and Rey-Biel, 2011; Ederer and Manso, 2013), or reduced salience when incentives are presented in conjunction with instructions to change other behavior.

The results are stable across different control groups. The specification in column (1) is relative to the Internal Control (so $\beta_4$ in equation (1) is omitted); column (2) replaces the Internal Control group with the External Control as the baseline. Columns (3) and (4) add back the Internal Control. Estimates change little across columns. Agents in the Internal Control group were aware of the experiment (see Appendix Table A.1, Panel B), had an assigned partner, and had publicized joint sales information, but they did not change their sales, relative to the (off-site) External Control group that was unaware of the experiment. The sales increases in the active treatments are thus unlikely to be driven by Hawthorne effects or by the common treatments across groups. Merely displaying performance information was not sufficient to improve sales, as most agents were already aware of their place in the distribution (see Appendix Figure A.1).[15] These estimated treatment effects are robust to the inclusion of agent fixed effects in column (4), which would capture changes in the composition of the workforce.

The main results are similar when looking at total revenue, as displayed in column (5). During the intervention period, total revenue increased by $475 per agent-week in the Pair-Incentives treatment, $579 per agent-week in the Structured-Meetings treatment, and $723 per agent-week in the Combined treatment, indicating that treatments targeting revenue-per-call did not distort other margins, like hours or calls answered. The results are also not sensitive to the level of aggregation, meaning that both individual and aggregate team revenue increased. (See Appendix Table A.5 for results that aggregate to the manager level.) A final question is whether gains came at the expense of quality, a dimension that is harder to observe. Upstream brand providers perform call audits to ensure that sales agents accurately represent their products,

14. The larger gains in the Structured-Meetings treatment become apparent graphically in weeks 2 through 4 in Figure IV, as the effect of the Pair-Incentives treatment appears to decline relative to the first week. While we cannot reject a common effect across weeks 1 to 4, week-to-week revenue-per-call roughly corresponds to agents' pre-experiment reported valuations for the different prizes. The average cost of the prizes was about $50 and reported valuations each week were $46, $37, $36, and $40, respectively.

15. According to the contingency results of Blader, Gartenberg, and Prat (2019), rank displays comported with prior practices and therefore may have had minimal effects relative to what has been found in the prior literature (Bandiera, Barankay, and Rasul, 2013).

but we do not have access to that data. However, as mentioned earlier, agents' commissions include a quality multiplier based on these audited scores. With the commission data we have available, we construct a proxy for quality by considering how agents' commissions, relative to revenue, vary with treatment. In Appendix Table A.6, we find no changes in this quality proxy. In this firm, revenue metrics and service quality are closely aligned (Holmstrom and Milgrom, 1991).

These estimates provide some guidance for how output might respond when practice changes are permanent. Following Athey and Stern (1998) and Ichniowski and Shaw (2003), the final row in Table II provides a test of whether the Structured-Meetings and Pair-Incentives treatments should be implemented together. These results indicate that the Structured-Meetings and Pair-Incentives treatments are substitutes. The practices might still be jointly beneficial if the marginal benefit of adding the Pair-Incentives is greater than the costs. Using the results for log revenue-per-call on the Combined treatment, we find that it is possibly beneficial to bundle the treatments together, but the point estimates fall within the confidence interval for the Structured-Meetings effect in isolation. To understand the mechanism behind the treatment effects, we turn to their persistence in the post-intervention period.

## *IV.C. Persistence of Treatment Effects in the Post-Intervention Period*

To assess persistence of the observed sales gains, we re-estimate equation (1) using data from the four-week pre-intervention period and the post-intervention period, weeks 5 through 24. The results, reported in Table III, are consistent with Figure IV, which shows that treatments addressing initiation costs lead to persistent sales gains. During the post-intervention period, agents in the Structured-Meetings treatment had log revenue-per-call that is 0.17 to 0.21 greater than agents in either control group, representing sales gains between 18% and 23%. The Combined treatment also had positive gains in excess of 20% after interventions ended. Using randomization inference, the joint test of no persistent treatment effect for the three active treatments rejects the null at the 5% level in all columns.[16] Post-intervention sales gains for the Pair-Incentives group are statistically indistinguishable from either control group. The transitory gains in the Pair-Incentives treatment indicate temporary effort increases, while the persistent gains in the Structured-Meetings and Combined treatments are consistent with knowledge transmission between agents.

Columns (1)–(3) of Table III are analogous to the corresponding columns in Table II but instead capture effects during the post-intervention period rather than the intervention period. Comparing parameter estimates across tables indicates that about 80% of the initial sales gains in the Structured-Meetings and Combined treatments remain after interventions end. Gains remain persistent over time. Between weeks 21 through 24 after interventions ended, average log revenue-per-call in the Structured-Meetings and Combined treatments remained 0.188 and 0.211 points higher than baseline, respectively. (See Appendix Table A.8.) Figure A.2 provides extended graphical evidence through 34 weeks, showing that treatment effects remain persistent beyond the end of the sample.

We attempted to validate these estimates using "insider econometrics" approaches (Bartel, Ichniowski, and Shaw, 2004), entailing interviews with sales, operations, and HR executives. We asked about the plausibility of effect sizes and the underlying mechanisms that may be responsible. These managers reported that adopting new sales techniques or fixing regularly occurring problems would provide agents with long-term gains. Management also observed that the Structured-Meetings treatment provided a pathway for

16. The standard errors resemble those obtained when using two-way clustering by sales manager and week. (See Table A.7 in the Appendix.)

agents to continue asking questions and gaining knowledge from their partners, even after the formal meetings and lunches ceased. They believed these follow-up interactions increased the likelihood that treated agents would sustain their higher sales.

Worker sorting and retention differences do not appear to explain the long-term gains from treatment. Column (4) tests for sensitivity to agent attrition by using a balanced sample, which is restricted to those agents who are present in the intervention period and remain in the data through at least week 19.[17] The estimated effects in the balanced sample in column (4) are very similar to those in column (3). Column (5) returns to the baseline sample of all agents, adding individual worker fixed effects, and the results are similar to those with only manager fixed effects. This diagnostic, accounting for potential correlation between baseline productivity and retention, does not alter the results.[18]

A more direct examination of turnover shows that the propensity for agents to leave the sample did not change for those in the Structured-Meetings or Combined treatments, relative to those in the Pair-Incentives treatment or Internal Control group. Across the active treatments, there are no statistically significant differences in agent turnover over any horizon, ranging from 8 to 24 weeks after the beginning of the interventions. These results are in Appendix Table A.10.

Returning to Table III, column (6) contains results for total revenue in the post-intervention period. Total revenue is $817 higher than the controls in the Structured-Meetings treatment and $811 higher than the controls in the Combined treatment. The Pair-Incentives point estimate is indistinguishable from zero in the post-intervention period.

## *IV.D. Sales Changes by Partner Performance*

We leverage random agent pairings with high-performing partners to further understand the mechanism. We expect productivity gains to be largest for agents paired with high-performers if treatments induce knowledge exchange. We also expect these productivity gains to be larger for low-performers who are paired with high-performers, compared to high-performers who are paired with other high-performers.

Agents are labeled "high-performers" if their productivity is above the median in the eight weeks prior to the intervention for their division.[19] Appendix Figure A.3 provides visual evidence on these differences by plotting average revenue-per-call by treatment group and partner identity during the intervention and post-intervention periods. To estimate these effects, we interact partner quality with treatment in the following

17. The number of unique agents in the balanced sample falls to 388, reflecting that this is a high-turnover industry. Figure 1 of Hoffman, Kahn, and Li (2017) indicates that workers in similar types of service-sector jobs have a median completed tenure of about 100 days. In addition, turnover is seasonal. The experiment occurred immediately prior to a focal moving and back-to-school period, which is the highest turnover time of year for similar firms in both the local sales and call center industries.

18. A complementary exercise provides visibility into whether the gains are driven by agents who remain at the firm. Compared to the main specifications, a regression that weights by the inverse of the number of observations in the sample provides those who leave quickly with the same influence as those who remain. Results using this weighting approach in Appendix Table A.9 show similar or slightly larger point estimates for the Structured-Meetings treatment. Point estimates range from slightly smaller and less precise (while remaining significant) to somewhat larger for the Combined treatment.

19. Agents who join the firm during the intervention period are assumed to be low performers, as average revenue-per-call for these agents is significantly below the median.

equation:

$$\begin{aligned}(2) \qquad \mathrm{Y}_{it} \;=\; & \beta_0 + \sum_{j=1}^{3} \beta_j \text{Treatment}_{ij} \text{ x } \mathrm{T}_t + \sum_{j=1}^{3} \gamma_j \text{Treatment}_{ij} \text{ x } \mathrm{T}_t \text{ x High-Perf Partner}_{it} \\ & + \gamma_4 \mathrm{T}_t \text{ x High-Perf Partner}_{it} + \gamma_5 \text{Ever High-Perf Partner}_i + \lambda_t + \theta_g + \varepsilon_{i,t},\end{aligned}$$

where the variable $\mathrm{T}_t$ is again a placeholder to indicate either the intervention period or the post-intervention period. The parameters of interest are $\gamma_1$, $\gamma_2$, and $\gamma_3$, which compare how high-performing partners affect sales productivity in the three main treatments. The parameter $\gamma_4$ captures the baseline effect of having a high-performing partner for agents in the Internal Control group. This analysis omits the External Control group, as these agents did not have partner assignments. When examining the intervention period, high-performing partner is based on the concurrent identity of the partner; i.e., the *High-Perf-Partner* dummy variable is applied at the agent-week level for those agents who rotated partners each week. When examining the post-intervention period, high-performing partner is based on whether the agent was ever previously paired with a high-performer. The parameter $\gamma_5$ allows for differences in the pre-intervention period that may be correlated with the propensity to match with a high-performing partner subsequently (Guryan, Kroft, and Notowidigdo, 2009). This analysis uses revenue-per-call in levels as the dependent variable, as doing so allows for an assessment of the optimal assignment rule between high- and low-performers.[20]

Table IV shows that agents randomly paired with a high-performing partner in the Structured-Meetings and Combined treatments had larger gains in revenue-per-call than did other agents during both the intervention and post-intervention periods. Agents paired with a high-performing partner during the intervention period increased revenue-per-call by an additional \$10.89 in the Structured-Meetings treatment over the baseline Structured-Meetings treatment effect of \$11.94 (column (1)). High-performing partners in the Combined treatment raised average revenue-per-call by \$15.87 on top of the baseline treatment effect of \$7.51. Agents in the Pair-Incentives treatment did not have a statistically significant improvement on top of the baseline treatment effect of \$8.68 when they were paired with a high-performing partner. The last row of the table presents results from tests of the joint null that there are no heterogeneous effects by partner quality in the Structured-Meetings, Pair-Incentives, and Combined treatments. These tests come from wild cluster bootstrapping while imposing the null hypothesis (Roodman et al., 2019). We use this procedure as an alternative to randomization inference because the assignment of high- and low-performing partners happens at a level below the clustered unit of randomization.

The gains from being matched with a high-performing partner are largest for low-performing agents. Columns (2) and (3) split the sample depending on whether the agent is himself or herself a high-performer. Despite low-performers benefiting from active treatments even when paired with low-performing partners (the baseline estimates in column (2)), their gains are substantially larger when paired with a high-performer for some treatments. When paired with a high-performing partner, low-performing agents had additional positive gains in the Structured-Meetings and Combined treatments of \$17.25 and \$21.55, respectively. For high-performing agents (column (3)), we can reject a zero effect for the Structured-Meetings and Combined treatments only when they are partnered with another high-performer. Importantly, high-performers did not see a decrease in revenue-per-call during treatment, suggesting that their performance on calls was not

20. The analysis in logs is reported in Table A.11 in the Appendix and provides qualitatively similar conclusions.

harmed by the interventions.[21]

Column (4) of Table IV examines the persistence of high-performer effects in the post-intervention period. Most of the long-run sales increases from the Structured-Meetings and Combined treatments arise from agents who were previously paired with a high-performer. Columns (5) and (6) again split the sample based on the agent's own baseline performance, showing that persistent effects are greatest for low-performers who were paired with high-performing partners. Although having a high-performing partner benefits all agents, the larger interaction terms in columns (2) and (5) compared to columns (3) and (6) indicate that low-performers benefit most from being matched with high-performers.

These results highlight the role of initiation costs as a limiting factor to knowledge exchange and, hence, productivity growth. Worksheets in the Structured-Meetings and Combined treatments prompted individual agents to reflect on their own recent sales strengths and weaknesses before directing a similar set of questions to their partners. Neither the self-reflection nor the (potentially) improved ability to formulate or articulate requests for help can fully explain the differing treatment effects across agents matched with high-performing partners and low-performing partners. This is because agents paired with low-performers could have decided themselves to reach out for help from high-performers; i.e., absent initiation costs, there was nothing preventing agents from using the worksheets in an unofficial capacity. Section V.A. discusses what can be said about the sources of these initiation costs in more detail.

## *IV.E. Sales Dispersion in the Post-Intervention Period*

The evidence that low-performers have the largest gains from treatments suggests that the experiment reduced sales dispersion. To examine this, Figure V plots the density of log revenue-per-call in weeks 5 to 24 for the Internal Control group and for the Structured-Meetings and Combined treatments. The standard deviation of log revenue-per-call actually increases between the pre-intervention and post-intervention periods for agents in the Internal Control group, moving from 0.50 to 0.55. In contrast, the standard deviation of log revenue-per-call falls for agents in the Structured Meetings and Combined treatments from 0.49 in the pre-intervention period to 0.40 in the post-intervention period. For the Structured-Meetings and Combined treatments, Levene and Brown-Forsythe tests reject the null of equal variances in the post-intervention period against the Internal Control group, both in isolation and when the Pair-Incentives treatment is included.

A related question is how the assignment of high- and low-performing partners changed the baseline gap in revenue-per-call between high- and low-performers. Prior to the intervention, low-performers and high-performers in the Structured-Meetings and Combined treatments had average revenue-per-call of \$43.31 and \$69.74, respectively. This yields an average gap between high- and low-performers of \$26.43 in revenue-per-call. Returning to the estimates in Table IV, column (5), the sales lift to a low-performer from having a high-performing partner is \$21.55 compared to a sales lift of \$7.89 from having a low-performing partner.[22]

21. To further probe whether meetings came at the expense of sales, we also estimate equation (2), where the dependent variable is total calls per week. Table A.12 in the Appendix shows that there are no significant differences in calls answered across treatments during the intervention period. That high-performers do not change their total calls even when matched with low-performers indicates that time spent conversing with other agents did not detract from selling opportunities.

22. These numbers come from averaging the Combined and Structured-Meetings treatment effects. Having a low-performer partner yields $0.5 \times (11.56 + 4.2) = 7.89$. Having a high-performer partner yields $0.5 \times (4.20 + 19.32 + 11.56 + 19.35) - 5.66 = 21.55$. Calculations for the effect of high-performers includes the High-Performer $\times$ Post interaction, which is -5.66 (the standard error is 3.38) in column (5).

Under these estimates, assigning high-performers to low-performers closes 82% of the initial $26.43 gap in revenue-per-call, whereas pairing low-performers with each other closes 30% of the initial revenue-per-call gap. For high-performers in column (6), the sales lift from high- and low-performing partners is $7.69 and -$1.18, respectively.[23] These numbers suggest that a rule that rotates high-performers across all agents would both close performance gaps and maximize average output per agent. We focus on this rule because having one week with a high-performing partner has a similar effect on post-intervention sales as being partnered with a high-performer in all weeks. Under this rule, the gap between high- and low-performers would be $12.57 in revenue-per-call, significantly lower than the initial gap in performance absent the intervention.

# V. Additional Evidence and Discussion

This section provides additional evidence on the mechanism, considers alternative explanations, and discusses the generalizability of our findings.

## *V.A. Evidence on the Mechanism*

*Knowledge Exchange in Worksheet Content.* Agents in the Structured-Meetings and Combined treatments largely complied with the instructions to meet and fill out the worksheets, as over 80% of agents completed a worksheet every week (see Appendix Table A.1). The worksheets provide a partial record from which we can extract proxies for the content of conversations. We note that agent-pairs likely did not record everything shared in their conversations, meaning that the worksheet content is incomplete. Still, the worksheets capture instances of contextual knowledge being transferred between agents. The most relevant worksheet field was the prompt "Please write down one thing **your partner recommended you** to try." Of the 497 completed worksheets, 390 included entries to this prompt.[24]

Two clear types of responses are present. First, and most prevalent, is contextual knowledge useful for the sales process. In fact, many responses contain shorthand for a particular sequence of offers or product pitches, like "high-quality bundle 1 at $X price point, then mid-quality bundle 2 and additional product A at $Y price point," etc. Other examples include: use a pre-recorded list of questions on the computer notepad while transcribing customer responses; quote prices that include add-ons rather than giving an itemized breakdown; wait before offering discounts until the caller fully reveals their needs; quote full, higher prices first and then highlight the value of sign-up specials which may offer discounts. The second type of response consists of supportive comments and encouragement.

Two approaches were used to classify worksheet content for analysis. The first, which we label the "word presence" classification, associates key words or phrases with either (a) knowledge/advice/techniques, (b) support/encouragement, both (a) and (b), or neither (a) nor (b). In the second approach, which we label the blinded classification, we used a third-party student research assistant to categorize responses using these same categories. This student was not aware of the purpose of the work, only that we were studying whether

23. Calculations for the effect of high-performers includes the High-Performer × Post interaction, which is 1.04.

24. Fewer worksheets were collected than the reported completion rates would indicate. Worksheets were handed into sales managers and then collected by the support personnel before being returned to the authors. It is likely that some worksheets were completed but were never received.

salespeople converse with each other about knowledge to improve the sales process or provide support or encouragement.

The word presence classification scheme entailed parsing the 30 most prevalent non-stop words from the worksheet text entries and then classifying each record according to a pre-defined mapping from words to content type. Responses that do not include one of the 30 words are initially categorized as neither. Table A.13 lists these words, along with examples, and displays the response type, either knowledge or support. The word "pitch," or a response that is a dictation of an advised pitch, occurs most frequently (N = 76), followed by the words "call," "customer," and "positive." Twenty-four out of the 30 most prevalent words are attributed to conveying knowledge. This classification approach labels 282 responses as conveying knowledge alone, 60 responses as providing support alone, 26 responses as communicating both knowledge and support, and 74 responses as containing neither knowledge nor support. We augmented this approach by manually inspecting text entries in the neither category.[25] After manual classifications, more than 80% of all completed worksheets include evidence of contextual knowledge exchange between partners. The blinded classification yields slightly more entries as containing contextual knowledge alone (322, compared to 310) and fewer entries as containing support alone (78, compared to 92). Eighty-six percent of the classifications are identical.

We use this data to assess whether knowledge transfer from the worksheet content is associated with post-intervention sales performance. We interact the dummy variable *Received Knowledge*, which equals one if an agent's worksheet is classified as conveying knowledge, and zero otherwise, with an indicator for the post-intervention period. The sample is restricted to agents in the Structured-Meetings and Combined treatments for whom we have at least one worksheet. The base specification compares agents who received any knowledge to those who received only support from their partner using the following equation:

$$\begin{aligned} (3) \qquad Y_{it} &= \beta_0 + \beta_1 \text{Received Knowledge}_i \text{ x Post}_t \\ &\quad + \beta_2 \text{Received Knowledge}_i + \lambda_t + \theta_g + \varepsilon_{i,t}. \end{aligned}$$

The coefficient of 0.169 on *Received Knowledge* × *Post* in column (1) of Table V can be interpreted as the persistent increase in individual log sales from having received knowledge. Column (2) incorporates the worksheets that were manually inspected and categorized, yielding a parameter estimate of 0.187. Column (3) allows content categorized as conveying both knowledge and support to have a different effect from those providing knowledge alone. The small and insignificant point estimate on *Received Knowledge and Support* × *Post* suggests that there was little benefit from receiving support in addition to knowledge. Column (3) also incorporates agent fixed effects (omitting "received knowledge"), rather than manager fixed effects, and the results remain similar. Column (4) uses the blinded third-party classification, and the point estimate on *Received Knowledge* × *Post* increases to 0.243. Finally, columns (5) and (6) use total revenue per week as the dependent variable. The point estimates yield substantial effects on overall revenue for agents who document knowledge exchange on their worksheets. Although this exercise of correlating worksheet responses with sales performance is exploratory, the results suggest that knowledge spillovers, rather than

25. Most of these responses are clearly identifiable as either conveying knowledge or providing support. Of these 74 responses, 28 were classified as providing knowledge. Two examples of these responses are, "Have all [of the] info right in front of you, [and] say it like a normal conversation" and "Try to find ways to solve the problem if it's a credit fail." Of the remaining 46 responses, 32 were classified as providing support, with examples including: "Don't let the fear of striking out keep you from playing the game" and "[My] partner is new, he said I got it down." After this second categorization procedure, 14 responses remained as neither.

agents' improved sentiment or reflections on their own sales process, drove the increases in sales performance in the Structured-Meetings and Combined treatments.

We also find that agents were more likely to record advice when their partner was a high-performer. Seventy-four percent of low-performing partners are classified as providing advice/knowledge on one or more worksheets, whereas 93% of high-performing partners do so. The difference is significant at the 1% level and helps to explain why agents with high-performing partners outperform others. However, we cannot determine whether the difference in knowledge from high-performing partners arises because high-performers are more likely to share knowledge, or whether their partners are more likely to record the knowledge provided.

*Evidence on the Sources of Initiation Costs.* Our results suggest that agents, based on their commission rates, had been foregoing about $35 to $43 of average weekly pay by not self-organizing to exchange knowledge with coworkers. Results across different treatments suggest initiation costs borne by knowledge seekers limit knowledge flows. We use survey evidence, interviews, and auxiliary tests to investigate whether these costs are most likely due to search, coordination, or social frictions.

Search costs, either based on not knowing who to ask for advice or failing to anticipate the benefits of asking, appear small in this context. Survey responses show that agents can identify their relative standing compared to that of top-performers and 93% of agents can name three agents in the top 10% of the sales distribution for their division and location (see Figure A.1 in the Appendix). Agents themselves estimate positive treatment effects from asking others for help, suggesting they understand the benefits of seeking out knowledge (see Figure A.4 in the Appendix).

Proximity does govern communication patterns between agents at baseline, suggesting the presence of coordination or search costs.[26] However, proxies for social or physical distance do not yield differences in post-intervention sales gains. If distance were the main impediment to knowledge exchange in this workplace, we would expect those paired with partners on another team to have larger gains because of the higher likelihood of receiving novel information. There is little evidence for a distance channel, as agents paired with those on different teams (who are likely both physically and socially distant) have similar post-intervention gains to agents paired exclusively with partners on their own teams.[27] This suggests that barriers to knowledge exchange exist even for those who are co-located and familiar with one another.

The lack of evidence for search and coordination costs motivates an exploration of social-based initiation costs. Interview evidence points in this direction, but the exact source of social costs is difficult to identify, as different forces may matter more for some agents compared to others. One potential channel, suggested by Chandrasekhar, Golub, and Yang (2016), is that knowledge seekers may refrain from asking for help in order to mitigate feelings of shame or to avoid sending negative signals about their type—two potential social costs. A related channel emerged in interviews, as some agents reported an intimidation factor that prevented them from approaching others. In particular, one sales agent in the Structured-Meetings treatment expressed her

26. Twenty-five percent of survey respondents report: "When I ask other agents for help, I always (100% of the time) look for someone seated beside me." Another 36% of agents report: "When I ask other agents for help, I usually (greater than 75% of the time) look for someone seated beside me."

27. Each week, the probability that an agent was matched with a partner on his or her own team was 0.4. Table A.14 in the Appendix fails to detect heterogeneous treatment effects in the post-intervention period for agents matched with partners on different teams. We also estimate heterogeneous effects in Appendix Table A.15 based on whether the agent in question (1) rotated partners during the experiment and (2) reported an above-median number of work-related conversations per week (5) prior to the beginning of the intervention period. The results show modestly larger effect sizes for agents who previously had more frequent work-related conversations in the Structured-Meetings and Combined treatments during the intervention period, but interaction effects are small in the post-intervention period.

excitement to us when she learned she had been paired with a very skilled coworker. Specifically, she said: "I would never have had the courage to approach him for help or advice. But since we are paired together for lunch, I get to learn from one of the best sales agents in the company!" Although this evidence suggests the importance of social concerns, identifying the precise source(s) of underlying social cost(s) requires a more targeted experimental design.

## *V.B. The Firm's Return on Investment*

The economic significance of the findings was apparent to the firm. The firm previously relied exclusively on short-term, temporary boosts to monetary incentives to influence agents' performance. Controlled experiments of alternate practices, especially around knowledge sharing, had not been conducted. Following the experiment (after week 34), the firm implemented a mentoring program, where seasoned agents were partnered with new recruits to assist in onboarding

To estimate total returns to the firm, we pool all of the data and estimate treatment effects by week for total revenue. This has the advantage of allowing the estimates to vary based on the agents who remain in each future period. Using these estimates, we conservatively adjust for an 8% commission paid to agents, multiply by the number of agents, and discount future revenue using a 12.5% annual rate. Through the 24 weeks in which we track sales, the present value of revenue increases to the firm is $1.29 million for the Structured-Meetings treatment, $1.14 million for the Combined treatment, and $457,000 for the Pair-Incentives treatment. The per-treatment variable implementation costs (lunches, printed worksheets, prizes) were under $15,000 for each treatment, with the lowest cost for the Structured-Meetings treatment. These calculations do not include staff and academic overhead.

## *V.C. The Results in Context*

Despite the ubiquity of within firm productivity differences across many industries, it is worthwhile to consider whether the results generalize beyond sales functions. Relative to many other industries, sales positions provide rapid feedback and this feature may allow sales workers to avoid the costs of acquiring job-specific knowledge until they gain information about their match with the job. Under this dynamic, one might expect that highly tenured agents would endogenously choose to acquire knowledge in the absence of intervention because of their ability to spread initiation costs over many future transactions. To assess how this might influence the interpretation, we exclude the agents with the lowest quartile of tenure and re-estimate treatment effects for more highly tenured agents. Point estimates excluding the lowest tenured agents in Table A.16 for the post-intervention period exceed 80% of the estimates for the full sample in the Structured-Meetings and Combined treatments; the confidence intervals always include the original estimates. These results suggest that tenure and rapid on-the-job feedback alone are unlikely to close the original performance gaps that motivated the experiment.

A final discussion point is to consider how group incentive effects may differ between our context and others. Many studies find positive effects of group incentives, and one might have anticipated, following Englmaier et al. (2018), that incentives would encourage leadership to foster knowledge transmission. The lack of persistence in the Pair-Incentives treatment suggests that these incentives were insufficient to overcome initiation costs. Because many group incentive studies occur in settings where there is some degree of baseline goal alignment, these settings likely have somewhat lower initiation barriers. Blader, Gartenberg, and Prat (2019) emphasize that the effects of incentives, especially those around competition, depend on whether the

firm has a cooperative "relational contract" with employees. In this firm, despite agent reports that others would provide help, a factor contributing to initiation costs may be the perception of an individually oriented workplace, driven by relative performance evaluation in pay and the firm's tendency to celebrate individual achievement. An area for future work is to better understand the response to joint incentives and how that response varies with firm culture. Still, the reluctance to seek out knowledge is likely general to many environments, as recent evidence points to widespread frictions around information sharing. For example, Cullen and Perez-Truglia (2018) quantify how frictions limit the spread of information that all coworkers appear to value. In their setting, even when information is not considered sensitive and rewards are offered for sharing, employees who are not connected (measured through overlap at the firm) exhibit reluctance to approach one another for information.

# VI. Conclusion

In many workplaces, output varies dramatically across individuals. Managers are quick to credit workplace interactions—and their effort to stimulate such interactions—as a driving force behind employee productivity. Economists point to these interactions as one reason that firms exist (Grant, 1996). Careful examination surfaces a host of economic questions. In particular, what economic costs impede the flow of knowledge in the workplace? Two theorized frictions are contracting difficulties and initiation costs, with the latter defined as barriers preventing one from seeking assistance. Contracting difficulties concern the lack of incentives for others to share information, as highlighted in the team incentives literature (Bandiera, Barankay, and Rasul, 2013; Friebel et al., 2017). Initiation costs are less studied inside firms, but adjacent literature suggests they are important. In urban economics and the economics of innovation, distance is often cited as a barrier to information acquisition (Glaeser et al., 1992; Glaeser and Gottlieb, 2009; Catalini, 2017), as are search costs (Boudreau et al., 2017). A recent literature studies the (micro) social frictions that may burden those seeking help (Chandrasekhar, Golub, and Yang, 2016).

Within firms, little evidence exists on the role of management practices to spark knowledge sharing. Instead, the focus has largely been on formal organizational structure, reporting practices, or patterns of delegation, rather than practices influencing how coworkers interact with each other. To uncover the importance of peer knowledge flows, we ran a field experiment that randomly paired over 650 call center sales agents and assigned the pairs to treatments targeting different frictions to knowledge flows. One treatment, Structured-Meetings, targeted initiation costs by guiding randomly paired workers to participate in structured, work-related conversations. A second treatment, Pair-Incentives, targeted contracting frictions by tying together partners' expected contemporaneous earnings. A third treatment, Combined, simultaneously addressed both frictions.

Although all treatments raised contemporaneous individual sales relative to the control groups, workers in the Structured-Meetings treatment gained knowledge, as evidenced by persistent performance gains. The Pair-Incentives treatment yielded only temporary gains, suggestive of transitory effort responses. A number of additional results suggest that management practices can break down initiation costs and consequently induce the transfer of knowledge from highly skilled workers to their peers . These findings add to a small but growing set of studies showing that simple management interventions can dramatically raise productivity (Haynes et al., 2009; Bloom and Van Reenen, 2011; Bloom et al., 2013; Cai and Szeidl, 2017; Englmaier et al., 2018), while highlighting the role of social factors in the adoption of different practices (Shue, 2013).

While our setting provides a nearly ideal environment for measuring the effects of coworker knowledge

spillovers within a firm, the necessity of managerial processes to unlock knowledge flows likely generalizes. Glaeser's (1998) concept of the cost of moving ideas is useful for extending our results to other contexts. For example, many settings like cities, academic departments, and classrooms facilitate interactions and lower these costs. Information technology (IT) is also believed to decrease the cost of moving ideas (Rosenthal and Strange, 2019). It remains to be seen how IT adoption in the workplace affects knowledge seekers' initiation costs and how managerial practices will evolve to produce meaningful workplace knowledge flows.

Tulane University
Michigan State University
University of Utah
Harvard Business School and NBER

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# Tables and Figures

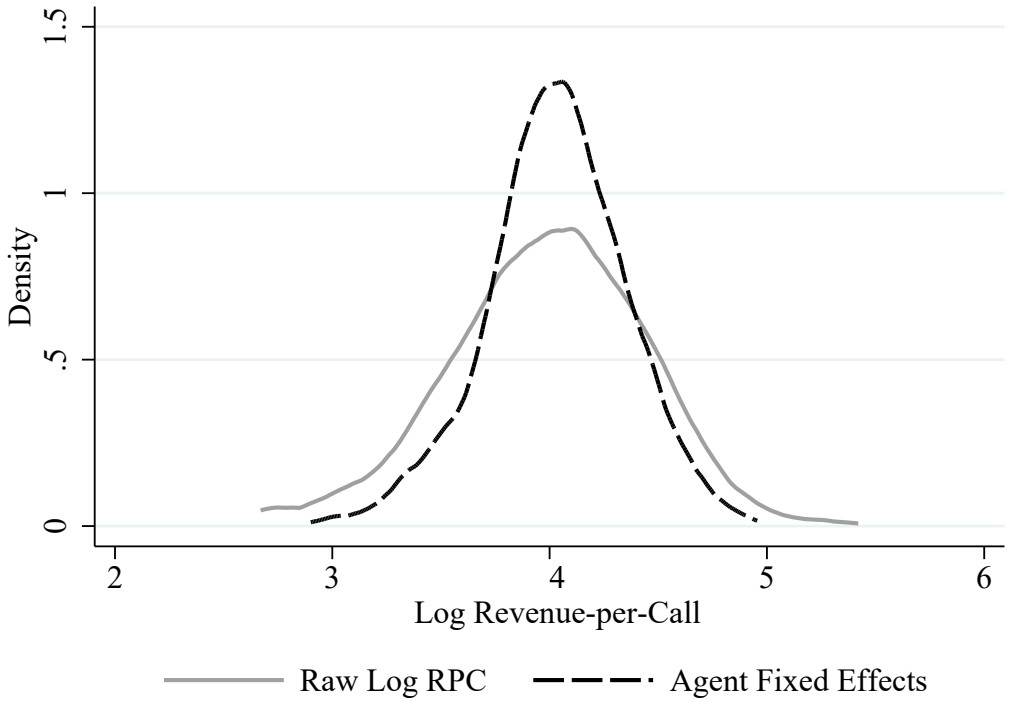


FIGURE I.
Dispersion in Log Revenue-per-Call

This figure displays density plots of raw log revenue-per-call and estimated agent fixed effects using the eight weeks of data prior to the intervention period. The sample includes 623 agents and 3,026 agent-weeks for those in the two treatment-eligible offices. The sample does not include the 26 agents who joined during the intervention period, nor does it include an additional four agents who moved from positions outside of the six main sales divisions. The agent fixed effects come from a regression that nets out sales division-by-week fixed effects, after which we apply the shrinkage procedure in Lazear, Shaw, and Stanton (2015). The interquartile range and standard deviation of log RPC are 0.60 and 0.47, respectively. The interquartile range and standard deviation of agent fixed effects are 0.39 and 0.30.

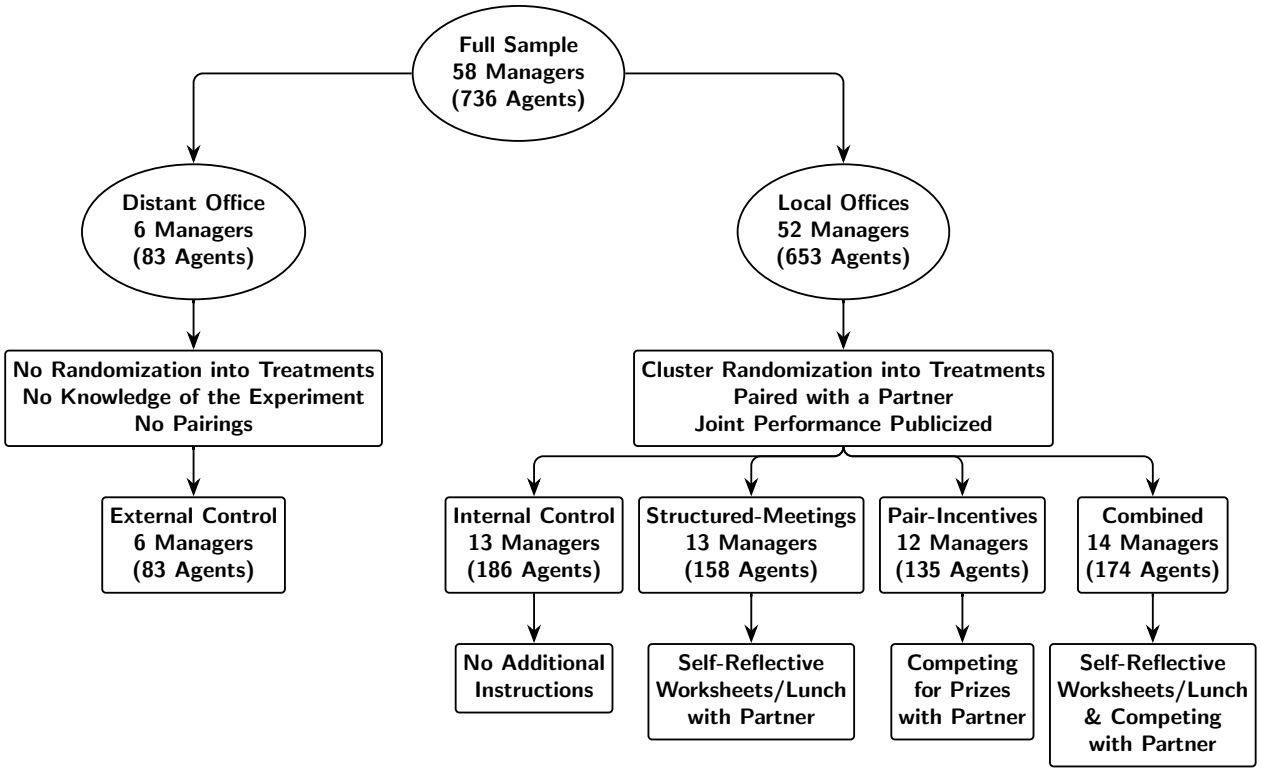


FIGURE II.
Illustration of Experimental Design and Allocation to Treatments

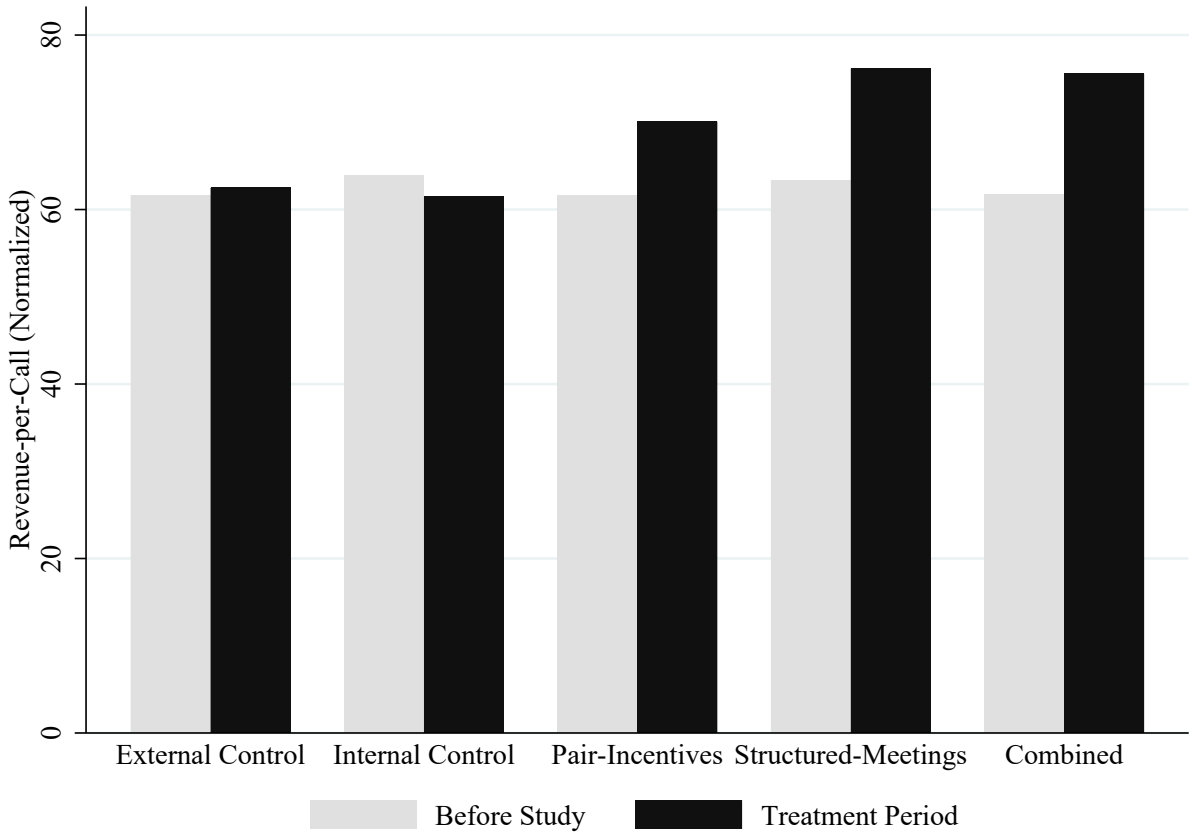


FIGURE III.
Mean Revenue-per-Call by Treatment During the Pre-Intervention and Intervention Periods

This figure displays means of revenue-per-call (RPC) using four weeks of pre-intervention data and four weeks of data during the intervention period (N=736 unique agents over 3,821 agent-weeks). To facilitate visual comparisons of changes across time periods, data for each group are normalized to the grand mean of the active treatment groups in the week immediately prior to treatment (week 0). The grand mean in week 0 was approximately \$60 in RPC. Table I provides additional detail on non-normalized revenue measures in the pre-intervention period.

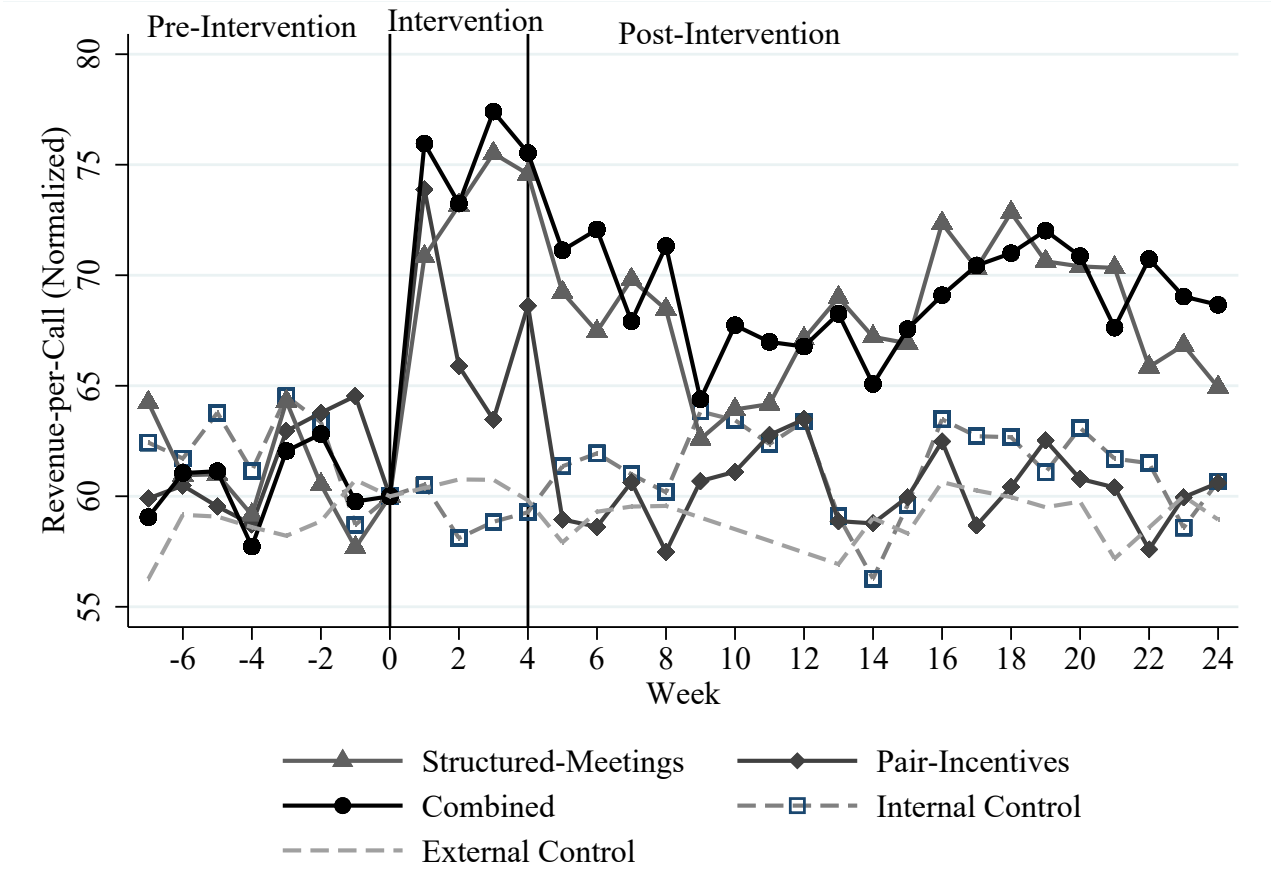


FIGURE IV.
The Evolution of Revenue-per-Call Over Time, by Treatment Group

This figure displays weekly averages of revenue-per-call (RPC) by week and treatment group (N=736 agents over 10,651 agent-weeks). Each series is normalized to the grand mean of RPC in week 0. The intervention period begins in week 1 and continues through week 4. The post-intervention period tracks agents based on their original treatment assignment through week 24.

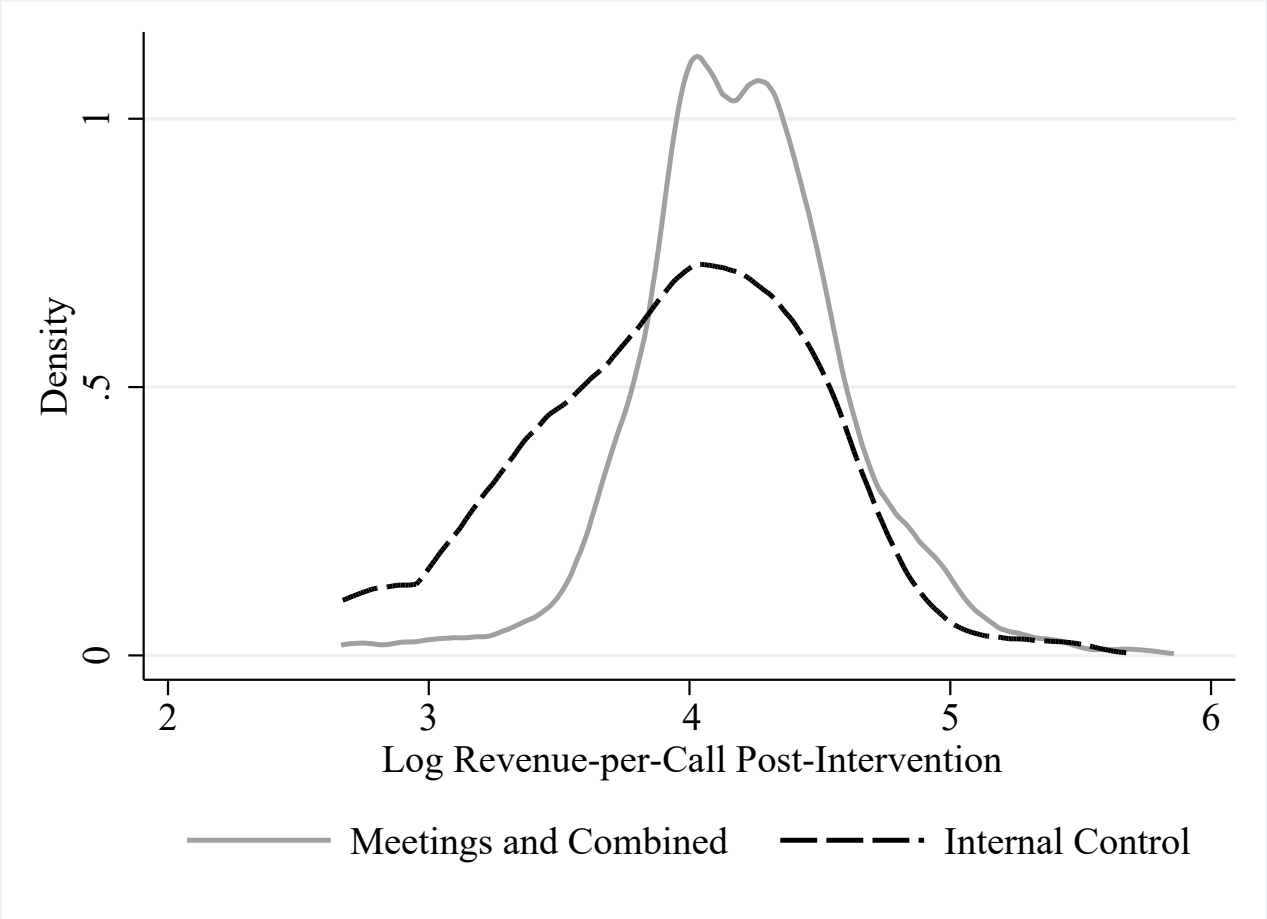


FIGURE V.
Dispersion in Log Revenue-per-Call in the Post-Intervention Period

This figure displays log revenue-per-call density plots in the post-intervention period for agents assigned to the Internal Control group and the Structured-Meetings and Combined treatments (N=397 agents over 3,438 agent-weeks).

TABLE I.
AGENT DEMOGRAPHICS AND SALES PRIOR TO THE EXPERIMENT

| | Full Sample | Structured Meetings | Pair Incentives | Combined | Internal Control | External Control | P-Value |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Age (yrs.) | | | | | | | |
| Mean | 26.08 | 25.76 | 26.61 | 26.43 | 25.14 | 27.19 | 0.62 |
| Median | 23.39 | 22.51 | 23.55 | 24.02 | 22.97 | 24.63 | |
| Std Dev. | 8.14 | 8.20 | 9.61 | 8.10 | 6.66 | 8.41 | |
| Tenure (log days) | | | | | | | |
| Mean | 5.25 | 5.14 | 5.38 | 5.59 | 5.18 | 4.67 | 0.61 |
| Median | 5.15 | 4.62 | 5.40 | 5.37 | 4.62 | 5.18 | |
| Std Dev. | 1.18 | 1.12 | 1.07 | 1.10 | 1.22 | 1.24 | |
| Percent Female | | | | | | | |
| Mean | 0.32 | 0.32 | 0.31 | 0.33 | 0.34 | 0.25 | 0.95 |
| Revenue-per-Call (log) | | | | | | | |
| Mean | 3.92 | 3.90 | 4.06 | 3.94 | 3.92 | 3.62 | 0.69 |
| Median | 3.97 | 4.04 | 4.09 | 3.99 | 3.99 | 3.69 | |
| Std Dev. | 0.49 | 0.52 | 0.37 | 0.47 | 0.55 | 0.33 | |
| Revenue-per-Hour (log) | | | | | | | |
| Mean | 4.51 | 4.48 | 4.69 | 4.56 | 4.51 | 4.11 | 0.54 |
| Median | 4.62 | 4.64 | 4.78 | 4.65 | 4.63 | 4.18 | |
| Std Dev. | 0.60 | 0.69 | 0.45 | 0.59 | 0.59 | 0.46 | |
| Commission | | | | | | | |
| Mean | 217.78 | 202.65 | 230.41 | 230.64 | 202.31 | | 0.75 |
| Median | 185.45 | 168.42 | 192.28 | 209.73 | 169.73 | | |
| Std Dev. | 155.61 | 159.99 | 156.09 | 157.73 | 147.70 | | |
| Total Calls | | | | | | | |
| Mean | 61.53 | 57.56 | 64.16 | 65.81 | 58.89 | | 0.33 |
| Median | 60.43 | 57.22 | 62.41 | 65.29 | 58.63 | | |
| Std Dev. | 21.32 | 19.16 | 22.02 | 20.81 | 22.43 | | |
| Weekly Phone Hours | | | | | | | |
| Mean | 32.61 | 32.52 | 33.76 | 33.17 | 31.22 | | 0.32 |
| Median | 34.05 | 34.08 | 34.77 | 33.33 | 33.75 | | |
| Std Dev. | 7.36 | 7.01 | 6.09 | 6.74 | 8.95 | | |
| Adherence | | | | | | | |
| Mean | 0.80 | 0.80 | 0.84 | 0.79 | 0.77 | | 0.19 |
| Median | 0.83 | 0.83 | 0.85 | 0.83 | 0.82 | | |
| Std Dev. | 0.14 | 0.11 | 0.07 | 0.14 | 0.21 | | |
| N Managers | 58 | 13 | 12 | 14 | 13 | 6 | |
| N Agents | 736 | 158 | 135 | 174 | 186 | 83 | |

*Notes.* Sales agent demographics (age, tenure with the firm, and gender) and performance measures are displayed by treatment group. The unit of observation is an agent, with data averaged over the pre-intervention period. Agent totals are the number of agents assigned to a treatment and include the 26 agents who enter the sample during the intervention period. P-values in the final column are tests for mean differences between treatments for agents in the firm's two primary offices. These tests are computed as the joint hypothesis test of equality of treatment groups from a regression of the variable of interest on treatment assignment dummies after clustering standard errors based on the manager's identity (the level of assignment). Missing data for the External Control reflects different reporting systems across offices. Weekly Phone Hours captures an agent's time at work while logged into the phone system, which is roughly equivalent to total potential hours less any time designated for non-production activities. Adherence is then calculated as the sum of an agent's time available to receive a call plus time spent on calls divided by the total time logged into the phone system. Other measures are defined in the text.

TABLE II.
REVENUE TREATMENT EFFECTS IN THE INTERVENTION PERIOD

| Dependent Variable: | Log Revenue-per-Call | | | | Revenue-per-Week |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Structured-Meetings | 0.241*** | 0.247*** | 0.247*** | 0.224*** | 578.78*** |
| | (0.045) | (0.044) | (0.044) | (0.065) | (143.59) |
| Pair-Incentives | 0.131*** | 0.141*** | 0.140*** | 0.126** | 474.95** |
| | (0.048) | (0.046) | (0.046) | (0.061) | (207.82) |
| Combined | 0.255*** | 0.266*** | 0.265*** | 0.265*** | 722.54*** |
| | (0.043) | (0.057) | (0.057) | (0.071) | (182.51) |
| Internal Control | | | 0.010 | 0.058 | -7.53 |
| | | | (0.044) | (0.060) | (229.96) |
| Control Group: | Internal | External | Both | Both | Both |
| Manager FE ($\theta_g$) | ✓ | ✓ | ✓ | | ✓ |
| Individual FE ($\theta_i$) | | | | ✓ | |
| Week FE ($\lambda_t$) | ✓ | ✓ | ✓ | ✓ | ✓ |
| Adj. R-Squared | 0.470 | 0.416 | 0.417 | 0.536 | 0.681 |
| Observations | 3,418 | 2,856 | 3,821 | 3,821 | 3,821 |
| Individuals | 653 | 550 | 736 | 736 | 736 |
| Managers | 52 | 45 | 58 | 58 | 58 |
| Randomization P-Value: | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Wald P-Values: | | | | | |
| $H_0$: Meetings = Incent. | 0.048 | 0.017 | 0.014 | 0.044 | 0.681 |
| $H_0$: Meetings+Incent.≤Comb. | 0.049 | 0.044 | 0.044 | 0.162 | 0.124 |

*Notes.* This table reports difference-in-differences estimates of treatment effects on log revenue-per-call (columns (1) through (4)) and total revenue-per-week (column (5)) using data from the four-week pre-intervention period and the four-week intervention period. The variables Structured-Meetings, Pair-Incentives, and Combined are shorthand for "Structured-Meetings x Intervention Period," "Pair-Incentives x Intervention Period," and "Combined x Intervention Period" and they are set to one in the intervention period for those randomly assigned to the treatment, and zero otherwise. Dummy variables for baseline treatment assignment are absorbed by manager fixed effects, as randomization is at the sales manager level. In column (1) the Internal Control (passive pairs) is the omitted category. Column (2) omits the Internal Control group and instead uses the External Control group (that was not aware of the experiment and had no partner pairing) as the excluded category. Other columns include both control groups, with an indicator for the Internal Control during the intervention period. The p-value from randomization row reports the Young (2018) test of the sharp null of no treatment effects for the three active treatments. The p-values in the bottom rows come from Wald tests of two null hypotheses: i) that the Pair-Incentives and Structured-Meetings have equal effects, and ii) that the Combined group has sales gains that exceed the sum of the gains in the Structured-Meetings plus the Pair-Incentives groups. Standard errors are clustered at the sales manager level and are reported in parentheses.

*10%, **5%, and ***1% significance level.

TABLE III.
TREATMENT EFFECT PERSISTENCE IN THE POST-INTERVENTION PERIOD

| Dependent Variable: | Log Revenue-per-Call | | | | | Revenue-per-Week |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Structured-Meetings | 0.189** | 0.204** | 0.204** | 0.211** | 0.174** | 816.75*** |
| | (0.077) | (0.084) | (0.084) | (0.085) | (0.076) | (295.60) |
| Pair-Incentives | 0.069 | 0.085 | 0.084 | 0.128 | 0.127 | 475.05 |
| | (0.052) | (0.070) | (0.069) | (0.087) | (0.080) | (371.26) |
| Combined | 0.210*** | 0.225*** | 0.225*** | 0.231*** | 0.276*** | 810.72*** |
| | (0.078) | (0.080) | (0.080) | (0.081) | (0.078) | (215.62) |
| Internal Control | | | 0.017 | 0.038 | 0.063 | -21.21 |
| | | | (0.076) | (0.068) | (0.063) | (321.60) |
| Control Group: | Internal | External | Both | Both | Both | Both |
| Manager FE ($\theta_g$) | ✓ | ✓ | ✓ | ✓ | | ✓ |
| Balanced panel | | | | ✓ | | |
| Individual FE ($\theta_i$) | | | | | ✓ | |
| Week FE ($\lambda_t$) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Adj. R-Squared | 0.351 | 0.396 | 0.389 | 0.415 | 0.528 | 0.625 |
| Observations | 6,236 | 6,026 | 7,334 | 5,518 | 7,334 | 7,334 |
| Individuals | 628 | 535 | 711 | 388 | 711 | 711 |
| Managers | 52 | 45 | 58 | 58 | 58 | 58 |
| Randomization P-Value: | 0.041 | 0.044 | 0.027 | 0.026 | <0.01 | <0.01 |
| Wald P-Values: | | | | | | |
| $H_0$: SM. = PI. | 0.068 | 0.135 | 0.129 | 0.538 | 0.464 | 0.436 |
| $H_0$: SM.+PI.≤Comb. | 0.253 | 0.284 | 0.287 | 0.358 | 0.393 | 0.165 |

*Notes.* This table reports difference-in-differences estimates of persistent log revenue-per-call (columns (1) through (5)) and total revenue-per-week (column (6)) treatment effects using data from the four-week pre-intervention period and the 20-week post-intervention period (weeks 5–24). The variables Structured-Meetings, Pair-Incentives, and Combined are shorthand for "Structured-Meetings x Post-Intervention Period," "Pair-Incentives x Post-Intervention Period," and "Combined x Post-Intervention Period." Sales manager fixed effects correspond to the manager at the time of treatment assignment. Dummy variables for treatments are absorbed by the individual or manager fixed effects. In column (1) the Internal Control (passive pairs) is the omitted category. Column (2) omits the Internal Control group and instead uses the External Control group (that was not aware of the experiment and had no partner pairing) as the excluded category. Other columns include both control groups, with an indicator for the Internal Control during the post-intervention period. The balanced sample panel includes only agents who remain in the data after week 19 (but agents may have gaps in some weeks). The p-value from randomization row and the Wald tests correspond to the analogous tests in Table II, where SM. is an abbreviation for Structured-Meetings, PI. for Pair-Incentives and Comb. for Combined. Standard errors are clustered at the sales manager level and are reported in parentheses.

*10%, **5%, and ***1% significance level.

TABLE IV.
REVENUE-PER-CALL TREATMENT EFFECT HETEROGENEITY BY PARTNER AND AGENT PERFORMANCE

| | Intervention Period | | | Post-Intervention Period | | |
|---|---|---|---|---|---|---|
| | Full sample | Low-Performer Agents | High-Performer Agents | Full sample | Low-Performer Agents | High-Performer Agents |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Structured-Meetings × High-Performing Partner | 10.89** | 17.25*** | 12.45** | 12.53* | 19.32** | 6.85 |
| | (4.76) | (5.83) | (5.80) | (6.30) | (8.56) | (6.23) |
| Pair-Incentives × High-Performing Partner | 4.93 | 7.78 | 6.93 | 6.66 | 7.28 | 3.39 |
| | (4.26) | (4.96) | (5.37) | (4.73) | (4.40) | (5.68) |
| Combined × High-Performing Partner | 15.87*** | 21.55*** | 16.68*** | 12.11*** | 19.35*** | 10.10* |
| | (4.89) | (6.56) | (5.19) | (4.26) | (5.23) | (5.18) |
| Structured-Meetings | 11.94*** | 9.14* | 9.79 | 4.59 | 4.20 | 6.03 |
| | (4.09) | (4.71) | (5.97) | (6.49) | (7.29) | (7.27) |
| Pair-Incentives | 8.68*** | 16.70*** | 3.57 | -2.01 | -0.96 | 1.52 |
| | (2.80) | (4.24) | (3.43) | (5.13) | (6.24) | (6.24) |
| Combined | 7.51 | 15.42*** | 1.16 | -0.38 | 11.56* | -8.40 |
| | (5.87) | (4.50) | (7.52) | (5.52) | (6.05) | (7.14) |
| Manager FE ($\theta_g$) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Week FE ($\lambda_t$) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Adj. R-Squared | 0.358 | 0.444 | 0.317 | 0.324 | 0.421 | 0.322 |
| Observations | 3,418 | 1,484 | 1,934 | 6,236 | 2,745 | 3,491 |
| P-Value from Wild Bootstrap: | 0.02 | $< 0.01$ | 0.01 | 0.12 | 0.03 | 0.18 |

*Notes.* This table reports revenue-per-call treatment effects and interactions for random pairing with a high-performing partner. An agent is defined as a high-performer if their RPC is above the median within their own sales division in the pre-intervention period. Agents without pre-intervention data are classified as low-performers (they are almost always below the median when first observed). The Internal Control group is the baseline category because agents in the External Control do not have partner assignments. In the intervention period analysis in columns (1)–(3), High-Performing Partner is defined based on the concurrent partner. In the post-intervention period analysis in columns (4)–(6), High-Performing Partner is defined based on whether the agent was ever paired with a high-performer. Columns (2), (3), (5), and (6) further split the sample based on whether the individual agent is a high-performer. Each regression includes week fixed effects and fixed effects for the manager at the time of treatment assignment. Standard errors are clustered at the sales manager level and are reported in parentheses. Wild bootstrap p-values display the test of the joint null that the High-Performing Partner interactions for the active treatments are zero. This test imposes the null and re-samples over clusters, as described in Roodman et al. (2019).

*10%, **5%, and ***1% significance level.

TABLE V.
Post-Intervention Correlations Between Sales Productivity and Knowledge Documented in Worksheets

| | Log RPC | | | | Revenue | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Received Knowledge × Post | 0.169** | 0.187** | 0.168** | 0.243*** | 897.50*** | 873.54** |
| | (0.068) | (0.074) | (0.084) | (0.056) | (232.03) | (202.09) |
| Knowledge and Support × Post | | | -0.053 | 0.044 | -90.82 | -82.71 |
| | | | (0.045) | (0.051) | (378.66) | (136.46) |
| Word presence classification | ✓ | | | | | |
| Word and manual classification | | ✓ | ✓ | | ✓ | |
| Blinded classification | | | | ✓ | | ✓ |
| Manager FE ($\theta_g$) | ✓ | ✓ | | ✓ | ✓ | ✓ |
| Individual FE ($\theta_i$) | | | ✓ | | | |
| Week FE ($\lambda_t$) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Adj. R-Squared | 0.331 | 0.335 | 0.322 | 0.337 | 0.232 | 0.223 |
| Observations | 1,929 | 2,102 | 2,102 | 2,218 | 2,102 | 2,218 |

*Notes.* This table reports difference-in-differences estimates of log revenue-per-call and total revenue in the post-intervention period for agents in the Structured-Meetings and Combined treatments for whom we have at least one completed worksheet. The reported coefficients represent the post-intervention change in the dependent variable for agents who received knowledge, or received knowledge and support, relative to agents who received supportive advice alone (the baseline). In column (1), these classifications come from the prevalence of the 30 most common words (excluding stop-words) as detailed in Table A.13 in the Online Appendix. Columns (2), (3), and (5) include manually classified worksheet responses based on the authors' readings. Columns (4) and (6) use classifications where a third-party student, who was unaware of the research, was asked to classify worksheet text into categories. These categories were "The Statement Provides Knowledge/Advice/Tips to Improve Sales Performance," "The Statement Provides Support," "Both Knowledge and Support," and "Other." Eighty-six percent of the blinded and the word presence plus manual classifications align, while the blinded coding has more entries classified as "Received Knowledge." Ninety-four percent of the entries classified as "Received Knowledge" in the word presence plus manual scheme were also classified as "Received Knowledge" in the blinded coding. Standard errors are clustered at the sales manager level and are reported in parentheses.

*10%, **5%, and ***1% significance level.

# Online Appendix for "WORKPLACE KNOWLEDGE FLOWS"

JASON SANDVIK
RICHARD SAOUMA
NATHAN SEEGERT
CHRISTOPHER STANTON

# A Theory Development

We provide a parsimonious model to specify costs that hinder agent knowledge transfer and to illustrate how treatments potentially allow agents to overcome these costs. It is important to note that we do not attempt to characterize an optimal contract; instead, we consider comparative statics based on features of observed contracts. For simplicity, we focus on two agents, $L$ and $H$. Suppose each agent has a commonly known body of knowledge, $Z_i \subset \Omega$ for $i \in \{L, H\}$, where $z \in \Omega$ is knowledge required to complete an individual sale. The random variable $z$ can be thought of as the issue (or collection of issues) that arise in a transaction, and $f(z)$ is the probability that issue $z$ arises on any given call. Thus, $\theta_i = \int_{z \in Z_i} f(z)dz \leq 1$ is a measure of agent $i$'s knowledge, capturing the probability that the agent has the necessary knowledge required to successfully close a transaction. To simplify what follows, we further assume that agents' knowledge is ordered, such that $\theta_L < \theta_H \Rightarrow Z_L \subset Z_H$.[28] Put simply, agents with a higher probability of closing sales possess a broader body of knowledge.

Agents may connect with other agents to transfer knowledge, but establishing a connection is potentially costly and requires one or both agents to invest in the relationship ex-ante. We analyze a two-stage model where the agents choose how much to invest toward establishing a relationship, $k_i \geq 0$, simultaneously in the first stage. If the sum of the relationship-specific investments exceeds a commonly known threshold, $K > 0$, then we say that a connection is forged between the two agents. When a connection is forged, the lesser informed agent, $L$, absorbs their better informed colleague's knowledge, such that $\theta'_L = \theta_H > \theta_L$. On the other hand, agent $H$'s knowledge, $\theta_H$, is unaffected by the connection with their less informed colleague. Finally, if no connection is made, then both agents' knowledge remains constant.

In the second stage, each agent takes their knowledge, $\theta_i$, as given and chooses their sales effort, $e_i \geq 0$ with a personal cost of effort $\frac{e_i^2}{2}$. Sales effort and knowledge combine to produce expected sales: $E[Y_i] = \theta_i e_i$, upon which agents earn a commission of $B \in (0, 1)$. Taking agent $-i$'s relationship-specific investment strategy, $k_{-i}$, as given, agent $i$ solves:

$$\max_{e_i} \left( \max_{k_i} U(e_i, k_i; \theta_i, \theta_{-i}) \right) = B\theta_i(k_i; k_{-i}, \theta_{-i})e_i - \frac{e_i^2}{2} - k_i.$$

Working backwards from the second stage, the first-order condition yields $e_i^* = B\theta_i$, allowing us to write agent $i$'s equilibrium utility as: $\frac{(B\theta_i)^2}{2} - k_i$. In the first stage, each agent chooses their relationship-specific investment as a function of the potential gains from connecting with their peer; specifically, the amount of knowledge that they can glean from the relationship. Because the better informed agent has nothing to gain from connecting with the less informed agent, the former will be unwilling to make relationship investments absent additional incentives. Accordingly, the knowledge seeker (agent $L$), optimally invests:

$$k_L^* = \begin{cases} 0, & \text{if } \frac{B^2(\theta_H^2 - \theta_L^2)}{2} \leq K \\ K, & \text{if } \frac{B^2(\theta_H^2 - \theta_L^2)}{2} > K. \end{cases}$$

28. This assumption is justified if agents endogenously choose which knowledge to invest in acquiring. Knowledge about the most frequent problems has the highest payoff for sales, which gives rise to this ordering.

Our model highlights two types of frictions to knowledge exchange, initiation costs and contracting costs. Initiation costs capture the knowledge seeker's costs, including overcoming social stigmas and search costs. The magnitude of these costs are incorporated in the connection threshold, $K$. Because we model the relationship-specific investment as a threshold, initiation costs may also include transfers between the agents required to compensate knowledge providers for help. Contracting costs limit the knowledge provider's ability to benefit from improving their partner's performance. In our model, the firm collects a tax of $(1 - B)$ on sales, which limits the knowledge seeker's willingness to shoulder all of the upfront relationship development costs. Other considerations include the inability of knowledge seekers to borrow from future human capital (Garicano and Rayo, 2017), which could be incorporated into richer models that limit the transfer of resources between knowledge seekers and providers more generally.

*Structured-Meetings Treatment*

The Structured-Meetings treatment targets initiation costs by decreasing the investment threshold needed to forge a connection from $K$ to $K' < K$, via a series of worksheets and partner lunches. Relative to the Internal-Control benchmark, only the cost of connecting changes, as the benefit to the less informed agent remains at $\frac{B^2\left(\theta_H^2-\theta_L^2\right)}{2}$, whereas the benefit to the better informed agent remains at zero. Consequently the Structured-Meetings treatment:

- Induces more connections due to the decreased connection investment threshold, $K'$.
- Induces the (ex-ante) less knowledgeable agent to connect, leading to increased sales, if and only if they expect their sales productivity will subsequently increase.
- Will result in a sales productivity increase whenever agent $L$ is paired with agent $H$, with all returns accruing to agent $L$, as highlighted in Figure A.5.

*Pair-Incentives Treatment*

The Pair-Incentives treatment targets contracting costs by providing partnered agents with additional incentives to increase their joint sales. In particular, the treatment provides agent $H$ with an explicit incentive to transfer knowledge to the less informed partner to increase their sales. We model this incentive with an expected bonus commission $b > 0$ paid to each agent on their joint sales. Accordingly, when agent $i$ and $-i$ are formally paired together, agent $i$ expects to collect $(B + b)Y_i + bY_{-i}$.[29] Relative to the Internal Control group benchmark, both agents in the Pair-Incentives treatment explicitly gain from the less-informed agent increasing their knowledge. In particular, the benefit to agent $L$ of connecting with agent $H$ is given by $\frac{(B+b)^2\left(\theta_H^2-\theta_L^2\right)}{2}$, whereas the direct benefit to agent $H$ is given by: $\frac{b^2\left(\theta_H^2-\theta_L^2\right)}{2}$. In the Internal Control group, the equivalent benefits are given by $\frac{B^2\left(\theta_H^2-\theta_L^2\right)}{2}$ and 0, respectively. Consequently, relative to the Internal Control group, the Pair-Incentives treatment:

- Induces both agents to exert more sales effort due to the increased commission, $b$, on their own output, $Y$.
- Induces more connections by raising both agents' returns to first-stage, relationship-specific investments.

29. The actual treatment compensated sales gains relative to the pre-intervention period and awarded prizes to agent-pairs who managed to outperform two other, randomly selected agent-pairs. We follow Bandiera, Barankay, and Rasul (2013) in modeling this with linear profit-sharing rules.

*Combined Treatment*

The Combined treatment included both the Pair-Incentives and Structured-Meetings interventions. Relative to the Internal Control group, agents in the Combined treatment faced both a reduced connection threshold, $K'$, and an additional commission, $b$, on joint output. The treatment thus provides a test of whether:

- Both initiation costs and contracting costs were restricting knowledge transfers.
- The interventions are themselves complements or substitutes (Athey and Stern, 1998).

*Graphical Representation of Comparative Statics*

We plot the potential effects of each treatment in Figure A.5. In particular, the figure shows that knowledge transfers occur in equilibrium whenever the knowledge gap between paired agents is sufficiently large. The solid line demarks the minimum spread in knowledge between two agents in the Internal Control group needed to overcome the first-stage, relationship-specific investment threshold. The long-dashed line plots the minimum knowledge spread among agents in the Pair-Incentives treatment, the short-dashed line plots the same threshold for the Structured-Meetings treatment, and the dashed and dotted green line represents the minimum spread for agents in the Combined treatment. The shaded knowledge transfer region expands with the interventions. However, the ordering of the treatments (based on which treatment expands the knowledge transfer region the most) and the sub- or super-modularity of the Combined treatment are only illustrated for arbitrary parameter values of $K, K', B$, and $b$. The relative cost and benefit of relaxing initiation and contracting costs are empirical questions.

Figure A.5 highlights the empirical prediction that knowledge transfers are most likely to occur between agents with vastly different levels of knowledge. Agents are more likely to connect with significantly better- or worse-informed peers, because the value to doing so increases with the knowledge provider's relative knowledge advantage. The same logic suggests that if knowledge transfers are at the root of any observed productivity gains, then the greatest gains should occur between agent-pairs with highly differentiated knowledge levels; for example, between below- and above-median agent pairs.

# B Implementation Details, Documentation, and Communication

## *Implementation Details and Pre-Registration*

The RCT Registry notes 650 treatment-eligible agents and 44 managers. The RCT Registry sample size does not include the *External Control* group because these agents were not treatment eligible. The 653 agents in the two main offices reported in the paper reflect updated data given to us by the firm. In the data update, more agents joined the sales floor after training than originally anticipated. Twenty-six new agents, those who just finished their formal training, entered the sample in the middle of the intervention, with 11 joining in week 2, and 15 joining in week 3. These new agents received the same treatment associated with their sales manager in the first week on the sales floor.

The pre-registration was based on having 44 sales managers, but additional managers were added between planning the pre-registration and the implementation of treatments. In our final

sample, we observe 52 different managers in the two main locations and an additional six managers in the third location.

Finally, the pre-registration protocol called for a four-week intervention period and at least three months of post-intervention data. We extended the analysis to 20 weeks of post-intervention data in response to seminar questions about the persistence of the effects.

### *Survey Responses*

Several survey results are compiled in Table A.1. All surveys were administers through Qualtrics and distributed via email and links on the experiment website. Over 300 agents completed the preliminary survey, answering questions about their social and work-related conversations with coworkers. These results are contained in Panel A of Table A.1. Post-experiment survey results are in Panel B. These questions allow us to obtain an approximate measure of the effectiveness and salience of the experiment as a whole and of the *Structured-Meetings* treatment specifically.

### *Timeline of Events*

The following timeline documents the implementation of the experiment:

Week -2, Day 6 (Friday): Posters placed at entrance and throughout sales floor in the two buildings housing (future) treated agents.
Week 0, Day 2 (Monday): Email blast promoting the opening survey.
Week 0, Day 7 (Saturday): Opening survey closed.
Week 1, Day 1 (Sunday) July 16: Kickoff of Week 1 treatments. Pairs announced on website and worksheets made available to agents.
Week 1, Day 3 (Tuesday) July 18: Deadline for worksheets to be handed in.
Week 1, Days 4 and 5 (Wednesday and Thursday) July 19–20: HR hands out lunches to qualifying pairs.
Week 1, Day 7 (Saturday): Week 1 treatment ends, brackets are drawn, prize winners announced.
Week 2, Day 1 (Sunday): Kickoff of Week 2 treatments. Pairs announced on website and worksheets made available to agents.
Week 2, Day 3 (Tuesday): Deadline for worksheets to be handed in.
Week 2, Days 4 and 5 (Wednesday and Thursday): HR hands out lunches to qualifying pairs.
Week 2, Day 7 (Saturday): Week 2 treatment ends, brackets are drawn, prize winners announced.
Week 3, Day 1 (Sunday): Kickoff of Week 3 treatments. Pairs announced on website and worksheets made available to agents.
Week 3, Day 3 (Tuesday): Deadline for worksheets to be handed in.
Week 3, Days 4 and 5 (Wednesday and Thursday): HR hands out lunches to qualifying pairs.
Week 3, Day 7 (Saturday): Week 3 treatment ends, brackets are drawn, prize winners announced.
Week 4, Day 1 (Sunday): Kickoff of Week 4 treatments. Pairs announced on website and worksheets made available to agents.
Week 4, Day 3 (Tuesday): Deadline for worksheets to be handed in.
Week 4, Days 4 and 5 (Wednesday and Thursday): HR hands out lunches to qualifying pairs.
Week 4, Day 7 (Saturday): Week 4 treatment ends, brackets are drawn, prize winners announced.
Week 5, Day 1 (Sunday): Final survey opens.
Week 5, Day 5 (Thursday): Final survey closed.

## *Text of Website Communications to Agents*

Posters around the office announcing a "Sales Sprint" directed agents to a website that revealed the details of their treatment assignment. The following text details how each treatment was presented, but agents were only able to see the text corresponding to their own treatment.

*Pair-Incentives*

**Competition** You and a partner will compete against other pairs in your tournament. Together, you will work to increase your average RPC over the course of a week. Each week we will either pair you with a new partner, or re-pair you with your last partner, and the two of you will compete from Sunday till Saturday against other pairs based on your average RPC. We'll surface a leaderboard so you can keep track of your progress against everyone else.

**WHY?** We want to encourage you to talk about your calls with colleagues, and possibly meet some new people along the way. When the books close on Saturday, we will combine your average RPC growth relative to your average individual RPC in the last two weeks.

**Scoring** To score each pair and keep the tournament fair, we will be measuring your joint, weekly RPC relative to your individual RPCs in the last two weeks of June. So, for example:

| | **You** | **Your Partner** | **Total** |
|---|---|---|---|
| Week 1 | \$70 | \$60 | = \$130 |
| June 17 - 30 | \$50 | \$50 | = \$100 |
| Group RPC Growth | | | 30% |
| Group Score | | | 130 |

**Next Steps...** Reach out to your partner, ask them about their calls, you never know, it might help your numbers.

**Week 2 Results**[30] Winners in green. How did we pick winners? We didn't. Winners won. We randomized all pairs into brackets of three, and the best team won. The scoreboard is reset every Sunday, do it again and win a 30-min on-site massage next week.

*Structured-Meetings*

**(FREE) Lunch** You and your partner will be involved in our lunch chat initiative where you two meet over lunch on Wednesday or Thursday, provided you have both filled out a simple worksheet and handed it to your employee advisor by Wednesday.

**WHY?** We want to encourage you to talk about your calls with colleagues, and possibly meet some new people along the way. We encourage you to meet and learn from your partner as early in the week as possible. When the books close on Saturday, we will combine your average RPC growth relative to your average individual RPC in the last two weeks.

**How it works** 1) Please print out the worksheet on the right or ask [your manager] for a golden worksheet. 2) Fill out the front side on your own. 3) Work face-to-face with your partner to complete the back of the worksheet and agree on when you'd like to lunch. 4) Once you are finished, please go together and hand in both completed worksheets to your employee adviser. 5) Pick-up your lunch on Wednesday or Thursday, on us...

**Scoring** To score each pair and keep the tournament fair, we will be measuring your joint, weekly RPC relative to your individual RPCs in the last two weeks of June. So, for example:

30. This text referenced a table that listed the Group Score for each group. This table was only added after results were present, but it is an example of how feedback was communicated to agents.

| | You | Your Partner | Total |
|---|---|---|---|
| Week 1 | \$70 | \$60 | = \$130 |
| June 17 - 30 | \$50 | \$50 | = \$100 |
| Group RPC Growth | | | 30% |
| Group Score | | | 130 |

*Internal Control and Combined*

Agents in the *Internal Control* group received only the "Why" and "Scoring" parts of the communication that was given to the *Pair-Incentives* treatment. Agents in the *Combined* treatment got descriptions for both the "Competition" and the "Free Lunch."

## *Worksheets Given to Partners in the Structured-Meetings and Combined Treatments*

The following are the materials that were provided to sales agents in the *Structured-Meetings* and *Combined* treatments. The first two pages show the front and back sides of the collaboration worksheets handed out to agents and completed at the beginning of each week. The third page contains the lunchtime talking points that were given to partners as they ate their free lunch.

[redacted] Sales Representative Collaboration Worksheet
PLEASE PRINT LEGIBLY

Your Full Name: _____ [redacted]: _____

Think about the **most successful** sales call **you** had in the last week. What did you do that made it successful?

Think about the **least successful** sales call **you've** had in the last week. How could you have done better?

Describe the most difficult deal-breaker that **you've** come across **in the last week**; for example: *upgrading callers to a specific new bundle*.

Please write down two goals for **you** to work on for the **rest of this week**; for example: *be braver in suggesting products*.

Goal 1:

Goal 2:

If you did the same exercise **last week**: were you successful in executing your goals? If no, why not?

Goal 1:

Goal 2:

**Your Partner's** Full name and [redacted]ID: _____

Please TALK to your partner about the questions below and write down their responses.

Ask **your partner** about their **most successful** sales call **last week,** what did they do right?

Ask **your partner** about their **least successful** sales call from the **last week**. What advice did **you** offer your partner?

Was **your partner** successful in accomplishing their goals **last week**? If no, why not?

Goal 1:

Goal 2:

What are **your partner's** two goals for **rest of this week**?

Goal 1:

Goal 2:

Please write down one thing **your partner recommended you** to try:

What day would you and our partner like to pick-up lunch from 12-2? (must hand in with 24 hour notice!): ☐ Thursday ☐ Friday

RXd by Adviser: date/time:

## Lunch Talking Points

[redacted] 3 & 4

You do not need to turn this sheet in, put please read through it: is designed to help you make the most of the time with your partner.

1) *Bon Appetit!*

2) Have either of you had an awesome sale since you last met? What made it great?

3) Have either of you had a call go completely sideways? What happened? Does your partner have any advice?

4) Your partner gave you some advice on how to handle difficult stations earlier this week. Did it help?

5) You and your partner each made goals earlier this week, what progress have you each made on those goals?

6) If you have suggestions on how this lunch program could be more productive, please let your adviser know—we greatly appreciate your feedback.

Thank you!

# C Figures and Tables

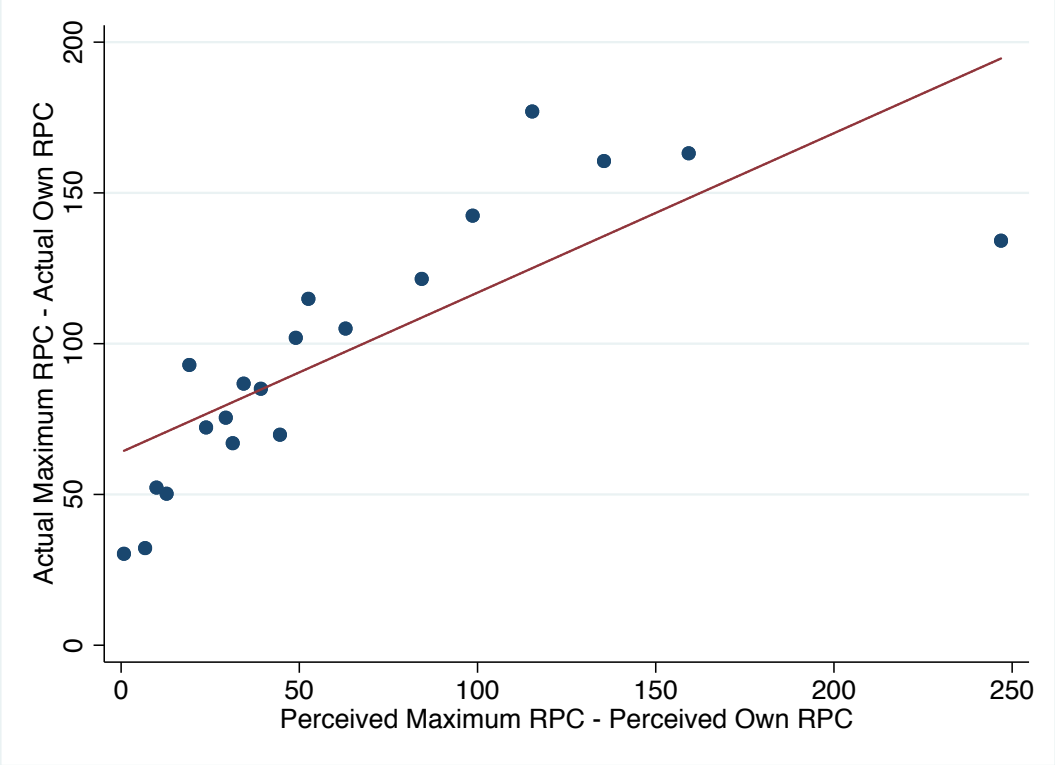


FIGURE A.1.
Perceived and Actual Differences Between Individual and the Top Sales Agents

This figure plots the difference between i) the maximum RPC in a division/office and the agent's own RPC against ii) the agent's report of their perceived maximum RPC in their own division and office relative to their own RPC (N=469). The upward sloping fit indicates that agents who perceive a greater distance between themselves and the top performers in their division are likely to have the largest actual distance from the top agents. These measures were collected in a follow-up survey done over a year after the end of the intervention. The standard deviation of the perceived versus actual difference is similar for agents who were present during the experiment and those who joined the firm after interventions had concluded.

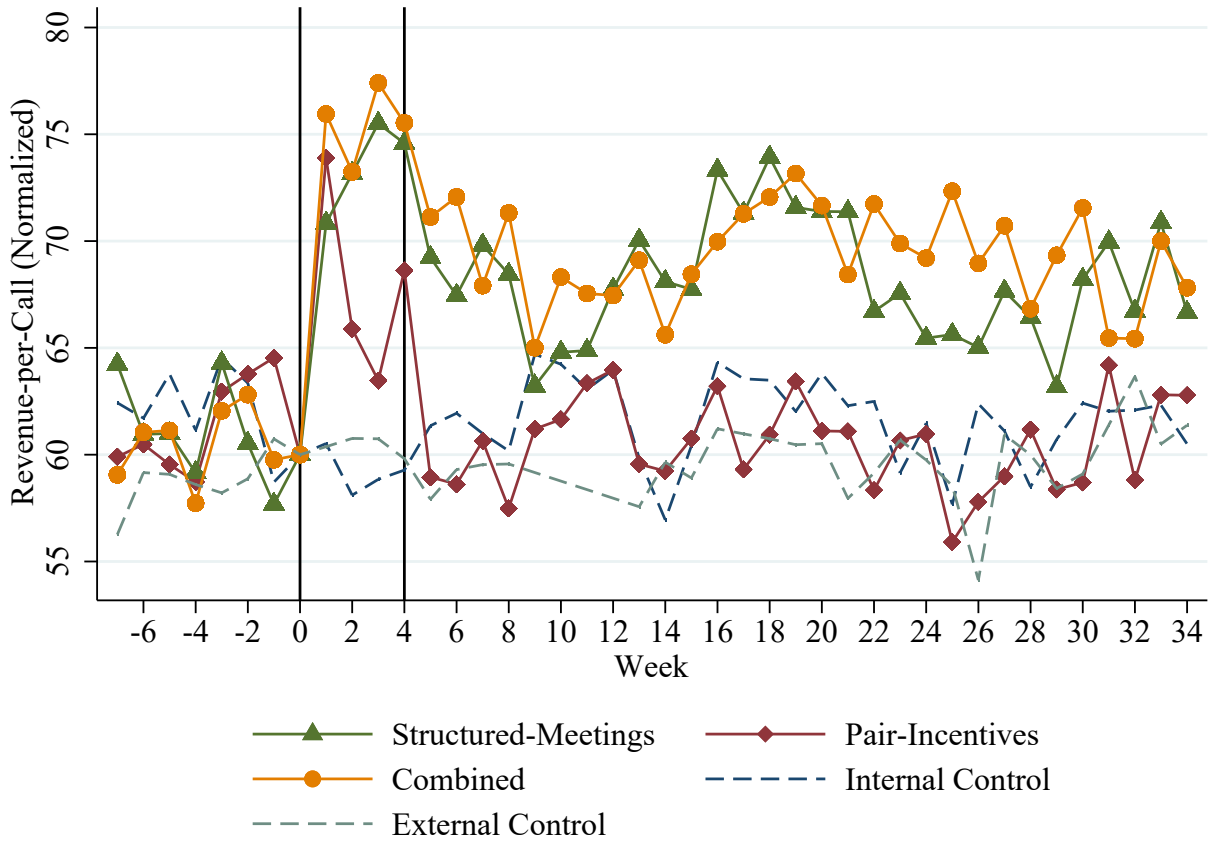


FIGURE A.2.
Revenue-per-Call Over an Extended Post-Intervention Period

This figure replicates Figure IV but extends the data through 34 weeks after the beginning of interventions. There are 736 agents over 13,321 agent-weeks.

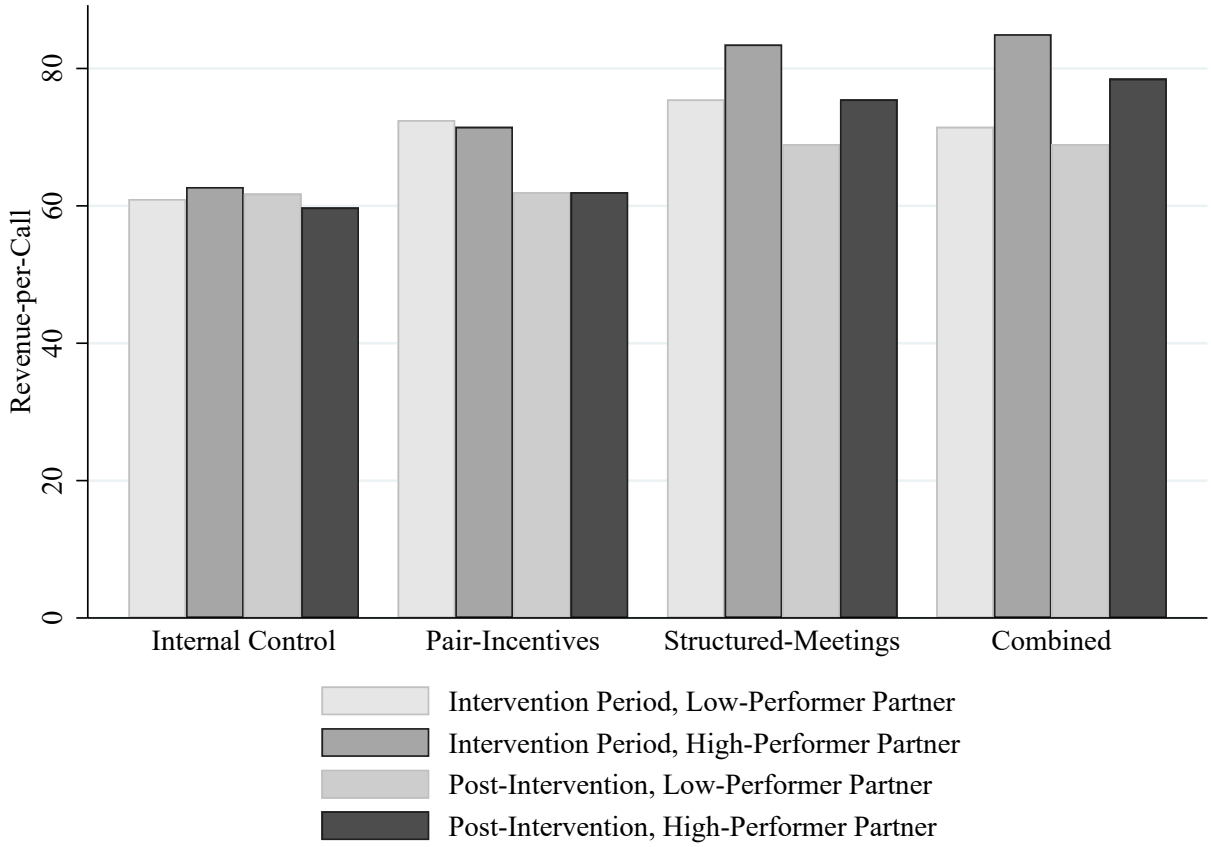


FIGURE A.3.
Average Revenue-per-Call in the Intervention and Post-Intervention Periods by High-Performer Partner Assignment

This figure displays average revenue-per-call (RPC) by treatment group during the intervention period (N=1,654 agent-weeks) and the post-intervention period (N=4,472 agent-weeks), based on whether the agent was randomly paired with a high-performer (defined as above median RPC within division in the pre-intervention period). Agents are classified as being paired with a high-performer during the intervention period based on their concurrent partner match (N=833 agent-weeks with a high-performer partner). In the post-intervention period, agents are classified as paired with a high-performing partner if they were ever assigned a high-performer partner (N=2,896 agent-weeks after pairing with a high-performer partner). The External Control group is not included in this sample due to lack of a partner pairing.

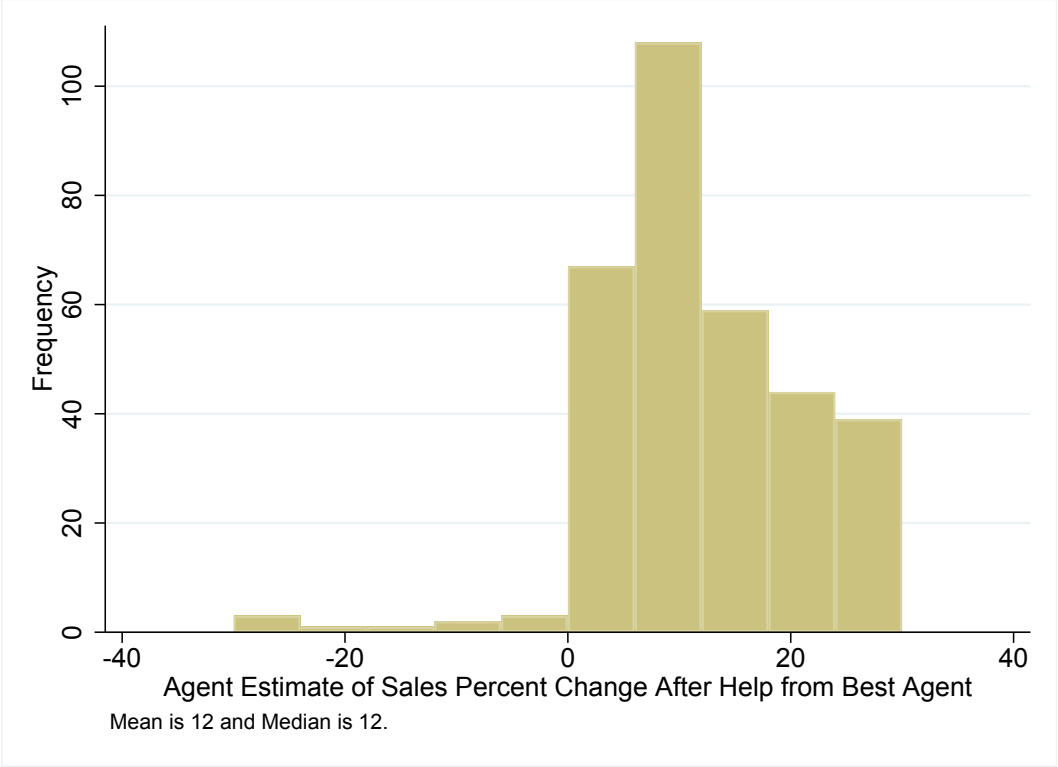


FIGURE A.4.
Agents' Reported Estimates of Perceived Treatment Effects After Help from High-Performers

This figure plots agents' responses to a survey question asking for their estimated percentage change in RPC if they were to receive help from the top agent on their team. This measure was collected in a follow-up survey done over a year after the end of treatment (N=327 for this question). There are no differences for agents who joined the firm after interventions concluded and who were not exposed to treatments. Prior to the experiment, agents responded that they believed reaching out to coworkers had positive benefits. In response to the question "On average, when you reach out to others about individual calls or selling, how beneficial are those conversations to you?," 0.8% of respondents answered "Always disappointing," 3.5% answered "Often disappointing," 20% answered "OK," 54% answered "Often helpful," and 21% answered "Always helpful."

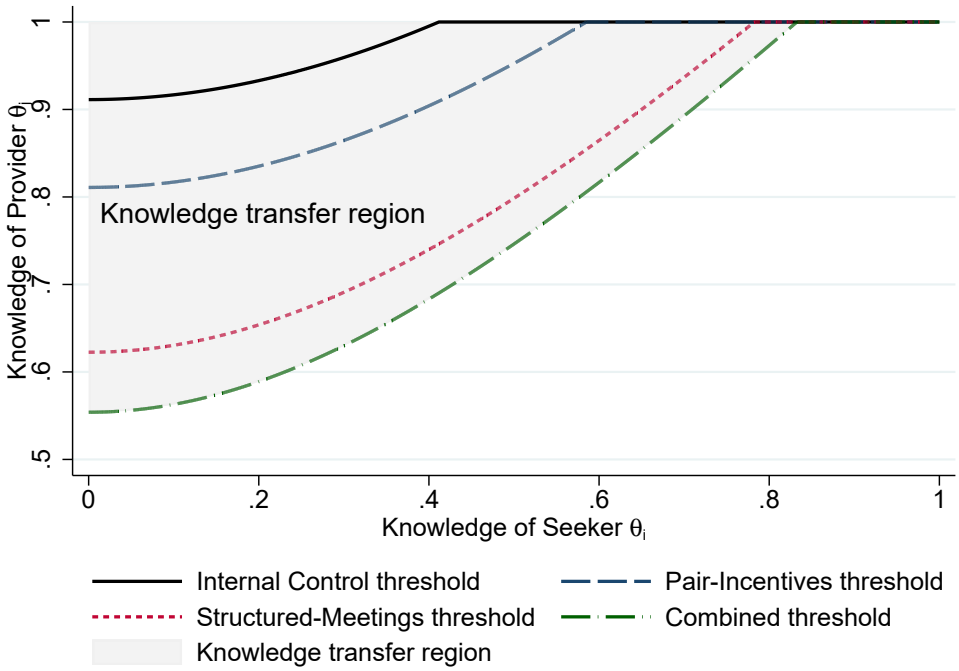


FIGURE A.5.
Knowledge Transfer Region

This figure plots the region in which knowledge transfers will occur in the knowledge seeker - knowledge provider space. All curves reflect a baseline commission rate of $B = 0.425$, and the underlying cost threshold is given by $K = 0.075$ (see Online Appendix A for definitions). The solid curve plots the knowledge provider's level of knowledge, $\theta_H$, required by the knowledge seeker as a function of their own knowledge level, $\theta_L$ for the Internal Control group. The long-dashed curve (Pair-Incentives threshold) reflects the knowledge seeker's reduced requirements vis-à-vis the knowledge provider when both earn a marginal commission of $b = 0.05$ on their joint output. The small-dashed curve (Structured-Meetings threshold) reflects a reduced threshold cost, $K' = 0.035$, which further reduces the knowledge seeker's requirements regarding the knowledge provider's knowledge level. Finally, the dashed and dotted curve reflects the Combined threshold with $b = 0.05$ and $K' = 0.035$.

TABLE A.1.
PRE-EXPERIMENT AND POST-EXPERIMENT SURVEY RESPONSES FOR TREATMENT-ELIGIBLE AGENTS

| | Full Sample | Internal Control | Pair-Incentives | Structured-Meetings | Combined |
|---|---|---|---|---|---|
| | | Panel A: Pre-Experiment Survey | | | |
| *On a scale of 1-5, how connected do you feel to others within the firm?* | 3.7 | 3.7 | 3.4 | 3.7 | 3.8 |
| *How many work-related interactions do you initiate in an average work week?* | 5.8 | 5.0 | 5.3 | 7.1 | 6.1 |
| *On a scale of 1-5, how beneficial are these interactions to you personally?* | 3.9 | 3.9 | 3.9 | 4.0 | 4.0 |
| *What dollar value would you be willing to spend on the proposed incentives?* | \$40.20 | | | | |
| | | Panel B: Post-Experiment Survey | | | |
| *I was aware of the [treatment] that took place this past month.* | 82.5% | 77.4% | 78.3% | 84.8% | 92.0% |
| *We turned in a completed worksheet each week.* | | | | 82.6% | 88.2% |
| *I spent [ ] minutes with my partner on the worksheet.* | | | | 6.3 | 7.3 |
| *These interactions with my partner were beneficial.* | | | | 78.6% | 76.0% |
| $N_A$ (Agents) | 378 | 115 | 83 | 105 | 75 |

*Notes.* Panel A contains answers from the preliminary survey that we administered one week prior to the start of the experiment. The survey was not given to the External Control group. The question wording, as displayed, has been adapted from its original form to remove institutionally distinct jargon. Agents were provided with a link to the survey and were asked to complete it while at work. Agents were not aware of which treatment they were going to be placed in at the time they took the survey. The question regarding the dollar value of the proposed incentives is the average valuation for the set of prizes offered in the Pair-Incentives treatment. Panel B contains responses given at the end of the intervention period using the same protocol.

TABLE A.2.
Balance Across Managers

| | Full Sample | Structured Meetings | Pair Incentives | Combined | Internal Control | External Control | P-Value |
|---|---|---|---|---|---|---|---|
| Manager Age (yrs.) | | | | | | | |
| Mean | 29.27 | 29.38 | 29.15 | 28.97 | 30.62 | 27.02 | 0.853 |
| Std Dev. | 4.972 | 4.336 | 4.209 | 6.269 | 5.775 | 2.085 | |
| Manager Tenure (yrs.) | | | | | | | |
| Mean | 3.065 | 3.688 | 3.449 | 2.742 | 3.094 | 1.634 | 0.542 |
| Std Dev. | 1.777 | 1.566 | 1.968 | 1.603 | 1.967 | 1.224 | |
| Manager Female | | | | | | | |
| Mean | 0.138 | 0.0769 | 0.167 | 0.0714 | 0.154 | 0.333 | 0.827 |
| Std Dev. | 0.348 | 0.277 | 0.389 | 0.267 | 0.376 | 0.516 | |
| Average log(RPC) of Agents on Team Pre-Intervention | | | | | | | |
| Mean | 3.958 | 3.917 | 4.127 | 4.044 | 3.877 | 3.655 | 0.601 |
| Std Dev. | 0.430 | 0.400 | 0.369 | 0.388 | 0.614 | 0.109 | |
| Number of Agents on Team during Intervention | | | | | | | |
| Mean | 12.69 | 12.15 | 11.25 | 12.43 | 14.31 | 13.83 | 0.870 |
| Std Dev. | 4.07 | 3.60 | 3.68 | 3.06 | 4.40 | 3.13 | |
| N Managers | 58 | 13 | 12 | 14 | 13 | 6 | |

*Notes.* Manager demographics and average team characteristics are displayed by treatment group. P-values in the final column are tests for differences between groups for treatment-eligible managers in the firm's two primary offices. These tests are computed as the joint hypothesis test of equality of treatment group indicators from a regression of the variable of interest on treatment assignment dummies.

TABLE A.3.

ANALYSIS OF OTHER SALES MEASURES IN THE INTERVENTION AND POST-INTERVENTION PERIODS

| | Revenue-per-Hour | | Log Revenue-per-Hour | | Revenue-per-Call | |
|---|---|---|---|---|---|---|
| | Intervention | Post | Intervention | Post | Intervention | Post |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Structured-Meetings | 32.910*** | 25.360*** | 0.222*** | 0.141* | 19.252*** | 15.664** |
| | (6.876) | (9.043) | (0.082) | (0.072) | (3.975) | (6.740) |
| Pair-Incentives | 16.893** | 13.977 | 0.086* | 0.052 | 12.622*** | 5.009 |
| | (6.841) | (10.247) | (0.051) | (0.092) | (3.582) | (3.299) |
| Combined | 28.351*** | 30.058*** | 0.187*** | 0.159** | 17.171*** | 9.950** |
| | (5.433) | (7.496) | (0.059) | (0.080) | (5.373) | (3.747) |
| Internal Control | 10.606 | 8.557 | 0.030 | -0.002 | 1.795 | 2.224 |
| | (6.415) | (8.801) | (0.058) | (0.059) | (2.491) | (3.802) |
| Manager FE ($\theta_g$) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Week FE ($\lambda_t$) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Adj. R-Squared | 0.274 | 0.252 | 0.371 | 0.372 | 0.444 | 0.362 |
| Observations | 3,821 | 7,334 | 3,821 | 7,334 | 3,821 | 7,334 |
| P-Value from Randomization: | <0.01 | <0.01 | 0.012 | 0.165 | <0.01 | 0.013 |

*Notes.* This table reports difference-in-differences regressions for the outcome displayed in the column headings. Samples contain the four weeks of pre-intervention data and either the four weeks of intervention data or the 20 weeks of post-intervention data. Specifications in odd-numbered columns mimic those in Table II column (3) and specifications in even numbered columns mimic those in Table III column (3). The p-value from randomization reports the Young (2018) test of the sharp null of no treatment effects for the three active treatments. Standard errors are clustered at the sales manager level and are reported in parentheses.

*10%, **5%, and ***1% significance level.

TABLE A.4.
Do Agents Give-up After Winning or Losing a Prize

| | Pair-Incentives | Combined | Both |
|---|---|---|---|
| | (1) | (2) | (3) |
| Won Last Week | -0.031** | -0.029* | -0.035*** |
| | (0.015) | (0.016) | (0.011) |
| Manager FE ($\theta_g$) | ✓ | ✓ | ✓ |
| Week FE ($\lambda_t$) | ✓ | ✓ | ✓ |
| R-Square | 0.110 | 0.156 | 0.134 |
| Observations | 744 | 912 | 1,656 |

*Notes.* This table reports regressions of log RPC on an indicator that the agent received a prize in the prior week. The estimate is relative to a baseline of agents who did not win in the previous week. The sample contains only those agents in either the Pair Incentives or Combined treatments during the intervention period. Standard errors are clustered at the sales manager level and are reported in parentheses.

*10%, **5%, and ***1% significance level.

TABLE A.5.
DIFFERENCE-IN-DIFFERENCES ESTIMATES OF TREATMENT EFFECTS AT THE MANAGER LEVEL

| | Intervention Period | | Post-Intervention Period | | Intervention Period | | Post-Intervention Period | |
|---|---|---|---|---|---|---|---|---|
| | Log RPC | Revenue | Log RPC | Revenue | Log RPC | Revenue | Log RPC | Revenue |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Structured-Meetings | 0.279*** | 715.383*** | 0.235*** | 1045.497*** | 0.247*** | 578.784*** | 0.204** | 816.750*** |
| | (0.048) | (162.036) | (0.084) | (373.066) | (0.044) | (143.604) | (0.084) | (295.624) |
| Pair-Incentives | 0.163*** | 377.841 | 0.082 | 635.538 | 0.140*** | 474.945** | 0.084 | 475.052 |
| | (0.052) | (246.178) | (0.077) | (479.794) | (0.046) | (207.844) | (0.069) | (371.286) |
| Combined | 0.284*** | 551.714** | 0.240*** | 869.862*** | 0.265*** | 722.538*** | 0.225*** | 810.716*** |
| | (0.063) | (273.671) | (0.080) | (259.115) | (0.057) | (182.538) | (0.080) | (215.630) |
| Internal Control | 0.026 | -56.733 | 0.007 | 85.567 | 0.010 | -7.525 | 0.017 | -21.210 |
| | (0.052) | (243.890) | (0.086) | (320.078) | (0.044) | (229.986) | (0.076) | (321.624) |
| Manager FE ($\theta_g$) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Week FE ($\lambda_t$) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Weighted by Team Size | | | | | ✓ | ✓ | ✓ | ✓ |
| Adj. R-Squared | 0.777 | 0.563 | 0.670 | 0.499 | 0.855 | 0.681 | 0.767 | 0.625 |
| Observations | 433 | 433 | 1,271 | 1,271 | 433 | 433 | 1,271 | 1,271 |

*Notes.* This table displays difference-in-differences estimates where the dependent variable in each column is averaged at the manager-week level. Here the manager-week level comes from fixed manager groupings at the time of assignment, and agents in the original group are averaged together even if working under a different manager in the post-intervention period. Columns (5)–(8) weight by the number of agents on a team in each week, as suggested by Chandar et al. (2019). Standard errors are clustered at the sales manager level and are reported in parentheses.

*10%, **5%, and ***1% significance level.

TABLE A.6.
Estimates of Quality Changes During the Intervention Period

| | |
|---|---|
| Structured-Meetings | 0.118 |
| | (0.104) |
| Pair-Incentives | 0.087 |
| | (0.097) |
| Combined | -0.069 |
| | (0.088) |
| Adj. R-Square | 0.338 |
| Observations | 2,400 |

*Notes.* This table reports analysis of how a quality proxy changes by treatment during the intervention period. The fraction of revenue paid to agents as commissions is a function of relative RPC, relative RPH, and audited call quality. Because we lack data on audited call quality, we proxy for it by asking whether the fraction of revenue paid as commissions changes with treatment. The quality proxy is $log(Commission) - log(Revenue)$. We regress this proxy on indicators for treatments x Intervention Period, quintiles of RPH-by-division fixed effects, quintiles of RPC-by-division fixed effects, manager fixed effects, and week fixed effects. Commission calculations are not centralized, so we do not have data for the External Control group. We are also missing two weeks of pre-intervention data and all commission data in the post-intervention period. Standard errors are clustered at the sales manager level and are reported in parentheses.

*10%, **5%, and ***1% significance level.

TABLE A.7.
TWO-WAY CLUSTER DIFFERENCE-IN-DIFFERENCES ESTIMATES OF LOG REVENUE-PER-CALL CHANGES DURING THE POST-INTERVENTION PERIOD

| Dependent Variable: | Log Revenue-per-Call | | | | | Revenue-per-Week |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Structured-Meetings | 0.189** | 0.204** | 0.204** | 0.211*** | 0.174** | 816.750*** |
| | (0.075) | (0.082) | (0.082) | (0.081) | (0.077) | (295.624) |
| Pair-Incentives | 0.069 | 0.085 | 0.084 | 0.128 | 0.127 | 475.052 |
| | (0.065) | (0.067) | (0.067) | (0.087) | (0.080) | (371.286) |
| Combined | 0.210*** | 0.225*** | 0.225*** | 0.231*** | 0.276*** | 810.716*** |
| | (0.073) | (0.081) | (0.081) | (0.077) | (0.076) | (215.630) |
| Internal Control | | | 0.017 | 0.038 | 0.063 | -21.210 |
| | | | (0.071) | (0.067) | (0.056) | (321.624) |
| Control Group: | Internal | External | Both | Both | Both | Both |
| Manager FE ($\theta_g$) | ✓ | ✓ | ✓ | ✓ | | ✓ |
| Balanced panel | | | | ✓ | | |
| Individual FE ($\theta_i$) | | | | | ✓ | |
| Week FE ($\lambda_t$) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Adj. R-Squared | 0.336 | 0.396 | 0.389 | 0.420 | 0.528 | 0.625 |
| Observations | 6,236 | 6,026 | 7,334 | 5,518 | 7,334 | 7,334 |
| Individuals | 628 | 535 | 711 | 388 | 711 | 711 |
| Managers | 52 | 45 | 58 | 58 | 58 | 58 |

*Notes.* This table replicates the specifications in Table III, except standard errors are two-way clustered by sales manager and week (reported in parentheses).

*10%, **5%, and ***1% significance level.

TABLE A.8.
ESTIMATES OF PERSISTENCE OF LOG REVENUE-PER-CALL GAINS OVER DIFFERENT INTERVALS IN THE POST-INTERVENTION PERIOD

| | Weeks 5–8 | Weeks 9–12 | Weeks 13–16 | Weeks 17–20 | Weeks 21–24 | Weeks 5–24 |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *Weeks 5–8* | | | | | | |
| Structured-Meetings | 0.208*** | | | | | 0.258*** |
| | (0.061) | | | | | (0.077) |
| Pair-Incentives | 0.030 | | | | | 0.058 |
| | (0.057) | | | | | (0.071) |
| Combined | 0.242*** | | | | | 0.288*** |
| | (0.062) | | | | | (0.084) |
| *Weeks 9–12* | | | | | | |
| Structured-Meetings | | 0.090 | | | | 0.087 |
| | | (0.075) | | | | (0.078) |
| Pair-Incentives | | 0.039 | | | | 0.019 |
| | | (0.060) | | | | (0.063) |
| Combined | | 0.147** | | | | 0.123 |
| | | (0.071) | | | | (0.074) |
| *Weeks 13–16* | | | | | | |
| Structured-Meetings | | | 0.176 | | | 0.185* |
| | | | (0.108) | | | (0.108) |
| Pair-Incentives | | | 0.044 | | | 0.076 |
| | | | (0.093) | | | (0.094) |
| Combined | | | 0.144 | | | 0.142 |
| | | | (0.095) | | | (0.096) |
| *Weeks 17–20* | | | | | | |
| Structured-Meetings | | | | 0.177 | | 0.216 |
| | | | | (0.140) | | (0.130) |
| Pair-Incentives | | | | 0.064 | | 0.140 |
| | | | | (0.125) | | (0.116) |
| Combined | | | | 0.231* | | 0.259** |
| | | | | (0.130) | | (0.119) |
| *Weeks 21–24* | | | | | | |
| Structured-Meetings | | | | | 0.136 | 0.188* |
| | | | | | (0.113) | (0.105) |
| Pair-Incentives | | | | | 0.030 | 0.129 |
| | | | | | (0.096) | (0.089) |
| Combined | | | | | 0.154 | 0.211** |
| | | | | | (0.104) | (0.096) |
| Manager FE ($\theta_g$) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Week FE ($\lambda_t$) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Adj. R-Squared | 0.418 | 0.290 | 0.319 | 0.301 | 0.306 | 0.339 |
| Observations | 3,252 | 2,724 | 2,545 | 2,426 | 2,341 | 6,236 |

*Notes.* This table presents estimates of log RPC persistence using a specification analogous to Table III column (1). Columns (1)–(5) include the pre-period and a different four-week interval in the post-intervention period. The variables Structured-Meetings, Pair-Incentives, and Combined are set to one in the weeks after the intervention for those assigned to the treatment and are zero otherwise. The specification in column (6) includes separate interactions for each of these four-week intervals. The Internal Control group is the omitted category. Standard errors are clustered at the sales manager level and are reported in parentheses.

*10%, **5%, and ***1% significance level.

TABLE A.9.

TREATMENT EFFECT ESTIMATES IN THE POST-INTERVENTION PERIOD WEIGHTING BY THE INVERSE NUMBER OF WEEKS AN AGENT IS IN THE SAMPLE

| Dependent Variable: | Log Revenue-per-Call | | | | | Revenue-per-Week |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Structured-Meetings | 0.217** | 0.238** | 0.237** | 0.244*** | 0.280*** | 1147.746*** |
| | (0.090) | (0.108) | (0.107) | (0.090) | (0.084) | (348.678) |
| Pair-Incentives | 0.016 | 0.033 | 0.035 | 0.037 | 0.070 | 510.916 |
| | (0.079) | (0.098) | (0.097) | (0.096) | (0.095) | (331.002) |
| Combined | 0.169* | 0.186 | 0.188* | 0.302*** | 0.341*** | 940.872*** |
| | (0.096) | (0.111) | (0.111) | (0.102) | (0.094) | (216.859) |
| Internal Control | | | 0.021 | 0.140* | 0.112 | 33.267 |
| | | | (0.112) | (0.072) | (0.073) | (343.330) |
| Control Group: | Internal | External | Both | Both | Both | Both |
| Manager FE ($\theta_g$) | ✓ | ✓ | ✓ | ✓ | | ✓ |
| Balanced panel | | | | ✓ | | |
| Individual FE ($\theta_i$) | | | | | ✓ | |
| Week FE ($\lambda_t$) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Adj. R-Squared | 0.375 | 0.388 | 0.397 | 0.412 | 0.598 | 0.679 |
| Observations | 6,236 | 6,026 | 7,334 | 4,811 | 7,334 | 7,334 |

*Notes.* This table replicates the specifications in Table III, except regressions are weighted by the inverse number of weeks an agent is observed in the sample. Standard errors are clustered at the sales manager level and are reported in parentheses.

*10%, **5%, and ***1% significance level.

TABLE A.10.
AGENT TURNOVER AT DIFFERENT HORIZONS

| Turnover by: | Week 8 | Week 12 | Week 16 | Week 20 | Week 24 |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Structured-Meetings | 0.022 | 0.045 | -0.021 | -0.004 | -0.010 |
| | (0.065) | (0.070) | (0.065) | (0.061) | (0.062) |
| Pair-Incentives | 0.013 | 0.020 | -0.044 | -0.027 | -0.057 |
| | (0.060) | (0.071) | (0.079) | (0.075) | (0.077) |
| Combined | 0.004 | -0.000 | -0.078 | -0.065 | -0.074 |
| | (0.074) | (0.083) | (0.080) | (0.084) | (0.090) |
| Adj. R-Squared | -0.004 | -0.003 | -0.001 | -0.002 | -0.001 |
| Observations | 653 | 653 | 653 | 653 | 653 |

*Notes.* This table reports regressions of an indicator for agent turnover across different horizons after interventions begin on treatment assignment indicators. The dependent variable is an indicator that the agent is no longer included in the sample. The omitted category is the Internal Control. Standard errors are clustered at the sales manager level and are reported in parentheses.

*10%, **5%, and ***1% significance level.

TABLE A.11.
TREATMENT EFFECT HETEROGENEITY ON LOG REVENUE-PER-CALL BY PARTNER AND AGENT PERFORMANCE

| | Intervention Period | | | Post-Period | | |
|---|---|---|---|---|---|---|
| | Full sample | Low-Performer Agents | High-Performer Agents | Full sample | Low-Performer Agents | High-Performer Agents |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Structured-Meetings × High-Performing Partner | 0.120** | 0.217*** | 0.159*** | 0.238** | 0.353** | 0.079 |
| | (0.045) | (0.050) | (0.054) | (0.096) | (0.138) | (0.085) |
| Pair-Incentives × High-Performing Partner | 0.047 | 0.080 | 0.073 | 0.085 | 0.025 | 0.040 |
| | (0.047) | (0.059) | (0.053) | (0.078) | (0.089) | (0.089) |
| Combined × High-Performing Partner | 0.189*** | 0.250*** | 0.200*** | 0.245*** | 0.374*** | 0.115 |
| | (0.055) | (0.080) | (0.051) | (0.083) | (0.102) | (0.083) |
| Structured-Meetings | 0.180*** | 0.228*** | 0.071 | 0.021 | 0.087 | 0.054 |
| | (0.039) | (0.052) | (0.056) | (0.094) | (0.117) | (0.089) |
| Pair-Incentives | 0.115*** | 0.209*** | 0.056 | -0.061 | -0.099 | 0.089 |
| | (0.036) | (0.055) | (0.040) | (0.092) | (0.112) | (0.096) |
| Combined | 0.164** | 0.247*** | 0.089 | 0.043 | 0.158 | 0.038 |
| | (0.068) | (0.062) | (0.065) | (0.100) | (0.111) | (0.111) |
| Manager FE ($\theta_g$) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Week FE ($\lambda_t$) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Adj. R-Squared | 0.422 | 0.478 | 0.370 | 0.341 | 0.449 | 0.296 |
| Observations | 3,418 | 1,484 | 1,934 | 6,236 | 2,745 | 3,491 |
| P-Value from Wild Bootstrap: | 0.01 | $< 0.01$ | $< 0.01$ | 0.13 | 0.08 | 0.47 |

*Notes.* This table reports regressions of log RPC with interactions for treatment assignment and random pairing with a high-performing partner. See notes for Table IV. Standard errors are clustered at the sales manager level and are reported in parentheses.
*10%, **5%, and ***1% significance level.

TABLE A.12.
TREATMENT EFFECT HETEROGENEITY ON TOTAL CALLS BY PARTNER AND AGENT PERFORMANCE

| | Intervention Period | | | Post-Intervention Period | | |
|---|---|---|---|---|---|---|
| | Full sample | Low-Performer Agents | High-Performer Agents | Full sample | Low-Performer Agents | High-Performer Agents |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Structured-Meetings × High Performing Partner | 1.061 | -3.496 | 5.406 | 5.535 | 6.589 | 2.349 |
| | (3.229) | (4.200) | (4.330) | (5.756) | (6.058) | (6.033) |
| Pair-Incentives × High Performing Partner | -6.194* | -3.935 | -7.661* | 0.417 | 1.125 | -8.232 |
| | (3.212) | (3.988) | (4.393) | (5.722) | (3.441) | (9.629) |
| Combined × High Performing Partner | 1.719 | -0.032 | 4.040 | 3.524 | 10.913 | -2.317 |
| | (3.695) | (5.192) | (4.723) | (5.449) | (7.464) | (6.092) |
| Structured-Meetings | 0.450 | 0.509 | 0.817 | -3.690 | -4.581 | 1.382 |
| | (5.058) | (6.511) | (4.529) | (6.173) | (7.404) | (8.181) |
| Pair-Incentives | 0.596 | -6.676 | 7.203 | -4.046 | -12.230* | 11.970 |
| | (4.530) | (5.196) | (4.627) | (6.884) | (6.798) | (10.253) |
| Combined | -3.714 | -5.345 | -2.027 | -7.559 | -16.077** | 0.027 |
| | (4.998) | (6.594) | (5.594) | (5.738) | (7.068) | (8.354) |
| Manager FE ($\theta_g$) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Week FE ($\lambda_t$) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Adj. R-Squared | 0.153 | 0.241 | 0.100 | 0.156 | 0.205 | 0.179 |
| Observations | 3,020 | 1,327 | 1,693 | 5,893 | 2,605 | 3,288 |
| P-Value from Wild Bootstrap: | 0.23 | 0.81 | 0.19 | 0.75 | 0.11 | 0.13 |

*Notes.* The table reports regressions of total calls per week, with interactions for treatment assignment and random pairing with a high-performing partner. For details on the specification, see notes for Table IV. Standard errors are clustered at the sales manager level and are reported in parentheses.

*10%, **5%, and ***1% significance level.

TABLE A.13.
EXAMPLE WORKSHEET RESPONSES ORGANIZED BY WORD PREVALENCE

| | Please write down one thing **your partner recommended you** to try. | | |
|---|---|---|---|
| Type | Key Word | N | Example Response |
| Knowledge | Pitch* | 76 | "Naturally pitch extras..." |
| | Call | 64 | "Follow call flow to offer [specific product]." |
| | Product** | 57 | "Work on [product name] pitch, be more strategic." |
| | Customer | 39 | "Match and mirror the customer." |
| | Time | 26 | "Be more direct and shorten call time." |
| | Brand*** | 22 | "...assume [brand] as part of up-front costs..." |
| | Assume | 22 | "Study packages! Be assumptive [of the sale]." |
| | Sell | 18 | "Don't be afraid to up-sell and provide the details ..." |
| | Push | 15 | "Push for [add-on features] when closing..." |
| | Ask | 14 | "Use the notepad... to remember what questions to ask..." |
| | Process | 12 | "Make sure to follow new updated sales process..." |
| | Value | 11 | "Educate them on the value of [product]." |
| | $ | 11 | "...set the expectation of $2.99." |
| | Slow | 10 | "Slow down [when] reading recaps." |
| | Phone | 9 | "Remember we can always pitch cell phones." |
| | Offer | 8 | "Lead offer with 2nd year price..." |
| | Control | 8 | "Get info on them to use later to regain control." |
| | Hold | 8 | "Don't go on hold until after credit check." |
| | Discover | 7 | "Get the most out of discover before lead offer." |
| | Rebuttal | 7 | "Rebuttal when you get ... a no, and ask why." |
| | Price | 7 | "Give non-sales price before promotional price." |
| | Close | 7 | "Gave me points on how to close on the 1st call." |
| | Quality | 6 | "... make sure you achieve 8/8 quality scores." |
| | Connect | 6 | "Use hold time to connect [with the customer]." |
| Support | Positive | 27 | "Stay positive." |
| | Confident | 10 | "Be confident." |
| | Patience | 7 | "Be more patient." |
| | Breath | 6 | "Breathing, everything will work out." |
| | Laugh | 6 | "Laugh often." |
| | Don't Give Up | 6 | "Find your drive! Don't give up!" |

*Notes.* *Responses are marked as containing "Pitch" if either the word "pitch" is present in the response or if the response itself is the advised pitch. **This includes responses that use the word "product" or that mention a specific type of product—e.g., "TV" or "security." ***This indicates responses that mention a specific brand name. Responses that include common variants of words—e.g., "positive" versus "positivity"—are marked as containing the main word. Similarly, "patience" gets grouped under the "patient" category, and "confidence" gets grouped under the "confident" classification, etc.

TABLE A.14.
ESTIMATES OF TREATMENT EFFECTS DURING THE POST-INTERVENTION PERIOD, ALLOWING FOR HETEROGENEITY BASED ON PARTNERS REPORTING TO A DIFFERENT MANAGER

| Dependent Variable: | Log Revenue-per-Call | | | | | Revenue-per-Week |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Structured-Meetings | 0.189** | 0.237*** | 0.216** | 0.216** | 0.258*** | 743.333** |
| | (0.087) | (0.084) | (0.082) | (0.089) | (0.078) | (308.979) |
| Pair-Incentives | 0.093 | 0.146 | 0.121 | 0.135 | 0.133 | 413.483 |
| | (0.090) | (0.087) | (0.085) | (0.112) | (0.111) | (333.524) |
| Combined | 0.162* | 0.207** | 0.188** | 0.236** | 0.216* | 817.925*** |
| | (0.091) | (0.090) | (0.087) | (0.106) | (0.118) | (215.373) |
| Internal Control | | | 0.038 | 0.135 | 0.050 | 64.683 |
| | | | (0.086) | (0.096) | (0.077) | (294.341) |
| Structured-Meetings x Distant | 0.001 | -0.044 | -0.016 | -0.041 | -0.021 | 103.586 |
| | (0.057) | (0.057) | (0.056) | (0.080) | (0.047) | (120.149) |
| Pair-Incentives x Distant | -0.029 | -0.075 | -0.046 | -0.027 | -0.026 | 74.676 |
| | (0.051) | (0.053) | (0.050) | (0.076) | (0.096) | (143.358) |
| Combined x Distant | 0.076 | 0.030 | 0.059 | 0.024 | 0.092 | -12.983 |
| | (0.046) | (0.051) | (0.047) | (0.069) | (0.107) | (78.311) |
| Control Group: | Internal | External | Both | Both | Both | Both |
| Manager FE ($\theta_g$) | ✓ | ✓ | ✓ | ✓ | | ✓ |
| Balanced panel | | | | ✓ | | |
| Individual FE ($\theta_i$) | | | | | ✓ | |
| Week FE ($\lambda_t$) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Adj. R-Squared | 0.337 | 0.397 | 0.390 | 0.420 | 0.529 | 0.625 |
| Observations | 6,236 | 6,026 | 7,334 | 4,811 | 7,334 | 7,334 |

*Notes.* This table mimics the specifications in Table III but adds interactions for Distant, an indicator that in at least one week during the intervention period the agent had a partner who reported to a different manager. Each week, the probability of being paired with a partner reporting to the same manager is 0.40. Standard errors are clustered at the sales manager level and are reported in parentheses.

*10%, **5%, and ***1% significance level.

TABLE A.15.
Estimates of Log Revenue-per-Call Treatment Effect Heterogeneity by Rotation and Baseline Connections

| | Intervention | Post-Intervention | | Intervention | Post |
|---|---|---|---|---|---|
| | | Never with High-Perf. | Paired with High-Perf. | | |
| | (1) | (2) | (3) | (4) | (5) |
| Structured-Meetings x Rotate Pairs | 0.012 | -0.102 | -0.052 | | |
| | (0.051) | (0.112) | (0.086) | | |
| Pair-Incentives x Rotate Pairs | -0.116*** | 0.013 | 0.015 | | |
| | (0.026) | (0.101) | (0.064) | | |
| Combined x Rotate Pairs | -0.063 | 0.024 | 0.034 | | |
| | (0.037) | (0.097) | (0.066) | | |
| Structured-Meetings x Connected | | | | 0.115** | 0.006 |
| | | | | (0.044) | (0.106) |
| Pair-Incentives x Connected | | | | 0.023 | 0.016 |
| | | | | (0.050) | (0.098) |
| Combined x Connected | | | | 0.127** | -0.036 |
| | | | | (0.045) | (0.107) |
| Structured-Meetings | 0.238*** | 0.080 | 0.291*** | 0.248*** | 0.123 |
| | (0.053) | (0.118) | (0.100) | (0.052) | (0.106) |
| Pair-Incentives | 0.183*** | -0.073 | 0.131 | 0.144*** | 0.001 |
| | (0.051) | (0.116) | (0.078) | (0.037) | (0.088) |
| Combined | 0.290*** | 0.043 | 0.264*** | 0.231** | 0.130 |
| | (0.037) | (0.123) | (0.087) | (0.078) | (0.095) |
| Manager FE ($\theta_g$) | ✓ | ✓ | ✓ | ✓ | ✓ |
| Week FE ($\lambda_t$) | ✓ | ✓ | ✓ | ✓ | ✓ |
| Adj. R-Squared | 0.416 | 0.311 | 0.359 | 0.396 | 0.315 |
| Observations | 3,418 | 3,340 | 4,660 | 1,776 | 3,922 |

*Notes.* This table displays point estimates of log RPC treatment effect interactions for agents who were re-paired with different partners and who have high baseline workplace connections with other agents. Coefficients come from difference-in-differences regressions including the pre-intervention period and either the intervention period or the post-intervention period. The Rotating interaction indicates that the agent was randomized into being re-paired with a different partner each week. Because rotating agents are more likely to ever have at least one high-performing partner, the post-intervention analysis is split by those who ever have a high-performing partner and those who never have a high-performing partner. Connected agents are those who report 5 or more work-related conversations per week on pre-experimental surveys. Specifications in columns (4) and (5) exclude agents who did not respond to the pre-experiment survey, limiting the sample size. Standard errors are clustered at the sales manager level and are reported in parentheses.

*10%, **5%, and ***1% significance level.

TABLE A.16.
ESTIMATES OF TREATMENT EFFECTS DURING THE POST-INTERVENTION PERIOD FOR AGENTS IN THE TOP 75% OF THE TENURE DISTRIBUTION

| Dependent Variable: | Log Revenue-per-Call | | | | | Revenue-per-Week |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Structured-Meetings | 0.195** | 0.165* | 0.164* | 0.183** | 0.144* | 589.696** |
| | (0.080) | (0.086) | (0.085) | (0.090) | (0.075) | (262.458) |
| Pair-Incentives | 0.101 | 0.074 | 0.071 | 0.107 | 0.122* | 400.932 |
| | (0.062) | (0.069) | (0.069) | (0.074) | (0.069) | (359.411) |
| Combined | 0.241*** | 0.212** | 0.210** | 0.252*** | 0.268*** | 716.794*** |
| | (0.075) | (0.081) | (0.081) | (0.088) | (0.079) | (202.154) |
| Internal Control | | | -0.030 | 0.084 | 0.031 | -114.097 |
| | | | (0.068) | (0.072) | (0.061) | (288.576) |
| Control Group: | Internal | External | Both | Both | Both | Both |
| Manager FE ($\theta_g$) | ✓ | ✓ | ✓ | ✓ | | ✓ |
| Balanced panel | | | | ✓ | | |
| Individual FE ($\theta_i$) | | | | | ✓ | |
| Week FE ($\lambda_t$) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Adj. R-Squared | 0.313 | 0.403 | 0.390 | 0.421 | 0.518 | 0.614 |
| Observations | 5,597 | 5,623 | 6,695 | 4,747 | 6,695 | 6,695 |

*Notes.* This table reports results from Table III but the sample is restricted to agents in the top three quartiles of tenure at the time they are first observed in the data. This restriction excludes agents with less than 88 days of completed tenure when first observed in the sample. Standard errors are clustered at the sales manager level and are reported in parentheses.

*10%, **5%, and ***1% significance level.