Social Comparison in Multi-Task Environments – Sacrificing Overall Performance for Local Excellence?

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Abstract

Using a field experiment with a German retail chain, we will provide evidence on how different aggregation levels of relative performance information (RPI) affect effort allocation in multi-task environments. Employees have two separate tasks which make up their overall performance. We will randomly assign store employees to three different groups: (i) the control group which receives only RPI on the overall performance of both tasks, (ii) a treatment group which receives RPI on both tasks separately, but not overall performance, and (iii) a treatment group which receives RPI on overall performance and separate tasks. We expect that employees who only receive RPI on both separate tasks will focus on one task while neglecting the other, even though this might be detrimental to overall performance (effort distortion effect). However, presented with RPI on overall performance and separate tasks we expect that employees will focus on overall performance and shift their effort on tasks with a higher contribution to overall performance (decision facilitating effect).

Keywords: Relative Performance Information, Multitasking, Social Comparison, Effort Distortion, Decision Facilitating, Field Experiment

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1. Introduction

Using social comparison is a long-standing practice in organizations. In the U.S., nearly one-third of organizations have provided their employees with relative performance information (RPI) (McGregor, 2006). Evidence from the lab (e.g. Tafkov, 2013), as well as field research on RPI, has shown that enabling people to compare themselves with others using one performance measure affects their performance in the absence of explicit monetary incentives (e.g. Blanes i Vidal & Nossol, 2011; Song et al., 2018). However, in practice, many jobs involve a variety of different tasks and objectives (Prendergast, 1999). To date, there is only a limited number of studies investigating the effect of RPI in multi-task settings. Using a laboratory experiment, Hannan et al. (2013, 2019) show that people focus on the task in which they are already ahead while neglecting the other task when presented with RPI on separate tasks. We will contribute to the literature by providing evidence from a field experiment inside a large retail firm on how providing additional information, namely RPI on overall performance in addition to RPI on separate tasks, might help to reduce effort distortion effects.

The idea that incentives can distort effort allocations in settings with multiple tasks is formulated in the classical multitasking theory (Datar et al., 2001; Feltham & Xie, 1994; Holmstrom & Milgrom, 1991). These formal models show that the effort allocation between different tasks can be directed by providing incentives. Only recently scholars started studying how behavioral mechanisms, such as social comparison, can be leveraged to influence effort allocation (Hannan et al., 2013, 2019). Using laboratory experiments with RPI on separate tasks, they find that, due to peoples’ drive to outperform others, people try to excel in some tasks while neglecting others. In consequence, similar to the effort distortion effect in economic theory (Baker, 2000), the effort is not allocated fully congruent with what would be optimal for the firm.

We argue that a possible effort distortion effect of RPI can be reduced with the help of additional information. Specifically, we claim that if employees receive RPI on overall performance in addition to the separate tasks that make up the overall performance this may mitigate the tendency to overinvest effort in one task. Moreover, this combination enables employees to improve their overall performance based on a better understanding of how separate tasks

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1 According to social comparison theory, this is because people learn about their performance by comparing themselves to others and derive utility from outperforming others (Festinger, 1954; Suls & Wheeler, 2000).

2 In our setting, for example, selling different products can be aggregated to overall revenue. In general, firms often use weights on different performance dimensions to construct overall performance measures.
contribute to overall performance. Knowledge about their own performance and the performance of their peers could hereby enable employees to improve their effort allocation (decision facilitating effect) (Casas-Arce, Martínez-Jerez, et al., 2017; Manthei & Sliwka, 2019; Manthei et al., 2021a).³

Using the idea of the classical multitasking theory and building on social comparison theory our research question is thus: How does providing RPI on overall performance, RPI on separate tasks, or a combination of both affect effort allocation?

To answer this question, we propose a field experiment with approximately 505 sales employees of a German supermarket chain working in the butchery department. This setting is particularly appropriate for our research question. The firm does not use any explicit incentives based on individual performance for salespeople but already uses RPI of the overall average receipt per transaction in the butchery department. Employees of the butchery department have considerable influence on effort allocation between two tasks (selling meat vs. selling sausage) and work in different stores under relatively similar conditions on the same tasks. Moreover, German food retailers need to operate with high efficiency due to the market share of discounters, which exceeds 40 percent (Baily & Solow, 2001; Roik, 2020). This suggests that the allocation of effort to different tasks in line with their contribution to overall performance is crucial for the company. Furthermore, the retail sector is very important for the economy. With around 9.8 million employees, retailers employed roughly 6.3 percent of the U.S. workforce in 2018 (Anderson, 2020). By using randomization in such a natural setting to estimate the treatment effect on employees we are able to combine the advantages of control and realism (i.e. internal and external validity) (Floyd & List, 2016).

In our field experiment, we will provide employees of the butchery department every two weeks with RPI on their average sales per transaction by means of a mobile app. Average sales per transaction is a typical metric in retail (see, e.g. Bullard, 2016; Manthei et al., 2021b) and is considered very important by the firm. In our setting, employees have practically no influence on the number of customers visiting their department. However, they have a considerable impact on what and how much customers buy. Thus, the average sales per transaction is a good indicator of sales performance. Furthermore, the average sales per transaction is comparable

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³ Bloom et al. (2013) and Hanna et al. (2014) provide evidence from field experiments that often managers do not know the underlying production function of their jobs. In our case, individual RPI provided in terms of absolute performance (actual score) informs employees about performance levels in different tasks allowing them to draw conclusions about the tasks’ potential contribution to overall performance.
across employees, even though they work different hours, making it a suitable performance measure for RPI.

There will be three groups – *Overall, BothTasks, Overall&BothTasks*. Employees will be randomly assigned to one of the three groups at the store level. Employees in the *Overall* group will receive RPI about their overall average sales per transaction in the butchery department. Employees in the *BothTasks* group will receive only RPI on their average sales per transaction in the tasks selling meat and selling sausage separately, but they will not receive RPI about their overall average sales per transaction in the butchery department. Employees in the *Overall&BothTasks* group will receive RPI on their average sales per transaction in the butchery department as well as RPI on their average sales per transaction in both tasks. Importantly, all RPI is provided among peers of three peer groups based on store size to create homogenous groups. The experimental intervention will last for a period of three months.

Our experiment intends to make three main contributions. First, to the best of our knowledge, there exists no study investigating whether the additional provision of information can mitigate a possible negative effort distortion effect of RPI. While it has already been shown in the laboratory that people shift effort to some tasks at the expense of other tasks as a result of RPI and thereby sacrifice overall performance (Hannan et al., 2013, 2019), we need evidence on different performance information that reduces this effect. Since benchmarking and multi-tasking are widely present in organizations, it can be expected that potential findings would be relevant for organizations and researchers alike. Second, given that we use a smartphone app to provide RPI, our study also speaks to the current developments regarding the digitization of accounting information (Nikiforow, 2020). Third, we contribute to a small but growing literature on firm-level field experiments to evaluate causal effects of possibly performance-enhancing management controls (Casas-Arce, Lourenço, et al., 2017; Delfgaauw et al., 2013; Friebel et al., 2017; Lourenço, 2016; Manthei et al., 2021a, 2021b).

## 2. Literature Overview and Hypotheses

### 2.1 EFFORT DISTORTION EFFECT OF RELATIVE PERFORMANCE EVALUATION

According to social comparison theory, people obtain utility from outperforming others (Festinger, 1954; Suls & Wheeler, 2000). In the absence of objective standards, RPI allows

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4 The overall average sales per transaction is the weighted average of the average sales per transaction in the tasks meat and sausage. The formula of the average sales per transaction is explained below in the environment section.
people to learn about their performance compared to others, thus stimulating motivation to increase performance. Studying the effect of RPI, field research shows that employees increase performance after receiving RPI, even though performance is not linked to explicit incentives (Azmat & Iriberri, 2010; Blanes i Vidal & Nossol, 2011; Eyring & Narayanan, 2018; Song et al., 2018).

In a multitasking setting where employees have multiple objectives to focus on, incentives can be used to influence how they allocate their effort (Datar et al., 2001; Feltham & Xie, 1994; Holmstrom & Milgrom, 1991). In this regard, it is argued that effort allocation can be shifted towards a task/objective by increasing incentives for that task or by reducing incentives for other tasks. The underlying assumption is that incentives motivate and focus attention which in turn directs effort. If, however, the performance measures respond differently to employee effort than organizational performance, this can lead to an effort allocation that is not optimal for organizational performance (effort distortion effect) (Baker, 2000). For example, a production worker who is compensated only based on measurable quantitative output may focus on quantity and neglect quality, thereby potentially reducing organizational performance.

Building on social comparison theory and self-affirmation theory, Hannan et al. (2013, 2019) argue that employees strive to outperform others and that they can justify the negative utility of low performance in one task by superior performance in other tasks. Using laboratory experiments, they find that people accept low performance in one task to excel in another task, resulting in lower overall performance. Relatedly, Barankay (2012) finds that salespeople shift their effort to selling other brands after receiving negative RPI on one brand, suggesting that employees can switch between tasks to maintain a positive self-image. Consequently, like explicit incentives for incongruent performance measures, the drive to outperform others might cause an effort distortion effect in the sense of Baker (2000) if employees receive RPI only on separate tasks.

Provided marginal returns are decreasing, shifting effort towards the task in which employees already have a high relative performance can – ceteris paribus – be expected to reduce overall performance. If employees receive RPI only on separate tasks but not on overall performance

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5 Self-affirmation theory suggests that employees can compensate negative utility from poor performance in one area by superior performance in another area, thereby maintaining a positive self-image (Steele, 1988).
6 Decreasing marginal returns have been assumed in prior literature and can also be expected in our setting (Hannan et al., 2013, 2019). It will take more effort to sell an additional product to someone who has already ordered a large number of products in a category (sausage or meet) than to someone who has not yet done so.
we expect employees to overinvest effort into achieving “local excellence” in one task, resulting in lower overall performance. Therefore, we test the following hypotheses:

**H1:** Provided with RPI on separate tasks but not on overall performance in a dual-task environment, employees focus their effort on the task in which they are already performing better while neglecting the other task, thereby reducing their overall performance (effort distortion effect).

### 2.2 DECISION FACILITATING EFFECT OF ADDITIONAL RELATIVE PERFORMANCE EVALUATION

While our hypothesis 1 – that individuals strive for local excellence – is in line with prior evidence (Barankay, 2012; Hannan et al., 2013, 2019), it is important to note that in all three prior studies participants did only receive information on the separate tasks and not additional information about their overall performance. Whether employees would sacrifice overall performance for local excellence when receiving RPI not only on separate tasks but also on overall performance is not clear yet. We argue that, when providing employees with RPI, providing RPI on overall performance is beneficial to ensure that employees’ relative performance measure responds similarly to employees’ effort as the organizations’ performance. RPI on overall performance signals that overall performance matters and that maximizing performance in one task at the expense of the other task is not desirable.

RPI on separate tasks informs employees about their production function, i.e. how much each task contributes to overall performance. Furthermore, RPI for separate tasks allows employees to assess whether they are already among the best at a task or whether they still have significant potential for improvement compared to their peers. In settings with decreasing marginal returns to effort, this helps employees to allocate their effort more efficiently concerning their overall performance. Consider an employee who performs two tasks A and B, both with decreasing marginal returns. Presented with RPI on both overall performance and separate tasks, she learns that she is among the best in task A and among the worst in task B. Consequently, she may

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7 This prediction follows prior evidence from the laboratory which suggests that the “pride effect” in RPI is stronger than the “shame effect” and that social distinction preferences prompt individuals to shift effort towards the task at which they perform better (Hannan et al., 2019; Kachelmeier, 2019). However, we note that some trailing employees might focus on catching up – which is known as “behind avoidance” in the literature (Roels & Su, 2014). While this may occur for some employees, the following arguments suggest that in our setting an “ahead seeking” mechanism is likely to dominate, where employees maximize their utility by being ahead of their peers (not by avoiding being behind): The employees have exclusive access to their relative performance information. Neither their peers nor their supervisors can see their actual performance. Due to requirements of the works council, there is a general instruction that individual performance information may not be evaluated by anyone other than the employee concerned. Even if managers would ignore this requirement, they would have to invest a great amount of time to obtain individual performance information with the existing IT system. Thus, except that they might “feel bad”, employees do not face any punishment for being behind.
conclude that it is easier for her to improve in task B than in task A and shift some effort from task A to task B to improve her overall performance. Assuming decreasing marginal returns to effort, we thus expect a notable fraction of employees in the Overall&BothTasks group to increase their effort on the task on which they perform relatively poorly, even if it means giving up their local excellence on the other task.⁸

Summing up, we hypothesize that employees in the Overall&BothTasks treatment group will focus on improving overall performance rather than striving for local excellence in one task. Furthermore, we hypothesize that they use RPI on the separate tasks to allocate their effort in accordance with their contribution to overall performance (decision facilitating effect).⁹

H₂: Provided with RPI on both separate tasks and overall performance in a dual-task environment, employees use the information on the separate tasks to allocate their effort in line with tasks’ contribution to overall performance, thereby increasing overall performance (decision facilitating effect).

3. Environment

We will collect data from a large retail organization operating supermarkets in Germany. The focus of our study will be on employee-level performance data of 42 supermarkets in one region of the company (Southern Germany). The average store of our sample is approximately 3,000 square meters in size and an average employee generates 2,142 Euro sales per week in its butchery department. In our study, we will focus on sales employees in the butchery department of each store. Sales employees are generally responsible for stocking and presenting products as well as for customer service (i.e. selling and providing advice). In the selected department, goods are personally sold at fresh food counters, similar to a weekly market. The butchery department represents one long fresh counter, which is divided into two sections (meat and sausage). Employees of the butchery department sell products from both categories (see Figure 1). They have practically no influence on how many customers visit their department and only limited influence on the category which customers buy. Usually, they serve customers according to their waiting time. However, employees can choose their effort per transaction, thus, trying to influence the number of products sold in the given category. For example, an

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⁸ Note that we do not claim that it is always optimal to shift effort towards the task with the lower relative performance, since the optimal effort allocation also depends on individual skills (see Kachelmeier, 2019). We rather suggest that RPI on separate task contains some incremental information in addition to overall performance that helps employees to allocate effort more efficiently to achieve higher overall performance.

⁹ For an overview of papers studying decision-facilitating effects of information see Manthei et al. (2021a), Casas-Arce, Martinez-Jerez, et al. (2017) and Sprinkle (2003).
employee can influence the amount of sausage a customer buys by making an effort in giving better advice or being more friendly to the customer. The employee can also recommend more exclusive (higher priced) items.

Insert Figure 1 about here

Employees do not receive any compensation or bonuses based on individual performance, but a fixed salary in line with the collective wage agreement for their industry. Moreover, no financial incentives are or will be linked to sales performance. Accordingly, an employee’s relative performance does not influence on his or her compensation or that of other employees. Due to an agreement with the works council the company does not use employee level performance data for the performance evaluation of sales employees. Employees have the opportunity to advance to management positions (e.g. department manager) or to become experts in their product category (e.g. meat sommelier). However, getting access to training and promotions does not greatly depend on employees’ quantifiable sales performance but rather on skills like personnel management, estimating order volumes, and basic business know-how. A tournament game based on sales performance is therefore unlikely. Our setting can thus be regarded as free of explicit incentives, making it particularly suitable for studying the “pure” effect of social comparison.

The information environment before the start of the experiments is as follows. Through their department manager employees have access to performance measures on the department level (sales, average sales per transaction, margin). Furthermore, via an app (“My D-Bon”), all employees have access to their overall average sales per transaction of the past two weeks as well as the development of their average sales per transaction over the last eight weeks. Moreover, all employees receive RPI about overall performance for the last two weeks in form of deciles. Appendix 1 shows the information that is available for the employees before the experiment starts. The control group in our experiment (Overall) will continue to receive only this information. Employees do not receive any individual performance information or RPI for

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10 Each butchery department usually has a department manager, a deputy department manager and two foremen.

11 As part of a prior experiment, a mobile app was introduced which enables sales employees in the butchery department to view their average sales per transaction. Employees in the CONTROL group were informed about their average sales per transaction of the past two weeks as well development of their average sales per transaction over the last eight weeks. Employees in the treatment groups received a report similar to the control group. In addition, they received two different designs of RPI on employees from their department from comparable stores over the last two weeks. The reports were completely anonymous and did not allow conclusions about individual performance data of peers. At the end of the prior experiment, the RPI design shown in Appendix 3 was implemented for all employees.
the separate tasks (meat and sausage),\textsuperscript{12} but only on overall performance prior to the experiment.

**The Average Sales per Transaction**

\[
\text{Average Sales per Transaction} = \frac{\sum Sales}{\#Transactions}
\]

The performance measure of interest is the average sales per transaction. As explained above, it is difficult for individual employees to influence how many customers visit the butchery department and in which category they buy. However, in the respective category employees have considerable influence on what and how much customers buy. They can increase their average sales per transaction by selling additional products or higher-priced products. They can do so, for example, by spending more time with a customer, being more friendly, or by acquiring additional knowledge about the assortment and sales techniques. In addition, the average sales per transaction is comparable across employees. Employees participating in our experiment work different hours.\textsuperscript{13} Since the number of transactions performed does strongly depend on the hours worked, it would not make sense to provide employees with RPI on total sales generated. For the average sales per transaction, however, it does not matter whether an employee served 500 or 700 customers.

Moreover, receipts are generated for customers after each transaction (separately for sausage and meat). Thus, employees receive very frequent feedback on their performance, which helps them to understand how their effort translates into the output measure. They can also compare the amount on each receipt with the RPI in the app, to reflect on their relative performance immediately after each transaction.

**Contribution of Each Task to Overall Performance**

In our setting, overall performance equals the total sales generated divided by the number of transactions performed. This can also be displayed as the weighted average of the average sales per transaction of the different tasks. If an employee performs 10 meat transactions generating

\textsuperscript{12} Except for the values of individual transactions, which employees can see on the receipt when selling products.

\textsuperscript{13} For example, some employees work 40 hours per week while other employees only work 20 hours per week.
12.87 Euro sales on average and 15 sausage transactions generating 7.72 Euro sales on average the overall average receipt is 9.87 Euro.\textsuperscript{14}

\[
\text{AvgSaleOverall} = \text{AvgSaleMeat} \cdot \frac{\text{TranMeat}}{\text{TranOverall}} + \text{AvgSaleSausage} \cdot \frac{\text{TranSausage}}{\text{TranOverall}}
\]

Since in our setting the average sales per transaction as well as the number of transactions per task is known, the contribution of each task (meat and sausage) to overall performance can be calculated. The share of a task corresponds to the share of sales generated with a task. It indicates how many transactions and how much sales per transaction an employee generates with a task compared to other tasks.

\[
\text{ShareMeat} = \frac{\text{AvgSaleMeat}}{\text{AvgSaleOverall}} = \frac{\text{SaleMeat}}{\text{SaleOverall}}
\]

While the overall average sales per transaction answer the question of how much sales employees sell on average per transaction (performance measure), the share shows in which task they perform (effort allocation).

4. Experimental Design

4.1 THE TREATMENTS

All butchery department employees in our environment are equipped with a mobile app that enables them to view their average sales per transaction in their department. All employees are informed about their average sales per transaction of the past two weeks as well as the development of their average sales per transaction over the last eight weeks. Furthermore, they receive RPI on their average sales per transaction in their department over the last two weeks. The information is updated on a weekly basis. We chose a time interval of two weeks for RPI instead of, for example, a daily interval to avoid random variance thereby increasing the informativeness of RPI.\textsuperscript{15} Due to privacy restrictions, the reports are completely anonymous.

\textsuperscript{14} \text{AvgSaleOverall} is the overall average sales per transaction. \text{AvgSaleMeat} is the average sales per transaction. \text{TranOverall} is the overall number of transactions. \text{TranMeat} is the number of meat transactions.

\textsuperscript{15} A relevant moderator for the effect of RPI in multi-task environments is whether RPI is presented more temporally aggregated (cumulative) or less temporally aggregated (reset) (Hannan et al., 2019). Cumulative RPI is more informative than reset RPI for social comparison because noise is averaged out over time, resulting in a performance measure that reflects effort more accurately. As a result, cumulative RPI should have a stronger effect on effort allocation than reset RPI. In their laboratory experiment, Hannan et al. (2019) conducted four periods of 6 minutes each. Our two-week period aggregates a large number of transactions conducted over several days. Aggregating such a large number of transactions ensures the informativeness of the RPI provided during the experiment. We will not cumulate over multiple two-week periods because after a few weeks, employees would have little influence on their average sales per transaction. Over three-months, this could risk employees losing interest in the performance reports thereby reducing the effect of RPI.
and do not allow conclusions about individual performance data of peers. We will randomly assign all employees working in the butchery department on the store level to three groups that differ in the level of aggregation of information they receive.

**Overall (Butchery Department)**

Employees in the *Overall* condition, which serves as our control group, only receive RPI based on their overall average sales per transaction in the butchery department. However, they do not receive information on their average sales per transaction in the separate tasks. In other words, the overall group will continue to receive the same information that all employees receive before the start of the experiment. The *Overall* group is our reference group as our objective is to analyze how providing RPI on separate tasks instead of or in addition to overall performance RPI affects effort allocation.  

**BothTasks (Meat and Sausage)**

Employees in the *BothTasks* group receive RPI informing them separately on their average sales per transaction for the two tasks: selling meat and selling sausage. However, they do not receive information on their overall average sales per transaction in the butchery department.

**Overall&BothTasks (Butchery Department, Meat and Sausage)**

Employees in the *Overall&BothTasks* group receive RPI on their average sales per transaction in the two tasks separately as well as RPI on the overall average sales per transaction in the butchery department.

4.2 THE IMPLEMENTATION

The experimental intervention will last for three months. We will randomly assign the different stores to one of the three groups mentioned above. We will stratify our randomization based on store size (which is also a proxy for the number of employees and length of the sales counter) and prior average sales per transaction (which captures unobservable characteristics and reduces the standard deviation between groups). We randomize on the store level to avoid

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16 We acknowledge that we do not have a no RPI condition. However, it is not our aim to analyze how RPI per se influences effort allocation as there is already evidence on this regard (Hannan et al., 2013, 2019). Instead, we aim to investigate how effort allocation differs with RPI at different aggregation levels (overall, separate tasks). Given that also our control group receives RPI, we do not expect that the three groups substantially differ regarding total effort. Rather, we assume that total effort is largely constant, but effort allocation between tasks changes. We will analyze the possibility of overall effort increases in our additional analyses.
spillover and contamination effects. Furthermore, due to randomization at the store level our treatment groups should, on average, experience similar effort requirements. To make the RPI “fair” for employees, we increase homogeneity among peers by forming three peer groups based on store size. In other words, each employee will receive RPI that is calculated based on similar stores. Forming peer groups based on store size is easy to understand for employees and reasonable, as store size determines the assortment employees have available as well as local demand differences of customers. Before the intervention, all sales employees working in the butchery department will be informed that the designs of the performance reports in the app will be updated. We will provide this information by distributing a staff notice via the store manager. To increase exposure to the intervention, employees will be informed when the data of their performance reports have been updated during the experiment by the store manager. In addition, a large poster explaining the app and the report will be installed in the staff room.

At the end of the experiment, we will invite employees of all groups to participate in a survey regarding the “My D-Bon” app (see Appendix 2). Employees will receive a personal invitation letter handed over by their store manager. The survey will be operationalized by the university to guarantee employees’ anonymity. It will contain questions regarding, for instance, satisfaction, stress, and social comparison, as well as questions regarding the usage of the displayed RPI. Participation in the surveys will be incentivized with the possibility of winning an Apple watch. Overall, store managers, department managers, and employees will not be informed that they are part of an experiment. Moreover, given our rigorous procedure, it is also not possible for them to infer from the intervention that they are part of an experiment run by a university. This enables us to maintain a natural environment. The firm will use the word “pilot” for internal communication which is often used in firm-level field experiments (Friebel et al., 2017). By using randomization in such a natural setting to estimate the treatment effect on employees we can combine the advantages of control and realism (Floyd & List, 2016).

5. Data Collection

There are four different data sources for our analysis. First, the company’s IT system, from which data on generated sales and the number of transactions performed per sales employee

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17 Since we randomize at the store level and employees usually do not change stores, it is excluded that employees from one treatment group receive information on their reference group from another treatment group.

18 In general, our setting is quite homogeneous. All stores are supermarkets (e.g., there are no discounters in our dataset), the product categories are similar (i.e., we compare meat with meat and sausage with sausage), and all stores are located in a similar cultural environment (Southern Germany). Nevertheless, we acknowledge that employees from different stores may face slightly different customer preferences that could affect their overall performance and their performance in separate tasks. To ensure comparability across treatment groups we randomize at the store level.
can be extracted through a query running in the background.\(^{19}\) Second, the company’s personnel records, which provide information on age, gender, length of service, working hours, and position. Third, the app's reporting system, which allows us to track how often an employee has opened her average sales per transaction report. And fourth, the questionnaire obtained at the end of the intervention. 42 stores will participate in our experiment, in each of which is a butchery department. So far, we are still waiting for the approval of the works council in five of the 42 stores. However, we already have access to the complete dataset, starting in August 2021. For a list of dependent, independent, and control variables see Table 1.

In total, we expect around 505 employees to participate in our experiment. In our sample, we will consider all employees who worked in the butchery department for at least one month during the experiment. Table 1 shows summary statistics of the dataset (see Appendix). Studies testing RPI in field experiments address concerns that the introduction of RPI may cause attrition among certain employee segments, resulting in a biased sample (Barankay, 2012; Song et al., 2018). However, they find no evidence that the introduction of RPI has an effect on attrition. Due to restrictions of German law and the design of our app, which only informs employees about their individual performance but not the company, it is unlikely that the introduction of RPI will lead to layoffs of low-performing employees.

6. Pre-Analysis Plan

To investigate our main hypotheses, we will use fixed effects difference-in-difference regressions with employee as well as time fixed effects. The respective regression equation is:

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Y_{i,t} = \beta_0 + \beta_1 \cdot BothTasks_{i,t} + \beta_2 \cdot Overall&BothTasks_{i,t} + X_{i,t} + \alpha_i + \delta_t + \epsilon_{i,t}
\]

\(Y_{i,t}\) denotes the dependent variable. \(X_{i,t}\) captures time-variant controls (such as possible refurbishments etc.). \(\delta_t\) are weekly time fixed effects, \(\alpha_i\) are individual fixed effects of the employees. The error term \(\epsilon_{i,t}\) is clustered on the unit of randomization (i.e. the store level). \(BothTasks_{i,t}\) is a dummy variable equal to 1 for employees in the BothTasks treatment during the experimental period and 0 otherwise. \(Overall&BothTasks_{i,t}\) is a dummy variable equal to 1 for employees in the Overall&BothTasks treatment during the experimental period and 0 otherwise. The reference group for our regression is the control group Overall, i.e. employees

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\(^{19}\) In our company, each employee records every transaction on her individual number. If an employee sells products from the two different sections (meat and sausage) this is registered as two different transactions. Thus, the sales generated, the number of transactions performed, and the resulting average sales per transaction can be calculated separately on task level and overall.
who only receive RPI based on their overall performance. We plan to use data from August 2021 until the end of the experimental period. The estimated treatment effects from the above regression give us intention-to-treat effects (ITT) which we compare to the control group and between each other using a Wald test.

To investigate our hypotheses, we will proceed as follows:

1) Overall Effect on Average Sales per Transaction

To estimate the overall effect on performance we will use the above regression equation with the individual overall average sales per transaction for employee \( i \) in week \( t \) as the dependent variable. In case of an effort distortion effect the estimated treatment effects should be negative. In case of a decision facilitating effect the estimated treatment effects should be positive. Thus, given our hypotheses, we expect to find that \( \text{BothTasks} \) has a negative estimate with the overall average sales per transaction being the dependent variable (hypothesis 1) and \( \text{Overall&BothTasks} \) a positive estimate (hypothesis 2). Furthermore, to estimate the effect of RPI on the performance in separate tasks, we will also use the average sales per transaction for employees \( i \) in week \( t \) of the two different tasks (meat and sausage) as a dependent variable.

2) The Effect of Separate Task RPI on Effort Allocation

To investigate the behavioral mechanism (effort focus) behind the treatment effects on the average sales per transaction, we will use the variable \( ff\text{focus}_{i,t} \):

\[
\text{ShareMeat}_{i,t} = \frac{\text{AvgSaleMeat}_{i,t} \times \text{TranMeat}_{i,t}}{\text{AvgSaleOverall}_{i,t}} = \frac{\text{SaleMeat}_{i,t}}{\text{SaleOverall}_{i,t}}
\]

\[
\text{ShareSausage}_{i,t} = 100% - \text{ShareMeat}_{i,t}
\]

\[
\text{EffortFocus}_{i,t} = |\text{ShareMeat}_{i,t} - \text{ShareSausage}_{i,t}|
\]

\( \text{AvgSaleOverall}_{i,t} \) is the overall average sales per transaction of employees \( i \) in week \( t \). \( \text{AvgSaleMeat}_{i,t} \) is the average sales per transaction of employees \( i \) in week \( t \) in the meat selling task. \( \text{TranOverall}_{i,t} \) is the overall number of transactions performed by employees \( i \) in week \( t \). \( \text{TranMeat}_{i,t} \) is the number of meat transactions performed by employees \( i \) in week \( t \). The variable \( \text{ShareMeat}_{i,t} \) represents the relative share of the meat task (see Environment). The

20 Note that we also run the above described other experiment during this time period. Thus, we will eventually control for these treatments in the described regression when using this larger time horizon.

21 If an employee sells only meat and no sausage, the \( \text{ShareMeat} \) variable corresponds to 100%. If an employee sells only sausage and no meat, the \( \text{ShareMeat} \) variable equals 0%.
variable $\text{EffortFocus}_{i,t}$ reflects how much an employee focuses on one task. It can take values between 0 and 100%. If the overall average sales per transaction is based equally on the sale of meat and sausage, $\text{EffortFocus}_{i,t}$ is 0%. If an employee sells only meat or sausage, i.e. focuses solely on one task, $\text{EffortFocus}_{i,t}$ is 100%. If an employee increases or decreases focus on one task, i.e. changes her effort allocation, $\text{EffortFocus}_{i,t}$ will change. Figure 2 shows employees’ effort focus in our sample (see Appendix). The figure indicates that the majority of employees have a relatively constant effort allocation between the two tasks meat and sausage.

*Insert Figure 2 about here*

To estimate the effect of different treatments on $\text{EffortFocus}_{i,t}$ we will use the above regression (1) with $\text{EffortFocus}_{i,t}$ being the dependent variable. We do not have a clear prediction about the size of the treatment effects. However, we use this analysis to show that treatment effects on the performance variable overall average sales per transaction are indeed driven by different effort allocation and not, for instance, due to a pure motivational effect (see also additional analyses).

To analyze how effort focus affects overall performance in more detail we will then interact our treatment indicator variables with $\text{EffortFocus}_{i,t}$:

\[
\text{AvgSaleOverall}_{i,t} = \beta_0 + \beta_1 \text{BothTasks}_{i,t} + \beta_2 \text{Overall&BothTasks}_{i,t} + \beta_3 \text{EffortFocus}_{i,t} + \beta_4 \text{BothTasks}_{i,t} \times \text{EffortFocus}_{i,t} + \beta_5 \text{Overall&BothTasks}_{i,t} \times \text{EffortFocus}_{i,t} + X_{i,t} + \alpha_i + \delta_t + \epsilon_{i,t}
\]

In the above regression, positive coefficients for the interaction terms $\beta_4$ and $\beta_5$ would indicate a decision facilitating effect of the treatments because a change in effort focus is associated with higher overall performance. In contrast, negative interaction terms $\beta_4$ and $\beta_5$ would be indicative of effort distortion effects, because the change in effort focus is associated with lower overall performance. Thus, given our first hypotheses, we expect to find a negative coefficient $\beta_4$ for the interaction of $\text{BothTasks}_{i,t} \times \text{EffortFocus}_{i,t}$ (effort distortion). In line with our second hypothesis, we expect a positive coefficient $\beta_5$ for the interaction of $\text{Overall&BothTasks}_{i,t} \times \text{EffortFocus}_{i,t}$ (decision facilitating).

3) Effort Shift and Increase/Decrease of Local Performance

According to hypothesis 1, we expect that employees in BothTasks focus their effort on the task in which they are already performing well. To analyze this mechanism, we will use the
following dependent variable: $\text{ShareBest}_{i,t}$. This should be the relative contribution of employees $i$ in week $t$ in the task where they performed better, i.e. reached a higher relative performance decile, in the respective reporting period. Given our hypothesis, we predict that the treatment effect of $\text{BothTasks}$ should be positive. Related to our hypothesis 2, we will also analyze whether the $\text{Overall&BothTasks}$ treatment has a negative effect on $\text{ShareBest}_{i,t}$.

7. Additional Analysis

We plan to do several further analyses. First, we will estimate the local average treatment effect (LATE) instead of only the ITT to estimate the performance effect on those employees who complied with the treatment and actually used the app.\textsuperscript{22} Second, we will split employees into two groups (below the median average sales per transaction and above) to investigate the effect of different “starting points”. Third, we will investigate the effect of the treatments on further outcomes elicited from the survey such as satisfaction, commitment, engagement, empowerment, and stress, etc. Fourth, to exclude that employees tried to game the performance measure we will further assess whether our treatments did not only affect the average sales per transaction but also the number of customers per task and sales generated separately.\textsuperscript{23} Fifth, we will explore whether some employees do show an increase or a decrease of the average sales per transaction for both tasks.\textsuperscript{24}

Finally, analyzing the effect of RPI on effort allocation and performance one has to consider interdependencies between tasks. In line with Eyring (2020) we understand interdependence between tasks as the degree to which tasks share the same input factors and, accordingly, the effort in one task influences the outcome of the other task. In our setting, this would be the case, for example, when employees increase their average sales per transaction by learning new sales techniques, which can be applied in both tasks. If we were to find that performance increases in both tasks as a result of RPI on separate tasks, this could be a sign of interdependencies.

\textsuperscript{22} Note, that we cannot estimate the treatment effect of providing only $\text{Overall}$ RPI to the employees in a clean way. However, we can in principle use a prior time horizon in which a clean control group exists and investigate the effort focus during this time.

\textsuperscript{23} While employees at the fresh food counter have relatively little influence on the number of customers, it is important to make sure that changes in the average sales per transaction are not driven by the number of customers per task. For example, if an employee would be able to avoid serving some sausage customers, that would increase the proportion of meat receipts which in turn increases the average sales per transaction, because meat receipts are higher on average than sausage receipts.

\textsuperscript{24} While our theory focuses on effort shifting between tasks, it is possible that receiving RPI for each task instead of overall performance has a general motivational aspect – i.e. the effort for both tasks increases or decreases.
8. *Statistical Power*

Given our fixed sample of 42 stores with 505 employees and thus currently (October 2021) 168 potential employees per treatment (note, that this eventual sample can still slightly change due to fluctuation of employees until the start of the experiment) we can illustrate the statistical power. Using the employees’ mean average receipt over the previous 6 weeks (mean = 9.01, sd = 3.12) and assuming an unchanged standard deviation as well as a treatment effect of 1/3 standard deviations, we do have a power of 85.45% with our sample. An increase by 1/2 standard deviations results in a statistical power of 99.55%. Even with a considerable low increase by 1/4 standard deviations we would still have a statistical power of 62.73%. Hence, we believe that we have sufficient statistical power to detect the treatment effect if present.

Note that we furthermore expect our eventual power to be larger as we will use a fixed effects regression rather than a simple mean comparison and additionally will have more pre- and post-experimental data available (McKennzie, 2012).

9. *Conclusion*

Many jobs in modern economies require multiple input factors/tasks to execute. In simpler jobs with only one important task, it has been shown that RPI can be performance enhancing. However, designing RPI for multiple tasks is not only difficult but, if designed wrongly, can also lead to suboptimal effort allocations.

Our proposed field experiment will shed light on the design of RPI in multitask settings. Specifically, it will present results about how detailed the level of information provided should be – on the single tasks, on the aggregate measure, or on both. Importantly, it combines the high internal validity of experiments with high external validity as the data comes from a large retailer.
References


APPENDIX 1: THE APP (CONTROL GROUP “OVERALL”)
APPENDIX 2: THE SURVEY

We will translate the survey questions into German before implementing the survey.

Experimental Survey with Employees

To assess how the treatments affect satisfaction, stress, and workplace culture we included items from different scales (Allen & Meyer, 1990; Anderson & West, 1998; Fletcher & Nusbaum, 2010; Hackman & Oldham, 1976; Hoegl & Gemuenden, 2001). The selected items were subsequently adjusted in collaboration with the company's works council.25 For this reason, the wording and number of items differs from the scales taken into account in advance. One requirement of the works council is that it must be clearly evident to employees that the questionnaire is related to the app. The survey consists of six categories:

1) Relevance of the Information: 1, 2, 3, 4, 22
2) Individual well-being and motivation: 5, 6, 7, 8, 9, 13, 14
3) Team spirit: 10, 11, 12
4) App usage 15, 16, 21, 23
5) Skills and preferences: 17, 18
6) Learning 19, 20

Your Opinion on the Average Sales per Transaction Report (My D-Bon App)

To better tailor our reporting system to your needs in the future, we would like to hear your opinion on the average sales per transaction app (My D-Bon). Please indicate whether the following statements are true or not true. In this set of statements, please indicate your level of agreement on a scale of 1 (disagree strongly) to 7 (agree strongly). Please think of the last three months when answering the questions.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Neither agree nor disagree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. The information I received about the average sales per transaction was interesting.
   _ _ _ _ _ _ _

2. I would like to continue to receive the information on the average sales per transaction in the future.
   _ _ _ _ _ _ _

25 In the company we examine, questionnaires must be approved by the works council.
3. I think the average sales per transaction is an important variable to evaluate my sales performance.

4. The information I received about the average sales per transaction helped me to evaluate my sales performance.

5. The information I received about the average sales per transaction motivated me.

6. I feel a great sense of personal satisfaction when I do well in the average sales per transaction report.

7. I feel bad and unhappy when I do poorly in the average sales per transaction report.

8. I try my hardest to perform well in the average sales per transaction report.

9. The introduction of the average sales per transaction report has improved my overall job satisfaction.

10. The average sales per transaction report has improved the level of cooperation between team members.

11. The average sales per transaction report has improved supportiveness of my team members.

12. Due to the average sales per transaction report, my coworkers are constantly competing with one another.

13. Because of the average sales per transaction report, it seems to me that I am constantly being monitored.

14. Due to the average sales per transaction report, I feel stressed during work hours.
15. What do you think is an average value for the average sales per transaction in the following product categories*:
   Meat: _______
   Sausage: _______

16. When evaluating your sales performance, what is relevant to you? (Multiple answers possible)
   ( ) My average sales per transaction in the butchery department
   ( ) My average sales per transaction in selling meat
   ( ) My average sales per transaction in selling sausage
   ( ) None is relevant

17. Working in the butchery department, do you have a preference for selling meat or selling sausage?
   ( ) I prefer to sell meat
   ( ) I prefer to sell sausage
   ( ) I do not have a preference for either meat or sausage

18. Working in the butchery department, do you have specialized knowledge about the products you sell?
   ( ) I know a lot about meat
   ( ) I know a lot about sausage
   ( ) I know a lot about meat and sausage
   ( ) I do not have specialized knowledge about meat or sausage

19. Which information helped you to increase your average sales per transaction?* (Multiple answers possible)
   ( ) Information from the intranet (e.g. activity catalogs)
   ( ) Tips from my supervisor
   ( ) Tips from my colleagues
   ( ) The individual receipts after each transaction
   ( ) The average sales per transaction report
   ( ) ______________________________________
   ( ) None of the information was relevant

20. Do you have any tips on how one can increase the average sales per transaction? (We anonymously collect best practices of all employees)

21. Did you have difficulties understanding the performance report presented in the app?

22. Is there any other information or performance metrics you would like to be informed about?

23. Do you have any suggestions for improvements for the app?

Note: Questions marked with * (15, 19) can only be asked in a subset of 10 stores due to a missing consent of the works council in the other stores.
## APPENDIX 3: VARIABLE DEFINITIONS

<table>
<thead>
<tr>
<th>Variables</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SaleOverall</td>
<td>Sales value generated with the tasks meat and sausage</td>
</tr>
<tr>
<td>SaleMeat</td>
<td>Sales value generated with the task meat</td>
</tr>
<tr>
<td>SaleSausage</td>
<td>Sales value generated with the task sausage</td>
</tr>
<tr>
<td>TranOverall</td>
<td>Number of transactions with the tasks meat and sausage</td>
</tr>
<tr>
<td>TranMeat</td>
<td>Number of transactions with the task meat</td>
</tr>
<tr>
<td>TranSausage</td>
<td>Number of transactions with the task sausage</td>
</tr>
<tr>
<td>AvgSaleOverall</td>
<td>Average sales per transaction overall:</td>
</tr>
<tr>
<td></td>
<td>[ \text{AvgSaleOverall} = \frac{\text{SaleMeat} \cdot \text{TranMeat} + \text{SaleSausage} \cdot \text{TranSausage}}{\text{TranOverall}} ]</td>
</tr>
<tr>
<td>AvgSaleMeat</td>
<td>Average sales per transaction with the task meat:</td>
</tr>
<tr>
<td></td>
<td>[ \text{AvgSaleMeat} = \frac{\text{SaleMeat}}{\text{TranMeat}} ]</td>
</tr>
<tr>
<td>AvgSaleSausage</td>
<td>Average sales per transaction with the task sausage:</td>
</tr>
<tr>
<td></td>
<td>[ \text{AvgSaleSausage} = \frac{\text{SaleSausage}}{\text{TranSausage}} ]</td>
</tr>
<tr>
<td>ShareMeat</td>
<td>Relative share of the task meat:</td>
</tr>
<tr>
<td></td>
<td>[ \text{ShareMeat} = \frac{\text{AvgSaleMeat} \cdot \text{TranMeat} + \text{SaleMeat} \cdot \text{TranOverall}}{\text{AvgSaleOverall}} = \frac{\text{SaleMeat}}{\text{SaleOverall}} ]</td>
</tr>
<tr>
<td>ShareSausage</td>
<td>Relative share of the task sausage:</td>
</tr>
<tr>
<td></td>
<td>[ \text{ShareSausage} = \frac{\text{AvgSaleSausage} \cdot \text{TranSausage} + \text{SaleSausage} \cdot \text{TranOverall}}{\text{AvgSaleOverall}} = \frac{\text{SaleSausage}}{\text{SaleOverall}} ]</td>
</tr>
<tr>
<td>ShareBest</td>
<td>Share of sales generated with the task where employees reached a higher</td>
</tr>
<tr>
<td></td>
<td>decile, i.e. performed better</td>
</tr>
<tr>
<td>EffortFocus</td>
<td>The absolute value of the difference between ShareMeat and ShareSausage.</td>
</tr>
<tr>
<td>Overall</td>
<td>Indicator variable equal to one if the employee is a member of the overall</td>
</tr>
<tr>
<td></td>
<td>group</td>
</tr>
<tr>
<td>BothTasks</td>
<td>Indicator variable equal to one if the employee is a member of the treatment</td>
</tr>
<tr>
<td></td>
<td>group BothTasks</td>
</tr>
<tr>
<td>Overall&amp;BothTasks</td>
<td>Indicator variable equal to one if the employee is a member of the treatment</td>
</tr>
<tr>
<td></td>
<td>group Overall&amp;BothTasks</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control Variables</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>InitiallyAboveMedian</td>
<td>Indicator variable equal to one if an employee’s average sales per</td>
</tr>
<tr>
<td></td>
<td>transaction is above the median average sales per transaction at the</td>
</tr>
<tr>
<td></td>
<td>beginning of the experiment</td>
</tr>
<tr>
<td>Age</td>
<td>The age which is listed in personnel records of employees</td>
</tr>
<tr>
<td>Tenure</td>
<td>The length of service with the company of interest, which is listed in</td>
</tr>
<tr>
<td></td>
<td>personnel records of employees</td>
</tr>
<tr>
<td>Position</td>
<td>Indicator variable equal to one if an employee is a department manager and</td>
</tr>
<tr>
<td></td>
<td>zero if he is a sales employee</td>
</tr>
</tbody>
</table>

25
<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Indicator variable equal to one if an employee’s gender is Female and zero if an employee’s gender is Male according to personnel records</td>
</tr>
<tr>
<td>Hours worked</td>
<td>Weekly working time of an employee</td>
</tr>
<tr>
<td>Number of accesses</td>
<td>The number of times an employee accessed her average sales per transaction report</td>
</tr>
<tr>
<td><strong>Survey Response Variables</strong></td>
<td>Answers to the surveys performed during the experiment</td>
</tr>
</tbody>
</table>
Figure 1: Multitasking in the Butchery Department

Note: This figure shows the number of employees who achieve a certain share of sales with meat in the butchery department. The sample includes data from 505 employees. The data covers a period of 6 weeks (2021, Week 35-40. Please note that our eventual sample might be slightly different due to fluctuations in stores. Moreover, for 5 stores the works council still has to agree to the intervention.
Figure 2: Within Variation of Employees’ Effort Focus

Note: This figure shows the number of employees who have a certain standard deviation on the EffortFocus variable over a period of 6 weeks (2021, Week 35-40). The sample includes data from 505 employees. Please note that our eventual sample might be slightly different due to fluctuations in stores. Moreover, for 5 stores the works council still has to agree to the intervention.
Table 1: Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>Descriptives</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female Employee (1/0)</td>
<td>0.7821</td>
<td>(0.4131)</td>
</tr>
<tr>
<td>Age</td>
<td>42.9538</td>
<td>(13.7800)</td>
</tr>
<tr>
<td>Tenure</td>
<td>9.3695</td>
<td>(9.3572)</td>
</tr>
<tr>
<td>Store Size (m$^2$)</td>
<td>3087.525</td>
<td>(1263.993)</td>
</tr>
<tr>
<td>Length Fresh Food Counters (m)</td>
<td>25.5689</td>
<td>(6.5625)</td>
</tr>
<tr>
<td>Average Weekly Revenue per Employee - Butchery Department</td>
<td>2142.895</td>
<td>(1430.358)</td>
</tr>
<tr>
<td>Average Weekly Receipt of Employees - Butchery Department</td>
<td>9.2198</td>
<td>(3.1221)</td>
</tr>
<tr>
<td>Average Weekly Revenue per Employee - Meat Department</td>
<td>1306.44</td>
<td>(1035.407)</td>
</tr>
<tr>
<td>Average Weekly Receipt of Employees - Meat Department</td>
<td>11.3833</td>
<td>(3.6959)</td>
</tr>
<tr>
<td>Average Weekly Revenue per Employee - Sausage Department</td>
<td>968.202</td>
<td>(794.891)</td>
</tr>
<tr>
<td>Average Weekly Receipt of Employees - Sausage Department</td>
<td>7.3860</td>
<td>(2.9113)</td>
</tr>
<tr>
<td>Average Weekly Effort Focus of Employees</td>
<td>0.3978</td>
<td>(0.2569)</td>
</tr>
<tr>
<td>Total Stores</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>Total Sales Employees</td>
<td>505</td>
<td></td>
</tr>
</tbody>
</table>

Note: The table reports means of the respective variables for the overall sample with standard deviations in parentheses. The data covers a period of 6 weeks (2021, Week 35-40). Please note that our eventual sample might be slightly different due to fluctuations in stores. Moreover, for 5 stores the works council still has to agree to the intervention.