Remote work and team productivity*

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Abstract

Remote work policies remain controversial mainly because of productivity concerns. The existing literature highlights how the remote setting affects individual productivity yet little is known about how the remote setting affects work in teams - where productivity losses are potentially higher given the additional role of beliefs over partner productivity. Our study closes this gap by examining the effort of individuals randomly assigned to work in either a remote or office setting with partners who are remote and office based. We find that remote workers contribute more effort to the team than office workers, with no differences based on the location of their partners. Office workers incorrectly believe their remote teammates' contributions will be lower and respond by contributing less effort to the team when paired with remote partners versus office partners. Hence, productivity issues in remote teams are driven by the biased beliefs of office workers rather than true productivity differences, which suggests that managerial policies should focus on correcting these incorrect beliefs rather than limiting remote work.

Keywords: Telecommuting, Remote Work, Team Production, Productivity, Economic Experiments

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1. Introduction

Remote work policies have increased in usage, reaching a peak during the Covid-19 pandemic.[1] While some have argued that the pandemic has ushered in a structural change which will keep remote work usage high, e.g. Barrero et al. (2021) estimate that workers will supply 20% of workdays fully remote compared to 5% pre-pandemic, some long-held hesitation remains.[2] This hesitation is not attributed to a lack of demand from employees, who are increasingly seeking more flexibility in their work environments,[3] but rather from management. Tesla's Elon Musk informed employees they must return to the office for 40 hours per week or be let go,[4] and when asked about the benefits of remote work, Netflix's CEO Rod Hastings stated that he did not see any positives.[5] In contrast, Twitter CEO Parag Agrawal announced a policy where employees can choose to work remotely as long as desired.[6] The pandemic showed that a vast number of jobs could be performed remotely, so why are some employers calling workers back to the office while others are letting them continue to work remotely?

The most serious criticisms lobbed at remote work policies center on concerns of reduced employee productivity. It is easy to imagine that the remote worker has better outside options (e.g., watching TV, doing the laundry, helping family members, or even other work) which standard economic theory would predict leads to lower work effort. However, a growing body of empirical evidence suggests that there are minimal differences in productivity between office and remote workers in individual work settings (Dutcher, 2012; Bloom et al., 2015; Künn et al., 2021; Gibbs et al., 2021), so this is not the likely cause of the continued controversy over remote work. Teams, on the other hand, are the more likely candidate as they are ubiquitous in organizations and are arguably more susceptible to negative impacts from remote work since most team work decisions, in contrast to individual work, are strategic. The effort choice a worker makes

[1] Prior to the pandemic, in 2017-2018, the percentage of U.S. employees who worked remotely at least one day a week was 15% (ATUS statistics retrieved Feb. 2, 2021 from https://www.bls.gov/news.release/flex2.htm). During the pandemic, remote work peaked in April 2020, with 51% of Gallop survey respondents reporting that all work took place remotely (retrieved Feb. 2, 2021 from https://news.gallup.com/poll/321800/covid-remote-work-update.aspx). This number had fallen to 33% by October 2020 but still constituted a large increase in remote work compared to pre-pandemic levels.

[2] Prior to the Covid-19 pandemic, the debate over whether remote work policies were optimal for firms was already generating media buzz. In 2013, Yahoo! CEO Marissa Mayer made the decision to reverse the company's telework policy, and Best Buy soon followed suit that same year with a similar reversal. Even IBM, who was an early adopter of telework policies in the 1980s curtailed their work-from-home policies in 2017.

[3] For example, Apple postponed a recall of workers to the office after a large number of employees signed an open complaint letter. Source retrieved June 16, 2022, https://www.npr.org/2022/06/05/1102744672/remote-work-from-home-return-to-office-covid-pandemic-workers-apple-google

[4] Source retrieved June 16, 2022, https://www.npr.org/2022/06/01/1102513281/elon-musk-tesla-return-to-work

[5] Source retrieved November 24, 2021, https://www.wsj.com/articles/netflixs-reed-hastings-deems-remote-work-a-pure-negative-11599487219

[6] Source retrieved from Twitter, July 12, 0222 https://twitter.com/paraga/status/1499422876134371329/photo/1

in a team depends on her own outside options *and* her beliefs over the outside options and subsequent productivity of her teammates. Hence, beliefs alone can drive productivity failures in teams, even if individually workers are no less productive. An example would be an office worker partnered with remote workers who holds biased (inaccurate) beliefs that the remote partners are giving less effort (even if they are actually contributing at a high level). In this scenario, for most team settings, the best response of the office worker who holds these beliefs is to provide less effort to the team, leading to lower team productivity. The bias could also work in a positive direction where, for example, remote workers could hold optimistic beliefs of their office partners' productivity, or it could even be the case that beliefs are not biased and workers have an accurate perception of partner effort costs. Ultimately, the direction and accuracy of beliefs under remote policies is an empirical question which we aim to address.

We present a combination of theory and experiments to improve our understanding of remote policies on team productivity through the channel of beliefs. We assume these beliefs are based on the worker's estimation of the cost of work effort for her partners which can be correct or incorrect (biased beliefs). Since the true direction and accuracy of beliefs is an empirical question, our theoretical analysis demonstrates what can occur under a variety of scenarios and our experiments provide a test bed for these scenarios. We use experiments rather than field data, which we view as complementary approaches, to precisely measure beliefs as well as work effort. Experiments also provide us with the control needed to avoid potential confounds such as worker synergies, differential pay schemes, and non-random assignment to work location.

The experiment randomized subjects to participate either as a remote worker in a location and time of their choice, or in the laboratory at a predefined time to simulate office work. Regardless of their location, everyone participated in the same three round experiment. In the first round, participants were asked to complete a real effort transcription task for five minutes and were paid a piece-rate for each task completed. The next two rounds were team rounds where participants continued to work on the same type of task, but in teams of three and for twenty minutes per round. A critical element of our design is that prior to the start of the team rounds, the participants were informed that they would be partnered with two remote workers in one round and two office workers in the other round. All team members faced the same decision of whether to contribute their completed tasks to an individual account or to a team account. The individual account paid the same piece rate as the non-team (first round) baseline while the team account paid an amount based on minimum effort - all members of the team were paid a piece rate for the minimum number of tasks contributed by a member of the team. The piece rate paid to the team account was higher than the individual account to incentivize team work.

Choosing a minimum effort payment scheme for the team account was an intentional deci-

sion. First, this structure is a simplification of externally relevant team projects where worker's inputs are complements in production. Second, it provides a clean measure of beliefs of partner productivity. Under a minimum effort scheme, participants are theoretically predicted to give an amount equal to what they believe the minimum contribution of others will be so effort given to the team directly measures beliefs. Therefore, to understand how beliefs may change with remote or office partners, one can simply difference the effort choice to the teams across the two team rounds. In other words, a participant should contribute more effort to the partners they believe are most productive, and if they believe there are no differences between their remote and office partners then contributions should be equal. In addition to precisely measuring beliefs, the minimum effort team compensation scheme allows us to avoid using a team structure that would give rise to free-rider problems, i.e. revenue sharing (Alchian and Demsetz, 1972; Holmstrom, 1982; Jones, 1984; Albanese and Van Fleet, 1985), so we are able to isolate beliefs based on location alone.[7]

The empirical results demonstrate that at the individual level remote workers are no less productive than office workers in terms of overall productivity (individual + team effort). Teams, on the other hand, are negatively impacted by remote work through the response of office workers partnered with remote workers. Office workers contribute significantly less effort to the team when partnered with remote workers than with other office workers. Utilizing post-experimental survey evidence as a robustness check, we demonstrate that this is driven by office workers who respond that remote workers are less productive, providing evidence of biased beliefs held by office workers. In contrast, remote workers' contributions to the team do not differ based on the location of their partners *and* they give a significantly higher proportion of their effort to the team than the office workers. To examine why remote workers are so generous, we again exploit post-experimental survey evidence which suggests that guilt avoidance (a desire not to be the lowest contributor) plays a role.

The empirical results favor the theoretical model where biased beliefs rather than differing costs of effort cause productivity losses, and they have at least two managerial implications. First, increased outside options for remote workers do not appear to impact their productivity in teams. In fact, the results suggest that all-remote teams might be even more productive than all-office teams for mundane work settings where effort costs are more likely to matter as the

[7]Without this control it would be difficult to disentangle the primary cause of any observed reductions in effort - is it due to beliefs that the partners will free-ride given the incentives to do so or due to beliefs that the partners are working less due to their work location? Of course, there is empirical evidence which suggests that individuals do not fully exploit the opportunities for free riding in teams, e.g., Dickinson and Isaac (1998).Other studies also find that individuals are conditionally cooperative - as long as workers believe their teammates are contributing, they will also continue to contribute (Fischbacher et al., 2001; Croson et al., 2005; Fallucchi et al., 2018), but to be as careful as possible it was necessary to eliminate free-riding as a potential confound.

work is less likely to carry intrinsic value. Second, we identify the main detrimental effect of remote work policies to be biased beliefs of office workers in mixed location teams. Managers can work to correct these beliefs using feedback mechanisms or by limiting the use of mixed teams. Importantly, both of these implications are counter to calling all workers back to the office.

To our knowledge, no study has examined the impact of remote work on team productivity and closing this gap is critical given the prevalence of teams in the workplace; Cross et al. (2016) estimates that a typical worker spends about 80 percent of their time on collaborative work activities and a recent survey finds that 85% of managers expect teams with remote workers will be the new norm.[8] Our study also adds to the growing literature on the productivity of remote workers. The current evidence on whether remote policies result in reduced worker productivity at the individual level is mixed, but leans towards limited differences. Dutcher (2012) found a reduction in productivity in an experimental laboratory setting using dull tasks but also found increases in productivity with creative tasks. In a field setting examining call center employees, Bloom et al. (2015) found that the performance of those working from home exceeded that of those working in the office primarily through reduced sick time and tardiness. More recently, Künn et al. (2021) examined professional chess player performance in both online and in-person tournament settings and found a decline in performance in early tournaments conducted online; this effect reduced with time suggesting some adaptation to the remote environment. Gibbs et al. (2021) use data from the shift in work status due to Covid-19 for IT workers. They found that output remained relatively similar, but remote policies increased the hours worked causing a decrease in worker's average productivity. This productivity hit is attributed to increased distractions and higher coordination costs in the remote setting. While these studies contribute to an understanding of individual productivity when workers telecommute, our paper differs in that it provides empirical evidence on the determinants of team output when some in the team may be working remotely. We also measure overall productivity (team + individual output) for the individual, but using a measure that is novel to the literature as it examines productivity in a setting with both team and individual incentives rather than just individual. Last, we uniquely provide evidence on beliefs over productivity in the remote environment.

The remainder of this paper is organized as follows: Section 2 introduces our experimental design and Section 3 provides theoretical predictions. Section 4 presents our results and Section 5 discusses the results and concludes.

[8]Source retrieved July 27, 2022 https://findstack.com/remote-work-statistics/

2. Experiment Design

There are two types of subjects in our experiment: remote workers (R) and office workers (O). Remote workers are subjects who participate online in a location of their choice any time in a block of 24 hours. Office workers are subjects who also participate online, but at a pre-specified time and location in a university computer laboratory.[9]

Participants are asked to complete a real effort typing task. Each task requires typing a 20-character string of letters and numbers. Subjects are not allowed to continue to the next string until the current string is typed correctly. The same sequence of random strings is used across rounds. The work is performed on an online platform which guides all participants through the experiment. The experiment is self-guided for both office workers and remote workers to ensure that the work platform and information given to all participants is identical. After a set of instructions and an unpaid practice work exercise, the paid portion of the experiment begins with an individual work round, followed by two team work rounds. The experiment ends with a basic survey.[10]

The individual work round lasts for 5 minutes. Decisions are framed as submitting completed tasks to an individual account, which pays \$0.10 per correct task. As an outside leisure option, subjects are instructed that they can browse the web, or engage in any other activity besides the typing task. Given their flexibility of participation, remote workers have a wider range of alternative activities than office workers.

Following the individual round, all subjects enter into the two team work rounds, each lasting 20 minutes. In each team round, a subject is randomly paired with two others for a team of three. All members in a team perform work individually using the typing task used in the individual round. The payment scheme in the team rounds includes the individual account seen in the first round that continues to pay \$0.10 per correct task, and also includes a team account that pays \$0.18 to the minimum number of correct tasks contributed by a team member. A subject chooses, in real time, to contribute the completed task to the individual account or the team account.[11] Subjects are again instructed that they can browse the web, or engage in any other activity besides the typing task, and they are informed that their partners have this

[9] In the experiment we use the following phrasing to introduce types: There are two types of participants in this experiment: 1. Those that participate in a computer lab at Ohio University at a designated time (LAB PARTICIPANTS) 2. Those that participate in a location of their choice (e.g. in their apartment, at a coffee shop, in the library, etc.) at any time within a block of 24 hours (TELECOMMUTERS).

[10] Screenshots of the experiment and survey are available in the Appendix.

[11] While relatively novel, we are not the first to use real effort in a minimum effort game, see e.g. Bortolotti et al. (2016); Dutcher et al. (2020). In choosing real effort and real leisure options, we are losing some experimental control over effort costs, however, given the potential asymmetries in the opportunity costs between the location types, and that our core research question seeks to understand individual perceptions about these costs, the most clear way to test our research question was through a real effort task and real leisure option.

same option.[12]

Our main treatment is the location type of partner assignment in team rounds. In one team round, subjects, who are either O or R type, are paired with two remote workers (RR) and in the other team round, they are paired with two office workers (OO). To control for order effects, in some sessions subjects are paired with two remote workers first and in the remaining sessions subjects are paired with two office workers first. The locational composition of every team member in both rounds is announced prior to the beginning of the team work rounds so that subjects know the location composition of the team they are participating with in the upcoming rounds prior to the start of the first team round. During the team rounds, they are also given a reminder about the location of their current team members at the top of their screen. All other feedback is restricted, including team payoffs.[13] To accomplish the matching scheme where the subjects of interest are partnered in team rounds with two office workers (OO) and then two remote workers (RR), we recruited an additional pool of subjects to serve as partners. Partner subjects include both office worker and remote worker types and the basic structure of the experiment is identical to the primary subjects other than the location of teammates.[14]

Teams were purposefully minimalistic, with no interaction or feedback of partner performance. The best response of an individual in this type of strict environment is to contribute an amount equal to what they believe is the minimum contribution of the other teammates, provided the value of leisure is not high enough to rule out work.[15] Hence, a direct comparison of the one-shot team contributions when subjects are partnered with two office workers versus two remote workers provides insights into how subjects view the relative productivity of those types.

Table 1 outlines the session structure of the two orders of partner matching used. Rounds 1 - 3 are paid rounds. After completion of these rounds, all subjects are asked to complete the post-experiment survey, which is not incentivized. The survey asks basic demographic

[12]Corgnet et al. (2015) demonstrate that having internet browsing as a real leisure outside option affects choices, particularly in the team setting. In our design subjects can browse the internet instead of working for the team, but they also can submit work to the individual account. In the individual work round subjects only have internet browsing as the known outside option (remote workers have potentially more unknown outside options).

[13]Since remote participants can participate at any time within a 24 hour block, simultaneous play is ruled out and payoffs are delayed due to the asynchronous timing of participation. While necessary by design, we also view this is as a realistic feature of remote work environments. It is also useful to measure what individuals believe teammate contributions are based on location without confounds of past history of play since coordination can break down over time in weak link games. See Devetag and Ortmann (2007) for a discussion of coordination failure in this class of games.

[14]We use four types of teammate structures for the partner subjects: O partners who play OO then OR; O partners who play OR then OO; R partners who play OR then RR; and R partners who play RR then OR.

[15]While we have no way to observe the value of leisure, the wage paid to group work was calibrated in such a way to encourage group work.

	Order 1	Order 2
Round 1 - Individual work 5 minutes	no partners	no partners
Round 2 - Team work 20 minutes	OO	RR
Round 3 - Team work 20 minutes	RR	OO
Survey	-	-
# O subjects	22	23
# R subjects	28	19

Table 1: Session structure and partner type order; OO denotes two lab partners, RR denotes two remote partners.

questions, risk preferences, working preferences (alone or in groups, flexible or structured), and a series of questions of their expectations of partner output related to their own output and relative performance of partner types (OO versus RR).

2.1. Other Procedural Details

The experiment was programmed using oTree software (Chen et al., 2016). We recruited subjects using the online recruitment process at Ohio University and types were randomly assigned. Those assigned the role of remote workers were sent an email inviting them to participate online at a place of their choosing anytime within a 24-hour block of time. The email contained an individual URL directing the remote subject to the self-paced experimental platform. Subjects assigned to participate in the laboratory as office workers were sent an email inviting them to participate in the campus laboratory at a specific time and once they arrived at the laboratory, they were given their individual URL.

Subjects were emailed no more than one week after their participation and informed that their payment was ready. In total, there were 113 subjects who participated in an experiment that lasted approximately an hour where they made an average of $18.29, including the $5 participation fee. Out of these, we used 21 as partners while the remaining 92 were subjects who participated in the main treatments and whose data we use in the analysis. Out of these 92, 47 (51%) were in the lab and 48 were female (52%). The no-show rate was similar across settings as 6 people did not show up for the on-campus experiments and 3 did not sign into/complete the online experiment after receiving the email announcement.

3. Theory and Hypotheses

This section develops a simple theory based on the design of the experiments to understand how the location of team members may affect team work.

Individuals can choose to spend their time engaging in individual work, s_i, team work, g_i, or a leisure activity, l_i. Individual types $i \in \{O, R\}$ are defined by location where O denotes

the office worker and R denotes the remote worker who can work in a location of their choice. The team consists of k risk-neutral members.

We assume that total time for all three tasks, t, is constant and the same across individuals and that all time is spent engaging in work or leisure, $t = s_i + g_i + l_i$. To simplify the analysis, we assume a deterministic one-to-one relationship between time units and output (completed tasks) that is identical across individuals.[16] Each completed task for the individual account generates a piece rate wage of w_s. Tasks completed for the team pay each member a piece rate wage of w_g for the minimum number of tasks completed from all team members. Individual utility from work and leisure is given by:

$$U_i = w_s s_i + w_g \min_{k=1,2,3}[g_k] + \phi_i(l_i) \tag{1}$$

The first two terms are the monetary payoffs from individual and group work. We assume that wages are ranked $w_g > w_s$, conditional on $g_i \geq g_k$ for $i \neq k$, which captures a real-world situation where the output of teams is valued more highly than individual work and defines the environment as a minimum effort game.[17] The third term, $\phi_i(l_i)$, represents utility from leisure where we make the standard assumptions of $\phi_i(0) = 0$, $\phi_i'(l_i) > 0$, and $\phi_i''(l_i) < 0$. Individuals choose s_i, g_i, and l_i to maximize their utility, subject to the time constraint. We assume that leisure utility is at least as high (and possibly higher) for the remote worker than the office worker, $\phi_R(\cdot) \geq \phi_O(\cdot)$ and $\phi_R'(\cdot) \geq \phi_O'(\cdot)$ for $l_i > 0$, since the set of leisure activity outside options for the remote worker includes all options for the office worker and may include more.[18]

An individual will choose to work if the benefit exceeds the cost of effort, $w_s > \phi_i'(l_i)$ or $w_g > \phi_i'(l_i)$. The highest potential return is to team work, $w_g > w_s$, but the minimum effort payoff structure (see equation 1) may yield a marginal payoff of 0 to team work. Thus, the amount of time devoted to team work will depend on what the individual believes is the

[16] The main restriction arising from this specification is that we are removing the possibility of ability differences (e.g. differing functions for translating time into output). We return to the issue of ability differences at the end of this section and explore the issue in more depth in our empirical results since ability differences are known to be an important driver of differences in how individuals work in teams (Meidinger et al., 2003; Cooper et al., 2021). For our primary analysis, since subjects in the experiment were randomly assigned to work location, teams were anonymous with no interactions between teammates, and all participants worked on the same task, any observed differences in ability would also be randomly distributed across locations; and as we will show, these types of factors should not impact the comparison of effort in unequal ways between types.

[17] The minimum effort game, or weak-link game, mimics an environment where the production of a firm is only as strong as the lowest input (Knez and Camerer, 1994; Brandts and Cooper, 2006).

[18] While we allow for differences in utility to arise from leisure time, we recognize that the specification removes any idiosyncratic differences in utility arising from time spent in work. The work used in the experiment is a mundane typing task, and so we believe differences are unlikely to emerge, particularly by location.

minimum contribution of other team members where equal contributions from all team members are Nash equilibria (Van Huyck et al., 1990). Individuals will work for the team as long as the marginal benefit of working for the team exceeds the marginal benefit of leisure, $w_g \geq \phi_i'(l_i)$ *and* their current team contribution does not exceed what they believe the team minimum is, $g_i \leq \min_{k \neq i}(g_k)$. Let $g_i^* = \min_{k \neq i}(g_k)$ be the equilibrium effort devoted to the team. The remaining time will be devoted to individual work as long as $w_s \geq \phi_i'(l_i)$, or to leisure if $\phi_i'(l_i) > w_s$.

This sets up the core problem facing individuals working with remote team members: they should match what they believe is the minimum effort of the other remote workers, which is shaped by beliefs of the differences in the value of leisure based on a team member's location. There are two cases of interest: i) all members believe the value of leisure and subsequent cost of work effort is higher for remote workers. ii) all members believe that the value of leisure is identical across types.

To see how beliefs of others' value of leisure may impact effort provisions, define $\overline{g}_i$ as the maximum effort contribution an individual is willing to give to the team assuming others will match their contribution. In what follows we go through the two cases of interest.[19]

Case i) Higher Value of Leisure for Remote Workers

If leisure is more valuable to remote workers than office workers (higher cost of effort for remote workers), $\phi_R(\cdot) > \phi_O(\cdot)$ and $\phi_R'(\cdot) > \phi_O'(\cdot)$ for $l_i > 0$, then the maximum team contribution for remote workers will be lower than office workers, $\overline{g}_R < \overline{g}_O$. Because remote workers will never contribute more than $\overline{g}_R$, office workers' effort above this level will yield a payoff of 0 so $\overline{g}_R$ sets the maximum effort when remote workers are part of the team, whereas $\overline{g}_O$ sets the maximum when all workers are office-based. In this environment, coordination on any effort level between 0 and the maximum effort contribution, $\overline{g}_i$ is a Nash equilibrium (Cooper et al., 1990; Van Huyck et al., 1990; Goeree and Holt, 2001), but since previous empirical research in a similar set-up has shown that individuals try to match the contributions of others (Croson et al., 2005), we take the contribution to the team (assuming the maximum value) as a measurement of an individual's belief of partner productivity. As a result, teams with any composition of remote workers will be less productive than teams with all office workers.[20]

Case ii) Same Value of Leisure for Remote and Office Workers.

If workers have the same value of leisure (same cost of effort), $\phi_R(\cdot) = \phi_O(\cdot)$, then expected

[19]This threshold value for a team contribution is given by $t - \bar{l}_i$ where $\bar{l}_i$ is defined by $\phi_i'(l_i) = w_g$. Around this threshold, for low levels of l_i we have $\phi_i'(l_i) > w_g$ and for higher levels of $l_i < t$, $\phi_i'(l_i) < w_g$.

[20]We include a numerical example in the appendix.

maximum contributions are the same, $\overline{g}_R = \overline{g}_O = \overline{g}$, and the location of team members does not impact contributions to the team, $\overline{g}_i$. Productivity differences between teams will not emerge.

3.1. Biased Beliefs

The previous analysis focused on differing leisure outside options as the only possible channel for output to vary in teams with remote workers. However, the existing empirical evidence does not always align with this assumption as individuals are not always less productive in the remote environment (see e.g. Bloom et al. (2015)). To reconcile this empirical evidence with the controversy over productivity hits in the remote environment, we explore how the presence of remote teammates may still lead to productivity losses even if the cost of effort is the same (case ii).

Suppose that workers have the same value of leisure (same cost of effort), $\phi_R(\cdot) = \phi_O(\cdot)$, but suppose that stereotypes (prior beliefs) exist which lead to a biased understanding of the value of leisure. For example, assume that a worker incorrectly believes the remote worker's leisure utility is defined by $\gamma_R(\cdot)$, which differs from $\phi_R(\cdot)$ where $\gamma'_R(\cdot) > \phi'_R(\cdot)$. The worker who holds this biased belief will contribute less when partnered with remote workers because they believe the maximum possible output of the remote worker is $\widetilde{g}_R < \overline{g}_R$, and since team output is defined by the minimum, potential output in teams with remote workers is lower.[21]

3.2. Hypotheses

To develop testable hypotheses, we assume that either case i (with no biased beliefs) or case ii (with biased beliefs) holds. Both cases lead to the following hypotheses:

Hypothesis 1: Office workers will contribute more to the team when paired with office teammates than when paired with remote teammates.

Hypothesis 2: Remote workers will contribute equal amounts to the team when paired with office or remote teammates.

Contributions to the team will be used to test each of these hypotheses. If either of these hypotheses are supported, we will use individual productivity data (individual + team contributions) for both types to determine if beliefs are accurate or biased.

[21] If this bias exists then it is likely held by office workers who are a differing type, but it could also be held by other remote workers against their own type. Our theoretical analysis assumes the most common set-up, but empirically we test for either case.

3.3. Ability

We now turn to ability heterogeneity and show that relaxing the assumption of homogeneous ability will not affect our hypotheses. A simple way to approach modeling ability is through the production function where higher ability individuals are able to produce more in a given period of time. Suppose that we have the identical environment as before, but one member of the group is able to produce more in the time frame than the other two members. Suppose also that ability is randomly distributed and therefore not related to location. In this case, the absolute amount of time spent on the team task, g_i, is defined by the outside value of leisure for the two lower ability members, which will depend upon their location. Consequently the predictions remain the same as the original hypotheses stated, even with heterogeneous ability.

Despite no changes in absolute contributions, a difference will emerge in total productivity $(s_i + g_i)$, which will be higher for the member with a higher ability level. Consequently, if individuals are able to assess their relative ability, we will find a difference in the *proportion of the total output going to the team* $\left(\frac{g_i}{s_i+g_i}\right)$ which will be lower for higher ability types.[22]

Hypothesis 3: Ability is negatively related to the proportion of total effort contributed to the team, but ability is not related to beliefs of teammates' value of leisure based on their location.

4. Results

4.1. Main Treatment Analysis

We begin with an overview of the results followed by statistical tests of our hypotheses. We first examine whether the random assignment to subject type (remote worker or office worker) generated balanced samples. Table 2 displays averages and standard deviations for key variables for the remote and office workers. In the last two columns we present average differences between worker types with p-values reported for two-sided t-tests on the differences. All variables except

[22]Even though we may see a difference in the proportion of team-level contributions based on ability, ability is not related to the opportunity cost (the value of leisure, which is (in)correctly believed to be tied to location) and thus should not be affected by a partner's location when there is random assignment to location. This highlights another benefit of using an experimental approach. There could be a relationship between worker type and ability in the external setting. For example, it may be the case that workers choose the environment that best suits them; individuals who are more productive in the office choose to work in the office, and individuals who are more productive at home choose remote work. While this is an interesting question, we have purposefully designed the experiment to avoid this issue by randomly assigning workers to either a remote working environment or an office environment. Our purpose is to investigate beliefs cleanly, as a first step, without the without the confound of sorting by ability.

for the round 1 output are drawn from the post-experiment survey.[23] Round 1 output is the total output from the 5 minute individual work round, which we use as a measure of individual ability. The p-values provide evidence that random assignment into types is achieved as we do not uncover any statistically significant differences between the two populations of workers.

	Office workers (O)		Remote workers (R)		Difference (R-O)	
	mean	s.d.	mean	s.d.	diff.	p-value
Female	0.51	0.51	0.53	0.50	0.02	0.844
Age	20.77	3.01	22.04	4.97	1.27	0.148
Risk	5.89	2.25	6.15	1.91	0.26	0.551
Prefer flexible	0.69	0.47	0.64	0.49	-0.05	0.613
Prefer group work	0.24	0.43	0.34	0.48	0.10	0.318
Round 1 output (Ability)	12.87	3.91	12.64	3.39	-0.23	0.765
Observations	45		47			

Table 2: Overview of assignment of subjects into treatments.

	Office workers (O)		Remote workers (R)		Difference (R-O)	
	mean	s.d.	mean	s.d.	diff.	p-value
(1) Round 2 output	53.71	14.19	52.00	16.38	-1.71	0.594
(2) Round 3 output	57.38	13.42	52.40	18.47	-4.98	0.144
(3) Amount shared with RR	19.69	16.88	30.87	19.13	11.18	0.004
(4) Amount shared with OO	22.84	18.13	28.89	18.10	6.05	0.113
(5) Difference in amt. shared (RR-OO)	-3.16	10.72	1.98	8.66	5.14	0.013
(6) p-value	0.055		0.124			
(7) Proportion shared with RR	0.36	0.33	0.57	0.34	0.21	0.003
(8) Proportion shared with OO	0.43	0.33	0.55	0.33	0.12	0.084
(9) Difference in prop. shared (RR-OO)	-0.07	0.22	0.02	0.14	0.09	0.023
(10) p-value	0.044		0.309			
Observations	45		47			

Table 3: Overview of output and amount shared with teammates in the team rounds. p-values in rows (6) and (10) are the result of two-sided t-tests for differences in the amount and proportion shared, respectively.

Table 3 displays the outcomes for the main variables of interest from the team work rounds. Rows (1) and (2) display the average total output $(s_i + g_i)$ in rounds two and three across all team treatments. The remaining variables display how much of total output is shared with

[23]Risk is measured using a general risk question modified from the German Socio-Economic Panel (SOEP) (Dohmen et al., 2011), "How do you see yourself? Are you generally a person who is fully willing to take risks or do you try to avoid taking risks (0 means risk averse and 10 means fully prepared to take risks)." Prefer flexible and Prefer group work are also survey questions that ask whether they prefer structured or flexible work environments and whether they prefer working alone or working in groups, respectively. The survey is included with the experiment instructions in the appendix.

the team. The reported p-values are for two-sided t-tests. We use two different measures for sharing. In rows (3) and (4), we present Amount shared, which is the absolute amount shared with the team (g_i). This is the primary variable of interest to examine the theoretical hypotheses as it provides the clean measure of beliefs of the minimum of partner output. Row (5) presents differences within subject worker type (note that the differences presented in the second to last column are between subject type), and below that are the associated p-values for the differences within subject worker type. The second measure is the Proportion shared with the team, $\frac{g_i}{s_i+g_i}$, which provides the relative amount shared with the team out of all output (seen in rows (7) and (8), with (9) displaying within type differences and (10) the corresponding p-values).

Examining total output in (1) and (2), office workers are slightly more productive, but these differences are not significant.[24] We compare the amount shared with RR versus OO for each type in row (5). Between treatments (RR and OO), office workers shared less with their RR partners. More generally, remote workers shared more than office workers, in both absolute and relative terms, regardless of who the remote workers were paired with, but differences appear strongest when comparing behaviors in the RR treatment. These initial results indicate that the amount shared depends upon the location of a worker and for office workers the location of their teammates.

To carefully test our hypotheses and explore subject responses to the treatments, Table 4 presents the results of random effects GLS regressions where the dependent variable is the absolute amount shared with the team, giving two observations per subject.[25] Standard errors are clustered at the subject level. The reference worker type is the remote worker and the reference team treatment is two office workers (OO). Model 1 is the basic test of our treatments. It includes binary variables for whether or not the subject was an office worker (O), whether or not the subject was in the remote team treatment (RR), and an interaction term of these two variables. Model 2 adds demographic controls and also includes the round of play (Period) and

[24] Higher productivity was most noticeable in the third round. A one-sided t-test finds that differences are marginally significant in the third round only ($p = 0.072$; for the hypothesis that office workers produce more). The observation of higher productivity by office workers over time was similar to what was found in Dutcher (2012), and while this study is not designed to examine gender differences, we find that males are driving this trend. In the third period, office males produced 60.68 vs. 53.27 by remote males ($p = 0.076$). In contrast, office females produced 54.22 vs. 51.64 for remote females ($p = 0.285$). Males driving productivity differences is also found in Dutcher (2012).

[25] In models where age is included as an independent variable, the total number of subjects included drops to 90 rather than the full set of 92 subjects. This is due to missing observations for age for two subjects (1 remote and 1 office worker) that choose not to respond to this question. Including these subjects by removing age from the models does not change the qualitative results.

Order, which is a dummy indicating the pairing order assignment.[26]

	(1)	(2)
Amount shared		
Office worker (O)	-6.049	-5.315
	(3.789)	(3.795)
Remote teammates (RR)	1.979	1.909
	(1.268)	(1.372)
O×RR	-5.134**	-5.022**
	(2.043)	(2.190)
Period		0.019
		(1.099)
Order		2.234
		(3.937)
Female		-1.986
		(3.862)
Age		-0.911**
		(0.441)
Risk		1.982*
		(1.109)
Round 1 output (Ability)		0.056
		(0.444)
Prefer flexible		-0.464
		(4.941)
Prefer group work		6.547
		(4.141)
Constant	28.894***	33.686**
	(2.649)	(16.323)
Observations	184	180
Number of subjects	92	90

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Random Effects Panel Regressions on Amount Shared.

Hypothesis 2 predicts that remote workers will give equivalent amounts to OO and RR teammates, and we find support for this hypothesis as the coefficient on RR is not significant in either model. Turning to office workers, post-estimation Wald tests indicate the sum of coefficients on RR and O×RR is significantly different from zero ($p = 0.048$). This tests for

[26]This variable is assigned a value of 1 if the subject plays first with OO then RR, and 0 otherwise (i.e. if the subject is partnered with RR first then OO).

a difference in the amount shared by O to RR versus OO, and these results imply that office workers share less when they are paired with remote teammates than when they are paired with other office teammates, providing support for hypothesis 1.

In model 2, we add controls and find additional behavioral results: on average, higher levels of self-assessed risk tolerance lead to higher shared amounts, and age negatively impacts the amount shared. The previous results all continue to hold with the additional controls, leading to our first result.

Result 1. *Office workers give less to the team when paired with remote workers than with other office workers. The remote workers' team contribution is not affected by their partner location.*

Even though we find support for our core hypothesis, what remains unclear is if our results align with the standard theory of differing values of leisure (case i) or if they are the result of biased beliefs (and case ii). If the standard theory holds, then office workers and remote workers will give the same level of effort to the RR teams, and remote workers will give less to OO teams than office workers. We find no support for this. Office workers give significantly less than remote workers to the RR team (table 4, post-estimation Wald tests on the sum of coefficients on O and O×RR, $p = 0.003$) *and* tests for significance on the coefficient for office worker indicates that the amount shared with OO by remote workers is not significantly different from the amount shared with OO by office workers.

While our results do not align with case i) and the standard theory, we still need to check if they align with a behavioral model of biased beliefs (case ii). As stated previously, examining overall productivity levels, we find no evidence that productivity levels differ between worker types. Examining the responses of each type, remote workers appear to best understand that there are no differences as they give equal amounts to the team partner types. Office workers on the other hand give less to the remote partners indicating that they hold inaccurate beliefs that the remote partners are less productive. This suggests that biased beliefs exist, but they are one-sided, holding only for office workers. We examine this issue further by exploiting the post-experiment survey data in figure 1 which displays the team effort choice differences conditional on the worker's (non-incentivized) surveyed beliefs.[27] The height of each bar represents the average difference in the absolute amount shared with remote teammates and office teammates (RR-OO) for each of the survey subgroups. The strongest response is for the office workers who

[27] After the experiment participants were asked "Do you believe the MINIMUM contribution to the GROUP account was higher for your TELECOMMUTER or LAB PARTICIPANT group members?" with the following responses: "TELECOMMUTERS contributed MORE than LAB PARTICIPANTS;" "LAB PARTICIPANTS contributed MORE than TELECOMMUTERS;" "No Difference between TELECOMMUTERS and LAB PARTICIPANTS"

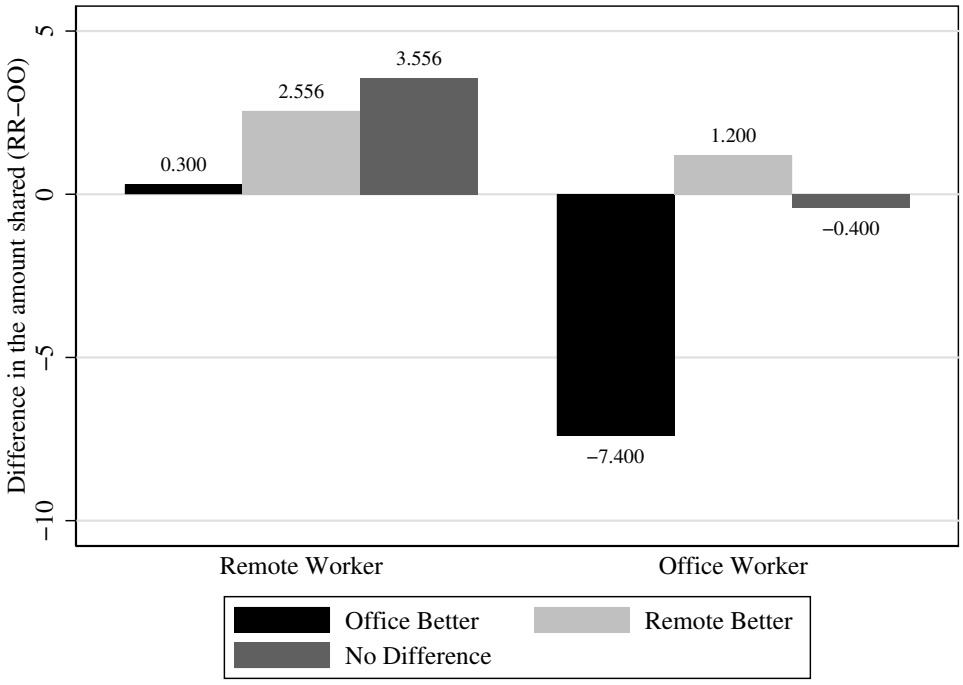

Figure 1: Surveyed responses versus actual sharing decisions. Numerical values at the top of the bars represent the average difference in the amounts given to RR versus OO.

self-report that office workers would be more productive than remote workers; they give 7.4 less to remote worker teammates. These results mirror what is observed in table 3, and provide additional evidence that biased beliefs are driving differences in behavior.

4.2. The Effects of Ability

The variable Round 1 Output (Ability) in table 4 indicates that ability does not impact absolute contributions to the team, which aligns with the theoretical structure of the minimum effort game. However, while ability should not impact absolute contributions, it is predicted to negatively impact the proportion shared (hypothesis 3).

Table 5 presents random effects GLS regressions where the dependent variable is the proportion of total output shared with the team in each of the two team rounds. Standard errors are clustered at the subject level and all other definitions of variables remain the same as in table 4. Models 1 and 2 present the basic treatment effects without demographic controls and models 3 and 4 add the controls.

The negative and significant coefficient on Ability across all models indicates that ability influences the proportion given in the predicted direction as higher ability individuals contribute a lower proportion of total output. In models 2 and 4 we explore whether this effect differs by either worker type or treatment through interaction effects. We find that the overall impact of

Proportion shared	(1)	(2)	(3)	(4)
Office worker (O)	-0.112*	-0.342*	-0.098	-0.294
	(0.067)	(0.193)	(0.066)	(0.183)
Remote teammates (RR)	0.020	0.062	0.016	0.063
	(0.022)	(0.068)	(0.023)	(0.069)
O×RR	-0.088**	-0.256**	-0.084**	-0.259**
	(0.039)	(0.125)	(0.041)	(0.128)
Period	-0.025	-0.027	-0.023	-0.025
	(0.020)	(0.021)	(0.021)	(0.021)
Order	0.061	0.041	0.037	0.024
	(0.067)	(0.069)	(0.069)	(0.071)
Female			-0.014	-0.013
			(0.066)	(0.067)
Age			-0.010	-0.011
			(0.009)	(0.008)
Risk			0.038**	0.036*
			(0.019)	(0.019)
Round 1 output (Ability)	-0.024***	-0.036***	-0.022***	-0.033***
	(0.008)	(0.010)	(0.007)	(0.010)
Prefer flexible			0.005	-0.006
			(0.086)	(0.088)
Prefer group work			0.117*	0.115*
			(0.070)	(0.070)
O×Ability		0.018		0.015
		(0.013)		(0.013)
RR×Ability		-0.003		-0.004
		(0.006)		(0.006)
O×RR×Ability		0.013		0.014
		(0.009)		(0.009)
Constant	0.878***	1.055***	0.817***	1.006***
	(0.126)	(0.150)	(0.270)	(0.281)
Observations	182	182	178	178
Number of subjects	92	92	90	90

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Random Effects Panel Regressions on Proportion Shared.

ability remains significant, but all interactions are insignificant indicating that ability does not have a stronger influence for different types of workers. This provides support for hypothesis 3.

Result 2. *Higher ability remote and office workers give a lower proportion of output to the team.*

Turning to the overall proportion shared, independent of ability, we find a marginally significant effect that office workers contribute proportionally less than remote workers in the reference OO treatment, which aligns with the basic statistics presented in table 3, but this effect loses significance once demographic controls are included. The negative and significant coefficient on O×RR across all models indicates that office workers give a smaller percentage of their total output than remote workers to remote teams (RR), which aligns with Result 1.

A remaining question is why remote workers are more generous. One reason for individuals choosing to give more in team settings is because they wish to avoid feeling guilty. To test for this behavioral effect in our experimental data, we look at the answers on two post-experimental questions that ask if the subjects feel they have contributed more than, less than, or equal to their teammates. Subjects may attempt to avoid being the lowest contributor by contributing a bit more than they believed others would contribute and their location may enhance guilt avoidance. In the data, we find that 74% of the remote subjects believe they were *not* the lowest contributor which is different than the 51% in the office (t-test; $p = 0.022$). We do not, however, find a difference in the proportion who believed they were the highest contributor, nor do we find a difference in those that believed there was no difference (t-test; $p > 0.10$ in both).

5. Discussion and Conclusion

Despite growing evidence that remote work does not appear to negatively impact productivity at the individual level (e.g., Dutcher (2012), Bloom et al. (2015)), firms are continuing to push back against permanent policy shifts that allow workers to work remotely. One likely reason for the continued hesitancy is the pervasive use of workplace teams which may be more susceptible to negative productivity impacts when some members are remote.

Effort choices within a team are more complex than individual effort choices. Teams require workers to not only understand their own cost of effort, but to also form accurate beliefs over the cost of effort and subsequent effort level of their partners. Therefore, to maintain high levels of team productivity all members of the team must contribute effort and all members must *believe* the others are contributing as well. This sets-up an environment where workers can be highly productive at the individual level, yet still have productivity losses in the team if they believe partners are not as productive. Of course, this issue exists even when teams are

office-based, but in the office, team members can more easily observe the effort of their team members. When working remotely, direct observation is more complicated.

Prior to our study, it was unknown what teammates' beliefs of their remote-working teammates were and how these beliefs would impact their team-level work effort. To causally answer both questions, we utilized a laboratory experiment. Workers were given a typing task and could choose to contribute completed tasks to either an individual account that paid 10 cents per task or a team account that paid 18 cents to the minimum number of tasks contributed by a member of the team. The experiment varied whether or not a worker (who was either randomly assigned to be a remote or office worker) was partnered with two remote workers or two office workers. Differences between the team contributions in each setting directly measured differences in beliefs over the productivity of the respective partner types. Our experimental environment is purposefully stark with no feedback and we eliminated possible confounding elements well-known to harm teams such as free-riding, as well as potentially positive confounds like team synergies. This allowed us to isolate beliefs based on partner location alone as a potential driver of productivity issues in teams.

At the individual level, we find no differences in effort levels measured by total tasks completed between remote workers and office workers. However, despite observing no differences in overall productivity, we do find that remote work harms team productivity through the beliefs channel. Our main finding is that the biased (incorrect) beliefs that office workers hold about remote workers negatively impacts team productivity in mixed-location teams. We also find that remote workers give more, overall, to both team types than remote workers.

Office workers choosing to give less to their remote teams is an efficiency loss for the firm and a welfare loss for both types of workers. In absolute terms, office workers give an average of 3.16 units of effort less to their remote teammates. This is a loss of 14% potential output for the firm choosing to implement mixed-location teams and is perhaps the most optimistic view of the loss. A more dim view is given by the following: the average amount remote workers give to their office teammates is 28.89 while office workers only give an average of 19.69 to their remote teammates. This implies that about 31% of the effort from remote workers is wasted in the team production task. Put differently, if office workers had matched their remote teammates contributions the team's output would have been almost 1.5x higher (relative to the 19.69 given by office workers).

Remote workers are no less productive and appear more generous than office workers. Our post-experimental survey evidence points to a desire to avoid being the lowest contributor as a potential driver of this generosity. This also aligns with previous empirical research that suggests that this type of guilt aversion is more likely to impact remote workers since they often report working harder, more hours, or both (Bailyn, 1988; Bélanger, 1999; Hill et al.,

1998).

In terms of managerial implications, because the negative impacts are generated by biased beliefs and not actual productivity differences, a manager can be somewhat assured that allowing remote work will not lead to massive amounts of shirking by remote workers. The job of a manager should instead focus on helping the employees form accurate beliefs. In concept, this sounds simple but it may be more difficult to implement in practice. For example, as an intervention managers could install monitoring technology on remote workers' computers to observe their work effort, transmitting this information to other team members. However, prior work has shown that monitoring practices may also harm implicit agreements and lead to lower effort in an individual setting (Dickinson and Villeval (2008)). Future work can explore if the result extends to team output where the monitoring technology serves as a coordination device instead of a signal of mistrust.

Even if monitoring technologies are installed, workers can find ways to game the system, which highlights a more general problem; effort and productivity may not be observable. In such cases, trust and trustworthiness amongst the members of the team may be critical. Again, we lack evidence on how these traits can be implemented in a remote work setting. The hybrid design adopted by many firms may achieve this goal, but we are not aware of any studies examining how a hybrid design affects trust and trustworthiness and how this may translate into beliefs of others productivity.

Our study answers crucial open questions about remote work policies, but it also raises a few more. Our results indicate that future work should be less concerned about the productivity effects of remote-working teams but instead should focus on how managers can guide their employees to form accurate beliefs.

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Appendix

5.1. Numerical Example

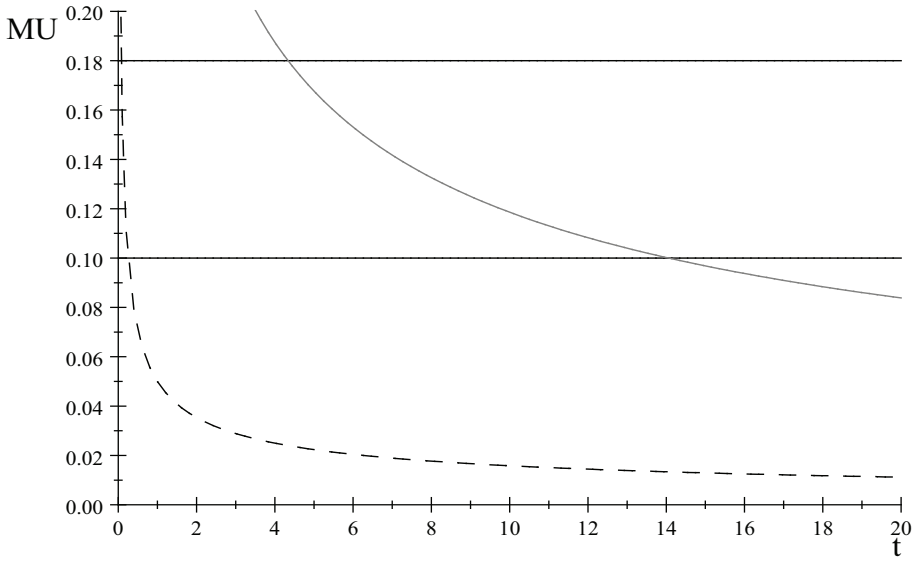

Figure 2: $w_s = .10$; $w_g = .18$; $\phi'_O(l_i) = \frac{1}{20\sqrt{l}}$; $\phi'_R(l_i) = \frac{3}{8\sqrt{l}}$

Figure 2 charts out marginal utility of leisure for both remote and office workers and wages for individual work and team work. We adopt the parameters from the experiment, $w_s = .10$, $w_g = .18$, and $t = 20$ and assume the specific functional forms for leisure utility are $\phi_R(l_i) = \frac{3}{4}\sqrt{l}$ and $\phi_O(l_i) = \frac{1}{10}\sqrt{l}$. The office worker's marginal utility of leisure is dashed, the remote worker's is solid grey.

The office worker wants to switch from leisure to team work at very low levels of leisure ($l_O = 0.08$) and because the marginal incentives for leisure are so low, the office worker also switches from leisure quickly to individual work ($l_O = 0.25$). The remote worker, on the other hand, places a higher value on leisure and therefore chooses to spend more time on leisure. The remote worker is willing to switch from leisure to team work after $l_R = 4.34$ and is only willing to switch from leisure to individual work after $l_R = 14.06$. In terms of the maximum willingness of each type to contribute to the team, remote workers are willing to contribute any amount between 0 and $\overline{g}_R = 15.66$ and office workers are willing to contribute any amount between 0 and $\overline{g}_O = 19.92$. Given the higher effort cost for remote workers, they are willing to give less to the team than office workers.

Turning to the Nash equilibria. As mentioned above, one equilibrium is that all members contribute 0 to the team ($g_R = 0, g_O = 0$) and each individual optimizes the remaining time between leisure and individual work. For the example presented in Figure 2, this equilibrium

Team Organization	$\min_{k=1,2,3}(g_k)$	s_O	l_O	s_R	l_R
OOO	19.92	0	0.08	–	–
ORR	15.66	4.09	0.25	0	4.34
RRR	15.66	–	–	0	4.34
ROO	15.66	4.09	0.25	0	4.34

Table 6: Optimal Decisions

would result in $l_O = 0.25, s_O = 19.75, g_O = 0$ for the office worker and $l_R = 14.06, s_R = 5.94$, $g_R = 0$ for the remote worker. In this scenario, the location of team members does not make a difference because everyone is working for themselves and not for the team, which produces zero output. In contrast, suppose individuals all choose the payoff dominant equilibrium. In the case of mixed teams of remote and office workers, even though the office worker would prefer to contribute more to the team, $\overline{g}_O > \overline{g}_R$, the office worker knows that the remote workers are not willing to contribute as much, so all members will choose the maximum team output that the remote worker is willing to produce; i.e., $g_O = g_R = \overline{g}_R$. If team members are all remote workers, they all have the same willingness to work for the team, $\overline{g}_R$, so team output is identical to the mixed teams; i.e., $g_R = \overline{g}_R$. The final comparison is a team of all office workers. Each office worker matches the maximum contribution of the others $g_O = \overline{g}_O$, but in this case team output is higher than mixed teams or all remote teams because $\overline{g}_O > \overline{g}_R$.

Table 6 summarizes these equilibrium predictions, but these point predictions should not be confused with what we expect to observe in the experiment given we cannot know what individual utility functions actually look like. Our goal is to highlight how differing opportunity costs of team effort, driven by location, can negatively impact team productivity. Teams comprised of all office workers are potentially the most productive (for the team) and mixed (heterogeneous) teams or homogenous teams of all remote workers are least productive.

5.2. Instructions

Office Worker

Email: Thank you for participating in today's experiment!

In this experiment, we are studying decisions made in the workplace. For choosing to participate, you will earn $5 and during the experiment you will have the opportunity to make more based on your decisions and the decisions of others.

To participate, please click your personalized link below. You have 1.5 hours to complete this experiment. You can leave once you have finished this experiment. Instructions in this link will guide you through this experiment, so please read carefully. The first page is a consent form that you must click through to connect. If you are disconnected, you can click the link to return to the experiment. Some portions of the experiment are timed, so if you leave during a

timed portion, the clock will continue until it reaches the next untimed portion.

The experiment is self-paced. Please click the link to begin.

{{link}}

Introduction

Thank you for participating in today's experiment.

This experiment will have three stages: 1 short (5 minutes) individual training stage that you will participate in alone and 2 longer group stages (20 minutes each) where you will participate in a group of three. In each stage you will be asked to perform work for payment and the type of work will remain the same for the duration of today's experiment.

At the end, there will also be a short survey that we will use to collect your contact information for payment. Because of the nature of today’s experiment, your payment will be available within one week of your participation. Detailed instructions for how you can pick up your cash payment will be emailed to you. All payments are confidential; no other participant will be told the amount you make.

This experiment is self paced; so when you have finished and a Continue button is available, please press it.

Continue

Work Description

Task

The task you are asked to work on is a transcription task. There will be a series of characters (letters and numbers) called a "string" that appear on your screen, which must be typed into the provided space. You must type them exactly as they appear including the spaces between letters, and you must make sure not to include extra spaces before or after the string. The program is not case sensitive so upper or lower case will be counted as correct. However, please note that the letter "O" and the number "0" look similar, so input carefully. An example task (already typed in) is provided below:

SAMPLE

Please transcribe (type) the text below into the input field. Be exact and make sure to get all characters and spaces correct.

75CNBQDHOQ 56KUBCI 9S Q

75CNBQDHOQ 56KUBCI 9S Q

Submit

Once you have typed in the string of characters and hit the “submit” button, the computer will automatically check your answer and if it is correct, you will be paid $0.10 for that correct task. This will add to your total balance of earnings, which is currently $5.00 for participating.

If you have made an error in typing the task, once you press submit, the program will inform you of this and you must fix your error before the next string of characters appear.

Practice:

On the next screen, you can practice this task. Please press Begin Practice to practice the task.

Begin Practice

Stage 1 Instructions

Individual Stage 1:

You are about to enter into the first paid portion of the experiment. You will have a total of 5 minutes to type as many tasks as you like. For each correct task you submit to the individual account, you will earn $0.10.

Once the five minutes are up, you will be automatically redirected to the results for stage 1. If at any time you are disconnected from this website, you can follow the initial link in your email which will take you back to the experiment (in progress – the clock will continue to run, even if the browser is closed).

If you prefer not to perform this work, you are free to browse the web instead.

Please press the Continue button to begin stage 1.

Continue

Individual Stage 1

Please transcribe (type) the text below into the input field. Be exact and make sure to get all characters and spaces correct. The bottom of the screen will update with the total correct tasks submitted to the Individual Account.

Please note that if you leave this webpage and return, the clock will be slightly off. It will reset to the correct time once you submit a new task. The correct time is always running in the background, so you only have 5 minutes to work on tasks. If time has run out by the time you return, when you submit the next task you will be automatically redirected to the results screen.

5WN1II5 S8EF 2XJK LTJ MD

Correct tasks submited to the Individual Account: **0**

Individual Account pays $0.10 per correct task to you.

Submit Individual Account

Results Stage 1

Correct tasks submitted to the Individual Account: **0**

Your earnings for stage 1 are: **$0.00**

Continue

Stage 2 and 3 Instructions

The work task in the remaining two stages of the experiment is the same as in stage 1, however, there are three important changes.

1. in both stage 2 and stage 3 you will be randomly and anonymously matched with two other participants to form a group of three.

2. you will now have the option to submit a work task to the group or individual account, both of which generate earnings.

3. the time limit in both stages is increased to 20 minutes.

Earnings:

INDIVIDUAL ACCOUNT

Each correct task you submit to the individual account pays **$0.10** per correct task. These earnings are only paid to you.

GROUP ACCOUNT

The return on the group account is not so easily determined. Your earnings from the group account depend on the minimum number of correct tasks submitted to the group by only one member of the group

For payment, the minimum number of correct tasks submitted by any member of your group, including you, will be used. You and everyone in your group is paid **$0.18** per correct task of the group member who submitted the least number of correct tasks to the group.

Your total earnings will be equal to your individual earnings + your group earnings.

Please click on the Continue button to find out more about the group account.

Continue

Group Account

You and the other two members are working under the same framework with the choice to submit tasks to the individual account or group account.

The minimum number of correct tasks submitted by a group member in the group account generates $0.18 to all group members.

Examples:

If *you submit no tasks* in the group account, the minimum number submitted is 0 (set by you). All group members would earn 0.

If *the at least one of the other members submits no tasks* in the group account, but you submit 20 tasks, the minimum number submitted is 0 (set by others). All group members would earn 0.

Suppose now that you submitted 20, and the other group members submitted 30 and 44. The minimum is 20 and each group member would earn 20*$0.18 = $3.60

Suppose instead that you submitted 40, and the other group members submitted 30 and 44. The minimum is 30 and each group member would earn 30*$0.18 = $5.40

Press Continue to see how this will change the work screen.

Continue

Task Description for Groups

The black comment bubbles explain the differences in the interface. These will not be visible during the paid portions.

SAMPLE

Please transcribe (type) the text below into the input field. Be exact and make sure to get all characters and spaces correct.

75CNBQDHOQ 56KUBCI 9S Q

75CNBQDHOQ 56KUBCI 9S Q

Notice that you now have the ability to submit to the group. Group earnings will depend on the minimum number of submitted tasks by a group member.

Individual Account pays $0.10 per correct task to you.

Group Account pays $0.18 per correct task for the minimum number submitted.

Submit Individual Account

Submit Group Account

Your stage earnings = Individual account earnings + Group account earnings.

On the next screen, we will tell you more information about your group members. Please press Continue.

Continue

Group Member Information

There are two types of participants in this experiment:

1. *Those that participate in a computer lab at Ohio University at a designated time **(LAB PARTICIPANTS)***
2. *Those that participate in a location of their choice (e.g. in their apartment, at a coffee shop, in the library, etc.) at any time within a block of 24 hours **(TELECOMMUTERS)***

You are a LAB PARTICIPANT.

In stage 2 (the next stage):

The other two members of your group will also be LAB PARTICIPANTS.

In stage 3 (the final stage):

The other two members of your group will be TELECOMMUTERS.

Last Information:

The next stage 2 and the final stage 3 will be identical in all ways except who your partners are. All choices are anonymous. The other members in your group will **never** be told how many tasks you completed nor the amount that you submitted to each account. Likewise, you will never be given this information for either of your group members.

Each group member knows the participant composition of the group (# telecommuters, # lab participants) and all group members are performing this independently – so your group members do not know each other, or you. The other members of your group may not be participating today.

Please press Continue.

Continue

Stage 2 Instructions

Group Stage 2:

You are about to enter into stage 2, the next paid portion. You will have a total of 20 minutes to type as many strings as you like. For each correct task you submit to the individual account, you will earn $0.10. For the minimum number of submitted correct tasks by a group member in your group, each member of the group will earn $0.18.

In this stage:

You are a LAB PARTICIPANT. The other two members of your group will also be LAB PARTICIPANTS.

If you prefer not to perform this work, you are free to browse the web instead. The other two group members have this same option.

Please press the Continue button to begin stage 2.

Continue

Group Stage 2

You are a LAB PARTICIPANT. The other two members of your group are also LAB PARTICIPANTS.

04:54

Please transcribe (type) the text below into the input field. Be exact and make sure to get all characters and spaces correct.

The amount submitted to the individual and group accounts will remain private. You and the other group members will only be told the minimum number submitted to the group account.

XM G HQSU F23J7Y AHDO82X

Correct tasks submitted to individual account: **0**

Correct tasks submitted to group account: **0**

Individual Account pays $0.10 per correct task to you.

Submit Individual Account

Group Account pays $0.18 per correct task for the minimum number submitted.

Submit Group Account

Results Stage 2

Correct tasks submitted to the Individual Account:**0**
Correct tasks submitted to the Group Account:: **0**

Your earnings from the Individual Account are: **$0.00**
Your earnings from the Group Account will provided to you later.

Continue

Stage 3 Instructions

Group Stage 3:

You are about to enter into stage 3, the next paid portion. This stage is identical to stage 2, **except you will now participate with two new group members of a different type.**

Recall, there are two types of participants:

1. Those that participate in a computer lab at Ohio University at a designated time **(LAB PARTICIPANTS)**
2. Those that participate in a location of their choice (e.g. in their apartment, at a coffee shop, in the library, etc.) at any time within a block of 24 hours **(TELECOMMUTERS)**

In this stage:

You are a LAB PARTICIPANT. The other two members of your group will be TELECOMMUTERS.

Please press the Continue button to begin stage 3.

Continue

Group Stage 3

You are a LAB PARTICIPANT. The other two members of your group will be TELECOMMUTERS.

04:54

Please transcribe (type) the text below into the input field. Be exact and make sure to get all characters and spaces correct.

The amount submitted to the individual and group accounts will remain private. You and the other group members will only be told the minimum number submitted to the group account.

UM Z K0 J8L31TDYWLWQ 8WU

Correct tasks submitted to individual account: **0**

Correct tasks submitted to group account: **0**

Individual Account pays $0.10 per correct task to you.

Submit Individual Account

Group Account pays $0.18 per correct task for the minimum number submitted.

Submit Group Account

Results Stage 3

Correct tasks submitted to the Individual Account:**0**
Correct tasks submitted to the Group Account:: **0**

Your earnings from the Individual Account are: **$0.00**
Your earnings from the Group Account will provided to you later.

Continue

Questionaire

Thank you for your participation in this experiment. Once you complete the survey your payment will be computed and you will receive an email with instructions on how to collect your cash payment within the next week.

Your name:

Your age:

Your email address:

Are you:

- **Male**
- **Female**

How do you see yourself? Are you generally a person who is fully willing to take risks or do you try to avoid taking risks? (0 means 'risk averse' and 10 means 'fully prepared to take risks'):

0

Which do you prefer working in?

- **Structured environments**
- **Flexible environments**

Which type of work do you prefer?

- **Working Alone**
- **Working in Groups**

Continue

Questionaire

We would like to ask you some final questions on your decisions in the experiment.

When you were in a group with two LAB PARTICIPANTS - how do you believe your contribution to the GROUP account compared to the lowest amount contributed by your group members?

- **I contributed more to the GROUP account than the lowest amount contributed by my group members**
- **My group members contributed more to the GROUP account than me**
- **There was not much difference between my contribution and the lowest amount contributed by my group members to the GROUP account**

When you were in a group with two TELECOMMUTERS - how do you believe your contribution to the GROUP account compared to the lowest amount contributed by your group members?

- **I contributed more to the GROUP account than the lowest amount contributed by my group members**
- **My group members contributed more to the GROUP account than me**
- **There was not much difference between my contribution and the lowest amount contributed by my group members to the GROUP account**

Do you believe the MINIMUM contribution to the GROUP account was higher for your TELECOMMUTER or LAB PARTICIPANT group members?

- **TELECOMMUTERS contributed MORE than LAB PARTICIPANTS**
- **LAB PARTICIPANTS contributed MORE than TELECOMMUTERS**
- **No Difference between TELECOMMUTERS and LAB PARTICIPANTS**

Did your group members' type (TELECOMMUTERS or LAB PARTICIPANTS) influence your decisions?

- **Yes**
- **No**

Please explain your above answer (did types influence you?):

Finish

Remote Worker

Email: Thank you for signing up for the experiment scheduled for tomorrow. For the experiment you signed up for, you will not participate in the usual room on campus, but will complete the experiment online at a location of your choice.

For choosing to participate, you will earn $5 and during the experiment you will have the opportunity to make more based on your decisions and the decisions of others.

To participate, please click your personalized link below. You have 24 hours to complete this experiment. Instructions in this link will guide you through this experiment, so please read carefully. The first page is a consent form that you must click through to connect. If you are disconnected or choose to take a break, you can click the link to return to the experiment. Some portions of the experiment are timed, so if you leave during a timed portion, the clock will continue until it reaches the next untimed portion.

The experiment is self-paced. Please click the link to begin.

{{link}}

Introduction

Thank you for participating in today's experiment.

This experiment will have three stages: 1 short (5 minutes) individual training stage that you will participate in alone and 2 longer group stages (20 minutes each) where you will participate in a group of three. In each stage you will be asked to perform work for payment and the type of work will remain the same for the duration of today's experiment.

At the end, there will also be a short survey that we will use to collect your contact information for payment. Because of the nature of today’s experiment, your payment will be available within one week of your participation. Detailed instructions for how you can pick up your cash payment will be emailed to you. All payments are confidential; no other participant will be told the amount you make.

This experiment is self paced; so when you have finished and a Continue button is available, please press it.

Continue

Work Description

Task

The task you are asked to work on is a transcription task. There will be a series of characters (letters and numbers) called a "string" that appear on your screen, which must be typed into the provided space. You must type them exactly as they appear including the spaces between letters, and you must make sure not to include extra spaces before or after the string. The program is not case sensitive so upper or lower case will be counted as correct. However, please note that the letter "O" and the number "0" look similar, so input carefully. An example task (already typed in) is provided below:

SAMPLE

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75CNBQDHOQ 56KUBCI 9S Q

75CNBQDHOQ 56KUBCI 9S Q

Submit

Once you have typed in the string of characters and hit the “submit” button, the computer will automatically check your answer and if it is correct, you will be paid $0.10 for that correct task. This will add to your total balance of earnings, which is currently $5.00 for participating.

If you have made an error in typing the task, once you press submit, the program will inform you of this and you must fix your error before the next string of characters appear.

Practice:

On the next screen, you can practice this task. Please press Begin Practice to practice the task.

Begin Practice

Stage 1 Instructions

Individual Stage 1:

You are about to enter into the first paid portion of the experiment. You will have a total of 5 minutes to type as many tasks as you like. For each correct task you submit to the individual account, you will earn $0.10.

Once the five minutes are up, you will be automatically redirected to the results for stage 1. If at any time you are disconnected from this website, you can follow the initial link in your email which will take you back to the experiment (in progress – the clock will continue to run, even if the browser is closed).

If you prefer not to perform this work, you are free to browse the web instead.

Please press the Continue button to begin stage 1.

Continue

Individual Stage 1

Please transcribe (type) the text below into the input field. Be exact and make sure to get all characters and spaces correct. The bottom of the screen will update with the total correct tasks submitted to the Individual Account.

Please note that if you leave this webpage and return, the clock will be slightly off. It will reset to the correct time once you submit a new task. The correct time is always running in the background, so you only have 5 minutes to work on tasks. If time has run out by the time you return, when you submit the next task you will be automatically redirected to the results screen.

5WN1II5 S8EF 2XJK LTJ MD

Correct tasks submited to the Individual Account: **0**

Individual Account pays $0.10 per correct task to you.

Submit Individual Account

Results Stage 1

Correct tasks submitted to the Individual Account: **0**

Your earnings for stage 1 are: **$0.00**

Continue

Stage 2 and 3 Instructions

The work task in the remaining two stages of the experiment is the same as in stage 1, however, there are three important changes.

1. in both stage 2 and stage 3 you will be randomly and anonymously matched with two other participants to form a group of three.

2. you will now have the option to submit a work task to the group or individual account, both of which generate earnings.

3. the time limit in both stages is increased to 20 minutes.

Earnings:

INDIVIDUAL ACCOUNT

Each correct task you submit to the individual account pays **$0.10** per correct task. These earnings are only paid to you.

GROUP ACCOUNT

The return on the group account is not so easily determined. Your earnings from the group account depend on the minimum number of correct tasks submitted to the group by only one member of the group

For payment, the minimum number of correct tasks submitted by any member of your group, including you, will be used. You and everyone in your group is paid **$0.18** per correct task of the group member who submitted the least number of correct tasks to the group.

Your total earnings will be equal to your individual earnings + your group earnings.

Please click on the Continue button to find out more about the group account.

Continue

Group Account

You and the other two members are working under the same framework with the choice to submit tasks to the individual account or group account.

The minimum number of correct tasks submitted by a group member in the group account generates $0.18 to all group members.

Examples:

If *you submit no tasks* in the group account, the minimum number submitted is 0 (set by you). All group members would earn 0.

If *the at least one of the other members submits no tasks* in the group account, but you submit 20 tasks, the minimum number submitted is 0 (set by others). All group members would earn 0.

Suppose now that you submitted 20, and the other group members submitted 30 and 44. The minimum is 20 and each group member would earn 20*$0.18 = $3.60

Suppose instead that you submitted 40, and the other group members submitted 30 and 44. The minimum is 30 and each group member would earn 30*$0.18 = $5.40

Press Continue to see how this will change the work screen.

Continue

Task Description for Groups

The black comment bubbles explain the differences in the interface. These will not be visible during the paid portions.

SAMPLE

Please transcribe (type) the text below into the input field. Be exact and make sure to get all characters and spaces correct.

75CNBQDHOQ 56KUBCI 9S Q

75CNBQDHOQ 56KUBCI 9S Q

Notice that you now have the ability to submit to the group. Group earnings will depend on the minimum number of submitted tasks by a group member.

Individual Account pays $0.10 per correct task to you.

Group Account pays $0.18 per correct task for the minimum number submitted.

Submit Individual Account

Submit Group Account

All tasks submitted to the Individual Account continue to pay $0.10 per correct task (to you alone). Any tasks submitted to the Group Account will be counted alongside the tasks the other members submit. The minimum number

Your stage earnings = Individual account earnings + Group account earnings.

On the next screen, we will tell you more information about your group members. Please press Continue.

Continue

submitted will pay $0.18 per correct task (to all members of the group).

Group Member Information

There are two types of participants in this experiment:

1. *Those that participate in a computer lab at Ohio University at a designated time **(LAB PARTICIPANTS)***
2. *Those that participate in a location of their choice (e.g. in their apartment, at a coffee shop, in the library, etc.) at any time within a block of 24 hours **(TELECOMMUTERS)***

You are a TELECOMMUTER.

In stage 2 (the next stage):

The other two members of your group will be LAB PARTICIPANTS.

In stage 3 (the final stage):

The other two members of your group will also be TELECOMMUTERS.

Last Information:

The next stage 2 and the final stage 3 will be identical in all ways except who your partners are. All choices are anonymous. The other members in your group will **never** be told how many tasks you completed nor the amount that you submitted to each account. Likewise, you will never be given this information for either of your group members.

Each group member knows the participant composition of the group (# telecommuters, # lab participants) and all group members are performing this independently – so your group members do not know each other, or you. The other members of your group may not be participating today.

Please press Continue.

Continue

Stage 2 Instructions

Group Stage 2:

You are about to enter into stage 2, the next paid portion. You will have a total of 20 minutes to type as many strings as you like. For each correct task you submit to the individual account, you will earn $0.10. For the minimum number of submitted correct tasks by a group member in your group, each member of the group will earn $0.18.

In this stage:

You are a TELECOMMUTER. The other two members of your group will be LAB PARTICIPANTS.

If you prefer not to perform this work, you are free to browse the web instead. The other two group members have this same option.

Please press the Continue button to begin stage 2.

Continue

Group Stage 2

You are a TELECOMMUTER. The other two members of your group are LAB PARTICIPANTS.

Please transcribe (type) the text below into the input field. Be exact and make sure to get all characters and spaces correct.

The amount submitted to the individual and group accounts will remain private. You and the other group members will only be told the minimum number submitted to the group account.

XZY ESBT5 G 71 IDQE93DEC

Correct tasks submitted to individual account: **0**

Correct tasks submitted to group account: **0**

Individual Account pays $0.10 per correct task to you.

Submit Individual Account

Group Account pays $0.18 per correct task for the minimum number submitted.

Submit Group Account

Results Stage 2

Correct tasks submitted to the Individual Account:**0**
Correct tasks submitted to the Group Account:: **0**

Your earnings from the Individual Account are: **$0.00**
Your earnings from the Group Account will provided to you later.

Continue

Stage 3 Instructions

Group Stage 3:

You are about to enter into stage 3, the next paid portion. This stage is identical to stage 2, **except you will now participate with two new group members of a different type.**

Recall, there are two types of participants:

1. Those that participate in a computer lab at Ohio University at a designated time **(LAB PARTICIPANTS)**
2. Those that participate in a location of their choice (e.g. in their apartment, at a coffee shop, in the library, etc.) at any time within a block of 24 hours **(TELECOMMUTERS)**

In this stage:

You are a TELECOMMUTER. The other two members of your group will also be TELECOMMUTERS.

Please press the Continue button to begin stage 3.

Continue

Group Stage 3

You are a TELECOMMUTER. The other two members of your group will also be TELECOMMUTERS.

Please transcribe (type) the text below into the input field. Be exact and make sure to get all characters and spaces correct.

The amount submitted to the individual and group accounts will remain private. You and the other group members will only be told the minimum number submitted to the group account.

R HEY 0K 47ZBIF9E1DUCSK

Correct tasks submitted to individual account: **0**

Correct tasks submitted to group account: **0**

Individual Account pays $0.10 per correct task to you.

Submit Individual Account

Group Account pays $0.18 per correct task for the minimum number submitted.

Submit Group Account

Results Stage 3

Correct tasks submitted to the Individual Account:**0**
Correct tasks submitted to the Group Account:: **0**

Your earnings from the Individual Account are: **$0.00**
Your earnings from the Group Account will provided to you later.

Continue

Questionaire

Thank you for your participation in this experiment. Once you complete the survey your payment will be computed and you will receive an email with instructions on how to collect your cash payment within the next week.

Your name:

Your age:

Your email address:

Are you:

- **Male**
- **Female**

How do you see yourself? Are you generally a person who is fully willing to take risks or do you try to avoid taking risks? (0 means 'risk averse' and 10 means 'fully prepared to take risks'):

0

Which do you prefer working in?

- **Structured environments**
- **Flexible environments**

Which type of work do you prefer?

- **Working Alone**
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Continue

Questionaire

We would like to ask you some final questions on your decisions in the experiment.

When you were in a group with two LAB PARTICIPANTS - how do you believe your contribution to the GROUP account compared to the lowest amount contributed by your group members?

- **I contributed more to the GROUP account than the lowest amount contributed by my group members**
- **My group members contributed more to the GROUP account than me**
- **There was not much difference between my contribution and the lowest amount contributed by my group members to the GROUP account**

When you were in a group with two TELECOMMUTERS - how do you believe your contribution to the GROUP account compared to the lowest amount contributed by your group members?

- **I contributed more to the GROUP account than the lowest amount contributed by my group members**
- **My group members contributed more to the GROUP account than me**
- **There was not much difference between my contribution and the lowest amount contributed by my group members to the GROUP account**

Do you believe the MINIMUM contribution to the GROUP account was higher for your TELECOMMUTER or LAB PARTICIPANT group members?

- **TELECOMMUTERS contributed MORE than LAB PARTICIPANTS**
- **LAB PARTICIPANTS contributed MORE than TELECOMMUTERS**
- **No Difference between TELECOMMUTERS and LAB PARTICIPANTS**

Did your group members' type (TELECOMMUTERS or LAB PARTICIPANTS) influence your decisions?

- **Yes**
- **No**

Please explain your above answer (did types influence you?):

Finish