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Gender Differences in Sabotage: The Role of Uncertainty and Beliefs

Abstract

We study gender differences in relation to performance and sabotage in competitions. While we find no systematic gender differences in performance in the real effort task, we observe a strong gender gap in sabotage choices in our experiment. This gap is rooted in the uncertainty about the opponent's sabotage: in the absence of information about the opponent's sabotage choice, males expect to suffer from sabotage to a higher degree than females and choose higher sabotage levels themselves. If beliefs are exogenously aligned by implementing sabotage via strategy method, the gender gap in sabotage choices disappears. Moreover, providing a noisy signal about the sabotage level from which subjects might suffer leads to an endogenous alignment of beliefs and eliminates the gender gap in sabotage.

JEL-Codes: J160, M120, C910.

Keywords: gender, sabotage, tournament, belief formation.

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1 Introduction

Rewards based on relative performance evaluations are commonplace, e.g., compensation schemes, promotion tournaments, sports contests, and elections. Such schemes provide powerful incentives to exert effort, but also create incentives to behave unethically by engaging in dark side activities such as collusion, cheating, or sabotage. Consequently, the reward is not necessarily assigned to the person with the highest performance. In particular, the competitive balance might be systematically distorted if the propensity to engage in unethical behavior is heterogeneous across contestants, eventually leading to imbalanced career progress and earnings (Azmat and Petrongolo, 2014; Blau and Kahn, 2017; Flory *et al.*, 2015).

Empirical research has demonstrated that unethical behavior does indeed occur regularly in competitions (Amegashie, 2015; Chowdhury and Gürtler, 2015; Harbring and Irlenbusch, 2011). Additionally, there is ample evidence that contestants systematically differ in the degree to which they exert unethical behavior: males appear to be more likely than females to behave unethically in various environments and situations. Davis *et al.* (1992) and Fang *et al.* (2013) report that males are more prone to engage in academic misconduct than females, whereas a similar gender gap is found regarding the intention or actual usage of doping in sports (Papadopoulos *et al.*, 2006), dishonest reporting in online labor markets (Brink *et al.*, 2017), or in unethical business behavior (Betz *et al.*, 1989). Experimental evidence that males are more likely to lie to secure a monetary benefit is reported by Dreber and Johannesson (2008) for individuals, by Muehlheusser *et al.* (2015) for teams, and by Conrads *et al.* (2014) in a competitive setting. Dato and Nieken (2014) document significant gender differences in sabotaging behavior in a competition.

However, despite various studies reporting gender differences in unethical behavior, we still lack a thorough understanding of the underlying mechanisms, and this understanding is crucial to develop strategies to prevent or mitigate this undesired behavior. To date, to the best of our knowledge, no contribution has explicitly addressed the roots of the gender gap in unethical behavior in competitions. Our paper thus helps to fill this gap by providing experimental evidence that sheds light on the channel through which the gender gap emerges. We focus on a specific type of competition, a simultaneous two-player tournament, and on sabotage as a very prominent type of unethical behavior in such tournaments.

The gender gap in sabotage in a simultaneous tournament could, in principle, emerge through various channels. In particular, as the sabotage choice is made in an uncertain, competitive environment, and affects the payoff of another player, it might depend on (i) the attitude towards uncertainty, (ii) preferences for competition, and (iii) social preferences. As previous literature has identified gender differences in these types of preferences, we focus on these three channels as the most promising sources of explanation for the gender gap in sabotage. First, the gap might be driven by the uncertainty inherent to sabotage: when choosing sabotage, contestants do not know, and therefore have to form beliefs about (possibly the own, most likely the opponent's) performance and the sabotage decision of the opponent. Bordalo *et al.* (2016) have demonstrated that females form more accurate beliefs than males regarding their own ability and those of others, while males are frequently reported to be more overconfident than females (Lundeberg *et al.*, 1994; Niederle and Vesterlund, 2007). Therefore, they might more strongly overestimate their own relative performance, leading to different sabotage levels than females.

Furthermore, Dato and Nieken (2014) document that females and males hold different beliefs regarding the opponent's sabotage choice. Accordingly, females and males might choose different amounts of sabotage because they expect different amounts of sabotage to be necessary to win the competition. There is also evidence that females are more ambiguity averse (Borghans *et al.*, 2009) as well as more risk averse (Croson and Gneezy, 2009) than males. Given that sabotaging is costly and its success is uncertain, the gap could also originate from the fact that females are more averse to such uncertainty than males. Moreover, the channel through which the gender gap emerges might not be connected to uncertainty, but to the presence of another player and the competitive nature of the tournament. Gender differences in competitive and social preferences have been frequently reported, with males typically being more competitive than females, having a lower level of altruism, and weaker preferences for redistribution than females (e.g. Gneezy *et al.*, 2003; Price, 2012).[1] Potentially, males choose higher amounts of sabotage than females as they value the event of winning more or care less about the other player than females. Accordingly, the gender gap in sabotage might also be driven by gender differences in competitive or social preferences.

The goal of this paper is to investigate the role of uncertainty as the potential driver of the gender gap in sabotage and to disentangle this channel from other potential sources, in particular social preferences and preferences for competition. We conduct a laboratory experiment with a two-player real-effort tournament. In the first stage, subjects work on a real-effort task that determines their performance. In the second stage, they can sabotage and reduce their opponent's performance to increase their own chance of winning the tournament. We implement four different treatments designed to separate uncertainty as a channel for the gender gap in sabotage from other channels. Specifically, we reduce the uncertainty inherent to the sabotage decision in a stepwise manner and analyze how the gender gap is affected by this reduction in uncertainty.

In the *baseline treatment*, subjects only know their own performance when choosing sabotage. Hence, they have to form beliefs regarding the opponent's performance as well as about the opponent's sabotage choice. Subjects in the *info treatment* are informed not only about their own, but also about their opponents' performance before choosing sabotage. Males sabotage significantly more than females in both treatments, indicating that the gender gap is not driven by uncertainty in the performance dimension. In both treatments, there is uncertainty about the opponent's sabotage choice, and the gender gap is also present in the beliefs about that choice. Males report rather high beliefs about sabotage while female contestants beliefs are, on average, lower in both treatments.

To reduce the uncertainty in the sabotage dimension, we implemented the *learning treatment* and the *strategy treatment*. These treatments do not build on one another but constitute two different approaches to reduce uncertainty compared to the info treatment. The learning treatment provides guidance for the formation of beliefs about sabotage: before stating the belief about the opponent's sabotage, subjects received noisy information regarding the sabotage choices of other subjects. In particular, they were informed about the sabotage levels of sub-

[1] Surveyed Evidence on gender differences in social and competitive preferences can be found, e.g., inBertrand (2011) and Croson and Gneezy (2009).

jects from the info treatment with a similar relative performance as the information-receiving subject's opponent in the learning treatment. Subjects might perceive the information about sabotage choices as a predictor of the sabotage choice of their current opponent, and update their beliefs accordingly. The experimental data reveal that the noisy signal leads to an endogenous alignment of beliefs about sabotage between females and males. Importantly, this also translates into sabotage choices, resulting in similar sabotage levels for males and females.

The purpose of the strategy treatment is to align beliefs exogenously and elicit a complete empirical response function of each subject by using the strategy method introduced by Selten (1967). In the strategy treatment, the sabotage decision is split into one unconditional and a number of conditional choices. Each subject states one conditional choice for each possible sabotage level of the opponent. The outcome of the tournament is determined by matching the unconditional choice of one opponent with the respective conditional choice of the other opponent. For the unconditional choice, subjects, therefore, have to form beliefs about their opponent's sabotage choice. In contrast to the info treatment, the belief does not concern the opponent's unconditional choice, i.e., a sabotage choice made in an uncertain environment. Instead, subjects know that their own unconditional choice will trigger a specific reaction from their opponent, a conditional choice that is devoid of uncertainty. This reduces the complexity of forming a belief about the opponent's sabotage choice, and accordingly reduces the degree of uncertainty inherent to the own sabotage choice. We do not observe a significant gender gap in sabotage in the unconditional choices. The conditional choices are made for a given sabotage choice of the opponent such that uncertainty is completely eliminated and subjects do not have to form a belief. If differences in outcome-based social preferences or the degree of competitiveness are the main driver of the gender gap in sabotage, the gap should also be present in the conditional choices. If, however, the channel through which the gender gap in sabotage choices emerges is uncertainty about the opponent's sabotage choice, we should not observe a gender gap. Indeed, we do not find systematic gender differences in the conditional sabotage choices either.

Our experimental evidence supports the hypothesis that the gender gap in sabotage choices emerges through the uncertainty inherent to sabotage. Apparently, it is not the uncertainty regarding the opponent's performance, but the uncertainty regarding the opponent's sabotage choice that drives the gap. Females and males deal differently with this uncertainty as males expect higher sabotage choices to be inflicted on them than females. By providing guidance for the formation of beliefs in the learning treatment, we are able to align these beliefs endogenously. The beliefs of subjects, when making conditional choices, are fixed and aligned exogenously in the strategy treatment. In both treatments, the alignment of beliefs also leads to an alignment of sabotage choices.

Our paper is related to the empirical literature on unethical behavior in competitions, such as lying and cheating and in particular sabotage (Amegashie, 2015; Chowdhury and Gürtler, 2015). As these types of behavior are difficult to observe in the field, researchers conduct lab and more seldom field experiments.[2] A large body of literature on unethical behavior in competitions

[2] Field studies rely on data from sports as reliable company data are not available for research due to the secret nature of sabotage acts (see, e.g., Balafoutas *et al.*, 2012; del Corral *et al.*, 2010; Deutscher *et al.*, 2013; Garicano and Palacios-Huerta, 2006; Preston and Szymanski, 2003). In sports, information regarding relative

focuses on the impact of the number of prizes, the number or heterogeneity of contestants, or incentives on the propensity to engage in unethical behavior. The seminal contributions on sabotage and cheating in controlled lab experiments used a chosen effort setting (Harbring and Irlenbusch, 2005, 2008, 2011; Falk *et al.*, 2008), while recently more papers have relied on real-effort settings to enhance external validity (e.g., Benistant and Villeval, 2017; Carpenter *et al.*, 2010; Vandegrift and Yavas, 2010). Often, these studies lack information about gender or do not discuss their findings if they insert gender as a control in their econometric analysis. However, if information about gender is available, there is a tendency in most studies for males to be more prone to unethical behavior than females. For instance, Gürtler *et al.* (2013) found a significantly higher sabotage level amongst males in a three-player tournament. Conrads *et al.* (2014) report that males lie more than females in competition. Benistant and Villeval (2017) investigated the impact of group identity on cheating and sabotage in a real-effort tournament. While the gender differences in their sample are not systematic, the econometric analysis reveals a significantly higher propensity for males to sabotage in the no group identity condition, which is closest to our set-up. This pattern is also observed by Rigdon and D'Esterre (2015), who compared cheating and sabotaging in a competition. In all treatments, they observed higher levels of unethical behavior by males, although the gender gap is not statistically significant. Even in the absence of monetary incentives, gender seems to play a role. In Charness *et al.* (2013), subjects received a fixed wage but could enhance their ranking by behaving unethically. While gender had no significant effect in general, more unethical behavior was observed in single than in mixed gender groups. Additionally, in a field experiment with call center workers, Flory *et al.* (2016) reported that males sabotage levels increase considerably when switching to a tournament payment scheme while females react less to this change. Furthermore, Leibbrandt *et al.* (2017) studied the effect of gender quotas in tournaments if contestants have the option to sabotage their peers. In these settings, females are reluctant to enter the competition as they expect to be sabotaged, thereby undermining the aim of the quota. This points to the direction that beliefs about sabotage actively influence the strategy of potential contestants. Another interesting finding comes from Charness and Levine (2010), who report results from a quasi-experiment in which females were less likely than males to tolerate acts of sabotage.

Our study is most closely related to that of Dato and Nieken (2014), who explicitly focused on gender differences in competitions with sabotage. They documented a gender gap in sabotage in tournaments in a controlled lab experiment and implemented a real-effort two-player tournament where the sabotage decision was made prior to exerting effort, i.e., under strong uncertainty. In addition, the contestants' sabotage harmed the payoff of a principal creating a negative externality. The authors can only speculate regarding the driving forces of the gender gap in sabotage. Our set-up, by reducing uncertainty and manipulating beliefs in a stepwise manner, allows to clearly disentangle different channels through which the gap might emerge.

performance is usually observable for all contestants.

2 Experimental Design

To gain a thorough understanding of the driving forces of the gender gap in sabotage in tournaments, we implemented four different treatments: the baseline treatment, the info treatment, the learning treatment, and the strategy treatment.[3] In those treatments, we reduced uncertainty in a stepwise manner to disentangle the impact of uncertainty from other channels that might drive the gender gap in sabotage. Each treatment consisted of a simple two-stage simultaneous tournament with two players. In the first stage, subjects worked on a real-effort task while, in the second stage, they had the opportunity to sabotage their opponent. In each treatment, we executed mixed gender and single gender sessions. While the mixed gender sessions contained approximately 50% males and 50% females, the single gender sessions consisted of males or females only. While waiting to enter the lab, subjects could see each other and conclude that they would be competing against an opponent of the same gender in the single gender sessions. No other priming of the gender aspect occurred in any session.

The tournament was played five periods with different opponents in each treatment. In the following, we describe the outline of one period before discussing more general aspects of the design. In each treatment, two subjects competed against each other by encoding words into numbers in the first stage (Dato and Nieken, 2014; Erkal *et al.*, 2011). A two-digit number was assigned to each letter of the alphabet. The code was identical for all subjects and was provided in an encryption table in the instructions. Subjects earned one point for every correctly coded letter. If a subject entered an incorrect code, he or she had to try again until the code was correct. The *performance* of a subject was determined by the number of points achieved. Before the five tournament periods commenced, all subjects had the opportunity to familiarize themselves with the task during a five-minute trial period during which they earned one taler for 5 points. After the trial period, subjects had to complete a short quiz about the game and incentive structure to ensure they had understood the task. In the following tournament, subjects again worked on the real-effort task for five minutes and were informed about their performance immediately afterwards in each period. Thereafter, they were asked to estimate the performance of their opponent. The elicitation of this belief was incentivized (subjects received $\max\{15-Z,0\}$ taler for each estimate that differed Z points from the true performance). Before selecting the level of sabotage, subjects were asked to estimate the amount of sabotage inflicted on them by their opponent. Again, the elicitation of the belief was incentivized using the same payoff function as above. All subjects then decided on the amount of sabotage by selecting a number x in increments of five ($x \in \{0, 5, ..., 70\}$). Inflicting sabotage on their opponent was costly for the subjects ($c(x) = 2x^2/49$). To keep the design and decision process as simple as possible, we restricted the number of possible sabotage levels and showed a table with available options and the corresponding costs instead of the functional form of the cost function in the instructions. By implementing a chosen sabotage set-up, we closely followed the seminal contributions of Harbring and Irlenbusch (2005; 2008; 2011) on sabotage in tournaments in controlled lab experiments. [4] The *output* of each subject was calculated as the difference

[3] The instructions, translated into English, can be found in the appendix.

[4] Several other contributions have used the same procedure but implement sabotage as a binary choice (Falk *et al.*, 2008; Gürtler *et al.*, 2013; Vandegrift and Yavas, 2010). Implementing chosen sabotage has the advan-

treatment	information opponent's perf.	information sabotage (noisy)	strategy method sabotage	number of subjects
baseline	no	no	no	96
info	yes	no	no	96
learning	yes	yes	no	96
strategy	yes	no	yes	96

Table 1: Overview of informational structure and number of subjects in treatments

between the performance minus the amount of sabotage selected by the opponent. The subject with the higher output won the tournament and received the winner's prize of 300 taler while the loser received 120 taler. In the case of a tie, the winner and loser were determined by a random draw of the software.

The set-up above describes the *baseline treatment.* The other treatments differed from the baseline treatment in the amount of information subjects received regarding the behavior of the opponent before selecting sabotage (see Table 1 for an overview). In all other treatments, subjects first received information about the actual opponent's performance immediately after stating their belief about the opponent's performance. This was the only difference between the baseline and the *info treatment.* Accordingly, in the info treatment (as well as in the learning and strategy treatment), subjects did not have to rely on their beliefs about the opponent's performance as they knew the actual relative performance, i.e., the starting position for the sabotage stage.

We employed two different approaches to reduce the uncertainty about the opponent's sabotage choice by conducting the *learning treatment* and *strategy treatment.* As well as informing subjects about the opponent's performance, we provided subjects with a noisy signal regarding the potential sabotage they might expect to suffer in the *learning treatment.* Before stating their belief about the opponent's sabotage choice, subjects in the learning treatment were shown a graph with actual sabotage choices from subjects in the info treatment with a similar relative performance as the information-receiving subject's opponent. [5] Therefore, we categorized subjects from the info treatment as either trailing (by more than ten points), being close (performance difference of at most ten points), or leading (by more than ten points). For each category, sabotage choices were split into the three categories *low* $(0-10)$, *intermediate* $(15-35)$, and *high* $(40-70)$.[6] Subjects in the learning treatment were then shown a bar chart with the relative frequencies of low, intermediate, and high sabotage choices of all subjects

tage that sabotage is available to each contestant under the same conditions (e.g., costs, knowledge about the opportunity for sabotage). Keeping the awareness of the sabotage option equal in all treatments is crucial for a between treatment comparison. As our design relies on providing different information about sabotage between treatments, a more subtle form of sabotage, e.g., simply the option to misreport, would not be feasible in our design. If information about sabotage is provided in one treatment, this would also automatically increase the awareness of the option to misreport.

[5]We use the sabotage choices from the info treatment as those subjects received the same information about relative performance as the subjects in the learning treatment. In the instructions, subjects were informed that they would receive information about sabotage choices from subjects who had the same information about relative performance.

[6]Categories of relative performance and sabotage choices contained an approximately similar number of observations for all combinations of the two dimensions.

from the same performance category as the current subject's opponent (see Figures A1 - A3 for details). A subject, for instance, leading by 15 points, was informed about the sabotage choices of all subjects in the info treatment who had been categorized as trailing (by more than ten points). The subjects in single gender sessions received information about sabotage choices from single gender sessions in the info treatment, whereas subjects in mixed gender sessions received information from the corresponding mixed gender sessions.

In the *strategy treatment*, subjects were not informed about the sabotage choices of other subjects. As compared to the info treatment, the treatment variation comprised a different implementation of sabotage. Instead of both contestants simultaneously choosing sabotage, we used the strategy method to elicit sabotage choices (Brandts and Charness, 2011; Selten, 1967). Accordingly, the sabotage decision was split into one unconditional and a number of conditional choices. First, subjects had to make one unconditional choice and select the amount of sabotage that would be inflicted on their opponent.[7] Second, subjects made conditional choices corresponding to the 15 different sabotage levels possible in the game. For every possible sabotage decision of their current opponent, subjects selected a sabotage level. The elicitation of all 15 conditional choices enables us to analyze the complete empirical response function of each subject. To determine the outcome of the two-player tournament, the unconditional choice of one opponent needed to be matched with the corresponding conditional choice of the other opponent. A random draw of the software decided whose unconditional choice was implemented. For the other contestant, the conditional choice that constitutes a response to this unconditional choice of the opponent, was implemented.[8] Compared to the info treatment, the uncertainty inherent to sabotage was reduced in both the unconditional and conditional choices. First, the conditional choices were devoid of uncertainty as subjects "knew" the opponent's sabotage choice. Second, when making the unconditional choice in the strategy treatment, subjects did not have to form a belief about the opponent's unconditional choice as in the info treatment. Instead, they knew that their own unconditional choice triggered a conditional choice of the opponent.

In each treatment, we conducted five periods of the tournament. After each period, subjects were informed of the winner of the tournament and reminded of their own performance and sabotage choice. Choosing a "repeated one-shot" setting enables us to study if and how subjects used the information provided to update their beliefs and/or behavior. It also allowed us to explore potential learning patterns as subjects became more familiar with the strategic elements of the game. We implemented a perfect stranger matching and randomly assigned subjects into units of six at the beginning of the experiment. Every subject of the respective unit played the tournament game in one period with a different member of its unit to prevent strategic considerations such as reciprocity, revenge, or reputation effects over the periods. [9] One period

[7] We elicited the belief about the unconditional choice of the opponent in the strategy treatment before subjects stated their own unconditional choice.

[8] Suppose subjects A and B compete against each other and have chosen the unconditional sabotage choices $s_u^A = 10$ and $s_u^B = 20$, whereas the relevant conditional choices were $s_c^A(20) = 0$ and $s_c^B(10) = 40$. If subject A was randomly drawn, then the pair of sabotage choices $(s_u^A, s_c^B(s_u^A)) = (10, 40)$ was implemented. If subject B was randomly drawn, $(s_u^B, s_c^A(s_u^B)) = (20, 0)$ was implemented.

[9] For a more detailed discussion about the benefits of repeated periods and experienced subjects, see, e.g., Harbring and Irlenbusch (2011) or Moffat (2016).

was randomly selected for payment at the end of the experiment. To mitigate the learning effects in the performance dimension, the encryption code for the real effort task was changed after each period.

We used a between-subjects design, which allowed all subjects to participate in one session only. In all treatments, we elicited risk preferences with a price list introduced by Dohmen *et al.* (2011), where subjects had to choose between a safe and a risky option. Social preferences were elicited with a prisoners dilemma using the strategy method (e.g., Fischbacher *et al.*, 2001; Hermann and Orzen, 2008). To elicit an approximate measure for the general propensity to engage in unethical behavior, we implemented the die rolling task introduced by Fischbacher and Föllmi-Heusi (2013). To measure the degree of competitiveness, joy of winning, and/or status seeking behavior, we implemented our real-effort tournament without the option to sabotage and, more importantly, without monetary incentives (see Sheremeta (2010) for a similar set-up). Instead of receiving a monetary prize, all subjects were informed about their rank within the session. Subjects with standard money maximizing preferences should not exert effort, while subjects that gain utility from competing, winning, and/or status will invest effort to increase their rank. We, therefore, use the achieved points as a rough proxy for measuring competitiveness and status-seeking behavior. Additionally, all subjects answered questions relating to demographic information such as gender, age, or course of study.

We used hroot to recruit the subjects (Bock *et al.*, 2014) and z-tree as the experimental software (Fischbacher, 2007). Each treatment encompassed four sessions (two mixed gender and two single gender), each of which lasted approx. two hours. All 384 subjects (193 male / 191 female) comprised students enrolled at a large European university. On average, subjects earned 17.23 euro (including a show-up fee of 4 euro). The exchange rate was 20 taler for one euro.

3 Results

We begin by analyzing the results from the performance dimension and proceed by investigating beliefs about sabotage as well as actual sabotage choices. In the main analysis, we restrict attention to data from mixed gender sessions. Unless stated otherwise, all tests are two-sided Mann-Whitney U tests. To account for the interdependency between periods, we collapse the data over periods and use the average performance and average sabotage over all periods by each subject as one observation. We implement panel models in the econometric analysis and discuss the impact of learning over periods and temporal patterns in subsection 3.3.1. To investigate if and how the opponent's gender affects behavior, we analyze the single gender sessions and compare them to the mixed gender results in subsection 3.3.2. Finally, we discuss other potential factors that might influence the gender gap in sabotage in subsection 3.3.3.

3.1 Performance

The left panel of Figure 1 displays, for each treatment, the average number of points achieved in the real-effort task. There is no systematic performance difference between females and males with the exception of the learning treatment, where we observe lower performance levels of females (learning treatment $p = 0.015$, all other treatments $p \geq 0.757$). As can be seen in Figure 1, the effect in the learning treatment is driven by a lower performance level of females and a slightly higher performance level of males than in the other treatments. Comparing the performance differences of each gender between treatments further supports that this effect is mostly driven by females as only they perform significantly worse in the learning treatment than in the strategy treatment ($p = 0.055$). All other treatment comparisons for each gender are not significantly different (males $p \geq 0.312$, females $p \geq 0.118$). [10]

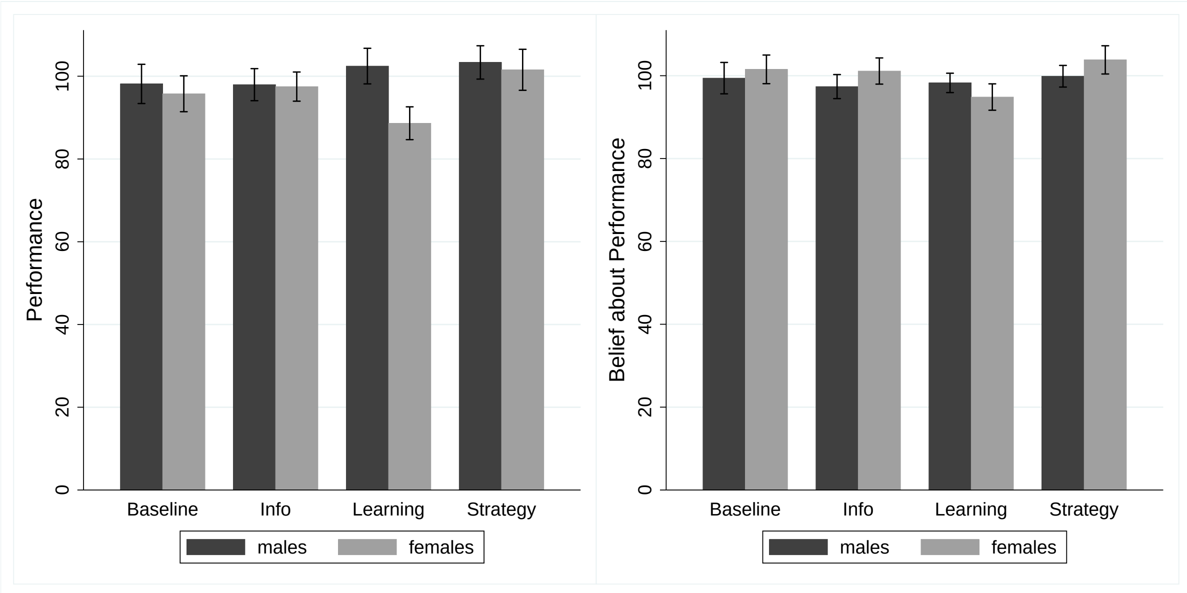

Figure 1: Average performance and belief about performance in each treatment (mixed gender sessions)

When deciding how much sabotage to inflict on the opponent, subjects should take into account the difference between their own and the opponent's performance. In the baseline treatment, subjects were not informed about the opponent's performance before making a sabotage decision. Instead, they had to rely on their belief about the performance of the opponent. The average beliefs of males (99.41 points) and females (101.53 points), displayed in the right panel of Figure 1, are very accurate and, more importantly, not significantly different from each other ($p = 0.592$).[11] The perceived performance difference reveals no gender difference ($p = 0.270$). The perceived "starting position" for the sabotage stage was, therefore, not different for females and males in the baseline treatment. In the other three treatments, subjects knew the actual performance difference when choosing sabotage. The actual "starting position" for the sabotage stage is not significantly different for females and males in any of these treatments (info treatment $p = 0.317$, learning treatment $p = 0.103$, strategy treatment $p = 0.576$) or between

[10] As feedback regarding relative performance did not enhance productivity in our sample, our results seem, at first glance, to contrast with previous findings (Azmat and Iriberri, 2010; Eriksson *et al.*, 2009; Fu *et al.*, 2015; Kuhnen and Tymula, 2012). However, Charness *et al.* (2013) report that sabotage can offset the positive effect of performance feedback, which might explain our finding.

[11] Except for the baseline treatment, subjects were informed about the opponent's performance before choosing sabotage such that subjects did not have to rely on a belief about the opponent's performance. To keep the structure and payments constant between treatments, we elicited the belief about performance in all treatments. As displayed in the right panel of Figure 1, the beliefs about performance are very similar across treatments and gender.

treatments (males $p \geq 0.173$, females $p \geq 0.301$). At first glance, it might seem puzzling that there is no significant gender gap regarding the starting position in the learning treatment, given their significantly different performances. However, as subjects not only compete with subjects from the opposite gender, but also with subjects from the same gender, the gender gap in relative performance is lower than the gender gap in performance.

Hence, except for the learning treatment, the performance of subjects does not display systematic gender differences in our treatments. Even in the learning treatment, the "starting position" of both genders does not differ systematically. This indicates that a possible gender gap in sabotage should not be driven by differences in the performance dimension.

3.2 Sabotage

In the following, we will analyze the sabotage choices of females and males under the different treatment conditions.

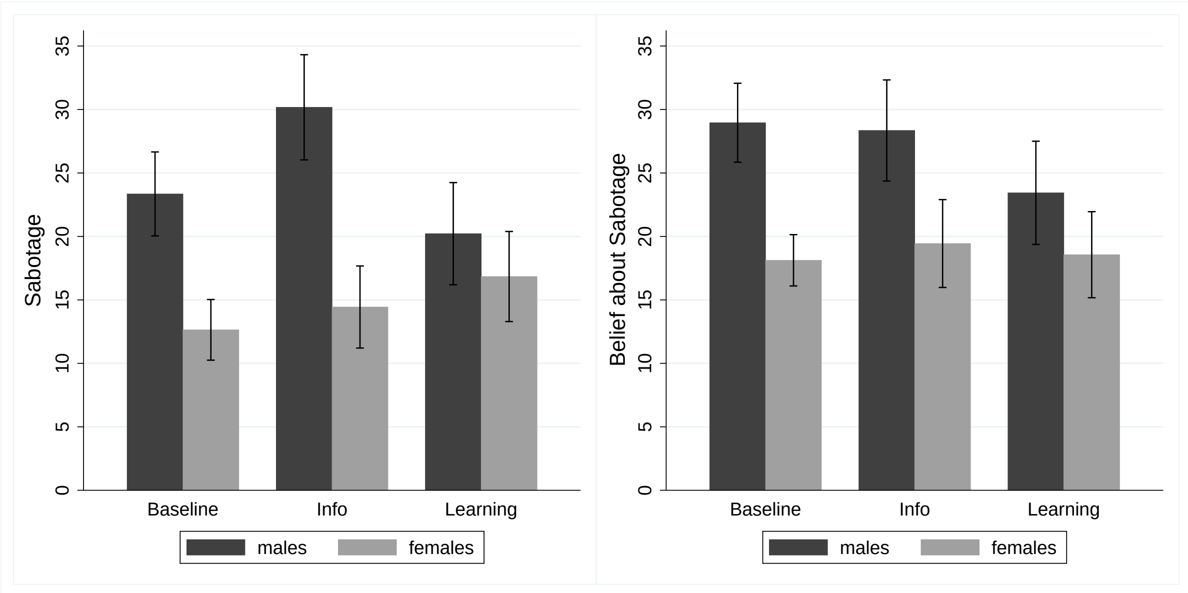

Figure 2: Average sabotage choice and belief about sabotage choice in the baseline, info, and learning treatments (mixed gender sessions)

We begin our analysis with the baseline treatment. The left panel of Figure 2 shows that males on average chose substantially and significantly higher amounts of sabotage than females (23.35 points vs. 12.64 points; $p = 0.010$).[12] One channel through which this gender gap might emerge is uncertainty regarding the opponent's performance. However, most subjects state very accurate and similar beliefs regarding the opponent's performance in the baseline treatment, indicating that uncertainty about the opponent's performance is not the main driver of the gender gap. The results of our econometric analysis reported in column 3 of Table 2 [13], where

[12] This finding indicates that the gender gap in sabotage documented by Dato and Nieken (2014) is not driven by uncertainty about own performance: in a setup where sabotage was selected prior to exerting effort, the authors demonstrated that males chose on average twice the amount of sabotage as females.

[13] Unless stated otherwise, we estimated panel Tobit models with bootstrapped standard errors to account for the censoring of our data. To check the robustness of our results, we estimated double hurdle regressions to take the possible two-step structure of our data (first, the decision to sabotage or not and, second, the decision about

sabotage in the baseline treatment is the dependent variable, provide further support. The control variable for the perceived performance difference is not significant. Nevertheless, we have only elicited point beliefs, and females and males might differ regarding the uncertainty of their reported beliefs about the opponent's performance.

In the info treatment, subjects were informed about the opponent's performance before the sabotage decision. The gender gap in sabotage choices is persistent: males again chose significantly higher amounts of sabotage than females (30.17 points vs. 14.44 points; $p = 0.001$, see also columns 4-6 in Table 2). The average sabotage choice of males is higher in the info treatment than in the baseline, whereas the average sabotage choice of females has increased only slightly. When simply comparing the average sabotage, the gender gap in the info treatment seems larger than in the baseline treatment. However, the increase in males' average sabotage choices from baseline to info treatment is just below the level of statistical significance ($p = 0.108$). Further support comes from the econometric analysis in columns 1 and 2 in Table A1 including a male and a treatment dummy as well as the interaction of both. The interaction is not significant, indicating that the impact of gender on the sabotage decision does not differ between the two treatments.

Result 1 The gender gap in sabotage is not affected by the degree of uncertainty in the performance dimension.

	Base	Base	Base	Info	Info	Info
Male	14.71^{**}	4.606	4.506	24.50^{***}	18.38^{***}	18.43^{***}
	(5.768)	(4.276)	(4.307)	(6.630)	(6.384)	(6.249)
Belief Sabotage		0.846^{***}	0.857^{***}		0.621^{***}	0.579^{***}
		(0.216)	(0.223)		(0.147)	(0.138)
(Perceived) Rel. Perf.			0.0998			−0.0619
			(0.110)			(0.0924)
Close Competition			3.790			10.54^{***}
			(2.864)			(3.698)
Period			0.228			2.628^{**}
			(0.811)			(1.127)
Constant	5.300	-9.263^{*}	-11.49^{**}	1.050	−10.50	-20.48^{***}
	(4.362)	(5.365)	(5.248)	(6.221)	(6.571)	(7.474)
N	240	240	240	240	240	240
# left censored obs.	78	78	78	91	91	91
# right censored obs.	2	2	2	5	5	5
Loglikelihood	−750.36	−726.37	−723.62	−754.27	−734.57	−727.72
Wald Chi2	6.51	23.46	27.03	10.31	26.12	41.99
p>chi2	0.107	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

Bootstrapped standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 2: Panel Tobit regressions for the baseline and info treatments (mixed gender sessions) with sabotage as the dependent variable.

the amount of sabotage) into account. The results are reported in Tables A4 to A8 in the appendix.

The baseline and info treatment differ regarding the information subjects received about the opponent's performance before choosing sabotage. In both, however, subjects had to form beliefs about the opponent's sabotage choice, as sabotage choices are made simultaneously. The average beliefs about sabotage are depicted in the right panel of Figure 2. Interestingly, when comparing the average sabotage choice with the average belief about sabotage in the baseline treatment, it becomes apparent that both females and males on average expect a higher amount of sabotage to be inflicted on them than they inflict on their opponent. For females, this also holds in the info treatment. One possible explanation for this behavioral pattern is that some subjects, due to risk aversion or "sabotage aversion," refrain from sabotage although it would be payoff-maximizing not to do so given their beliefs. Indeed, we observe a considerable share of zero sabotage choices even though it would, given the beliefs stated, be payoff-maximizing to select a positive amount of sabotage. This share is larger for females (baseline 32%, info 29.6% of the observations) than for males (18.26% in baseline and 13.91% in info). Some subjects even refrained from sabotaging in all periods regardless of whether or not sabotaging would maximize the expected payoff. Again, the share is larger for females (baseline 20% and info 24%) than for males (baseline and info each 8.7%). In cases where subjects do not take into account the possibility of the opponent's sabotage aversion when forming their beliefs about sabotage, they tend to overestimate the opponent's sabotage. This can lead to the observed behavioral pattern.

Analyzing how the belief about sabotage depends on gender reveals that males held a significantly higher belief than females in both treatments (28.96 points vs. 18.12 points in baseline, $p = 0.008$; 28.35 points vs. 19.44 points in info, $p = 0.049$). Therefore, the gender gap is already borne out in the beliefs about sabotage. The econometric analysis in Table 3 supports the impression that the gender gap in beliefs is robust in the baseline and info treatment: the coefficient of the male dummy remains stable in terms of size and significance when controlling for the (perceived) relative performance, closeness of competition, and period of the game.

As males expect to suffer from sabotage more severely and therefore perceive higher amounts of sabotage as necessary to win, they might also be more inclined to sabotage. Indeed, the econometric analysis in Table 2 reveals that the stated belief about sabotage has a highly significant impact on the sabotage decision even if various controls are added (e.g., (perceived) performance difference, closeness of competition, period). In the baseline treatment, controlling for the belief about sabotage leads to an insignificant coefficient and considerably reduced effect size of the male dummy. A higher belief is positively correlated with a higher sabotage level of the subject in the baseline treatment, independent of gender. As demonstrated previously, males hold higher beliefs, and, therefore, their sabotage levels are higher.

However, one should be careful when drawing the conclusion that beliefs about sabotage are the main driver of the gender gap in sabotage. First, although the belief also has a significant impact on the sabotage decision in the info treatment, the effect size and significance of the male dummy remain rather stable when controlling for beliefs (see columns 5 and 6 in Table 2). Apparently, the impact of the belief about sabotage is different in the info treatment than in the baseline treatment, which might be based on the different information structures in the two treatments. While subjects in the baseline treatment were uncertain about the

	Base	Base	Info	Info	Learning	Learning
Male	12.11***	12.03**	10.80*	10.05*	6.214	4.513
	(4.651)	(4.833)	(5.812)	(5.833)	(5.299)	(4.985)
(Perceived) Rel. Perf.		0.00539		0.155**		0.0222
		(0.0421)		(0.0735)		(0.0782)
Close Competition		−0.346		5.192*		23.23***
		(0.977)		(3.012)		(3.280)
Period		0.242		2.426**		−0.899
		(0.418)		(0.985)		(1.129)
Constant	16.26***	15.74***	14.67***	6.321	12.00***	9.610*
	(3.005)	(3.357)	(4.277)	(4.713)	(4.033)	(5.074)
N	240	240	240	240	240	240
# left censored obs.	31	31	58	58	78	78
# right censored obs.	3	3	7	7	3	3
Loglikelihood	−812.53	−812.30	−863.37	−856.247	−828.82	−810.44
Wald Chi2	6.78	7.11	3.45	21.68	1.38	51.6
p>chi2	< 0.01	0.1300	< 0.07	< 0.01	0.2409	< 0.01

Bootstrapped standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 3: Panel Tobit regressions for the baseline, info treatment, and learning treatments (mixed gender sessions) with belief about sabotage as the dependent variable.

closeness of the competition, subjects in the info treatment knew the performance gap for sure. While the control variable for the relative performance difference is neither statistically nor economically significant, the results in Table 2 reveal that subjects react more strongly to a close competition in the info treatment. In contrast to the baseline treatment, knowing for sure that the competition is close triggers higher amounts of sabotage. A similar picture emerges when comparing column 2 with column 4 in Table 3, where the belief about sabotage is the dependent variable. Moreover, the beliefs are influenced by the closeness of competition only in the info, but not in the baseline treatment. Subjects in the info treatment might, therefore, have shifted some attention from their own (noisy) belief about sabotage to the hard information about the closeness of the game.

Second, the direction of causality regarding the positive correlation of sabotage choice and belief about sabotage is ambiguous: Although the belief elicitation was incentivized, males might have stated motivated beliefs in the sense of Bénabou and Tirole (2016). For instance, they might have a preference for a positive self-image combined with a stronger preference for sabotage than females. It could then be optimal to state a high belief to sugarcoat or justify their own high sabotage choices. Either way, if the gender gap in beliefs in combination with the positive correlation of beliefs and choices is the channel through which the gender gap in sabotage choices emerges, it should disappear once beliefs are aligned between females and males. We conducted the learning and strategy treatment to tackle these issues.

The learning treatment allows us to check, in a first step, how sensitive beliefs about sabotage are to the provision of information and, in a second step, how this affects actual sabotage choices. Recall that each subject received information about the relative frequencies of low, intermediate, and high sabotage choices of those subjects from the info treatment, who were in a similar starting position for the sabotage stage as the information-receiving subject's

	Information about rel. frequency			Belief	
	low	intermediate	high	Male	Female
Trailing	39.3%	35.7%	25%	17.88	11.79
Close	26.8%	26.8%	34.1%	35.00	32.59
Leading	60.7%	14.3%	25%	19.38	17.88

Table 4: Information shown to subjects and average belief about sabotage reported by subjects for each relative performance category in the learning treatment (mixed gender sessions)

opponent. If subjects used this information to update their belief, which was elicited afterwards, the gender gap in beliefs for subjects from the same relative performance category (having received the same information) should be reduced. Table 4 displays the information shown to subjects in the learning treatment (i.e., the relative frequencies of low, intermediate, and high sabotage choices of subjects in the info treatment) for each relative performance category as well as the average beliefs stated after the information was displayed. [14]

We do not observe a significant gender gap in beliefs, neither in any of the three relative performance categories ($p = 0.144$ in trailing, $p = 0.664$ in close, $p = 0.616$ in leading), nor overall (males 23.43 points vs. females 18.56 points; $p = 0.160$). Overall, females and males reported similar beliefs if they received identical information. In addition, as shown in Table 3 with beliefs as the dependent variable, the coefficient of the male dummy is rather low and not statistically significant, whereas the coefficient for close competition is positive, large, and significant. As subjects in a close competition received information signaling a high propensity to be sabotaged by the opponent (see Table 4), this indicates that subjects used the information provided to update their beliefs.

Given that beliefs are aligned between females and males, the most important question is how that translates into actual sabotage behavior. Analyzing average sabotage choices reveals that a significant gender gap does not exist, neither in a given performance category ($p \geq 0.684$), nor overall (males 20.22 points vs. females 16.84 points; $p = 0.307$). Providing information about the expected sabotage level not only helped to align beliefs, but, more importantly, closes the gender gap in sabotage choices. Further evidence comes from the regressions in columns 1 to 3 in Table 5. The dependent variable is sabotage and the coefficient of the male dummy is insignificant in all specifications. Furthermore, the beliefs about sabotage have a highly significant impact on actual sabotage choices, which is in line with the results from the previous treatments. The impact of the belief on actual sabotage choices is stable if we add controls for relative performance as well as a close competition and period.

When comparing sabotage behavior with the info treatment, we observe that males have significantly lowered their average sabotage level ($p = 0.048$), while the average sabotage level of females has not changed significantly ($p = 0.533$). This demonstrates that the alignment of sabotage choices is mainly driven by a reduction of sabotage by male subjects. This observation is also supported by regressions in columns 3 and 4 of Table A1 in the appendix, where we pool the data of the info and learning treatments. Again, sabotage is the dependent variable and we

[14] The information was displayed graphically to subjects (see Figure A1 in the appendix for the original graphs). When reporting results from the category trailing (leading), we refer to the beliefs of trailing (leading) subjects in the learning treatment.

add a dummy for male subjects as well as for the learning treatment and allow for the interaction of both. The effect of the learning treatment for females is captured by the learning treatment dummy. The coefficient is not significant, thus further supporting the fact that females do not change their sabotage behavior as a result of information provision. The treatment effect for males is givenby the sum of the coefficients of the learning treatment dummy and the interaction, which is negative. Both coefficients are jointly different from zero (Wald test, $p = 0.028$ for the specification in column 3 and $p = 0.045$ in column 4 of Table A1), which is again in line with the results from the non-parametric analysis. The interaction demonstrates that the effect of providing information differs for females and males. The interaction is negative and significant, indicating a heterogeneous treatment effect between females and males. This leads to a significant decrease in the gender gap in sabotage. Overall, comparing the results from the info and learning treatments reveals that the provision of information leads to an endogenous alignment of (i) beliefs about sabotage and (ii) sabotage choices between females and males, which is mainly driven by a significant reduction of sabotage by male subjects.

	Learning	Learning	Learning	Strategy	Strategy
Male	5.933	1.650	1.491	5.098	5.843
	(7.282)	(5.069)	(5.009)	(6.903)	(6.746)
Belief Sabotage		0.761***	0.672***		
		(0.102)	(0.110)		
Rel. Perf.			−0.000191		−0.0270
			(0.0787)		(0.0655)
Close Competition			9.771**		8.093**
			(3.873)		(3.670)
Period			0.488		1.626
			(1.138)		(1.044)
Constant	5.614	−7.310	−9.349	9.708*	2.120
	(5.693)	(4.645)	(5.794)	(5.362)	(6.502)
N	240	240	240	240	240
# left censored obs.	100	100	100	85	85
# right censored obs.	2	2	2	3	3
Loglikelihood	−742.83	−710.57	−707.39	−771.20	−766.99
Wald Chi2	0.66	57.52	64.20	0.55	9.05
p>chi2	0.4151	< 0.01	< 0.01	0.4602	0.0598

Bootstrapped standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 5: Panel Tobit regressions for the learning and strategy treatments (mixed gender sessions) with sabotage (unconditional choice) as the dependent variable.

Implementing sabotage via the strategy method in the strategy treatment enables us to analyze unconditional sabotage choices as well as to elicit the complete empirical response function via conditional choices. For both types of choice, the uncertainty inherent to sabotage is reduced as compared to the info treatment. The unconditional choice is made in an uncertain environment in both treatments, such that subjects do have to form beliefs. Contrary to the info treatment, subjects do not have to estimate an unconditional sabotage choice of the opponent. Instead, they only have to form a belief about the opponent's reaction (conditional choice), which is a deterministic choice. Thus, subjects have less uncertainty about their opponent's reaction when making their unconditional choice. For the conditional choices, uncertainty is completely eliminated as choices are made for a given sabotage level of the opponent. In that sense, beliefs do not have to be formed but are (i) determined by the respective choice and (ii) exogenously aligned between females and males.

Regarding the unconditional choices, females and males chose very similar amounts of sabotage (males 21.04 points vs. females 17.41 points; $p = 0.330$, for the econometric analysis, see also columns 4 and 5 of Table 5). Implementing sabotage via the strategy method, which substantially reduces uncertainty compared to the info treatment, closes the gender gap in the unconditional sabotage choices. As in the learning treatment, the reduction of the gender gap in (unconditional) sabotage choices compared to the info treatment is driven by a reduction in the sabotage of males ($p = 0.045$), whereas females did not significantly adjust their sabotage levels ($p = 0.542$).[15]

We also observe no gender gap regarding the average conditional choice of subjects, i.e., the average over all fifteen different conditional choices (males 17.18 points vs. females 17.24 points, $p = 0.893$). This holds as well if we analyze all fifteen choices separately ($p \geq 0.508$). Accordingly, the average empirical response functions of females and males do not differ from each other.

As the sabotage choice depends on the relative starting position, we again split the dataset into performance categories as in the learning treatment. Figure 3 displays the average empirical response function of trailing subjects, subjects in a close competition, and leading subjects for females and males.[16] The shape of the average response functions helps to assess whether subjects' average conditional choices were payoff-maximizing or not. Given sabotage costs and the prize spread, it was payoff-maximizing to choose the minimal amount of sabotage necessary to win, as long as it did not exceed 65. Otherwise, it was payoff-maximizing to refrain from sabotage. Accordingly, the average payoff-maximizing response function of trailing subjects starts with a positive amount of sabotage, which is also born out in the empirical response function of female and male subjects. If the opponent, however, chose the maximum amount of sabotage, all trailing subjects should refrain from sabotage as the maximum sabotage choice was not sufficient to ensure the winning prize. This is not mirrored in the empirical response functions. Subjects chose on average a positive amount of sabotage even if the opponent had chosen the maximum amount of sabotage. Subjects in a close competition should typically choose the minimal amount necessary to win. Only for slightly trailing subjects did sabotaging to win become too costly for very high sabotage of the opponent such that the payoff-maximizing response sharply drops to zero for them. The average payoff-maximizing response function is therefore mostly increasing, but exhibits a kink at the end. These properties are nicely mirrored in the empirical response function of females and males. Finally, leading subjects should choose the minimal amount necessary to win only for sufficiently high sabotage of the

[15] To keep procedures and payments as identical as possible between the treatments, we have elicited the belief about the opponent's unconditional sabotage choice. The beliefs do not differ significantly between females and males (males 18.04 points vs. females 23.18 points; $p = 0.214$). Although the belief is not relevant for any of the sabotage choices in the strategy treatment, this nicely complements the result of aligned sabotage choices between females and males.

[16] Subjects are categorized as trailing, being in a close competition, or leading by implementing the same categories as in the learning treatment.

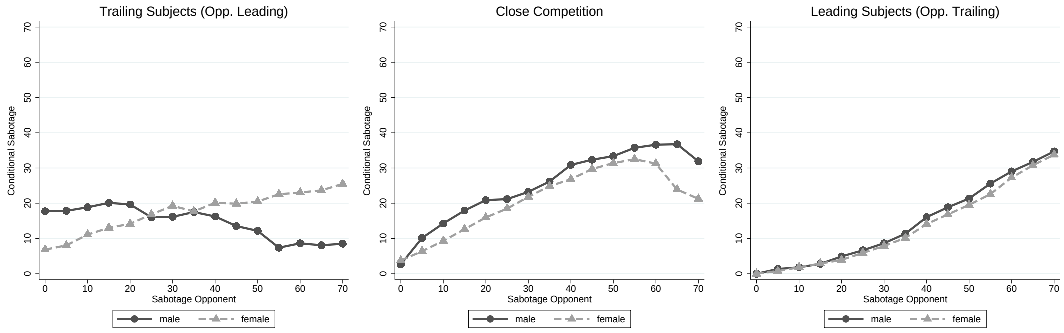

Figure 3: Empirical response function by performance category (mixed gender treatments)

opponent. Otherwise, there was no need to sabotage. This leads to a payoff-maximizing response function that is zero and flat in the beginning and increasing towards the end. The average empirical response functions of females and males displayed in the right panel of Figure 3 reflect a corresponding pattern. Overall, we conclude that subjects mostly followed a payoff-maximizing pattern when choosing conditional sabotage.

Most importantly, the empirical response functions of females and males look very similar for all categories. Only in a close competition do males select weakly significant higher sabotage levels than females ($p = 0.097$) but the overall pattern looks rather similar. For trailing and leading subjects, we do not find a significant gender difference in the empirical response function ($p = 0.599$ for trailing, $p = 0.593$ for leading). We thus conclude that there exists no systematic gender difference in the strategic sabotage behavior.

Result 2: If beliefs about sabotage are aligned between females and males, we observe no gender gap in sabotage.

Overall, we provide evidence that the gender gap in sabotage can be attributed to the uncertainty that is inherent in the sabotage decision: from baseline to strategy treatment, we reduce this uncertainty in a stepwise manner, and the gender gap is economically and statistically significant if uncertainty is rather high (baseline and info treatment). The results from the baseline and info treatments demonstrate that reducing uncertainty in the performance dimension does not help to eliminate the gap. In both treatments, we observe (i) a strong positive correlation between sabotage choices and beliefs about sabotage, and (ii) a significant gender gap in beliefs about sabotage with males reporting higher beliefs than females. Providing an additional signal regarding the amount of sabotage from which a contestant should expect to suffer, be it noisy (learning treatment) or perfect (strategy treatment), eliminates the gender gap in sabotage. In other words, by helping subjects to align their beliefs about sabotage, it is possible to close the gender gap in actual sabotage choices.

3.3 Robustness

3.3.1 Temporal Patterns

In our set-up, subjects played five identical periods in a perfect stranger matching and received feedback after each period. Since they may have adjusted their behavior and strategies based on previous experiences, we examine the gender differences in the first period in more detail, compare the behavior to the final period, and investigate temporal patterns by analyzing how behavior evolves over time. Again, we begin with the performance dimension before analyzing beliefs and actual sabotage decisions.

Figure A4 displays, for every treatment, the average performance of females and males in each period. With the exception of the learning treatment, we observe no gender gap in first period performance (learning treatment, $p = 0.010$, $p \geq 0.288$ for other treatments). Furthermore, the relative starting position in the first period does not differ significantly between genders, except for the learning treatment (learning treatment, $p = 0.072$, $p \geq 0.443$ for other treatments). Although subjects used a different encryption table in each period, the upward trend in performance as depicted in Figure A4 is intuitive as subjects became more familiar with the task in general over time. For all treatments and both genders, we observe a significant increase in performance from the first to the final period, which reveals a rather similar learning pattern for both genders (Wilcoxon signed rank test: males, $p \leq 0.037$, females, $p \leq 0.010$).

In the next step, we analyze how the beliefs about the opponent's sabotage evolve over time. This is of particular interest as the alignment of beliefs in the learning treatment helps to close the gender gap in sabotage. As displayed in Figure 4, the beliefs about sabotage do not vary substantially over time in the baseline treatment. We observe a significant gender gap in the first period ($p = 0.026$) and no significant differences when comparing first and final period beliefs (Wilcoxon signed rank test: males $p = 0.229$, females $p = 0.326$). The gender gap in beliefs is not significant in the first period of the info treatment ($p = 0.422$). However, the pattern shown in Figure 4 suggests that it evolves over time. The coefficient for period is positive and significant in Table 3, which is driven mainly by males who report higher beliefs in the final than in the first period, whereas we observe no significant differences for females (Wilcoxon signed rank test: males $p = 0.006$, females $p = 0.284$). As only males significantly increase their beliefs over time, the gender gap in beliefs widens over time. In contrast, the gender gap is weakly significant in the first period of the learning treatment ($p = 0.080$) and decreases over time. Although the difference is not significant when comparing first and final period beliefs (Wilcoxon signed rank test, males $p = 0.831$, females $p = 0.523$), the different temporal patterns observed in the info and learning treatment call for a deeper analysis. Estimating a panel Tobit regression with a three-way interaction between gender, treatment, and period with the pooled data of the info and learning treatments reveals that the interaction effect is negative and significant in any specification (see Table A2). This indicates that the learning treatment has a significant and negative impact on how the gender gap in beliefs evolves over time: providing noisy information about the level of sabotage from which subjects might expect to suffer leads to an alignment of beliefs that emerges over time.

In the final step, we examine the temporal patterns regarding sabotage. Analyzing the first period data only reveals that it is consistent with the overall patterns discussed in the previous subsection. While we observe a gender gap in sabotage in the baseline and info treatments (baseline $p = 0.013$, info $p = 0.027$), there is no significant difference in sabotage in the learning treatment ($p = 0.205$) or in the unconditional choice of the strategy treatment ($p = 0.907$). The average sabotage choices over time are displayed by gender and treatment in Figure A5. Similar to performance, there seems to be a tendency whereby sabotage increases over time. However, the effect is much weaker for sabotage than for performance, with the increase from the first to final period being significant for females as well as for males only in the info treatment (Wilcoxon signed rank test, males $p = 0.005$, females $p = 0.096$). In all other treatments, sabotage of females and males does not change significantly from the first to the final period (males $p > 0.106$, females $p > 0.270$). This is also supported by the econometric analyses in Table 2 and 5 where the coefficients for period are rather small and not statistically significant with the exception of the info treatment.

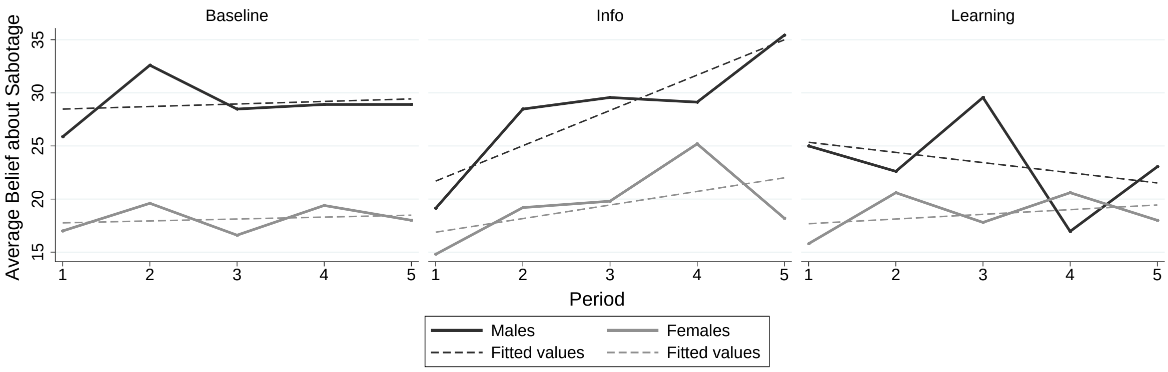

Figure 4: Average belief about sabotage over periods (mixed gender sessions)

3.3.2 Single gender vs. mixed gender environment

Thus far, we have concentrated our analysis on an environment where the gender of the contestant is unknown. To analyze whether subjects (subconsciously) condition their behavior on the opponent's gender, we analyze the single gender sessions of each treatment.

In the performance dimension, the effect of gender composition in the competition is almost negligible. Regarding actual performance, beliefs about performance and the "starting position" for the sabotage game, the only significant difference between mixed and single gender sessions is that females performed slightly better in the single gender sessions of the learning treatment ($p = 0.093$). All other comparisons are not significant ($p \geq 0.225$).

Regarding sabotage choices in the baseline treatment, neither females nor males chose different sabotage levels in the single gender sessions compared to mixed gender sessions ($p \geq 0.185$). Accordingly, the gender gap in sabotage choices is also present in single gender sessions ($p = 0.056$). In the info treatment, females again did not condition their sabotage behavior on the gender composition of the group ($p = 0.567$). Males, however, chose lower amounts of sabotage in single gender sessions than in mixed gender sessions ($p = 0.070$), leading to a considerable but insignificant gender gap in sabotage (males 22.38 points vs. females 16.04 points; $p = 0.151$).

In the learning treatment, subjects in single gender sessions received information from single gender sessions in the info treatment. Hence, in contrast to mixed gender sessions, females and males belonging to the same relative performance category did not receive identical information, as females (males) were informed about the sabotage choices of females (males)

	Males				Females			
	Information about rel. frequency			Belief	Information about rel. frequency			Belief
	low	intermediate	high		low	intermediate	high	
Trailing	25.5%	48.9%	25.5%	17.37	64.1%	33.3%	2.6%	4.89
Close	23.1%	30.8%	46.2%	30.75	45.2%	33.3%	21.4%	13.5
Leading	61.7%	19.1%	19.1%	14.5	61.5%	12.8%	25.6%	14.33

Table 6: Information shown to subjects and average belief about sabotage reported by subjects for each relative performance category in the learning treatment (single gender sessions)

from the info treatment. Table 6 depicts, for each performance category, the average belief as well as the information provided for females and males.[17] Note that the relative frequencies of low, intermediate, and high sabotage choices of trailing females and males from the info treatment are very similar, such that the information shown to leading female and male subjects in the learning treatment was very similar. Accordingly, they reported very similar average beliefs ($p = 0.880$). In the other two categories, the information shown to males signals a clearly higher propensity of the opponent to sabotage than the information shown to females. As a response, they also reported much higher beliefs than females (category trailing, $p = 0.001$; category close, $p = 0.001$). This observation nicely complements the results from the mixed gender sessions: again, females and males reported similar beliefs in cases where they had been provided with similar information. Moreover, when provided with different information, female and male subjects reported significantly different beliefs in line with the difference in the information received. This suggests that subjects did indeed react to the information with which they were provided and adjusted their beliefs accordingly. Overall we observe, in contrast to the mixed gender sessions, a strong gender gap in beliefs about sabotage in the single gender sessions of the learning treatment ($p = 0.006$).

In line with the difference in stated beliefs, males chose higher sabotage levels than females (17.71 points vs. 12.17 points). The difference, however, is not significant ($p = 0.180$). Nevertheless, the gender gap in sabotage choices is, on average, larger in the single gender sessions of the learning treatment than in the mixed gender sessions, which can be explained by differences in the information provided.

In the final step, we analyze the sabotaging behavior in the strategy treatment. Regarding the unconditional choices, no significant difference is found between mixed gender sessions and single gender sessions, either for males (single 16.04 points vs. mixed 21.04 points; $p = 0.321$) or for females (single 18.46 points vs. mixed 17.41 points; $p = 0.817$). For both female and male subjects, it also holds that the average conditional choice did not depend on the gender composition of the group, either overall ($p \geq 0.361$) or for a given performance category ($p \geq 0.234$).[18]

Result 3: Sabotage behavior of females and males does not systematically depend on the potential gender of the opponent.

[17]Again, the information was displayed graphically (see Figures A2 and A3 in the appendix for the original graphs).

[18]For the corresponding graphs depicting the empirical response functions, see Figure A6 in the appendix for males and Figure A7 for females.

3.3.3 Alternative Explanations

Our results also allow a variety of possible explanations for the gender gap in sabotage to be precluded. First, we are unable to unambiguously exclude gender differences in risk preferences as a driver of the gender gap in sabotage, as the degree of uncertainty and thereby the impact of risk preferences is affected by our treatment variations. However, the results suggest that the gap is not driven by differences in risk preferences. We do not observe a gender gap in sabotage in the conditional choices with deterministic consequences in the strategy treatment, and the same holds for the risky choices in the learning treatment. Due to the very different degrees of uncertainty, the gender gap in sabotage choices should differ substantially between the two treatments if gender differences in risk preferences were a main driver of the observed gap.

Second, gender differences in outcome-based social preferences do not mainly drive the gender gap in sabotage. Models of outcome-based social preferences like unconditional altruism (Andreoni and Miller, 2002; Charness and Rabin, 2002) or inequity aversion (Bolton and Ockenfels, 2000; Fehr and Schmidt, 1999) do not predict a treatment effect between any of the treatments. Hence, if gender differences in these types of preferences were the main driver of the gender gap, the gap should be present in all treatments. The same argument holds for several other possible explanations such as gender differences in joy of winning / status seeking or a general preference for competition. The econometric analysis displayed in Table A3 in the appendix provides further support for the impression that the gender gap in sabotage is not driven by social preferences, risk preferences, or motives like joy of winning / status seeking. Analyzing the controls for these motives, which we elicited in an incentivized way after the main experiment, reveals that the controls do not have a significant impact on the sabotage decision in all treatments.

Result 4: Gender differences in outcome-based social preferences, competitiveness or joy of winning / status seeking are not the main driver of the gender gap in sabotage.

4 Conclusion

We have investigated the drivers of gender differences in competitions with the opportunity to sabotage by conducting a laboratory experiment with a two-player real effort tournament. To disentangle the role of uncertainty as a channel through which gender differences might emerge from other possible channels, in particular social preferences and competitiveness, we implemented four different treatments. Those treatments reduced, in a stepwise manner, the uncertainty inherent in the sabotage choice. If subjects are uncertain about the opponent's performance and sabotage decision when choosing sabotage, males select significantly higher amounts of sabotage than females. This gender gap in sabotage is not driven by uncertainty about the opponent's performance, as (i) females and males state very similar beliefs about performance, and (ii) providing information about the opponent's performance in the info treatment does not help to close the gender gap in sabotage. However, the uncertainty about the opponent's sabotage choice seems to be a driver of the gender gap, as beliefs about sabotage and actual sabotage choices are positively correlated. Males state significantly higher beliefs, i.e., they are more pessimistic than females about the sabotage inflicted on them. Reducing uncertainty in the sabotage dimension in the learning treatment by providing a noisy signal about the sabotage from which subjects might expect to suffer, leads to an endogenous alignment of beliefs and, most importantly, closes the gender gap in sabotage. Finally, in the strategy treatment, we implement sabotage via the strategy method such that subjects have to make one unconditional sabotage choice in an uncertain environment as well as conditional choices that are devoid of uncertainty. First, regarding the unconditional choice, uncertainty about the opponent's sabotage choice is reduced as compared to the info treatment in the sense that subjects know that the opponent will choose sabotage not unconditionally, but as a reaction to the unconditional choice of the subject. Similar to the learning treatment, we do not observe significant gender differences in the unconditional sabotage choices in the strategy treatment. Second, subjects make conditional choices that are completely devoid of uncertainty as they are made for a given amount of sabotage chosen by their opponent. In that sense, beliefs are aligned exogenously between females and males and we again do not observe a significant gender gap in the conditional sabotage choices.

Our experimental results provide a strong indication that the gender gap in sabotage emerges through the uncertainty inherent in the sabotage decision and is not driven by gender differences in social preferences or different attitudes towards competition. It is, however, worth noting that sabotage in our experiment is, although not framed as such, part of the game as subjects are explicitly given the opportunity to reduce the opponent's performance. By implementing sabotage in that way, we closely follow the seminal contributions on sabotage in lab experiments by Harbring and Irlenbusch (2005; 2008; 2011). Implementing a more subtle form of sabotage, for instance the implicit option to misreport the opponent's output, would be closer to real world settings. However, our design relies on disentangling the effect of uncertainty from other potential channels. If we provided information about sabotage levels (as in the learning treatment), we would automatically have raised the awareness of the implicit sabotage option. Hence, gender differences could then be driven by differences in awareness regarding the sabotage option. Nevertheless, one must bear in mind that sabotage in real-world applications is not explicitly part of the game and executed in a somewhat "gray zone" reaching from withholding information to illegal activities. Moreover, the cost of sabotage, which might include sanctions associated with being caught, varies in companies depending on the severity of the sabotage. If the act of sabotage is clearly detectable, the consequence might also comprise losing the job. Accordingly, our results should be treated with caution when it comes to deriving managerial implications targeted at reducing the gender gap in sabotage choices and sabotage activities in general. Nevertheless, our paper is the first to offer insights into the underlying mechanisms that drive the gender gap in sabotage. Further research is required to analyze if and how a harmonization of beliefs can be achieved in companies.

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Appendix

	Base-Info	Base-Info	Info-Learning	Info-Learning
Male	7.703	9.101*	17.61***	17.83***
	(4.936)	(4.930)	(6.096)	(6.057)
Info Treatment	−1.160	0.560		
	(5.337)	(5.117)		
Male x Info Treatment	8.937	7.524		
	(7.665)	(7.579)		
Learning Treatment			5.399	5.782
			(5.971)	(5.874)
Male x Learning Tr.			−15.38*	−15.76**
			(8.101)	(7.709)
Belief Sabotage	0.657***	0.641***	0.685***	0.620***
	(0.116)	(0.119)	(0.0825)	(0.0805)
(Perceived) Rel. Perf.		−0.0286		−0.0240
		(0.0680)		(0.0608)
Close Competition		6.644***		10.26***
		(2.269)		(2.602)
Period		1.178*		1.484*
		(0.638)		(0.843)
Constant	−7.779*	−14.65***	−11.49**	−17.47***
	(4.432)	(4.785)	(5.221)	(5.787)
N	480	480	480	480
# left censored obs.	169	169	191	191
# right censored obs.	7	7	7	7
Loglikelihood	−1476.0006	−1469.1285	−1446.7341	−1437.4259
Wald Chi2	49.18	66.72	81.02	110.23
p>chi2	< 0.01	< 0.01	< 0.01	< 0.01

Bootstrapped standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table A1: Panel Tobit regressions with pooled data of mixed gender sessions of the baseline and info or the info and learning treatments, respectively. The dependent variable is sabotage.

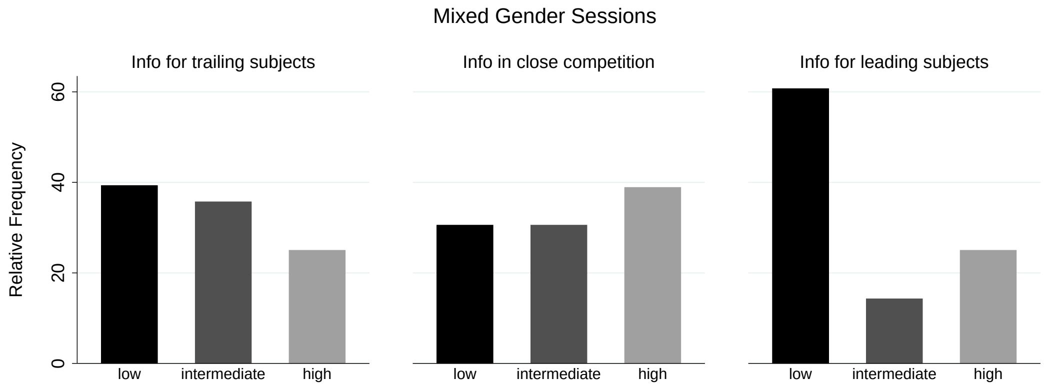


Figure A1: Information shown to subjects in the learning treatment (mixed gender sessions)

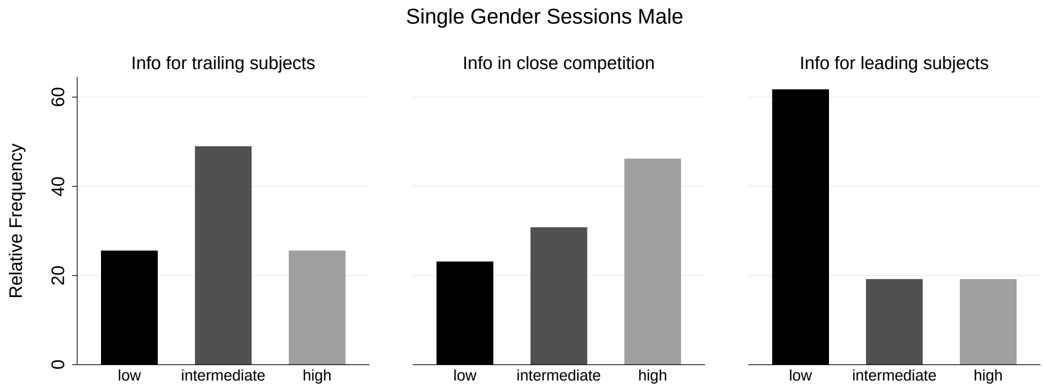


Figure A2: Information shown to male subjects in single genders sessions of the learning treatment

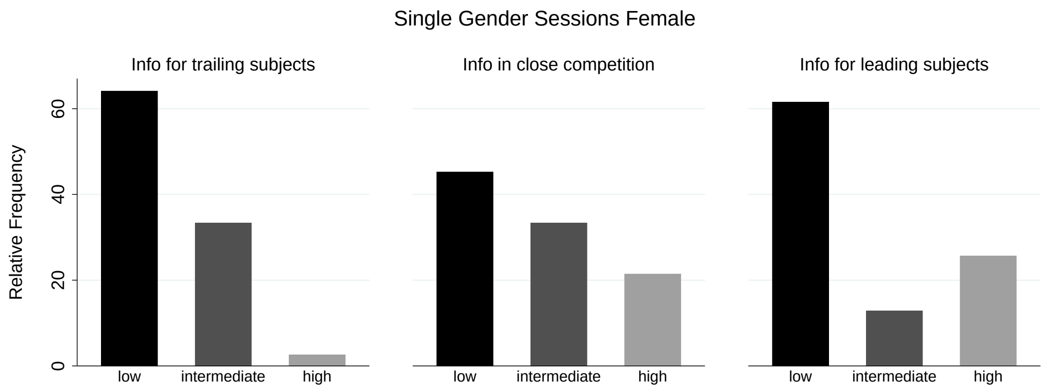


Figure A3: Information shown to female subjects in single genders sessions of the learning treatment

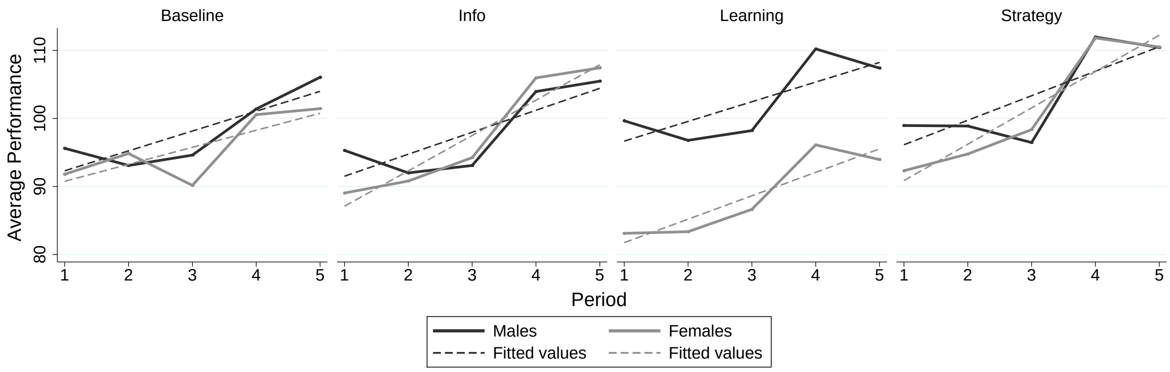


Figure A4: Average performance over periods (mixed gender sessions)

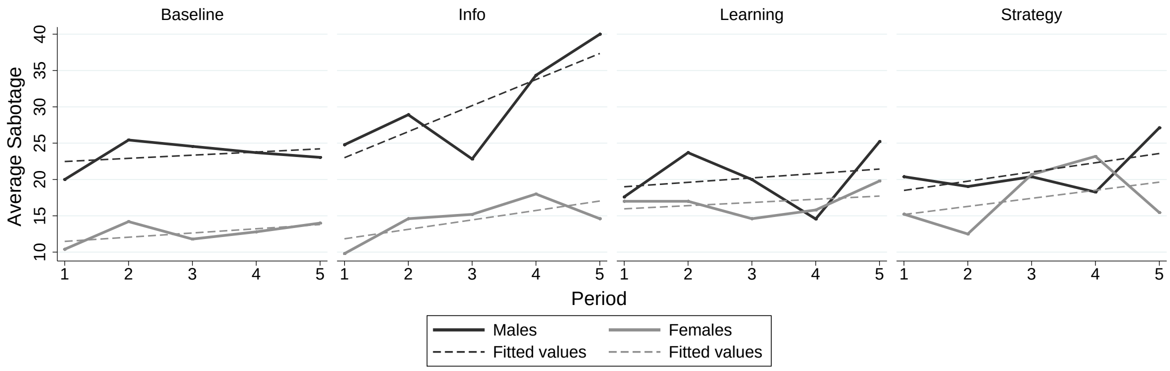


Figure A5: Average sabotage over periods (mixed gender sessions)

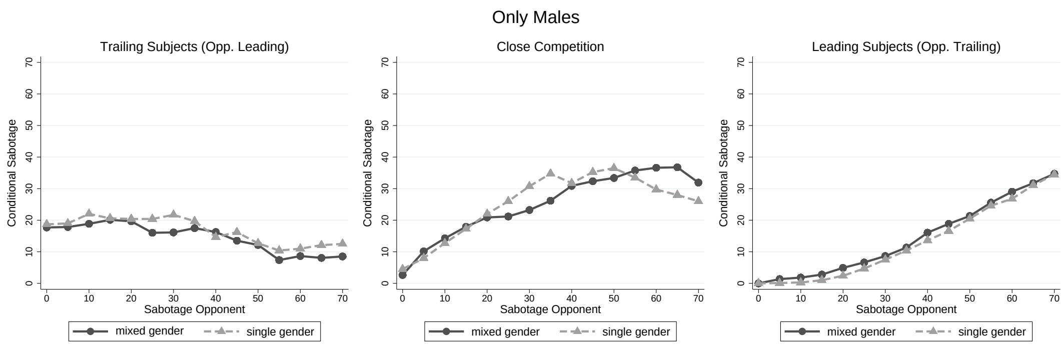


Figure A6: Empirical Response Function of males in the strategy treatment (single gender sessions)

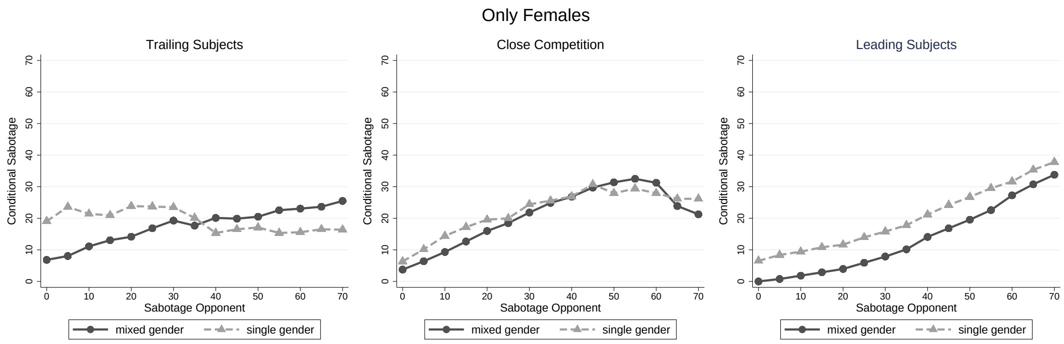


Figure A7: Empirical Response Function of females in the strategy treatment (single gender sessions)

	Info-Learning	Info-Learning
Male	2.109	0.531
	(7.478)	(7.262)
Period	0.805	1.207
	(1.364)	(1.207)
Male x Period	2.912	3.231
	(2.120)	(2.188)
Learning Treatment	−2.385	0.117
	(7.966)	(7.203)
Learning x Male	13.83	13.89
	(11.43)	(11.11)
Learning x Period	0.149	−0.337
	(2.051)	(1.837)
Learning x Male x Period	-6.153^{*}	-6.545^{**}
	(3.335)	(3.188)
(Perceived) Rel. Perf.		0.0792
		(0.0567)
Close Competition		14.20^{***}
		(2.525)
Constant	12.04^{**}	6.888
	(4.914)	(4.837)
N	480	480
# left censored obs.	136	136
# right censored obs.	10	10
Loglikelihood	−1692.4665	−1675.4226
Wald Chi2	10.86	53.37
p>chi2	0.1448	< 0.01

Bootstrapped standard errors in parentheses.
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table A2: Panel Tobit regressions regressions for the info and learning treatments (mixed gender sessions) with beliefs about sabotage as the dependent variable.

	Base	Info	Learning	Strategy
Male	12.66***	16.17***	2.474	4.217
	(4.019)	(5.335)	(4.441)	(4.275)
Single Gender	5.444	2.919	−7.011	2.327
	(3.915)	(4.667)	(5.099)	(5.093)
Male x Single Gender	−3.845	−10.38	3.756	−7.945
	(5.900)	(6.641)	(6.665)	(6.445)
Risk attitude	−0.320	1.505	2.242*	1.796
	(1.251)	(1.042)	(1.265)	(1.304)
Egoist (Prisoners Dilemma)	−0.172	2.963	4.857	2.858
	(2.947)	(3.440)	(3.286)	(3.221)
Lying (die roll)	−3.022	−1.857	−1.098	−4.505
	(2.984)	(3.569)	(3.339)	(3.304)
Status Seeking	0.0664*	0.0612	0.0683	−0.0598
	(0.0386)	(0.0652)	(0.0521)	(0.0765)
Constant	7.160	0.429	−0.617	16.19
	(7.125)	(9.024)	(8.024)	(10.21)
N	96	96	96	96
# left censored obs.	11	13	16	11
# right censored obs.	0	0	0	0
Loglikelihood	−355.10184	−359.99616	−350.4629	−365.26957
Pseudo R2	0.0252	0.0245	0.0147	0.0112

Robust standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table A3: Tobit regressions with subject averages of sabotage (unconditional choice) as the dependent variable and controls for risk attitude, social preferences, lying, and status seeking

	Base	Base	Info	Info	Learning	Learning
Hurdle						
Male	0.0638	0.0740	−0.00859	0.0435	−0.133	−0.364
	(0.288)	(0.280)	(0.292)	(0.271)	(0.260)	(0.468)
Constant	1.288***	1.271***	1.074***	0.997***	0.786***	1.210*
	(0.237)	(0.228)	(0.244)	(0.224)	(0.240)	(0.655)
Chi2	0.0490	0.0698	0.0009	0.0258	0.2623	0.6052
Above						
Male	12.01***	11.74***	10.34***	9.688***	8.848**	7.063
	(2.019)	(1.995)	(3.485)	(3.340)	(4.111)	(4.364)
(Perceived) Rel. Perf.		−0.0169		0.250***		0.147
		(0.0415)		(0.0630)		(0.0934)
Close Competition		−2.317		1.642		18.07***
		(1.917)		(3.323)		(6.370)
Period		0.541		2.784**		0.157
		(0.668)		(1.100)		(1.497)
Constant	19.71***	19.31***	21.67***	13.67***	21.96***	13.41**
	(1.554)	(2.634)	(2.706)	(4.294)	(3.530)	(6.481)
N	240	240	240	240	240	240
# left censored obs.	31	31	58	58	78	78
# right censored obs.	3	3	7	7	3	3
Loglikelihood	−905.212	−904.149	−896.541	−893.406	−837.316	−824.063
Chi2	35.392	38.766	31.712	38.916	4.632	32.917

Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table A4: Double hurdle regressions for the baseline, info treatment, and learning treatments (mixed gender sessions) with belief about sabotage as the dependent variable.

	Base	Base	Base	Info	Info	Info
Hurdle						
Male	0.310	0.618*	0.633	0.594***	0.615*	84.18
	(0.198)	(0.345)	(0.407)	(0.181)	(0.340)	(0)
Constant	0.427***	0.936***	0.633	0.101	0.691***	1.018***
	(0.151)	(0.227)	(0.407)	(0.127)	(0.262)	(0.381)
Chi2	2.4379	3.2043	2.4149393	10.7629	3.2760	–
Above						
Male	11.92***	0.00723	0.147	13.61***	11.17***	11.00**
	(2.567)	(2.513)	(2.667)	(3.230)	(4.026)	(4.478)
Belief Sabotage		0.968***	0.961***		0.707***	0.641***
		(0.0847)	(0.0852)		(0.102)	(0.0937)
(Perceived) Rel. Perf.			0.147**			0.0227
			(0.0614)			(0.0702)
Close Competition			2.462			13.98***
			(2.309)			(3.895)
Period			0.254			2.693**
			(0.789)			(1.298)
Constant	18.35***	−5.367**	−7.741**	26.20***	−0.339	−15.61**
	(2.099)	(2.671)	(3.886)	(2.633)	(4.680)	(6.061)
N	240	240	240	240	240	240
# left censored obs.	78	78	78	91	91	91
# right censored obs.	2	2	2	5	5	5
Loglikelihood	−785.173	−741.231	−737.755	−774.665	−760.341	−758.379
Chi2	21.577	148.780	152.784	17.762	61.041	79.951

Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table A5: Double hurdle regressions for the baseline and info treatments (mixed gender sessions) with sabotage as the dependent variable.

	Learning	Learning	Learning	Strategy	Strategy
Hurdle					
Male	0.0695	0.0862	−0.0350	0.0700	0.0692
	(0.213)	(0.591)	(0.410)	(0.226)	(0.207)
Constant	0.379**	1.323***	1.172***	0.550***	0.511***
	(0.175)	(0.446)	(0.353)	(0.194)	(0.166)
Chi2	0.1063	0.0212	0.0072	0.0963	0.1120
Above					
Male	4.557	0.142	1.178	4.661	6.096*
	(4.544)	(4.311)	(3.817)	(3.985)	(3.529)
Belief Sabotage		0.868***	0.774***		
		(0.0879)	(0.0863)		
(Perceived) Rel. Perf.			−0.0420		−0.176***
			(0.0583)		(0.0606)
Close Competition			12.13***		0.928
			(3.954)		(3.499)
Period			0.514		1.795
			(1.164)		(1.208)
Constant	24.48***	−4.944	−6.219	23.25***	17.96***
	(3.843)	(4.176)	(5.225)	(3.462)	(5.033)
N	240	240	240	240	240
# left censored obs.	100	100	100	85	85
# right censored obs.	2	2	2	3	3
Loglikelihood	−760.027	−720.098	−714.928	−806.867	−801.623
Chi2	1.006	99.130	115.925	1.368	13.790

Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table A6: Double hurdle regressions for the learning and strategy treatments (mixed gender sessions) with sabotage as the dependent variable.

	Base-Info	Base-Info	Info-Learning	Info-Learning
Hurdle				
Male	8.810	8.810	6.135	6.121
	(0)	(0)	(14, 146)	(31, 625)
Constant	1.053^{***}	1.269^{***}	1.150^{***}	1.241^{***}
	(0.232)	(0.293)	(0.280)	(0.296)
Chi2	–	–	$1.881e-07$	$3.746e-08$
Above				
Male	2.162	4.493	10.56^{**}	11.58^{***}
	(3.270)	(3.251)	(4.136)	(3.977)
Single	1.031	1.901		
	(3.316)	(3.259)		
Male x Info Treatment	6.582	5.812		
	(4.381)	(4.326)		
Learning Treatment			3.752	4.822
			(3.874)	(3.753)
Male x Learning Tr.			-13.22^{**}	-14.35^{***}
			(5.214)	(5.097)
Belief Sabotage	0.773^{***}	0.742^{***}	0.790^{***}	0.727^{***}
	(0.0640)	(0.0643)	(0.0644)	(0.0640)
(Perceived) Rel. Perf.		0.0924^{**}		0.0115
		(0.0455)		(0.0439)
Close Competition		8.061^{***}		12.68^{***}
		(2.235)		(2.802)
Period		1.071		1.439
		(0.761)		(0.895)
Constant	-4.859^{*}	-12.50^{***}	-6.954^{*}	-14.53^{***}
	(2.937)	(3.842)	(3.796)	(4.532)
N	480	480	480	480
# left censored obs.	169	169	191	191
# right censored obs.	7	7	7	7
Loglikelihood	−1531.1785	−1521.9606	−1488.4097	−1477.3302
Chi2	172.61146	196.03746	168.86798	195.71308

Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table A7: Double hurdle regressions for the baseline and info treatments (mixed gender sessions) with sabotage as the dependent variable.

	Info-Learning	Info-Learning
Hurdle		
Male	−0.0940	−0.0945
	(0.195)	(0.175)
Constant	0.895***	0.889***
	(0.183)	(0.148)
Chi2	0.2323	0.2911
Above		
Male	6.403	4.044
	(7.540)	(7.166)
Period	2.413	1.763
	(1.678)	(1.571)
Male x Period	1.694	2.040
	(2.335)	(2.189)
Learning Treatment	5.039	4.794
	(8.177)	(7.561)
Learning x Male	−0.359	−1.688
	(11.64)	(10.64)
Learning x Period	−1.989	−1.592
	(2.472)	(2.287)
Learning x Male x Period	−0.538	−0.162
	(3.718)	(3.307)
(Perceived) Rel. Perf.		0.222***
		(0.0452)
Constant	15.05***	17.59***
	(5.197)	(4.991)
N	480	480
# left censored obs.	136	136
# right censored obs.	10	10
Loglikelihood	−1739.233	−1728.687
Chi2	27.015	56.385

Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table A8: Double hurdle regressions for the info and learning treatments (mixed gender sessions) with beliefs about sabotage as the dependent variable.

Online Appendix

Welcome to this experiment!

You are participating in an economic experiment. All decisions are made anonymously, i.e. the other participants will not learn the identity of a participant who has made a certain decision. The payment is anonymous as well, i.e. a participant will not learn the amount of payments received by other participants.

Please read the instructions carefully. If you have trouble understanding the instructions, please take a second look at it. If you still have questions, please give us a hand signal.

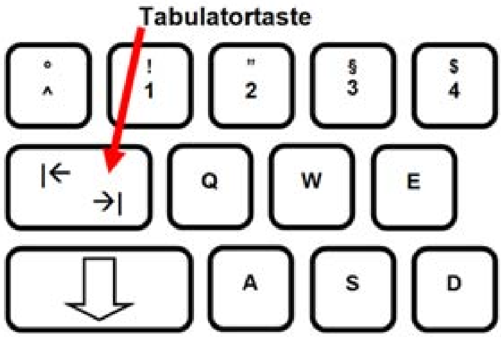
Overview

- This experiment consists of several parts and a short questionnaire.
- Before the start of each part, you will receive instructions for that part. In case of longer instructions, we will distribute them in printed form, whereas you can read the shorter instructions on screen. Please press "OK" only after having read the instructions and having made sure that no open questions remain.
- At the end of the experiment you will receive an overview over your results.
- Every part can influence your payment. Please consider each decision carefully.
- In this experiment we will use a currency called Taler. After the experiment, we will convert these Taler back into euro. One euro corresponds to 20 Taler.
- After the experiment, please remain seated in your cubicle until we call you for the payment.

Part 1

- In this part of the experiment it is your task to code words into numbers. For this, please replace the letters of a word with the numbers found in the table which you will find at the end of the instructions for this part:
    - Example: The screen displays the word "hut." According to the table: „H"=30, „U"=79 und „T"=93, so the resulting code is: 307993
    - For every letter you should enter the code into a separate box. You can move your cursor from one box to the next one by using the „Tabulator"-key on your keyboard. You will find the "Tabulator"-key on the left of your keyboard, right next to the letter "Q."

Position of the Tabulator-key on your keyboard:



- o The easiest way to enter the codes is via the number block on the right side of your keyboard. It should be activated by default. If entering numbers via the number block does not work, please activate the number block by pressing the „Num Lock“ key on the upper left side of the number-block.

Position of the Num-Lock key on your keyboard:

Num Lock	/	*	BS
7	8	9	-
4	5	6	+
1	2	3	Enter
0	00	.	

- Words with five, six, and seven letters will be displayed. You will receive a point for every letter. Please consider that you will only receive points if you have coded the entire word correctly. The sum of all points will be your **score**.
- If you have entered a code and clicked on "OK," you will be informed whether you have coded the word correctly. If the code is correct, please press "OK" to receive a new word for encoding. If you have encoded the word incorrectly, please try again until the code is correct.
- **You have 5 minutes to encode words.** After that, the task will stop automatically.
- **You will receive one Taler for every 5 points you have earned.** Your payment in Talers will thus be your achieved score divided by five. After part 1 is finished, we will inform you about your score and the resulting payment in Taler.

Good luck!

Overview of the letter to number encodings:

Letter	Number	Letter	Number
A	36	N	20
B	41	O	70
C	25	P	44
D	99	Q	22
E	96	R	43
F	48	S	45
G	12	T	93
H	30	U	79
I	50	V	40
J	56	W	73
K	54	X	82
L	81	Y	64
M	83	Z	37

Part 2

Please read the instructions carefully. If you have trouble understanding the instructions, please take a second look at it. If you still have questions, please give us a hand signal.

Overview

- This part consists of 5 identical rounds. After round 5 you will receive an overview over all your results in this part. At the end of the experiment, one of the five rounds will be drawn randomly. This round determines your payment from this part.
- You will be randomly allocated into units of 6 players each. During this part, you will only interact with players in your own unit. You and all other players will not learn the identity of the other players in your unit.
- Like in part 1 you will encode words into numbers in each round. You will replace the letters of a word with the corresponding number. You receive one point for every correctly encoded letter.
- **You have to use a new table with numerical codes in each round.** You will find these tables at the end of this instruction. Please use the „Table for round 1" for round 1, „Table for round 2" for round 2 and so on.
- Within a unit, **two players will be assigned to one group** in each round. Please note that a new player is assigned to you in each round, whose identity you do not know.
- Within a group, **the overall scores of each player will be compared** at the end of each round. The player with the higher overall score receives 300 Taler, the other player receives 120 Taler.

Course of action

- In each round, you will be assigned to a group with another player of your unit and 80 tokens will be credited to your experiment account.
- You have five minutes per round. The round starts and ends automatically.
- During this time, you and the other player have to encode words to numbers. Please note that you both receive identical words in identical order.
- As In part 1, you receive one point for every correctly encoded letter only if the entire word was encoded correctly. When you enter an incorrect code, you will be notified and have to try to enter the correct code.

- **Within a group, the overall scores of each player will be compared** at the end of each round. The player with the higher overall score receives 300 Taler. The more words a player has encoded correctly, the higher will the obtained score be. Please note, that your overall score is only used for **comparison** with the score of the other player. Only if your overall score is higher than the score of the other player, you will receive the high payment of 300 Taler. It does not matter how many points you are better than the other player. If your overall score is lower than the score of the other player, you will receive 120 Taler. In case of identical scores, the player with the higher payment will be drawn randomly.
- After the processing time has passed, we will inform you of your attained score and will ask you for an estimate of the other player's score. You will receive an additional payment for a correct estimate. (For more, see "Payment").
- [Info, Learning, and Strategy treatment: After you have given your estimate of the score of the other player, you will be informed about the actually attained score of the other player.]
- Then you will have the opportunity to **reduce the score of the other player by a certain amount X**. You will be able to choose X between 0 and 70 in steps of 5. This way, the other player will have a disadvantage when comparing scores at the end of the round. The more points you wish to deduct from the other player's score, the more costly this action is to you. These costs will be deducted from your final payment from this round in any case. You will find an overview of the costs in the following table:

Table Costs Number X

No costs occur if you choose X=0.

Number X	**5**	**10**	**15**	**20**	**25**	**30**	**35**
Costs	1.02	4.08	9.18	16.33	25.51	36.73	50.00

Number X	**40**	**45**	**50**	**55**	**60**	**65**	**70**
Costs	65.31	82.65	102.04	123.47	146.94	172.45	200.00

- The other player will face the same decision about reducing your score.

- [Learning treatment: Before you decide on a number of points X, you will receive information about how other players in previous sessions of the same experiment behaved concerning the choice of X, when **in a similar situation** as the player you have been paired up with.
- For this, your score and the score of the player from your group will be compared. Depending on the difference between your two scores, **the player you are paired up** with will be assigned to one of the three following categories:
    - Players, whose score was **more than 10 points lower** than that of the other player.
    - Players, whose **score was at most 10 points away** from that of the other player.
    - Players, whose score was **more than 10 points higher** than that of the other player.
- We will give you an overview about the numbers X players in the same category as the player you are paired up with have chosen. You will be informed what proportion of players chose a number X between 0 and 10, what proportion of players chose a number X between 15 and 35 and what proportion of players chose a number X between 40 and 70. Please note that all information has been aggregated over all five rounds.
- The player you are paired up with will receive information accordingly. That means, the player you are paired up with will receive information about the number X players, in a similar situation as you, have chosen.]
- [base, info, and learning treatment: Before you chose the number X, please give an estimate which number X the player you are paired up with will chose. Again, you will receive an additional payment for the correct estimate (for more, see „Payment")
- **The overall score** of a player comprises his **points achieved by encoding** minus the **number of deducted points X**, chosen by the paired up player. Please note that the player you are paired up with will at no point learn the number X you have chosen. Conversely, you will also not learn about the number X that the player you are paired up with has chosen for you.
- At the end of each round the following information will be displayed.
    - Your attained number of points by encoding
    - Your chosen number X which will be deducted from the points of the other player
    - Your payment, if this round is randomly chosen for payment (not considering the additional payment you can obtain by correctly estimating the choice of X by the other player)
- After that, a new round will commence.

Overall score = points achieved by encoding – number X (choice of other player)

-

]

[Strategy treatment

- Your decision about the number X consists of **two parts**.

Unconditional Choice

- Here, you simply state the number X that you want to choose.
- Before you make your unconditional choice, please give an estimate which number X the player you are paired up with will chose in his unconditional decision. Again, you will receive an additional payment for the correct estimate (for more, see „Payment")

Conditional Choice

- Here you have to state your chosen number X for each possible choice of the other player. Therefore, you have to state which number X you want to choose for each of the 15 possible numbers X, that the other player can choose.

Overview:

  - If the other player selects 0 points, I choose _________ points.
  - If the other player selects 5 points, I choose _________ points.
  - …
  - If the other player selects 70 points, I choose _________ points.

- The other player also states his preferred choice of the number X for each of the possible choices of the number X you could have made.
- After you and the other player have made all decisions, a random draw decides whether your or the unconditional choice of the other player is relevant for the result of this round. If your unconditional choice is drawn, this choice determines how many points will be deducted from his points achieved by coding. The conditional choice of the other player will be relevant for his number X. If the unconditional choice of the other player is drawn, this will determine how many points will be deducted from your points achieved by coding. For you, your conditional choice will be relevant.
- In the following, we demonstrate the course of action with an example. Assume that you have chosen ## points in your unconditional choice and the other player has chosen ++ points.
  - If your unconditional choice is drawn, ## points will be deducted from the other players points. The amount of points that will be deducted from your points achieved by encoding depends on the conditional choice of the other player for the case that you have chosen ## points.
  - If the unconditional choice of the other player is drawn, ++ points will be deducted from your points achieved by encoding. How many points will be deducted from the other player depends on your conditional choice for the case that the other player has selected ++ points.
- In each case, you will pay the costs for the number Y chosen (either based on your conditional or your unconditional choice)
- **The overall score** of a player comprises his **points achieved by encoding** minus the **number of deducted points X**, chosen by the paired up player (either from the conditional or the unconditional choice)
- At the end of each round the following information will be displayed.
  - Your attained number of points by encoding
  - Your unconditional or conditional choice that is relevant for this round

- Your chosen number X which will be deducted from the points of the other player (either based on your unconditional or your conditional choice]
- Your payment, if this round is randomly chosen for payment (not considering the additional payment you can obtain by correctly estimating the choice of X by the other player)

- After that, a new round will commence.

Overall score = points achieved by encoding – number X (choice of other player)

]

Payment

- At the beginning of each round, **you will receive 80 Taler** on your experimental account.
- The player in your group with the higher overall score (points achieved by encoding – number X, chosen by the other player) will receive an **additional payment of 300 Talers.** The player with a lower score will receive an **additional payment of 120 Taler.**
- Each player bears the cost associated with the number X he has chosen in the period which has been randomly drawn.
- Your payment can increase by an exact estimation of the choice of X by the other player, as well as a precise estimate of the attained number of points achieved by encoding by the other player. If your estimate corresponds exactly to the number of points achieved by the other player, you will receive 15 Taler. If your estimate differs from the achieved number of points by Z, you will receive 15-Z Taler. For deviations of more than 15 points you will receive zero Taler. Your estimate of the other players' choice of X will be awarded an additional payment according to the same payoff rule.

<u>Overview: Calculation of payments</u>

Higher overall score:

80 Taler + 300 Taler – choice costs of X + payments for precise estimates

Lower overall score:

80 Taler + 120 Taler – choice costs of X + payments for precise estimates

Table for <u>Round 1</u>

Letter	Number	Letter	Number
A	92	N	21
B	72	O	65
C	80	P	82
D	46	Q	31
E	55	R	88
F	24	S	57
G	27	T	66
H	71	U	42
I	50	V	23
J	68	W	49
K	56	X	73
L	20	Y	28
M	35	Z	40

Table for <u>Round 2</u>

Letter	Number	Letter	Number
A	32	N	17
B	96	O	75
C	25	P	88
D	33	Q	62
E	82	R	81
F	58	S	16
G	84	T	83
H	60	U	89
I	39	V	95
J	18	W	68
K	15	X	87
L	49	Y	63
M	69	Z	56

Table for <u>Round 3</u>

Letter	Number	Letter	Number
A	79	N	86
B	52	O	54
C	22	P	72
D	12	Q	51
E	87	R	47
F	63	S	69
G	70	T	43
H	49	U	64
I	91	V	48
J	65	W	56
K	81	X	71
L	62	Y	19
M	76	Z	90

Table for Round 4

Letter	Number	Letter	Number
A	33	N	65
B	71	O	95
C	53	P	84
D	44	Q	68
E	70	R	31
F	24	S	86
G	38	T	45
H	15	U	96
I	50	V	19
J	56	W	92
K	13	X	57
L	12	Y	98
M	97	Z	17

Table for <u>Round 5</u>

Letter	Number	Letter	Number
A	78	N	59
B	74	O	40
C	52	P	34
D	87	Q	79
E	96	R	57
F	30	S	64
G	13	T	60
H	80	U	58
I	51	V	20
J	72	W	12
K	55	X	54
L	65	Y	10
M	21	Z	82