CESifo WORKING PAPERS

9744
2022

May 2022

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CESifo

Impressum:

CESifo Working Papers
ISSN 2364-1428 (electronic version)
Publisher and distributor: Munich Society for the Promotion of Economic Research - CESifo GmbH
The international platform of Ludwigs-Maximilians University's Center for Economic Studies and the ifo Institute
Poschingerstr. 5, 81679 Munich, Germany
Telephone +49 (0)89 2180-2740, Telefax +49 (0)89 2180-17845, email office@cesifo.de
Editor: Clemens Fuest
https://www.cesifo.org/en/wp
An electronic version of the paper may be downloaded
· from the SSRN website: www.SSRN.com
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CESifo *Working Paper No. 9744*

The Effect of Losing and Winning on Cheating and Effort in Repeated Competitions

Abstract

Competitive rewards are often assigned on a regular basis, e.g., in annual salary negotiations or employee-of-the-month schemes. The repetition of competitions can imply that opponents are matched based on earlier outcomes. Using a real-effort experiment, we examine how cheating and effort evolve in two rounds of competitions in which subjects compete with different types of opponents in the second round (random/based on first-round outcome). We find that (i) losing causes competitors to increase cheating in the second round while winning implies a tendency to reduce cheating. A similar effect is found with regard to effort, which losers increase to a larger extent than winners. (ii) Competitor matching does not significantly affect behavior.

JEL-Codes: C910, C920, M520, J280, J330.

Keywords: cheating, effort, competition, competitor, social recognition, laboratory experiment.

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March 9, 2022
We gratefully acknowledge financial support by the Science Foundation of the University of Freiburg and the Fritz-Thyssen-Stiftung. David Amann, Jan Philipp Krügel and Katharina Pfeil provided valuable comments. We also thank participants of the following seminars and meetings: IMEBESS 2019, Université de Rennes 1 2019, Economic Science Association 2019, Verein für Socialpolitik 2019, Lüneburg Workshop on Microeconomics 2020.

1 Introduction

Competitive compensation is important in many incentive schemes. For example, researchers compete for publication slots, grants, or being ranked first. Workers compete for bonuses or being the "employee of the month."[1] Pupils compete for being awarded a "star" for the best weekly performance. Economists typically consider competition as desirable. Individuals are expected to increase productivity when rewards depend on relative performance (e.g., Lazear and Rosen, 1981). However, there is also a dark side of competition. Several studies show that competition also increases sabotage (harming opponents' performance through dishonest means, e.g., Chowdhury and Gürtler, 2015) and cheating (improving own performance through dishonest means, e.g., Schwieren and Weichselbaumer, 2010; Dato and Nieken, 2015; Faravelli et al., 2015). While it may not always be practical to sabotage rivals, in most settings it should be possible to artificially improve own performance.[2] Hence, understanding how competitions affect effort and cheating is particularly important.

Competitions for rewards often take place recurrently. If competitive rewards are assigned repeatedly, individuals may not only cheat to win early on but also because of having won or lost. Several studies show that earlier competition outcomes influence *effort* in subsequent rounds of competition (e.g., Charness et al., 2014; Gill and Prowse, 2014). However, with regard to *cheating* most existing studies focus on the static setting. To our knowledge, only two studies examine if cheating depends on previous competition outcomes. Charness et al. (2014) show that in repeated competitions for rankings, winners are less likely to artificially increase output than lower ranked contestants. In contrast, Schurr and Ritov (2016) show that competition winners are more likely to cheat in a subsequent unrelated task due to a sense of entitlement. We contribute to this literature by studying whether earlier competition outcomes influence cheating and effort in later rounds. By focussing on two rounds, we are able to unambiguously identify the effect of the previous outcome.[3]

An important aspect of many repeated competitions is that individuals are

[1] For example, Necker (2014) finds that almost all European economists participating in a survey perceive high or very high pressure to publish and to raise external funds. Bryson et al. (2013) show that the fraction of employees exposed to incentive pay schemes ranges from around 10-15 percent in some European countries to over 40 percent in Scandinavian countries and the US.

[2] Since sabotage is a targeted activity, it may be not be useful if, e.g., information about who is the most dangerous rival is not available (e.g., Gürtler et al., 2013).

[3] The study by Charness et al. (2014) and our study differ in several respects, most importantly that Charness et al. (2014) examine the relationship in 10 rounds. They study the effect of information about relative performance on effort, sabotage, and cheating in a flat-wage scheme. Sabotage and cheating are introduced as a separate step in which subjects can pay a price to decrease others' or articificially improve own performance. Subjects learn about others' cheating at the end of each round, thus confounding rank information with social norm effects.

matched based on their earlier relative performance. For instance, workers that succeeded in competitions and climbed up the career ladder in the previous year may compete with others that were equally successful. A priori, a winner is a stronger opponent than an opponent randomly drawn from the population (Rustichini, 2008). If the quality of the competitor increases with one's previous outcome, it becomes increasingly difficult to win. Furthermore, according to the so-called discouragement effect, competitors exert lower effort when they are heterogeneous than when they are homogeneous (e.g., Chowdhury et al., 2020). It could also be more satisfying to win against someone who has been equally successful before. While a large literature studies how *effort* is affected by the (a)symmetry of competitors (e.g., Brown, 2011; Lallemand et al., 2008), to our knowledge, the effect on *cheating* has not yet been explored.[4] We contribute to the literature by studying whether the effect of the first-round outcome depends on whether individuals compete against others that were equally successful or a random competitor. We also examine if individuals anticipate the competitor type and adjust behavior in the first round.

Our study is based on a laboratory experiment in which subjects compete against each other in a paper-and-pencil matrix task for two rounds. Subjects can cheat by over-reporting points (e.g., Mazar et al., 2008). By collecting sheets after the experiment, we can distinguish true performance (effort) and over-reporting (cheating).

The two-round setting allows us to examine our first research question whether individuals condition their behavior on previous outcomes. To investigate our second research question whether behavior depends on the type of competitors, we vary the matching of opponents in the second round in a between-subjects design. The competitor is chosen either randomly (treatment Random) or based on the relative performance in the first round (treatment performance based matching - PBC).

Following most previous studies, subjects compete for different amounts of money. However, competitors may also care about what the outcome says about their position in the social scale (Rustichini, 2008). Private or public recognition of achievements has been shown to increase effort (e.g., Tran and Zeckhauser, 2012; Charness et al., 2014; Gerhards and Siemer, 2016) as well as counterproductive behavior (Charness et al., 2014; Pascual-Ezama et al., 2013). Psychological research suggests that people are more likely to cheat to prevent a negative change in social ranking than to realize a positive change (Pettit et al., 2016). Hence, if competitions take place repeatedly, first-round winners may increase cheating to maintain social recognition in later rounds. We examine if the results are the same when we introduce

[4] A few theoretical papers examine the conditions that favor cheating when competitors are asymmetric (Berentsen, 2002; Kräkel, 2007; Stowe and Gilpatric, 2010). To our knowledge, no empirical paper examines if cheating is affected by the (a)symmetry of competitors.

public or private social recognition, while holding monetary rewards constant.

We find that first-round losers increase cheating and effort in the second round. While winners tend to reduce cheating, their effort tends to increase. The inconsistency in winners' behavior is likely due to learning effects, which may have prevented a decrease in effort. Importantly, the change of cheating and effort is significantly different between winners and losers. We conclude that the first-round outcome affects behavior. Our findings are in line with the ideas that individuals choose their second-round behavior based on a comparison of the first-round outcome with their fixed goal. Our post-experimental survey shows that those who lose after having won in the first round are significantly more satisfied with the outcome than other losers. This can be considered as suggestive evidence that the results are at least partially caused by goal achievement. Our results contradict Schurr and Ritov (2016) arguing that winners increase cheating due to a feeling of entitlement.

The change of behavior across rounds is largely unaffected by the type of the second round competitor. Individuals also do not anticipate opponents' behavior. Our examination of individuals' beliefs suggests that an explanation for the lack of an effect of the competitor matching is that opponents' are not perceived as significantly different.[5] The satisfaction with having won or lost also does not vary across matching protocols. We conclude that the effect of having won or lost dominates the effect of the competitor type (a similar finding is obtained by Benistant and Villeval, 2019; Dato et al., 2019). Importantly, neither the effects of the first-round outcome nor of the competitor matching are sensitive to the rewards at stake.

Our results have important policy implications. Assuming that our results carry over to competitions with more losers than winners or with multiple rounds which permanently generate losers, employers and research institutions have to keep in mind that competitive incentives may not only increase cheating in the short run but may also imply an increase of cheating over time. In contrast, organizations with incentive schemes in which competitors with the same earlier performance compete, e.g., if workers that climbed up the career ladder compete with each other for bonuses, do not have to be concerned that this will increase fraudulent behavior.

The paper is organized as follows. Section 2 describes the experiment. In Section 3, we discuss possible mechanisms that could affect behavior in repeated competitions. Section 4 contains the results. Section 5 discusses the findings and concludes.

[5] As described in Section 2, our control questions show that subjects understood with what kind of competitor they would be matched.

2 Experimental design

2.1 Overview of the experiment

In our experiment, subjects participate in two rounds of competition. We focus on two rounds to be able to unambiguously identify the effect of the previous outcome. Table 1 depicts the flow of the experiment (see Appendix A.1 for the instructions). At the beginning of each session, we randomly assign four subjects to a society. In each of the two rounds, two members of a society compete against each other in a paper-and-pencil real-effort task. They have to self-report their points on the PC which introduces the possibility to cheat (see Section 2.2). At the end of each round, subjects are informed about their relative outcome. The subject that reported more points is assigned the outcome "High", the other subject the outcome "Low". The outcomes are related to different rewards, varied in one dimension of our treatments, see Section 2.3. Subjects only receive information about the outcome in their own competition. They never learn about the self-reported points of others. In the first round, the competitors are always randomly matched. In the second round, the matching of competitors depends on the treatment, as described in Section 2.3.

2.2 Task and outcome variables

In each of the two rounds, subjects complete the matrix task introduced by Mazar et al. (2008). They receive a sheet with 20 different matrices, each containing 12 numbers consisting of an integer and two decimals (e.g., 4.96), see the example in Appendix A.1. The goal is to find in each matrix the unique two numbers that add up to exactly 10 and to indicate if the matrix was correctly solved. Subjects have five minutes to solve as many matrices as possible. We ask them to enter their points on the PC. The advantage of the matrix task is that subjects can easily assess whether they correctly solved a matrix. Any matrix incorrectly reported as having been solved can be reasonably interpreted as cheating, rather than as a mistake.[6]

Once the five minutes are up, subjects are told to count the number of points (matrices they solved correctly) and remember them. They are asked to put the matrix sheet in an envelope in their cabin and are informed that the envelopes will only be opened after the end of experiment, not earlier than in two weeks (see also,

[6] Heyman et al. (2020) argue that the matrix task conflates cheating with honest mistakes. Importantly, in contrast to many studies using the matrix paradigm, we are not comparing a condition in which the subjects self-correct with a condition in which the experimenter corrects. Since participants self-correct in all treatments, differences between the treatments cannot be explained by our use of the matrix task. In addition, as described in Section 4, the results are unchanged when we categorize those that over-reported just one matrix as having been honest.

Table 1: Flow of the experiment

Flow \ Treatment	Random	Performance Based Competition (PBC)
Before competitions	Society: 4 participants randomly matched	
Round 1	Random matching of two competitors Group X: Member 1 vs. Member 2 / Group Y: Member 3 vs. Member 4 *Rewards depending on treatment*	Random matching of two competitors Group X: Member 1 vs. Member 2 / Group Y: Member 3 vs. Member 4 *Rewards depending on treatment*
Round 2	*Matching of competitors depending on treatment* Group W: Random (perfect stranger) / Group Z: Random (perfect stranger) *Rewards depending on treatment*	*Matching of competitors depending on treatment* Group "High": High in X vs. High in Y / Group "Low": Low in X vs. Low in Y *Rewards depending on treatment*
After competitions	Post-experimental questionnaire	

Note: The experiment employs a between-subjects design. In treatment Random, in the second round, subjects compete against a random member of the society with whom they have not yet played. In treatment Performance Based Competition (PBC), competitor matching in the second round is based on performance in the first round. The two members that obtained the outcome "High" ("Low") compete against each other in group "High" ("Low"). Note that competitors are perfect strangers in both treatments, yet, in PBC this follows from the group formation.

e.g., Faravelli et al., 2015). Before they enter the number of points on the screen it is emphasized that only the self-reported points matter for subjects' outcome. The intention of asking subjects to enter points after having put the sheets in an envelope is to give them moral wiggle room that they are not cheating but misremember their points. During the experiment, over-reporting points is neither monitored nor sanctioned. A comparison of the sheets and self-reported points gives us the number of correctly solved matrices (effort) and of over-reported matrices (cheating).[7] We use these two variables and self-reported points in the analysis.[8]

[7] Two student assistants coded the sheets independently. In case there was a disagreement between their entries, a third student assistant assessed which of the entries was correct. Matrices were counted as solved when the two numbers adding up to 10 were correctly circled, independent of whether the matrix was ticked as having been solved correctly.

[8] Examining self-reported points in addition to cheating and effort is important, as effort and cheating are substitutes at the individual level, see Appendix A.4.

2.3 Treatments

We implement a 2x3 between-subjects design with a total of 380 participants, see Table 2. The first dimension varies how the competitor in the second round is chosen, the second dimension varies the rewards for winners and losers. The second treatment dimension is meant to account for the possibility that the effect of first-round outcome and competitor matching might be influenced by rewards.

The first dimension consists of two treatments. In treatment Random (left-hand side of Table 1), in the second round, the members of the society compete against a random player with whom they have not yet played. They receive no information about the type of their competitor, they are either assigned to group W or Z. In treatment Performance Based Competition (PBC) (right-hand side of Table 1), matching in the second round depends on the outcome in the first round. The two members that obtained the outcome "High" compete against each other in group "High." The two members that obtained the outcome Low compete against each other in group "Low." Hence, in this treatment competitors learn about their opponent's first-round outcome. Note that competitors are perfect strangers in both treatments, yet, in PBC this follows from the formation of the groups. The treatments vary the likelihood of a same type competitor. Those who obtain the outcome "High" ("Low") in the first round will face another "High" ("Low") with 100% probability in treatment PBC. In treatment Random, the probability of competing against a same type is only 50%.[9] However, the information about probabilities is not given.

Table 2: Overview of treatments and sample sizes

Matching in 2nd round \ Reward	Money Only	Money+ Ceremony	Money+ Ranking	Total
Random	68	72	48	188
Performance Based Competition (PBC)	72	72	47	191
Total	140	144	95	379

Note: Reported is the number of subjects per treatment. One subject in Money+Ranking/PBC did not return the sheets and thus had to be excluded from the sample.

The monetary rewards are the same in all treatments. The subject that obtained the outcome "High" receives 7.50 Euro. The subject with the outcome "Low" receives 2.50 Euro. The outcome is reported in a table on each subjects' screen at the end of each round (see Appendix A.1). We do not vary the monetary rewards across Random and PBC. Although advancement to a later round based on performance might in reality be related to higher rewards (e.g., a higher bonus), we aim

[9] Relatedly, Balafoutas and Sutter (2019) examine the effect of uncertainty (probabilities are known) vs. ambiguity (probabilities are unknown) with regard to the number of winners.

to measure the pure effect of having to compete against a same type opponent.

However, following previous literature showing that privately or publicly informing individuals about their relative standing increases effort (e.g., Tran and Zeckhauser, 2012; Kuhnen and Tymula, 2012; Charness et al., 2014; Gerhards and Siemer, 2016) and counterproductive behavior (Charness et al., 2014; Pascual-Ezama et al., 2013), we vary the social recognition that is at stake. In treatment Money Only, there is no social recognition. In treatment Money+Ceremony, in addition to the monetary rewards, participants receive public feedback on the winners of the round. Following, e.g., Ball et al. (2001), Kumru and Vesterlund (2010) and Gerhards and Siemer (2016) a ceremony is held at the end of each round. The experimenter calls those with the result "High" to the center of the room and awards them a gold medal. The medal is made from plastic and has hardly any value in itself (0.20 Euros each). Subjects with outcome "Low" are invited to observe the ceremony and encouraged to applaud the "High." The "High" return to their cubicles. The treatment is supposed to reflect ceremonies held to award, e.g., "employees of the month." Since subjects do not know with whom they are in a society, the estimated effect is likely to present a lower bound of real life where opponents know each other.

In treatment Money+Ranking, in addition to the monetary rewards, private feedback on the relative standing across the two rounds is introduced. Subjects are informed that the four members of the society will be ranked at the end of the second round. At the end of the first round, in treatment Ranking-PBC, the result table informs those who obtained the outcome "High" that they compete for "Rank 1/2" and those who obtained "Low" that they compete for "Rank 3/4." Since no reduction of achievable ranks is possible in treatment Ranking-Random, subjects are simply reminded that they compete for Rank 1-4. At the end of the second round, the results table reports the subject's final rank in the society. The treatment is supposed to reflect information on relative performance of workers.

2.4 Procedures

The experiment was conducted at the WISO research laboratory of the University of Hamburg. The experiment was programmed using z-tree (Fischbacher, 2007). Participants were recruited via the online recruitment tool hroot (Bock et al., 2014), the sessions took place between November 2016 and June 2018. After arrival, subjects were randomly assigned to cubicles. Printouts of the instructions explaining the entire experiment lay on the desks. At the beginning of the experiment, we read aloud the instructions. Before the competitions started, subjects were asked to answer control questions to ensure that they understood the rules. The questions on the

matching protocol and the rewards were answered correctly by almost everyone.

After the two rounds, participants were asked to complete a questionnaire which inquired, first, socio-demographic information (e.g., age, gender and field of study). Second, we asked subjects to report their satisfaction with their two outcomes on an ordinal scale (see Q10, Q11 in Appendix A.2). Third, we elicited beliefs about the behavior of subjects' two competitors. Previous studies show that beliefs about others' behavior play a role in explaining behavior in competitions (e.g., Dutcher et al., 2016; Balafoutas and Sutter, 2019). To avoid that inquiring beliefs affects behavior and call attention to the possibility to cheat, we decided to elicit beliefs after the competitions without giving an incentive for correct answers (e.g., Gächter and Renner, 2010; Schotter and Trevino, 2014). It has to be considered that the ex post belief elicitation might be influenced by ex-post rationalizations of behavior. We inquired beliefs about the competitors' self-reported points (Q12, Q14) and cheating behavior (Q13, Q15 in Appendix A.2). Fourth, we obtained a measure of the general propensity to cheat, inspired by Schweitzer and Hsee (2002) (Q16, Q17 in Appendix A.2). Fifth, we asked subjects to assess their cognitive ability (intelligence) compared to their fellow students to obtain a proxy of their perceived relative ability (Q19 in Appendix A.2). Previous studies suggest that beliefs about one's relative ability are important for competitive behavior (e.g., Kuhnen and Tymula, 2012; Dutcher et al., 2016). Finally, we asked subjects to self-report their willingness to take risks on an ordinal scale (Q20 in Appendix A.2). Previous literature finds a positive relation between risk-aversion and cheating behavior (e.g. Grolleau et al., 2016). We use these variables as controls in the empirical analysis.

The average age of participants is 25 years, 60% were female, 33% reported studying Economics. These characteristics, as well as the propensity to cheat and risk aversion, are not statistically different across treatments, see Table A.1 in the Appendix. A session lasted for about 50-60 minutes. Final payments were distributed at the end of the experiment. Payments vary between 5 Euros ("Low"-"Low"), 10 Euros ("High"-"Low" or "Low"-"High") and 15 Euros ("High"-"High"). The average payment was 10 Euros, there was no additional show-up fee.

3 Behavioral conjectures

We consider a setting in which individuals compete twice in a two person-contest. As described in Section 2.2, individuals self-report points obtained in a real-effort task to win the prize. To increase the probability of winning, they can solve matrices or cheat. We assume that solving matrices is related to effort costs, while cheating

causes lying costs (e.g., Gneezy et al., 2018; Abeler et al., 2019). Although the probability of winning increases in effort and cheating, there is thus a trade-off due to the costs related to the two actions. Assuming that individuals are heterogenous in the costs of solving matrices (e.g., due to differences in ability or effort functions) as well as the costs of lying, they may differ in the margin used to increase the probability of winning. The probability of winning also depends on the points reported by the opponent. A stronger competitor implies that individuals have to report more points. Hence, they have to form beliefs about opponents' behavior.

In line with previous studies, we assume that the prize of winning the contest not only consists of the monetary gain but also of an intrinsic reward for winning (e.g., Coffey and Maloney, 2010; Dohmen et al., 2011) as well as the reward related to the social image of achieving a high rank (e.g., Gill et al., 2018; Ashraf, 2019). In our setting, a prize is rewarded in each round (see Section 2.3). In PBC, we stress that the "High" are playing to achieve the highest possible rank in their society.

There are different reasons why the first-round outcome could affect subsequent behavior. First, it is possible that individuals have a *fixed goal*, what they want to achieve, and, consistent with prospect theory, choose their second-round behavior based on a comparison of the first-round outcome with their goal (e.g., Berger and Pope, 2011; Fu et al., 2015). The goal can be a certain compensation, perceiving oneself as better than others, or being perceived as better by others (Kuhnen and Tymula, 2012). If winners feel that they have achieved their intermediate goal and are in the gain domain, they decrease effort and/or cheating. In contrast, losers, being in the loss domain, increase reported points to catch up with their goal. Kuhnen and Tymula (2012) find that in a setting in which only self-perception can matter individuals who learn that they rank better than expected decrease their output, while those who learn that they rank worse than expected increase their output. Berger and Pope (2011) find that, presumably due to loss aversion, the effect of competitive feedback is stronger among losers.[10] Pittarello et al. (2013) document that falling behind can lead to an increase in unethical behavior, while winning decreases self-profitable behavior. However, with rising accuracy of the social ranking, increases in unethical behavior are observed even in above-average ranking competitors. If fixed goals determine the reaction to the first round outcome, we would observe that the "Low" increase and the "High" decrease effort and cheating.

Second, the first-round outcome may affect *winners' self-perception*. Schurr and Ritov (2016) show that due to a sense of entitlement competition winners are more likely to cheat in a subsequent unrelated task. Entitlement is the feeling that one is

[10] Garbarino et al. (2019) show that people cheat more to avoid a loss than to realize a gain.

more deserving of preferential treatment than other people are. Similarly, psychological research suggests that winners may benefit from psychological momentum, defined as an altered state of mind in which winners perceive things going unstoppably their way ("success breeds success", e.g., Iso-Ahola and Dotson, 2014). If the change of their perception is predominant among winners, we would find that the "High" increase effort and cheating. The behavior of the "Low" is unaffected.

Third, the first-round outcome may cause the *discouragement effect*. According to theory, competitors exert higher effort when they are homogeneous than when they are heterogenous. Heterogeneity can be given ex ante (e.g., from higher effort costs or lower ability of one competitor) or result from earlier rounds (e.g., Chowdhury et al., 2020).[11] Discouragement occurs as the weaker player finds it relatively unprofitable trying to beat the stronger player. This allows the stronger player to also decrease effort. Most models assume that the discouragement effect arises from differences in the probability of winning (e.g., Chowdhury et al., 2020). Gill and Prowse (2012) argue that a discouragement effect may also result from disappointment aversion. If individuals have expectation-based reference points and anticipate possible disappointment from losing, they will optimize, taking into account the expected disappointment from their choice. According to the *discouragement effect*, the "Low" and the "High" would decrease cheating and effort. However, empirical evidence on the discouragement effect is mixed (for an overview, see, e.g., Dechenaux et al., 2015). Some studies find that the discouragement effect is asymmetric, meaning that it either only affects the weaker or the stronger competitor. That could imply that the decrease is either only observed among the "Low" or the "High."

Importantly, the considerations suggest that the effect of having won or lost might differ across PBC and Random. First, the first-round outcome may affect the (perceived) strength of the competitor. For the "High", it should on average be more difficult to win in the second round in PBC than in Random. The effect is reversed for the "Low." Hence, the "High" ("Low") should be more (less) likely to increase effort/cheating in PBC. Another important difference is that competitors are homogeneous in PBC but not necessarily in Random. Therefore, a decrease in effort and cheating due to the discouragement effect should not affect behavior in PBC but may affect behavior in Random, if losers change behavior based on the feeling that they will be lagging and winners that they will be leading in Round 2. Finally, only in PBC a clear-cut winner of the two rounds is determined. This may create a motive for the "High" to increase effort and cheating in this treatment.

[11] While the literature usually assumes a static setting in which players exogenously have different abilities, Casas-Arce and Martínez-Jerez (2009) show that when tournaments take place over multiple periods interim performance acts in a way that is similar to heterogeneous ability.

Our contest is such that monetary rewards in the second round are independent from outcomes in the first round. Yet, only in PBC it is possible to be ranked first, which may cause individuals to increase cheating and effort in the first round to be able to achieve the first rank. It could also be that individuals adjust first-round behavior based on their belief how opponents will behave in the second round. If they expect that in PBC they have to compete against a strong opponent when they win and a weak opponent when they lose, they may decrease first-round cheating and effort.[12] Hence, depending on individuals' preferences for ranking and their beliefs, effort and cheating in the first round could be higher or lower in PBC.

In sum, with regard to behavior in the first round and the reaction to the first-round outcome it is an empirical question which of the mechanisms prevails. All considerations suggest that the "High" increase effort and cheating to a larger extent in PBC than in Random. However, the effect is ambiguous with regard to the "Low."

4 Results

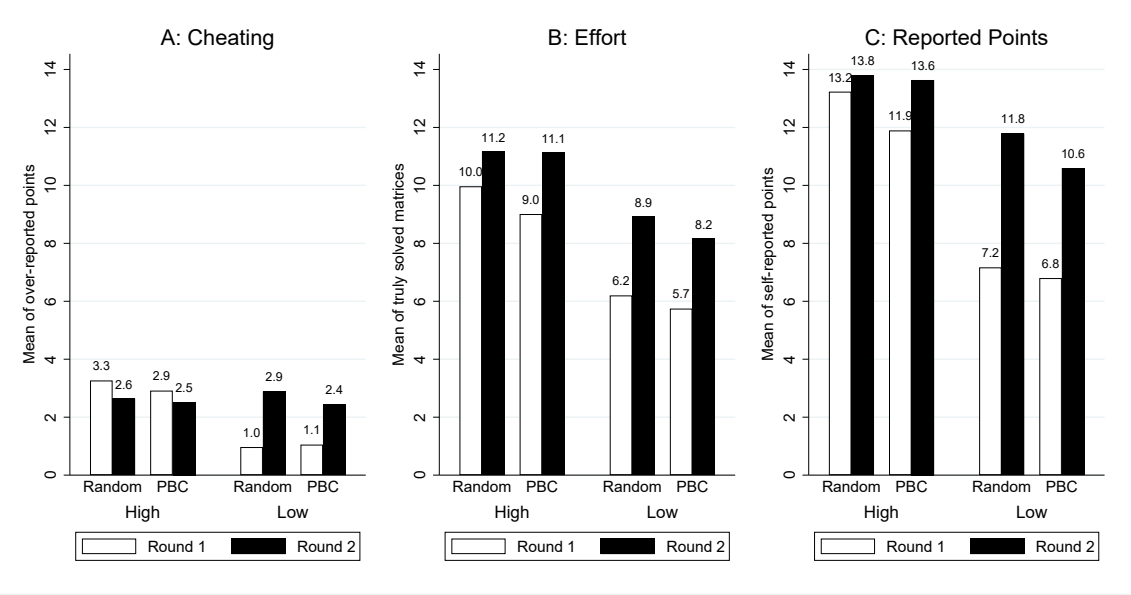
Our main interest is whether the behavior of those who won and lost (first-round outcomes "High" and "Low") changes across time and whether individuals adjust their behavior to the competitor that they are paired with (PBC and Random). We analyze our research questions by providing descriptive statistics and regression analyses for individuals' over-reported points (cheating), truly solved matrices (effort), and reported points (cheating+effort). We study behavior in Round 1 and 2 and the change across rounds. We examine if our results hold when we distinguish the results by our second treatment dimension (the rewards at stake), for different cheating variables, and when we take into account possible concern for endogeneity of the first-round outcome. Finally, we provide results on individuals' beliefs and satisfaction with their outcome to better understand what drives our results.

Figure 1 depicts cheating (panel A), effort (panel B) and self-reported points (panel C) for both first-round outcomes ("High" and "Low"), both matching protocols (Random and PBC), and the two rounds. Summary statistics on cheating, effort, self-reported points, and the percentage of cheaters by treatment and round (i.e., averaged across "High" and "Low") are shown in Table A.2 in the Appendix.

Panel A of Figure 1 shows that in the first round, the "High" over-report 3.3 (2.9) matrices in Random (PBC), while the "Low" over-report only 1 (1.1) matrix. The

[12] Brown and Minor (2014) show that in an elimination contest an increase in the skill of the future opponent decreases effort in the first stage due to a lower expected payoff from the final round. Similarly, Cason et al. (2010) show that individuals are more likely to enter tournaments against a weaker group and less likely to enter tournaments against a superstar group.

Figure 1: Outcome variables by first-round outcome, matching and rounds



Note: PBC stands for performance based competition in the second round, Random for random matching of competitors. We pool the observations from the three reward schemes Only Money, Money+Ceremony, Money+Ranking. "High" refers to first round winners, "Low" refers to first round losers. The sample sizes used to generate the bars are as follows: Random/"High": N=94, Random/"Low": N=94, PBC/"High": N=96, PBC/"Low": N=95.

difference between the "High" and the "Low" is statistically significant in Random as well as in PBC (Random: $\Delta = |2.30|$, p-value = 0.002, PBC: $\Delta = |1.86|$, p-value = 0.012).[13] In the second round, the "High" and the "Low" are similarly dishonest (Random: $\Delta = |0.25|$, p-value = 0.190, PBC: $\Delta = |0.08|$, p-value = 0.682).[14] Across rounds, the "High" slightly reduce cheating in Random ($\Delta = -0.63$, p-value = 0.07) and in PBC ($\Delta = -0.40$, p-value = 0.018).[15] We observe the opposite for the "Low ", who substantially increase cheating in both treatments (Random: $\Delta = 1.91$, p-value < 0.001, PBC: $\Delta = 1.38$, p-value < 0.001). We calculate the change of over-reported points between rounds at the individual level and find that it is significantly different between the "Low" and the "High" (Random: $\Delta = |2.54|$, p-value < 0.001, PBC: $\Delta = |1.79|$, p-value < 0.001), suggesting that the first-round outcome affects behavior. However, we do not find a significant difference of the

[13] p-values are always based on non-parametric tests (Mann-Whitney or Wilcoxon signed-rank). We consider differences to be statistically significant when the significance level is less than 0.05.

[14] Hence, in line with previous research (see, e.g, Abeler et al., 2019; Gerlach et al., 2019), subjects do not cheat to the full extent but rather on a small scale.

[15] We code whether subjects 1) increase, 2) keep constant, or 3) decrease their cheating across the two rounds. Table A.3 shows the fractions conditional on having cheated in the first round. The majority of the "High" that cheated in the first round reduce cheating in the second round. Among the "Low" that cheated in the first round the majority increases cheating. The differences in the fractions increasing/decreasing cheating is significantly different across "High" and "Low." A possible explanation in the behavior of cheaters is that lying cost vary with having won/lost.

change between Random and PBC ("High": $\Delta = |0.23|$, p-value = 0.855; "Low": $\Delta = |0.53|$, p-value = 0.06), indicating that the effect of the first-round outcome does not vary with the second-round matching. To examine if individuals anticipate how opponents will behave in the second round, we compare cheating in the first round between Random and PBC. We find no evidence for an anticipation effect.

Panel B of Figure 1 shows that effort increases among both types and in both treatments from Round 1 to Round 2. In the second round, the "High" solve 1.2 matrices more in Random and 2.1 in PBC, the "Low" 2.7 more in Random and 2.4 in PBC (all p-values < 0.002). It is likely that in all groups the increase is influenced by learning effects. However, the "Low" increase effort to a larger extent than the "High", the difference is significant in Random ($\Delta = |1.52|$, p-value = 0.002) but not in PBC ($\Delta = |0.30|$, p-value = 0.612). Examining if the change differs across matching, we find that the increase of the "High" is insignificantly larger in Random than in PBC ($\Delta = |0.92|$, p-value = 0.061). It is also insignificant for the "Low" ($\Delta = |0.30|$, p-value = 0.479). Hence, we do not find that the effect of the first-round outcome varies with matching. We again find no evidence for an anticipation effect.

Panel C of Figure 1 shows that "High" and "Low" increase reported points from Round 1 to Round 2. Among the "High", the increase is insignificant in Random ($\Delta = 0.55$, p-value = 0.093) and significant in PBC ($\Delta = 1.73$, p-value < 0.001). Among the "Low", the increase is highly significant in both treatments (Random: $\Delta = 4.61$, p-value < 0.001; PBC: $\Delta = 3.79$, p-value < 0.001). Under both matching protocols, the "Low" increase reported points to a larger extent than the "High" (Random: $\Delta = |4.06|$, p-value < 0.001; PBC: $\Delta = |2.05|$, p-value < 0.001), suggesting that the first-round outcome affects self-reported points. The change is significantly different across Random and PBC for the "High" ($\Delta = |1.19|$, p-value = 0.004) but not the "Low" ($\Delta = |0.83|$, p-value = 0.108). Examining self-reported points in the first round, we again find no evidence for an anticipation effect.

To examine if our descriptive results hold when we control for different sets of variables, we run pooled OLS regressions. As shown in Table 3 (cheating), Table 4, Panel A (effort), and Table 4, Panel B (self-reported points), we use three different samples. In columns 1 and 2, we pool the "High" and "Low" to examine the difference between their behavior and to study whether there is an anticipation effect. In columns 3 and 4, we use the sample of the "High" to examine if the effect of first-round outcome differs across PBC and Random. The same is done for the "Low" in columns 5 and 6. In the first step, we only control for the round, first-round outcome, and treatments (columns 1, 3, 5). In the second step, we include controls for individual characteristics like gender and age, the self-assessed propensity to

cheat and perceived relative ability to control for heterogeneity in effort and lying costs, and beliefs about others' behavior (columns 2, 4, 6, see also Section 3).

Table 3: Regression results cheating using pooled data

	High+Low	High+Low	High	High	Low	Low
	(1)	(2)	(3)	(4)	(5)	(6)
	b/se	b/se	b/se	b/se	b/se	b/se
Round 2	-0.437	-1.526***	-0.628*	-1.641***	1.915***	1.774***
	(0.260)	(0.343)	(0.315)	(0.466)	(0.343)	(0.324)
Matching: PBC	-0.118	-0.022	-0.329	-0.051	0.084	0.051
	(0.338)	(0.315)	(0.622)	(0.561)	(0.249)	(0.265)
Round 2 × PBC	-0.146	-0.242	0.232	-0.089	-0.525	-0.348
	(0.291)	(0.275)	(0.395)	(0.434)	(0.518)	(0.505)
Low	-2.076***	-2.925***				
	(0.351)	(0.402)				
Round 2 × Low	2.161***	3.268***				
	(0.358)	(0.427)				
Reward: Ceremony	0.716	0.683	0.841	1.157	0.590	0.598
	(0.422)	(0.389)	(0.648)	(0.592)	(0.457)	(0.422)
Reward: Ranking	1.199*	1.173*	2.626**	2.420**	-0.250	-0.101
	(0.489)	(0.479)	(0.865)	(0.867)	(0.440)	(0.409)
Age		0.004		0.113		-0.074
		(0.035)		(0.069)		(0.040)
Female		0.318		0.510		0.088
		(0.329)		(0.540)		(0.372)
Economics		0.268		0.125		0.220
		(0.445)		(0.663)		(0.469)
Risk Aversion		0.419*		0.969**		-0.167
		(0.202)		(0.291)		(0.226)
Exp. Points Others		0.177***		0.130		0.190***
		(0.046)		(0.093)		(0.046)
Exp. Cheating Others		0.768**		1.171**		0.300
		(0.232)		(0.358)		(0.229)
Perceived Rel. Ability		0.350		0.328		0.349
		(0.224)		(0.341)		(0.319)
Propensity to Cheat		0.421*		0.558*		0.254
		(0.187)		(0.280)		(0.221)
R2	0.053	0.169	0.055	0.237	0.074	0.174
N	758	758	380	380	378	378

Note: Pooled OLS regressions. The dependent variable is the number of over-reported matrices (cheating). "High" refers to first round winners, "Low" refers to first round losers. Round 2, Matching: PBC, Low, Reward: Ceremony, Reward: Ranking, Female, Economics are dummy variables. Risk aversion is based on subjects' self-assessment on a 5-point Likert-scale (5=very willing to take risks). Expected Points Others are the number of points the subject believes were entered by the opponent. Expected Cheating Others is subjects' beliefs how likely it is that the opponent has cheated (5-point Likert-scale with 5 as the highest likelihood). Perceived Relative Ability is a self assessment of relative ability elicited on a 5-point Likert-scale (with 5 as highest value). Propensity to cheat is based on a vignette study (5-point Likert scale with 5 as the highest propensity). Compare also Sections 2.4 and Appendix A.2 for further details of variables. Standard errors clustered at the "society" level in parenthesis, significance levels: $^{*}p \leq 0.05$, $^{**}p \leq 0.01$,$^{***}p \leq 0.001$.

Table 3 shows that the results on cheating are corroborated. We find that (i) the "High" decrease cheating (negative coefficient 'Round 2' in columns 3 and 4) and (ii) the "Low" increase cheating (columns 5 and 6). As a consequence, (iii) the "Low" increase cheating to a larger extent than the "High" in the second round (interaction

'Round 2 × Low' positive and significant in columns 1 and 2). (iv) The insignificant interactions 'Round 2 × PBC' in all columns indicate that the change of cheating across rounds does not depend on the matched competitor. (v) The regressions confirm that subjects do not anticipate how opponents will behave in the second round (insignificant coefficient on 'Matching: PBC', in all columns). Importantly, including our extended set of controls in the second step does not change the results. We find that private - but not public - social recognition has a positive effect on cheating.[16] The expectation that others self-reported more points or were more likely to cheat is positively related with cheating. While own perceived ability has no effect, we find a weakly significant positive relationship with the cheating attitude.

In Panel A of Table 4, the dependent variable is the number of truly solved matrices (effort). The regressions again confirm previous findings. (i) We find that the "Low" increase effort to a larger extent than the "High" in the second round (interaction 'Round 2 × Low' positive and significant in columns 1 and 2). (ii) The insignificant interactions 'Round 2 × PBC' in all columns confirm that the change of effort does not vary with the matched competitor. (iii) The regressions also confirm the lack of an anticipation effect (insignificant coefficient on 'Matching: PBC'). The significance among the "High" disappears if we consider our extended set of controls (compare columns 3 and 4). Effort does not vary across rewards (insignificant coefficients 'Reward: Ceremony' and Reward: Ranking).

Panel B of Table 4 shows that our results are also confirmed with regard to self-reported points: (i) the "Low" increase self-reported points to a larger extent in the second round (significant interaction 'Round 2 × Low' in column 1 and 2), (ii) although the effect of the first-round outcome differs between PBC and Random for the "High" in column 3, the differences are insignificant when we include our extended set of controls (interaction 'Round 2 × PBC' in column 4), and (iii) subjects do not anticipate the second round competitor, at least when we consider our extended set of controls (insignificant coefficient on 'Matching: PBC' in column 2, 4, and 6). Private social recognition has a positive impact on reported points (significant coefficient 'Reward Ranking' in columns 1-4).

The above results suggest that private - but not public - social recognition of achievements tends to increase cheating and self-reported points. We split the sample to study if the effects of the first-round outcome and matching are the same when only money is at stake (Money Only), when individuals are also publicly in-

[16] The result is surprising as the public ceremony provides a tangible benefit (e.g., respect and admiration by peers) while the private ranking does not. However, as also argued by Gerhards and Siemer (2016), individuals might fear negative peer responses from being recognized in public ceremonies or, in a setting in which cheating is possible, experience shame.

Table 4: Regression results effort/self-reported points using pooled data

	High+Low (1) b/se	High+Low (2) b/se	High (3) b/se	High (4) b/se	Low (5) b/se	Low (6) b/se
A. Effort						
Round 2	1.500***	0.289	1.191***	0.027	2.713***	2.395***
	(0.279)	(0.325)	(0.345)	(0.431)	(0.345)	(0.358)
Matching: PBC	-0.711	-0.287	-0.968*	-0.310	-0.445	-0.169
	(0.381)	(0.330)	(0.485)	(0.445)	(0.514)	(0.461)
Round 2 × PBC	0.312	0.232	0.923	0.220	-0.302	0.053
	(0.339)	(0.307)	(0.472)	(0.411)	(0.480)	(0.486)
Low	-3.513***	-4.123***				
	(0.330)	(0.339)				
Round 2 × Low	0.904**	1.985***				
	(0.338)	(0.385)				
Reward: Ceremony	-0.267	-0.423	-0.600	-0.748	0.066	-0.287
	(0.469)	(0.374)	(0.585)	(0.500)	(0.629)	(0.507)
Reward: Ranking	-0.226	-0.122	-1.131*	-0.789	0.690	0.631
	(0.443)	(0.429)	(0.556)	(0.559)	(0.649)	(0.621)
Additional Controls	No	Yes	No	Yes	No	Yes
R2	0.191	0.354	0.062	0.313	0.107	0.269
N	758	758	380	380	378	378
B. Self-reported points						
Round 2	1.061***	-1.242***	0.553	-1.622***	4.617***	4.157***
	(0.303)	(0.285)	(0.331)	(0.356)	(0.378)	(0.361)
Matching: PBC	-0.844*	-0.324	-1.328*	-0.393	-0.362	-0.117
	(0.416)	(0.295)	(0.561)	(0.389)	(0.483)	(0.385)
Round 2 × PBC	0.182	0.006	1.186**	0.161	-0.828	-0.294
	(0.351)	(0.271)	(0.441)	(0.387)	(0.547)	(0.512)
Low	-5.573***	-7.031***				
	(0.327)	(0.272)				
Round 2 × Low	3.049***	5.240***				
	(0.365)	(0.367)				
Reward: Ceremony	0.463	0.274	0.263	0.430	0.664	0.320
	(0.480)	(0.224)	(0.558)	(0.330)	(0.642)	(0.407)
Reward: Ranking	0.985*	1.066**	1.524*	1.660**	0.437	0.529
	(0.460)	(0.353)	(0.700)	(0.558)	(0.590)	(0.468)
Additional Controls	No	Yes	No	Yes	No	Yes
R2	0.280	0.537	0.051	0.425	0.216	0.493
N	758	758	380	380	378	378

Note: Pooled OLS regressions. In Panel A, the dependent variable is the number of truly solved matrices (effort), in Panel B it is self-reported points (cheating+effort). "High" refers to first round winners, "Low" refers to first round losers. Additional controls as in colums 2, 4, 6, of Table 3. Standard errors clustered at the "society" level in parenthesis, significance levels: $^{*}p \leq 0.05$, $^{**}p \leq 0.01$,$^{***}p \leq 0.001$.

formed about outcomes (Money+Ceremony), and when they are privately informed (Money+Ranking). We focus on self-reported points as the dependent variable. As shown in Table 5, the pattern of results is the same in all three reward schemes. The "Low" increase reported points to a larger extent than the "High" (coefficient 'Round 2 × Low' in column 1). Remarkably, the magnitude of the effect is very similar across rewards, suggesting that the effect of the first-round outcome does

not vary with rewards.[17] Competitor matching affects behavior neither in the first nor in the second round. We conclude that our findings do not vary with rewards.

We study the robustness of our results on cheating by using different dependent variables. In Table A.4 in the Appendix, we employ the fraction of cheaters as the dependent variable (see columns 1-3).[18] In line with our findings above, we find that in the second round the fraction of cheaters decreases among the "High" and increases among the "Low." Competitor matching has no effect. Figure A.2 in the Appendix depicts the distribution of over-reported points. It shows that the majority of individuals over-report only one point. We examine if our results hold when we code those over-reporting only one solved matrix across the two rounds as having been honest, to allow for true mistakes (see Faravelli et al., 2015). In columns 4-6 of Table A.4 in the Appendix, we confirm the results from Table 3.

To address possible concerns that the first-round outcome is not random, we run a regression on second round points in which we control for the behavior in the first round, see Table 6. Buser (2016) argues that in these specifications the explanatory variable first-round outcome can be considered random as it depends only on the self-reported points of the randomly allocated competitor. Hence, we obtain the causal effect of being "Low" (as compared to being "High") on the change of behavior from Round 1 to Round 2. By interacting first-round outcome with the matching protocol, the regressions also allows us to examine if the change varies with the competitor (see columns 2, 4, and 6). The results confirm previous findings. The "Low" increase reported points more strongly than the "High" (see column 1) due to an increase in cheating (see column 3) but not in effort (see column 5). Column (2) shows that the "High" significantly increase reported points when matched with a same type competitor (coefficient "Matching: PBC", significant at 5% level), while the "Low" decrease reported points (interaction "Low $\times$ PBC"). However, this is not reflected in significant effects of competitor matching on cheating and effort.

In sum, we find that the "High" tend to reduce cheating in the second round, while their effort tends to increase. Importantly, controlling for beliefs, perceived ability, and other variables, we find that the increase of effort is insignificant. It is possible that learning effects prevented a decrease in effort.[19] We consistently find

[17] To examine if the effect is statistically different across rewards, we run the regression from Table 6, column 1 including interactions of "Low" with "Reward: Ranking" and "Reward: Ceremony." None of the interactions is significant, confirming the lack of a difference across rewards.

[18] Table A.2 shows that on average 47.2% (49.9%) cheated in the first (second) round.

[19] We code whether subjects 1) increase, 2) keep constant, or 3) decrease their effort across the two rounds. While the largest fraction increases effort, we observe also the other two reactions (see Table A.3). In line with the idea that learning effects prevented a decrease, we find that at least in Random the fraction lowering effort is larger among the "High" than the "Low."

Table 5: Regression results self-reported points by reward scheme

	High+Low	High	Low
	(1)	(2)	(3)
	b/se	b/se	b/se
Panel A: Reward is Money Only			
Round 2	-1.073*	-1.956**	4.489***
	(0.525)	(0.635)	(0.661)
Matching: PBC	0.134	-0.362	0.482
	(0.390)	(0.526)	(0.663)
Round 2 × PBC	-0.273	0.523	-1.024
	(0.490)	(0.643)	(0.983)
Low	-6.770***		
	(0.406)		
Round 2 × Low	5.253***		
	(0.695)		
Additional controls	Yes	Yes	Yes
R2	0.546	0.441	0.482
N	280	140	140
Panel B: Reward is Money+Ceremony			
Round 2	-1.323**	-1.294*	3.658***
	(0.445)	(0.596)	(0.481)
Matching: PBC	-0.870	-0.430	-1.204
	(0.484)	(0.570)	(0.704)
Round 2 × PBC	0.193	0.026	0.233
	(0.432)	(0.762)	(0.680)
Low	-6.665***		
	(0.360)		
Round 2 × Low	4.950***		
	(0.496)		
Additional controls	Yes	Yes	Yes
R2	0.574	0.559	0.508
N	288	144	144
Panel C: Reward is Money+Ranking			
Round 2	-1.404*	-1.749**	4.371***
	(0.571)	(0.510)	(0.775)
Matching: PBC	0.254	0.096	0.799
	(0.849)	(1.175)	(0.857)
Round 2 × PBC	0.046	-0.060	-0.053
	(0.552)	(0.646)	(1.087)
Low	-8.105***		
	(0.664)		
Round 2 × Low	5.694***		
	(0.825)		
Additional controls	Yes	Yes	Yes
R2	0.555	0.337	0.607
N	190	96	94

Note: OLS regressions. The dependent variable is the number of self-reported points. "High" refers to first round winners, "Low" refers to first round losers. Control variables as shown in columns 2 ,4, and 6 of Table 3. The results are the same with our first set of controls, as reported in columns 1, 3, 5 of Table 3. Standard errors clustered at the "society" level in parenthesis, significance levels: $^{*}p \leq 0.05$, $^{**}p \leq 0.01$,$^{***}p \leq 0.001$.

Table 6: Regression results change of behavior across rounds

	Reported points		Cheating		Effort	
	(1)	(2)	(3)	(4)	(5)	(6)
	b/se	b/se	b/se	b/se	b/se	b/se
"Low"	1.778***	2.487***	1.801***	2.134***	-0.079	0.269
	(0.400)	(0.502)	(0.433)	(0.537)	(0.401)	(0.551)
Matching: PBC	0.113	0.775*	-0.099	0.212	0.193	0.517
	(0.279)	(0.350)	(0.322)	(0.425)	(0.304)	(0.440)
"Low" × PBC		-1.318*		-0.617		-0.645
		(0.613)		(0.718)		(0.654)
Report R1	0.690***	0.699***				
	(0.044)	(0.043)				
Cheating R1			0.847***	0.850***	-0.119*	-0.115*
			(0.068)	(0.067)	(0.056)	(0.056)
Effort R1			-0.082	-0.077	0.729***	0.734***
			(0.061)	(0.061)	(0.060)	(0.060)
Additional controls	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.586	0.591	0.521	0.522	0.525	0.526
N	379	379	379	379	379	379

Note: OLS regressions. The dependent variable is self-reported points (columns 1+2), over-reported points (columns 3+4), or truly obtained points (columns 5+6) in Round 2. We pool the observations from the three reward schemes Money Only, Money+Ceremony, Money+Ranking. Additional controls are Reward: Ceremony, Reward: Ranking, Female, Economics, Risk aversion, expected points others, expected cheating others, perceived relative ability and propensity to cheat (see the notes to Table 3). Standard errors clustered at the "society" level in parenthesis $^{*}p \leq 0.05$, significance levels: $^{**}p \leq 0.01$,$^{***}p \leq 0.001$.

that the "Low" increase cheating and effort. The difference in the change between the "High" and the "Low" is significant and large in almost all tests. Hence, with regard to our first research question, we conclude that the first-round outcome has an effect on behavior. However, with regard to our second research question, the results predominantly show that the change is unaffected by the type of the second round competitor, as varied in Random and PBC. We do not find support for the presumption that individuals anticipate opponents' behavior in the second round.

Our findings are in line with the idea that individuals choose their second-round behavior based on a comparison of the first-round outcome with their *fixed goal*, see Section 3. They contradict the ideas that the outcome changes *winners' perceptions* or that the *discouragement effect* has an impact on behavior. We run additional tests to better understand what drives our results. First, we study individuals' satisfaction with their outcomes. As shown in Table A.7 in the Appendix, those who lose after having won in the first round (path High-Low) are significantly more satisfied with their outcome than those who lost in the first round (path Low-High) or those who lost in both rounds (path Low-Low). This can be considered as suggestive evidence that the results are at least partially caused by the achievement of an intermediate goal.[20]. In contrast, satisfaction does not vary across matching

[20] As described in Section 3, individuals' goal could be to earn a certain compensation or to perceive oneself or to be perceived as being better than others. To distinguish these explanations, we

protocols. For instance, the "High" are not significantly more satisfied when they won against a same type in PBC and thus obtained the first rank in the society, suggesting that the rewards are not perceived as different across matching protocols.

Second, we examine individuals' beliefs. An explanation for the lack of an effect of the competitor matching is that opponents' are not perceived as different. For the first round, we investigate if the expected self-reported points of the competitor and the likelihood that the competitor cheated differ across PBC and Random on average. As shown in Table A.5 in the Appendix, both beliefs do not differ across treatments, providing a possible explanation for the lack of an anticipation effect. For the second round, we examine beliefs conditional on the first-round outcome. Although the pattern of results is in line with the idea that in PBC competitors are stronger for the "High" and weaker for the "Low", neither of them expect significant differences in opponents' behavior. Hence, also the lack of an effect of the actually matched competitor may be caused by the lack of a difference in beliefs.[21]

5 Discussion and Conclusion

A large literature shows that effort as well as cheating are higher in competitive settings. It is important to understand which features of competitions may produce adverse effects and how behavior evolves over time. We study the effect of the first-round outcome and whether this effect varies with the type of the opponent (someone with the same first-round outcome vs. random opponent) in two rounds of a competition in a laboratory experiment. While several studies examine the impact of having won/lost, competing against different types, and social recognition on *effort*, much less is known about the effect on *cheating*. In addition, it has not yet been investigated how these determinants affect effort when cheating is possible.

We find that winners tend to reduce cheating in the second round, while losers increase cheating substantially. Although winners and losers increase effort, possibly due to learning effects, we find that the increase is significantly higher among losers.

run a treatment in which subjects are assigned the outcomes "High" and "Low" and receive a flat payment of 5 Euro per round (24 observations, 12 "High", 12 "Low"). In line with Erkal et al. (2018), we find that effort provision is not significantly different from effort provision in the treatments with monetary incentives. In contrast, in line with Charness et al. (2019), we find that cheating is very low when no monetary incentives are at stake. The "High" over-report on average 0.5 points in the first round and 0.1 in the second round. While at a much lower level, the pattern of cheating is the same as in the treatments with monetary rewards. The "Low" over-report 0.2 points in both rounds. The result suggests that in the treatments with monetary rewards cheating is caused by the "Low" aiming to earn money.

[21] Table A.6 in the Appendix reports regressions including interactions of PBC with beliefs on others' points and cheating. Both interactions are insignificant, supporting the idea that the impact of expectations on behavior does not differ between PBC and Random.

Our results seem to be driven at least partially by individuals choosing their second-round behavior based on a comparison of the first-round outcome with their goal.

Hence, in contrast to non-competitive settings in which the tendency to lie has been found to be largely stable across rounds (Abeler et al., 2019), we find that in competitions the tendency to lie varies with having won or lost. Our findings are in line with Charness et al. (2014) who show in a different setting that lower-ranked contestants are more likely to cheat than higher-ranked ones. Our findings conflict with Schurr and Ritov (2016) showing that competition winners are more likely to cheat in a subsequent unrelated task. A possible explanation is that in Charness et al. (2014) and our study it is possible to cheat in the initial round. We find that those who win in the first round cheated to a large extent. It is possible that winners' perception that they deserve to win or have momentum only prevails if victory was achieved by honest means.[22] This is an interesting direction for future research.

We find little support for the conjecture that individuals react to the type of opponent in the second round. Our examination of individuals' beliefs and satisfaction with their outcomes shows that opponents' are not perceived as significantly different and satisfaction with having won or lost does not vary across matching protocols. Benistant and Villeval (2019) find that manipulations of the contestants' group identity does not affect behavior in competitions. Similarly, Dato et al. (2019) find that reciprocity considerations have no effect. The two studies argue that competitive pressure dominates their manipulations. We add to this literature by showing that the effect of having won or lost dominates the effect of the competitor type.

In most settings, cheating may be related to formal or informal sanctions. We explicitly stress that envelopes will only be opened in two weeks, thus allowing us to assess cheating only after the experiment. However, subjects may still have the feeling of being monitored. Abeler et al. (2019) and Gneezy et al. (2018) find that observability of the true state decreases the level of cheating. It has to be considered that the threat of observability should also be given in most real-world settings.

Another possible objection to our study is that the observed cheating behavior simply reflects noise or confusion. However, our results are largely unchanged when we recode subjects that only over-reported one point in the first or second round as having been honest, assuming that they may have made a mistake. We also find the same results when we consider whether or not an individual cheated.

We add to a large literature studying the effects of competitive pay schemes in a simplified setting. The advantage of the laboratory is that we can modify the features

[22] Klimm (2019) shows that the opportunity to cheat affects views on whether to accept inequality.

of the competition and observe effort as well as cheating in a controlled environment. In addition, we can rule out that individuals select into competition based on their preferences. Previous studies show that people differ in their willingness to compete (Niederle and Vesterlund, 2007). Recent studies suggest that cheating behavior in the lab generalizes to the field (Potters and Stoop, 2016; Dai et al., 2018). They show that cheating in the lab can predict "moral firmness" in real life. We believe that in organizations in which competitions for pay or fame take place on a regular level and individuals know each other, the effect of winning or losing or competing against a same type is likely to be stronger than in the anonymous lab setting.

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Appendix

A.1 Instructions (Money Only) and task sheet

Instructions in both conditions

Please read the instructions carefully. Do not talk to your neighbors during the entire experiment. Contact us if you have any questions. We will then come to you and answer your questions. It is very important to follow these rules. Otherwise the results of this experiment are scientifically worthless. Please take enough time to read the instructions and take your decisions. You cannot influence the duration of the experiment by deciding quickly, you always have to wait for the other participants to finish. The experiment is completely anonymous. You will learn neither during the experiment nor afterwards with whom you have played. The other participants will neither learn during the experiment nor afterwards what role you have played and what you have decided.

The experiment consists of 2 rounds. You can earn either 2.50 Euro or 7.50 Euro per round depending on your entries. After the experiment you will be paid privately in cash. The experiment will take approximately 60 minutes. The exact procedure of the experiment is described below.

Before the first round

At the beginning of the experiment you will be assigned to a society of four participants. The assignment is random. For the entire duration of the experiment you remain in your society. The other societies have no influence on the decisions in your society.

In the first round

Together with a randomly chosen member of your society, you participate in a competition. The other two members of the society participate in a second competition at the same time. Hence, in the first round, two competitions take place in your society. The competition is about finding as many pairs of numbers as possible. You have 5 minutes for the exercise. The task is described below. You will receive an exercise sheet with 20 matrices, which look like the following example:

6,63	7,81	3,39
7,64	5,01	4,98
2,78	3,19	3,37
3,44	6,55	3,82

☐ Richtig gelöst

Your task is to find in each matrix the two numbers that sum up to exactly 10. A matrix is solved correctly if you have found the pair of numbers which sum up to exactly 10. A pair of numbers always consists of 2 numbers. If you have found the two numbers, circle them and check the box "Correctly solved", as in the example below:

Your task is to find as many pairs of numbers as possible. You will receive one point for each correct pair of numbers. Please put the pen down once the 5 minutes are over. Once the 5 minutes are over, please do the following:

- Count the number of solved tasks. You will receive one point for each task solved. Please memorize the number of points you have achieved.

6,63	7,81	3,39
7,64	5,01	4,98
2,78	3,19	3,37
3,44	6,55	3,82

Richtig gelöst

- Place the task sheet in the envelope attached to your cabin. The envelopes will only be opened after all sessions for this experiment have taken place. At the earliest, this will be in two weeks.
- After all participants have placed their task sheets in the envelope, you can enter the number of correctly solved tasks (points) on the screen.

Your payment depends on the points entered in the task. If you have more points in the first contest than your randomly assigned competitor, your result is HIGH. You will be paid 7.50 Euro. If you have less points than your competitor, your result is LOW. You reice 2.50 Euro as payoff. Table 1 gives an impression of how the result is presented in your society after the first round.

Instructions in Treatment Random

Example table 1 (after the first round)

Wettbewerber	Wettbewerb in Runde 1: (mit zufälligem Mitbewerber)	Ergebnis in Runde 1	Wettbewerb in Runde 2: (mit zufälligem anderen Mitbewerber)	Ergebnis in Runde 2:
Sie	Gruppe X	HIGH: 7,50 Euro	Gruppe W	noch unbekannt
Ein Mitglied der Gesellschaft	Gruppe X	LOW: 2,50 Euro	Gruppe Z	noch unbekannt
Ein Mitglied der Gesellschaft	Gruppe Y	Bekannt in Gruppe Y	Gruppe W	noch unbekannt
Ein Mitglied der Gesellschaft	Gruppe Y	Bekannt in Gruppe Y	Gruppe Z	noch unbekannt

First column: 4 members of the society; second column: random assignment to the competitions of groups X and Y; third column: Result in the first round; fourth column: Random assignment to the competitions of groups W and Z; fifth column: Result in the second round

In the second round

In the second round you participate in another competition. The task is to find as many pairs of numbers as possible, as in round 1. You compete against a randomly selected member of the society against whom you have not yet played. The competitions in round 2 are called W and Z.

Instructions in Treatment PBC

Example table 1 (after the first round)

Wettbewerber	Wettbewerb in Runde 1: (mit zufälligem Mitbewerber)	Ergebnis in Runde 1	Wettbewerb in Runde 2: (Mitbewerber basierend auf Ergebnis in Runde 1)	Ergebnis in Runde 2:
Sie	Gruppe X	HIGH: 7,50 Euro	Gruppe HIGH	noch unbekannt
Ein Mitglied der Gesellschaft	Gruppe X	LOW: 2,50 Euro	Gruppe LOW	noch unbekannt
Ein Mitglied der Gesellschaft	Gruppe Y	LOW: 2,50 Euro	Gruppe LOW	noch unbekannt
Ein Mitglied der Gesellschaft	Gruppe Y	HIGH: 7,50 Euro	Gruppe HIGH	noch unbekannt

First column: 4 members of the society; second column: random assignment to the competitions of groups X and Y; third column: Result in the first round; fourth column: Assignment to the competitions of group LOW or HIGH; fifth column: Result in the second round.

In the second round

In the second round you participate in another competition. The task is to find as many pairs of numbers as possible, as in round 1. You do not compete against the competitor from round 1 but against the member of your society who achieved the same result as you in the first competition. Hence, there is a competition of the two members of the society with the result HIGH (group HIGH) and a competition of the two members of the society with the result LOW (group LOW).

- If you have achieved the result HIGH, you are playing against the member of the society who also achieved the result HIGH. You are playing to achieve the highest possible status in your society. In the second round you are also paid 7.50 Euro if you have achieved the result HIGH.
- If you have achieved the result LOW, you are playing against the member of the society who also achieved the result LOW. In the second round you also receive 2.50 Euro if you have achieved the result LOW.

Instructions in both conditions

Hence, in the second round there will be again two competitions in your society. In the two rounds, a total of 4 competitions will take place in your society. Once all the players have entered their scores from the second round, you will see a final screen showing the result of your society. This screen looks very similar to the example of table 1, with the difference that the result of the second round is also displayed in the last column.

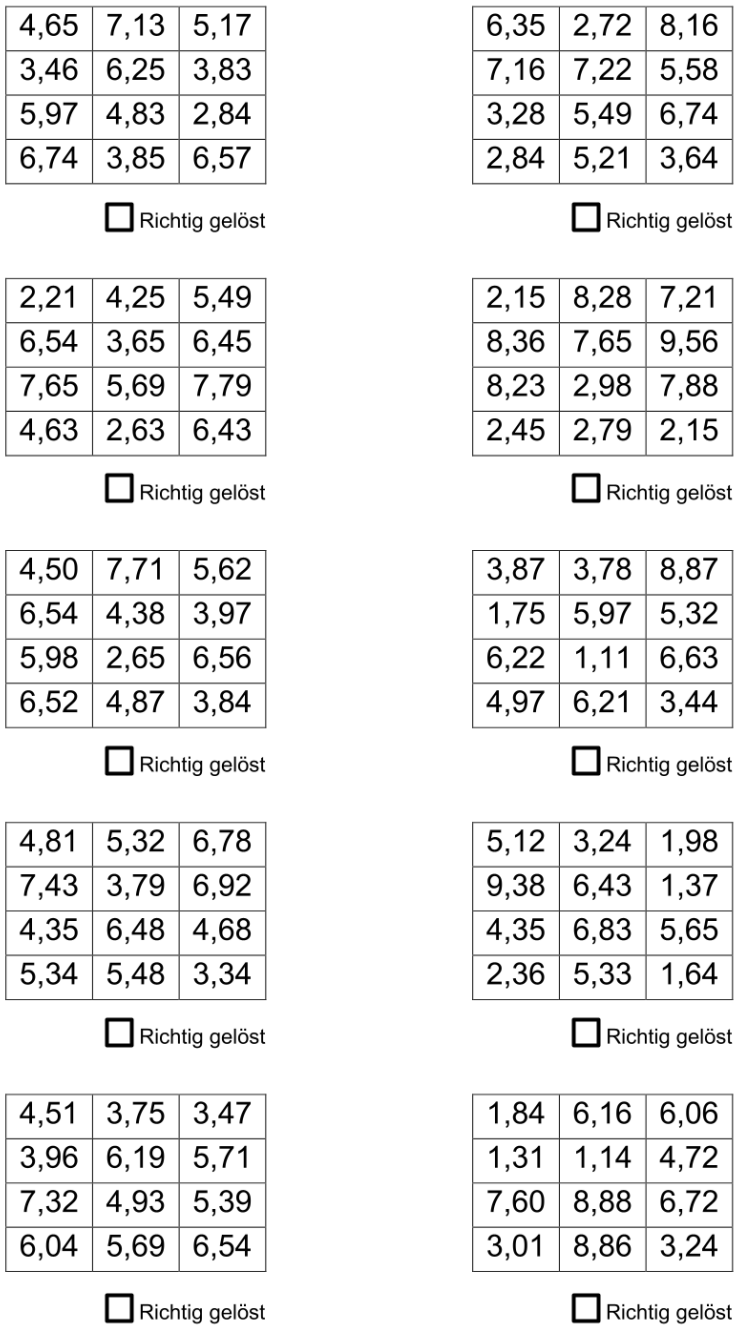
Payment:

Depending on your entries, you will receive either 2.50 Euro or 7.50 Euro per round. In total you can earn either 5.00 Euro (twice result LOW) or 10.00 Euro (once result LOW and once result HIGH) or 15.00 Euro (twice result HIGH) in the experiment (in the two rounds).

The last round is followed by a short questionnaire. After that, the payment is made in cash.

The experiment will begin now. If you have any questions, please raise your hand and wait for someone to come you. Please do not talk to any of the other participants during the entire experiment. Thank you very much for your participation.

Figure A.1: Example of work sheet



A.2 Post-experimental questionnaire

- *Q1:* How old are you?
- *Q2:* What is your gender? *(male / female)*
- *Q3:* How many siblings do you have?
- *Q4:* How often have you participated in experiments? *(never / one to three times / four to seven times / about ten times / more than ten times)*
- *Q5:* Are you currently studying? *(yes / no)*
- *Q6:* If yes, in which semester are you?
- *Q7:* If yes, what do you study? *(cultural studies or linguistics / philosophy or humanities / educational sciences / law / economics / social or political sciences / medicine or nursing sciences / land and forestry / mathematical or natural science subjects / technical sciences / art or music / other)*
- *Q8:* Do you currently have a permanent employment with over ten hours of work per week? *(yes / no)*
- *Q9:* Do you receive Bafög? *(yes / no / not specified)*
- *Q10:* How satisfied have you been with your result in the first round / competition? *(very satisfied / somewhat satisfied / neither satisfied nor unsatisfied / somewhat unsatisfied / very unsatisfied)*
- *Q11:* How satisfied have you been with your result in the second round / competition? *(very satisfied / somewhat satisfied / neither satisfied nor unsatisfied / somewhat unsatisfied / very unsatisfied)*
- *Q12:* Please guess how many points your opponent entered in the first round.
- *Q13:* Do you think that your opponent entered more points than he or she actually achieved on his or her task sheet in the first round? *(yes, very likely / yes, rather likely / no, rather unlikely / no, very unlikely)*
- *Q14:* Please guess how many points your opponent entered in the second round.
- *Q15:* Do you think that your opponent entered more points than he or she actually achieved on his or her task sheet in the second round? (yes, very likely / yes, rather likely / no, rather unlikely / no, very unlikely)
- *Q16:* Imagine you are selling a car. The odometer is broken, potential buyers have no way of knowing the actual number of kilometers of the car. Your guess is that the car has run between 60,000 and 90,000 km and all values between these two numbers are equally likely. If you had to propose a number, which mileage would you disclose to potential buyers?
- *Q17:* With regard to the previous question: How justifiable do you think it is, if a seller discloses 60,000 kilometers as the car's mileage? *(fully justifiable / rather justifiable / neither nor / rather unjustifiable / very unjustifiable)*

- *Q18:* How would you assess your study achievements relative to your fellow students in the same field of study? *(I am in the top 20 percent. / I am above average. / average / I am below average. / I am in the worst 20 percent.)*
- *Q19:* How would you rate your cognitive ability (intelligence) compared to your fellow students in the same field of study? *(I am in the smartest 20 percent. / I am smarter than average. / average / I am weaker than average. / I am in the weakest 20 percent.)*
- *Q20:* Would you consider yourself as a person willing to take risks or are you risk averse? *(very willing to take risks / rather willing to take risks / risk neutral / rather risk averse / very risk averse)*
- *Q21:* Here are some characteristics that can describe people. Please assess how strong the following characteristics apply to you:
  - I am someone who is communicative and talkative *(totally agree / rather applies / neither nor / rather does not apply / not correct at all)*
  - I am someone who can come out of one's shell and is sociable *(totally agree / rather applies / neither nor / rather does not apply / not correct at all)*
  - I am someone who is reserved. *(totally agree / rather applies / neither nor / rather does not apply / not correct at all)*
- *Q22:* How important is the opinion of others for you? *(not important / rather not important / neither nor / rather important / very important)*

A.3 Additional results

Table A.1: Characteristics of participants by treatment

	N	Age	Economics	Female	Cheating attitude	Risk aversion
Money/Random	68	24.07	0.38	0.56	2.83	3.10
Money/PBC	72	24.54	0.46	0.65	2.97	3.14
Ceremony/Random	72	24.54	0.29	0.56	2.91	3.15
Ceremony/PBC	72	25.06	0.28	0.65	2.87	3.13
Ranking/Random	48	24.88	0.23	0.50	2.60	3.23
Ranking/PBC	47	25.38	0.32	0.68	2.93	2.87
Total	379	24.70	0.33	0.60	2.86	3.11

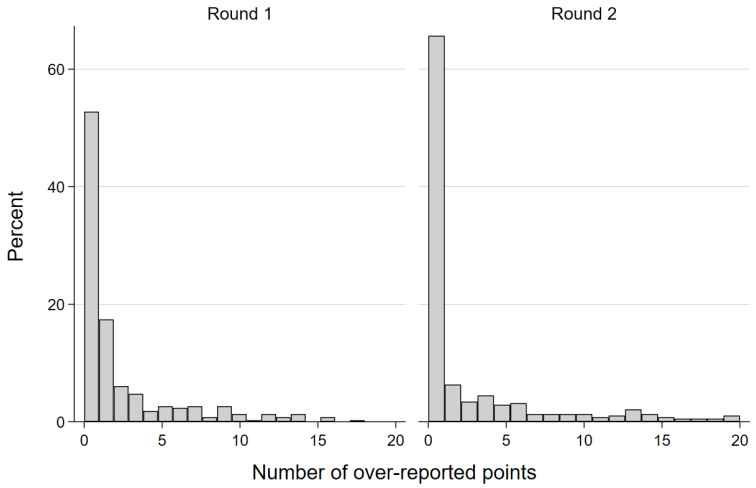
Note: Economics and Female are binary variables. Cheating attitude is based on subjects' assessment if it is acceptable to lie in a described scenario on a 5 point Likert scale (highly justifiable-not at all justifiable). Risk aversion is also self-assessed based on a 5 point Likert scale (highly risk loving-highly risk averse).

Table A.2: Descriptive statistics by treatment and round

		Money Only		Money+Ceremony		Money+Ranking		
	Round	Random	PBC	Random	PBC	Random	PBC	Total
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Self-reported pts.	1	9.529	9.236	10.67	8.986	10.46	10.13	9.778
		(4.470)	(4.002)	(4.902)	(4.238)	(5.871)	(5.102)	(4.722)
	2	12.34	11.64	12.94	12.01	13.19	13.02	12.45
		(4.424)	(4.139)	(4.927)	(4.831)	(5.123)	(5.198)	(4.744)
Effort	1	7.765	7.889	8.681	6.986	7.646	7.234	7.734
		(3.989)	(3.695)	(4.182)	(3.777)	(4.092)	(3.129)	(3.865)
	2	9.868	10.21	9.861	9.181	10.54	9.511	9.842
		(4.398)	(3.954)	(4.637)	(5.019)	(4.851)	(4.432)	(4.543)
Cheating	1	1.765	1.389	1.986	2	2.813	2.894	2.053
		(3.013)	(2.548)	(3.855)	(3.067)	(4.485)	(4.626)	(3.571)
	2	2.485	1.444	3.083	2.847	2.667	3.511	2.620
		(3.683)	(3.171)	(5.186)	(4.632)	(4.279)	(5.377)	(4.426)
Cheaters in %	1	0.485	0.431	0.431	0.486	0.500	0.532	0.472
		(0.503)	(0.499)	(0.499)	(0.503)	(0.505)	(0.504)	(0.500)
	2	0.559	0.375	0.556	0.500	0.479	0.532	0.499
		(0.500)	(0.488)	(0.500)	(0.504)	(0.505)	(0.504)	(0.501)
N		68	72	72	72	48	47	379

Note: Effort is number of correctly solved matrices, cheating is number of over-reported matrices, cheaters in % is fraction over-reporting at least one matrix. Reported are the mean and in parantheses the standard deviation.

Figure A.2: Number of over-reported points by round



Note: Based on 379 observations.

Table A.3: Direction of change of behavior

	High		Low		Δ High-Low	
	Random	PBC	Random	PBC	Random	PBC
	fractions		fractions		p-values	
A. Cheating (conditional on having cheated in R1)						
Increase	0.22	0.22	0.62	0.45	0.000	0.017
Constant	0.16	0.14	0.11	0.18	0.516	0.625
Decrease	0.63	0.65	0.27	0.38	0.000	0.009
p-value Random vs. PBC	1.000		0.623			
B. Effort						
Increase	0.60	0.70	0.74	0.73	0.030	0.666
Constant	0.12	0.10	0.11	0.12	0.818	0.798
Decrease	0.29	0.20	0.15	0.16	0.021	0.472
p-value Random vs. PBC	0.704		1.000			

Notes: We report for each type and treatment the fractions which choose to increase, keep constant, or decrease their effort and cheating from Round 1 to Round 2. p-values Random vs. PBC are based on Kolmogorov Smirnov tests for equality of distribution, p-values High vs. Low are tests for equality of means.

Table A.4: Regression results varying the cheating variable

Dependent Variable:	*Has cheated (binary)*			*Has cheated more than one point*		
	High+Low	High	Low	High+Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
	b/se	b/se	b/se	b/se	b/se	b/se
Round 2	-0.147**	-0.167**	0.185**	-1.525***	-1.642***	1.795***
	(0.051)	(0.057)	(0.064)	(0.350)	(0.472)	(0.328)
Matching: PBC	0.023	0.014	0.031	-0.000	-0.033	0.076
	(0.049)	(0.072)	(0.073)	(0.323)	(0.569)	(0.271)
Round 2 × PBC	-0.094	-0.060	-0.118	-0.239	-0.073	-0.357
	(0.056)	(0.073)	(0.087)	(0.280)	(0.436)	(0.511)
Low	-0.214***			-2.986***		
	(0.057)			(0.405)		
Round 2 × Low	0.322***			3.283***		
	(0.056)			(0.433)		
Reward: Ceremony	0.024	0.098	-0.023	0.706	1.168	0.638
	(0.052)	(0.068)	(0.064)	(0.398)	(0.604)	(0.439)
Reward: Ranking	0.043	0.128	-0.064	1.205*	2.491**	-0.090
	(0.055)	(0.083)	(0.076)	(0.492)	(0.884)	(0.419)
Additional controls	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.081	0.157	0.105	0.170	0.238	0.170
N	758	380	378	758	380	378

Note: Pooled OLS regressions. In columns 1-3, the dependent variable is binary, indicating whether the subject cheated in the respective round. In columns 4-6, the dependent variable is the number of over-reported matrices if across the two rounds at least two matrices were incorrectly indicated as having been solved. "High" refers to first round winners, "Low" refers to first round losers. In all regressions, we pool the observations from the three reward schemes Only Money, Money+Ceremony, Money+Ranking. Control variables as shown in columns 2 ,4, and 6 of Table 3. Standard errors clustered at the "society" level in parenthesis *$p \leq 0.05$, **$p \leq 0.01$,***$p \leq 0.001$.

Table A.5: Beliefs by treatment

	Round 1	Round 2	
		if High	if Low
A. Expected points others			
Random	10.6	12.7	12.5
PBC	10	13.2	11.3
p-value	0.134	0.309	0.059
B. Expected cheating others			
Random	2.4	2.6	2.7
PBC	2.4	2.7	2.7
p-value	0.922	0.393	0.861

Note: Expected Points Others are the number of points the subject believes were entered by the opponent. Expected Cheating Others is subjects' beliefs how likely it is that the opponent has cheated (5-point Likert-scale with 5 as the highest likelihood).

Table A.6: Regression results cheating/effort incl. interactions with beliefs

	Cheating			Effort		
	High	Low	High+Low	High	Low	High+Low
	(1)	(2)	(3)	(4)	(5)	(6)
	b/se	b/se	b/se	b/se	b/se	b/se
Round 2	-1.509***	-1.674**	1.778***	0.256	-0.085	2.286***
	(0.351)	(0.560)	(0.334)	(0.332)	(0.529)	(0.366)
Matching: PBC	-0.194	0.334	-0.696	-0.167	0.428	-0.404
	(1.079)	(1.490)	(1.547)	(1.033)	(1.331)	(1.744)
Round 2 × PBC	-0.308	-0.063	-0.346	0.373	0.483	0.161
	(0.321)	(0.748)	(0.506)	(0.344)	(0.667)	(0.488)
Low	-2.941***			-4.081***		
	(0.403)			(0.340)		
Round 2 × Low	3.297***			1.914***		
	(0.434)			(0.389)		
Reward: Ceremony	0.696	1.171*	0.579	-0.465	-0.754	-0.383
	(0.386)	(0.588)	(0.439)	(0.376)	(0.494)	(0.519)
Reward: Ranking	1.162*	2.362**	-0.094	-0.076	-0.832	0.684
	(0.481)	(0.877)	(0.419)	(0.429)	(0.553)	(0.606)
Exp. Points	0.153*	0.106	0.181*	0.494***	0.545***	0.472***
	(0.073)	(0.143)	(0.079)	(0.072)	(0.114)	(0.088)
Exp. Points × PBC	0.045	0.049	0.024	-0.122	-0.040	-0.189
	(0.090)	(0.183)	(0.096)	(0.098)	(0.142)	(0.129)
Exp. Cheating	0.840*	1.387*	0.220	-1.073***	-0.919*	-1.056**
	(0.365)	(0.573)	(0.410)	(0.271)	(0.404)	(0.334)
Exp. Cheating × PBC	-0.120	-0.395	0.171	0.471	-0.181	0.876
	(0.390)	(0.666)	(0.468)	(0.383)	(0.514)	(0.520)
Additional controls	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.169	0.239	0.174	0.357	0.314	0.282
N	758	380	378	758	380	378

Note: Pooled OLS regressions. In columns (1) to (3), the dependent variable is the number of over-reported matrices (cheating). In columns (4) to (6), it is the number of truly solved matrices (effort). "High" refers to first round winners, "Low" refers to first round losers. In all regressions, we pool the observations from the three reward schemes Only Money, Money+Ceremony, Money+Ranking. Control variables as shown in columns 2 ,4, and 6 of Table 3. Standard errors clustered at the "society" level in parenthesis *$p \leq 0.05$, **$p \leq 0.01$,***$p \leq 0.001$.

Table A.7: Satisfaction by outcomes and treatments

	Outcome in Round 1	Outcome in Round 2
	High	High
Random	4.43	4.51
PBC	4.4	4.71
	High	Low
Random	4.39	2.69
PBC	4.6	2.64
	Low	High
Random	1.81	4.26
PBC	2.04	4.08
	Low	Low
Random	1.9	2.04
PBC	1.7	1.81

Note: Based on the questions "How satisfied have you been with your result in the first/second round?" Responses on a 5-point Likert scale with 5 as the highest.

A.4 Relationship effort and cheating

In our experiment (as in most real life situations), subjects have two margins through which they can adjust behavior: effort and cheating. We study the relationship between the two variables. First, the variables could be positively correlated. People that provide higher effort could further improve their performance by over-reporting points as found by Charness et al. (2014). Second, it is possible that the variables are negatively correlated. People who provide higher (lower) effort could be less (more) likely to cheat as found by Schwieren and Weichselbaumer (2010).

Table A.8: Relationship between effort and cheating

	(1)	(2)
	b/se	b/se
Effort	-0.420***	-0.301***
	(0.048)	(0.047)
Round 2	0.785***	2.589***
	(0.183)	(0.470)
Round 2 × Effort		-0.210***
		(0.041)
Additional controls	Yes	Yes
R2	0.434	0.443
N	758	758

Notes: OLS regression. Dependent variable is the number of over-reported matrices. Additional controls as in columns 2, 4, 6 of Table 3. Standard errors clustered at the "society" level in parenthesis, significance levels $*p \leq 0.05$, $**p \leq 0.01$,$***p \leq 0.001$.

To assess the correlation between effort and cheating in our experiment, we use the pooled data and regress cheating on effort, the round, and a set of controls. Table A.8 reports the results. The two margins seem to be substitutes. On average, we find a negative relationship of 0.42 (column 1). Those who provide high effort over-report fewer points, and vice versa. When we interact round and effort (column 2), we find that the relationship is -0.30 in the first round and -0.51 (-0.30-0.21) in the second period. The larger relationship suggests that the substitution of low effort with higher dishonesty (or vice versa) is more pronounced in the second round.