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How Reliable are the Marginal Totals in Cooperation Experiments in the Laboratory?

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Abstract: How Reliable are the Marginal Totals in Cooperation Experiments in the Laboratory?

Subjects in laboratory experiments are prone to effects of social desirability. This reactive behavior is due to the subjects perceived anonymity in the entire experiment. Especially, socially desirable behavior is also triggered by assembling and/or payment procedures that are not anonymous. Indeed, in a laboratory experiments with a one-shot prisoner's dilemma (PD) and perfect stranger anonymity subjects (n=174) showed significantly different cooperation rates depending on the anonymity conditions during assembling and the payment procedure, ranging from 33.3% to 19.9%. In addition, a first experiment with the PD and anonymous payment and double blind experimenting lead to a cooperation rate of 33.3%. Only after the *same* subjects (n=34) took part a second time in *same, entire* experiment, the cooperation rate fell to 8.8%. Therefore this measurement of the cooperation rates in a laboratory experiment failed the test-retest check on reliability. This happened though all manipulations used fulfilled the standards of fully anonymous experimenting. This means that such processes could go unnoticed and bias the results of any standard laboratory experiment on cooperation in one shot decisions. Therefore, in accordance with the textbook logic of laboratory experiments, but in contrast to a common practice (cf. Behavioral Game Theory) marginal totals from cooperation experiments in the laboratory should not be interpreted.

Keywords: repetition of laboratory experiments, reliability, marginal totals, double blind anonymity, confusion.

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1 Introduction

In sociology the use of laboratory experiments has started later than in neighboring disciplines like psychology and economics. All the more, laboratory experiments are becoming an important method of empirical research, especially for the analysis of cooperation (cf. Diekmann 2008; Fehr and Gintis 2007; Falk and Heckman 2009). In contrast to observational data (e.g. from surveys), data from an experimental design allow for a direct causal interpretation. Because of the randomization of subjects to control and treatment group, all confounding effects of covariates (no matter if they are observed or not) on the dependent target variable are controlled. So, the difference between the value of the target variable in the treatment group and the value of the target variable in the control group can be logically interpreted as the causal effect of the stimulus (Lewis 1973; Morgan and Winship 2007). Therefore, the internal validity of an experiment is said to be maximal. This is especially true for laboratory experiments that are conducted in the most standardized way that is achievable in the social sciences.

On the other hand, the laboratory is a highly simplified and artificial environment compared to real life. Hence, experimental designs, and laboratory experiments in particular, are said to have a low external validity. While the *difference* between marginal totals of the treatment and the marginal totals of the control group can be interpreted as the treatment effect, the marginal totals themselves are hard to interpret. That is why experimental settings are suggested for the test of different theories on a problem (for a current discussion see Smith 2010). Typically, wrong theories will fail in laboratory experiments, and correct ones will survive. Only after such a causal relationship has been approved, its external validity can be tested with other methods such as field experiments, surveys, etc. (cf. Fehr et al. 2002; Raub and Buskens 2008).

Nobody blatantly doubts this interpretation of experimental results. Nevertheless, the interpretation of laboratory results is often extended beyond the effect of the stimulus. So, "Behavioral Game Theory" often refers to interpretation of marginal totals from laboratory experiments. E.g. the marginal totals in prisoner's dilemmas and other games with cooperation problems are interpreted as individual tendencies to cooperate (cf. Camerer 2003 and the many tables therein for an overview). Consequently and in contrast to standard game theory, in Behavioral Game Theory it is assumed that individuals have social preferences which can be measured by the marginal totals of laboratory experiments. Fehr (2009: 217) gives a corresponding instruction: "The main tool for eliciting social preferences are simple one-shot games [...] that involve real monetary stakes and are played between anonymous interaction partners." But such a procedure would only be suitable if the marginal totals from laboratory experiments were externally valid.

This article studies one necessary prerequisite of the external validity of laboratory experiments: namely reliability. This is done with a test-retest check on reliability by simply repeating the same experiments with the *same* subjects. Only if the marginal totals remain constant with both experiments they are reliable. This is not the case.

In order to explain varying marginal totals we analyze the relationship of reliability and reactivity. Reactivity is know as being the main methodological problem of laboratory experiments, and is a plausible reason for lacking reliability. This is done next in the theoretical section. Then, follows the presentation of the experimental design and the corresponding results. The results are discussed and possible theoretical explanations are presented. The article concludes with a discussion and some methodological propositions.

2 Reactivity and Reliability

Already the experiments in the Hawthorne works in the 1930ies (cf. Roethlisberger and Dickson 1939) showed that subjects – aware of the fact that they were scrutinized scientifically – reacted in a way that they perceived as being socially desirable. Such so called Hawthorne effects compromise the reliability of experiments.[1] In the real world, under the same conditions but without social control by scientists such socially desirable behavior would disappear immediately. Later, reactivity effects were confirmed in other experimental settings (Rosenthal and Jacobson 1966; Orne 1962). Milgram with his famous experiment (1963) showed that in a laboratory experiment obedience of the subjects to what they perceive as being socially desirable can go to the extreme. This effect also seems to be generated by the serious scientific environment of the university and by the role of the scientists themselves. Burger (2009) recently showed with a successful replication that Milgram was not taken in by a historical artefact.

As soon as reactivity does not interact with the stimulus under research it can be controlled with the experimental design. In an experiment that studies e.g. the influence of information on cooperative behavior reactivity might increase the overall tendency to cooperate. But randomization makes sure that the average level of cooperation due to reactivity is the same in both groups before the stimulus is set. So the cooperation rate in the treatment group can be compared with the one in the control group. This allows

[1] In the Hawthorne study the effect of illumination on work productivity was explored. In contrast to the expectations of the researchers, reduced light did not decrease work productivity. The workers worked the harder the less light they had. Of course, on a normal workday without observation this would not have happened, and the conclusion that the extent of light has no effect on work productivity is wrong. Insofar the Hawthorne effect can also compromise the internal validity of experiments if it is confounded with the treatment.

for the interpretation of *relative* cooperation rates. Albeit, *absolute* cooperation rates can not be interpreted as the natural tendency to cooperate *outside* the laboratory (cf. Benz and Meier 2008; Laury and Taylor 2008; Levitt and List 2007).

2.1 Anonymity and Reactivity

So far only few studies examined reactivity of subjects in laboratory experiments. Hoffman et al. (1994 and 1996) and Bolton and Zwick (1996) studied the effect of different anonymity settings on cooperation in laboratory experiments. They found some evidence that higher anonymity of the subjects in laboratory experiments reduced their tendency to cooperate (anonymity hypothesis). But these results were not unambiguous.

Hoffman et al. (1994) also introduced the concept of double blindness into economic laboratory experiments.[2] It means that subjects are blind to each others, as much as to the experimenters.[3]

Only in 2002, Cherry et al. presented another study that explored the effect of anonymity on cooperation in laboratory experiments. They used the one-shot dictator game. This is the most simple game known and is often advocated as being a measure of cooperative preferences in its purest form (cf. Fehr 2009). In a dictator game the dictator has an endowment to share between himself and a partner. He can walk away with all the endowment, which is the Nash equilibrium prediction (Nash 1950). Or he can give a fair share to the partner. So, any dictator who gives some of his endowment to a completely powerless partner seems to be guided by some sort of social preference. Cherry et al (2002) studied this game in three conditions, two of which are of interest here: The first condition was oriented on other common dictator game experiments. Subjects were blind to the fact with whom they were interacting. But the experimenter knew the behavior of the subjects, even more because they had to pay them according to their decisions. This anonymity condition is called "perfect stranger anonymity", [4] and it is the strongest anonymity condition normally used in laboratory experiments. In this

[2]Note that double blindness in economic experimenting does not mean the same as in medical research. There, it denotes the fact that neither the subjects, nor the experimenters know which subjects receive a treatment, and which receive a placebo. In addition, neither subjects, nor experimenters know the aim of the study. By this procedures reactivity by the subjects and the experimenters is avoided.

[3]Reactivity from the experimenter's side is also known in social science. It happens, if the experimenter – intentionally or unknowingly – pushes the subjects to the desired behavior. Such "Pygmalion" effects were discovered in classroom experiments (Rosenthal and Jacobson 1966). Though Pygmalion effects can also bias experiments, they are not studied here.

[4]The term is taken from the"z-tree" manual. This software of the Institute for Empirical Research in Economics of the University of Zurich (Fischbacher 2007) is often used for laboratory experiments in the social sciences, as it is for the experiments presented here.

anonymity condition only 19% off all dictators didn't give anything to the responders, while all the others shared a considerable part of their endowment with their partners. This seems to show some considerable amount of pro-social behavior.

In the condition of interest here subjects played the same game on a double blind anonymity condition. Now, also the experimenters did not know the decisions of the subjects, and subjects did know this. This was guaranteed by a complex procedure that allowed to pay the subjects according to their decisions without revealing these decisions to anybody else. With this double blind condition that canceled out any social control, 95% of the subjects did not give anything to their partners. Unfortunate for the research interest here, this anonymity condition was confounded with another treatment. Namely, the subjects had to make some effort to get their endowment, i.e. the endowment was no "windfall gain" (Arkes et al. 1994). From several studies it is know that subjects tend to act more pro-social if they decided about costless windfall gains (Ackert et al. 2006; Clark 2002; Güth and Kliemt 2003; Thaler and Johnson 1990; Poppe and Valkenberg 2003). This was also the case with the subjects of Cherry et al. (2002). They already reduced pro-social behavior as soon as they had to share a costly endowment. So, the negative effect of anonymity on pro-social behavior can not be separated from the negative effect of costly endowments on pro-social behavior. Therefore, it remains unclear how much double blind anonymity alone would have reduced pro-social behavior. This will be tested with a methodological experiment.

2.2 Confusion and reactivity

In a follow-up experiment Cherry et al. (2004) focused on effects of the heterogeneity of the endowment on pro-social behavior. Instead of the most simple dictator game they used the much more complex linear public good game with a group size of four.[5] The anonymity condition was perfect stranger, and it was not experimentally varied. In contrast to Cherry et al. (2002), the subjects in Cherry et al. (2004) behaved pro-social and contributed substantially to the public good.

How can these two results be brought together? A methodological answer to this

[5]In the public good game several players can invest a part of their endowment into a common public good. The Pareto optimum is reached if all the subjects invest their complete endowment. Yet, there is an incentive for all subjects to free-ride by keeping the own endowment and nevertheless profit from the public good that is created by the investments of the other subjects. Because this is true for all the subjects, the Nash equilibrium (Nash 1950) predicts that no subject will invest anything and therefore the beneficial public good will not be produced. Any investment in the public good then may be interpreted as an indicator for social preferences.

problem is given in the following. It is based on the question that Andreoni (1995) set in the title of his article: "Cooperation or confusion?"[6] The argument runs as follows: Subjects in a laboratory experiment might be confused by the complexity of its course of action. This complexity may originate from the experimental decision like in the public good game of Cherry et al (2004), or from the methodological settings like the double blind anonymity condition in Cherry et al (2002), or from both.

In any case the subjects might be confused by this artificial situation which does not compare at all with their real-life situations. This confusion can be seen as one characteristic of the Hawthorne effect. We assume, that this confusion forecloses the subjects from believing in the anonymity procedure, and the anonymity of their decisions in the laboratory. Hence, double blind anonymity procedures might *not increase* the *perceived* anonymity of the subjects but rather *decrease* it. This might especially be true for subjects who take part in a laboratory experiment for the first time and are not used to the artificial environment. Consequently, reactivity will increase, and subjects will tend to do what they perceive as being the socially desired behavior (confusion hypothesis). So, cooperative behavior in laboratory experiments measured by the corresponding marginal rates is not necessary due to social preferences of the subjects. It might rather be a methodological artefact caused by confused subjects who misperceived the anonymity setting. This will be tested with a methodological experiment.

3 Experimental design

Because Cherry et al. (2002) already showed some biases for the case of one-shot dictator games, a slightly more complex game that is also very common in the laboratory research on cooperation is used: The one-shot prisoner's dilemma. Figure 1 presents the strategic interaction with payoffs in €. The game is played only once during the experiment, and subjects know that. Player 1 and player 2 decide simultaneously between option C (cooperation) or option D (defection). If both players cooperate ($C\ C$), the Pareto optimum is reached and the players gain a common payoff of €$2 \times 9 = 18$.

However, it is well-known that for both players there exists an individual incentive to deviate from this Pareto-optimal decision and to defect. If then one player sticks to his cooperative decision, the other can gain €11 ($D\ C$). But even if the other player also deviates from being cooperative ($D\ D$), player 1 will not regret his decision. He will still gain €8, instead of the €6 he would have obtained from unilateral cooperation ($C\ D$). Hence, to choose D is a dominant strategy for both players, and therefore ($D\ D$) is the

[6] Andreoni's (1995) answer is "cooperation". But in the light of the above reported Hawthorne effect, this seems questionable.

		player 2	
		C	D
player 1	C	9 9	6 11
	D	11 6	8 8

Figure 1: Prisoner's dilemma with payoffs in €

only Nash equilibrium (Nash 1950). Because the interaction only lasts for one round, there is no incentive to build a reputation. Therefore, rational subjects will not deviate from the Nash equlibrium (D D). Only subjects with pro-social preferences, subjects who did not understand the game, or subjects who did not understand the experimental setting will choose the cooperative option C. Especially, if subjects wrongly think that the interaction is not anonymous, but that their decisions are controlled by other subjects and/or the experimenter this could give rise to cooperation due to socially desirable behavior.

3.1 Anonymity

The anonymity setting was varied in two dimensions, one concerning anonymity versus other subjects ((not) anonymous), and one concerning anonymity versus the experimenters ((double) blind).

3.1.1 Anonymous vs not anonymous

The experiment was carried out so that interacting subjects got to see each other (not anonymous), or never got to see each other (anonymous). This was done on the ground that even slight cues like faces (Bateson et al. 2006; Halley and Fessler 2005); Rigdon et al. 2008), identification (Bohnet and Frey 1999) and names (Charness and Gneezy 2008) might abolish the *feeling* of anonymity, even though there is no rational reason for it. Variation on this anonymity dimension was implemented by the *assembling* of the subjects in the following way: In the *not anonymous* treatment, all the subjects were assembled in one room. They were instructed orally about the experiment. Afterwards half of the randomly chosen subjects were sent to the other laboratory by calling their names.[7] So subjects learned names and appearance of each other, and it became common knowledge that all the subjects were students. The two laboratories were located on different floors and connected by stairs.

[7] One session of the experiment consisted of $2 \times 6 = 12$ subjects.

In the *anonymous* treatment the randomized subjects were directly invited to the doors of the two separated laboratories. And they also left the experiment through those doors on different floors so that subjects that interacted never got to see each other. In both conditions subjects placed themselves before one of the six monitors that were made anonymous with a cardboard blind. In addition, the experimenters also sat behind a cardboard blind to amplify the subjects the feeling of not being observed.

After both of the two assembling procedures the subjects read the experimental instructions on a paper handout and on the computer screen. The instructions including possible decisions, consequences and the payment procedures were presented in words.[8] Afterwards subjects could take one virtual decision on the computer. For this trial they were matched randomly to a partner in the other laboratory. Subjects then learned about the result of this virtual decision.[9] Afterwards the real decision with monetary payment was taken with a blind or double blind procedure that is presented next.

3.1.2 Double blind vs blind

The experiment was carried out with a blind and a double blind condition. In the blind condition only subjects did not know the decisions of each other, but the experimenters knew the decisions. In the double blind condition neither the experimenters, nor other subjects ever got to know a specific decision.

In practice, a double blind condition particularly calls for a double blind payment procedure. This was inspired by the corresponding procedures of Hoffman et al. (1994) and Cherry et al. (2002). Concretely, in the *double blind* treatment subjects were endowed with purses that contained € 8 in cash (a € 5 bill, a € 2 coin and a € 1 coin). The purses were black in one laboratory and red in the other one. Subjects were informed, that they should remove € 8 from the purse if they decided for defection D, and € 6 if they wanted to act cooperatively. It remained invisible from the outside, if the purses contained any money, and if so, how much. Then the subjects placed the closed purses in a box in the middle of the laboratory. Afterwards, the experimenters took the closed box and shook it to mix the purses up. The box was taken behind the experimenters blind and the remaining money in the purses was inspected. If the purse was empty, strategy D was noted. If there was a € 2 coin in the purse, strategy C was noted. In addition a € 1 coin was put into the purse. This additional € 1 corresponded to the cooperation gain. The closed purses (either empty or with € 3) were put back into the box. Again the box was shaken visible for all subjects. Then the boxes were exchanged

[8] This read e.g. as follows: "If your partner has decided to do . . . , you will get . . . . Afterwards you will get the money from . . . ."

[9] Again, this was done in words like: "Now you would receive € 6".

between the two laboratories by the experimenters. The exchanged boxes were opened and placed in the middle of the room again. Now the subjects chose a purse from the box and took it behind their blinds. From the colours of the purses it was observable that they indeed came from the other laboratory. Subjects took the money from the purse if there was any in it and left the experiment through the respective door of their laboratory.

This procedures guaranteed that nobody except the subjects themselves knew the individual decision. However, because the double blind conceals the individual decisions of the subjects, this is also true for any other individual attribute of the subjects. Therefore, interesting characteristics as e.g. measures of the individually perceived anonymity or confusion cannot be matched to the individual decisions. So, a direct test of the hypothesis on individual level is not possible. It must be done on the collective level of cooperation rates.

The *blind* treatment was simpler. Not only the trial decision was taken on the computer screen, but also the one with monetary consequences. The procedure was exactly the same as in the trial decision and the subjects also learned from the screen how much money they would receive. Afterwards, the experimenters gave this money directly and without any formalities to the subjects that were sitting behind their blinds.[10] So, it was clear to the subjects that the experimenters knew their individual decisions. Then the subjects left the laboratory.

The blind anonymity procedure differed from the double blind one not only by the payment procedure, but to some extent also by the decision itself. In the double blind treatment subjects dealt with real money and the familiar situation of taking it from a purse. In the blind treatment the decision was made on the screen as it is often the case in laboratory experiments. So, the double blind treatment not only allows for a comparison of different anonymity settings, but it can also be seen as a being closer to a real-life situation than the blind treatment. Therefore, the comparison of the double blind condition with the artificial situation with decisions at the screen can be interpreted as an indicator for the external validity of the standard laboratory experiment.

The combination of the two anonymity procedures lead to $2 \times 2 = 4$ different anonymity treatments, namely: 1) blind/not anonymous (B-NA), 2) blind/anonymous (B-A), 3) double blind/not anonymous (DB-NA), and 4) double blind/anonymous (DB-A). The first condition has the least anonymity, and the last one has the highest. Con-

[10]Note that compared to most laboratory experiments this is still a rather high grade of anonymity. For example, subjects often have to sign a receipt for their payment. Such a signature probably erases the subjective feeling of anonymity.

dition 2 and 3 are in between and can not be ranked. Note that all of the treatments fulfill the perfect stranger condition that normally is the strongest anonymity condition used in laboratory experiments. Therefore, any methodological effect of anonymity on cooperation that is discovered here, principally could have biased the results of most laboratory experiments on cooperation.

3.2 Confusion and repetition

The four anonymity conditions do not only differ in levels of anonymity, but also in levels of complexity. While the "anonymous" and "not anonymous" condition do not differ much related to complexity, this is not the case for the "blind" and "double blind" procedure. Especially the latter is hard to understand from scratch, as already the above description shows. It may confuse inexperienced subjects even – or only – if the instructions they read are detailed. But as soon as the subjects manually deal with real money, purses, boxes, etc. the anonymity procedure is figured out on an intuitive rather than a rational basis. In addition, they learn that their decision is really anonymous not from respective assertions, but from their own experience of not having been controlled or even sanctioned. Hence, the *repetition of the whole experiment* with the *same* subjects should reduce confusion, and consequently reduce socially desirable behavior. So, in such a repeated prisoner's dilemma experiment cooperation rates, measured by the marginal totals, should decrease. This effect should be more visible for the more complex, and therefore more confusing conditions. Hence, the most complicated experimental condition DB-A was repeated with the same subjects.

This design corresponds to the familiar test-retest design (Diekmann 2007) to explore the reliability of a measurement. In this "within"-design subjects in the first experiment serve as the control group for themselves in the treatment group of the second experiment.[11] The two experiments took place within about three months. The subjects were never informed that they were taking part in the same experiment again, and that all the other subjects also had taken part in the same experiment before. Because subjects in the first experiment had only seen the five other subjects in their laboratory, and because reinviting the subjects of the different sessions naturally mixed them up, hardly anybody saw a familiar face again. So, to the subjects repeated experiment seemed to be a new experiment that, after a while, turned out to be a familiar one.

[11]Nevertheless, due to the double blind anonymity measures of reliability cannot be calculated.

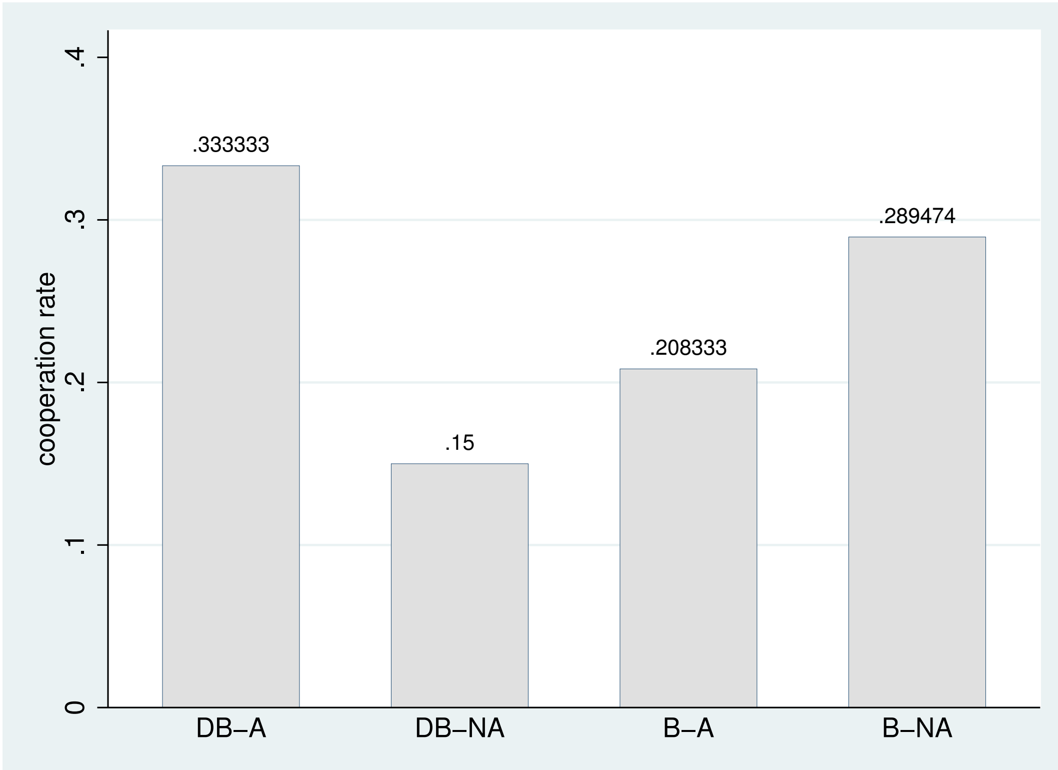

Figure 2: Grades of anonymity and cooperation rates (n=174)
DB-A=double blind, anonymous; DB-NA=double blind, not anonymous; B-A=blind, anonymous; B-NA=blind, not anonymous

4 Results

First the empirical results for the different anonymity and then for the repetition of one anonymity condition are reported.

4.1 Results anonymity

Figure 2 reports the cooperation rates of the one-shot prisoner's dilemma for the four anonymity conditions. All the subjects took part in a laboratory experiment for the first time.

The condition DB-A on the left is most anonymous, and the condition B-NA on the right is least anonymous. The other ones are in between. Indeed, as theoretically expected, the cooperation rates diminish with increasing anonymity for the three conditions. However, for the highest anonymity condition (DB-A), not the lowest, but the highest cooperation rate of $\frac{1}{3}$ is found. Though the differences in the cooperation rates of the four anonymity conditions are substantial, they do not differ significantly overall ($F = 1.57$, $p = 0.12$). But a significant difference ($t = 2.00$) is found between the conditions DB-A (n=48) and DB-NA (n=40).

As mentioned above the double blind procedure forecloses the possibility of testing on an individual level wether the subjects were afraid of being observed and for this reason acted cooperatively. Only a measurement on the collective level of the different conditions shows that the anonymity settings themselves worked in the intended way. When the subjects were not anonymously assembled ("not anonymous" condition) 57.5% (double blind payment), and 68.4% (blind payment) of the subjects said that they did not know anybody who was also taking part in the experiment. For the anonymously assembled subjects ("anonymous" condition) this figures were 84.6%, and 86.8% respectively. Particularly in the DB-A condition, only 8.0% of the subjects reported that they knew of a potential partner taking part in the experiment in the other laboratory. So, the unexpectedly high cooperation rate in this condition cannot be explained with an anonymity procedure that accidentally failed. The failure must have happened in the *perception* of anonymity of the subjects. The difference between the DB-NA condition, where subjects saw each other at the beginning of the experiment, and the DB-A condition where this was not the case must have caused this different behavior.

Overall, the results show that laboratory experiments can be very sensitive to minimal variations of the anonymity setting, not only in simple dictator games but also in the more complex prisoner's dilemma. Moreover, it should kept in mind that all the anonymity conditions explored here fulfill the perfect stranger anonymity. So, such slight variations of the anonymity setting beyond perfect stranger anonymity probably will go unnoticed most of the time. But nevertheless they influence the experimental outcomes. Interpretations of the marginal totals with regards to content are therefore prone to be biased, and do not tell us anything about the preferences for cooperation.

4.2 Results repetition

In the repeated experiment not all subjects from the first experiment could take part. Therefore, the case number was reduced to 34.[12] Figure 3 shows the cooperation rates of the one-shot prisoner's dilemma for the DB-A treatment for the repeated experiment in black. For the sake of comparison the cooperation rates from the first experiment are also reported (shaded bars, cf. figure 2).

[12]No hint was found that this attrition of the subjects sample was somehow biased. In particular, it was not confirmed that male subjects took part more often in further experiments than female subjects, as Guillen and Veszteg (2009) found (see also discussion below).

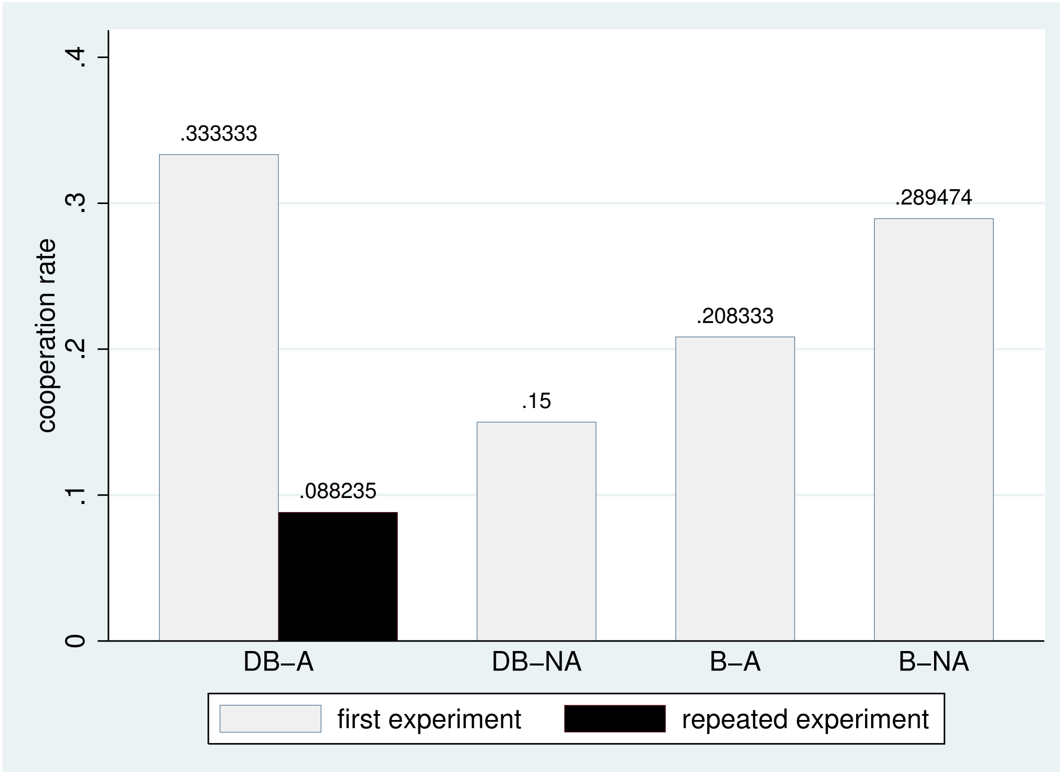

Figure 3: Cooperation rates in the first (n=48) and the repeated experiment (n=34) for the DB-A condition (other anonymity conditions from the first experiment, cf. figure 2) DB-A=double blind, anonymous; DB-NA=double blind, anonymous; B-A=blind, anonymous; B-NA=blind, not anonymous

From the first to the repeated experiment about three months later the cooperation rate fell from 33.3% to 8.8%. This difference is significant (binomial test $p < 0.01$). It shows that this laboratory measurement of cooperation by the marginal totals is not reliable (, and therefore not valid). In addition, in the repeated experiment the cooperation rate reached the point that was expected already for the first experiment.

The above presented confusion hypothesis gives a possible explanation for this result: With increasing anonymity cooperation rates decrease because subjects do not feel observed and socially controlled. However, in the experiment with the double blind and anonymous treatment subjects did not believe in the anonymity procedure the first time because they were confused by its complexity. This changed in the repeated experiment. After having experienced no social control by anybody in this experimental condition, subjects acted rationally in the repeated experiment with a behavior that is close to the Nash equilibrium prediction.

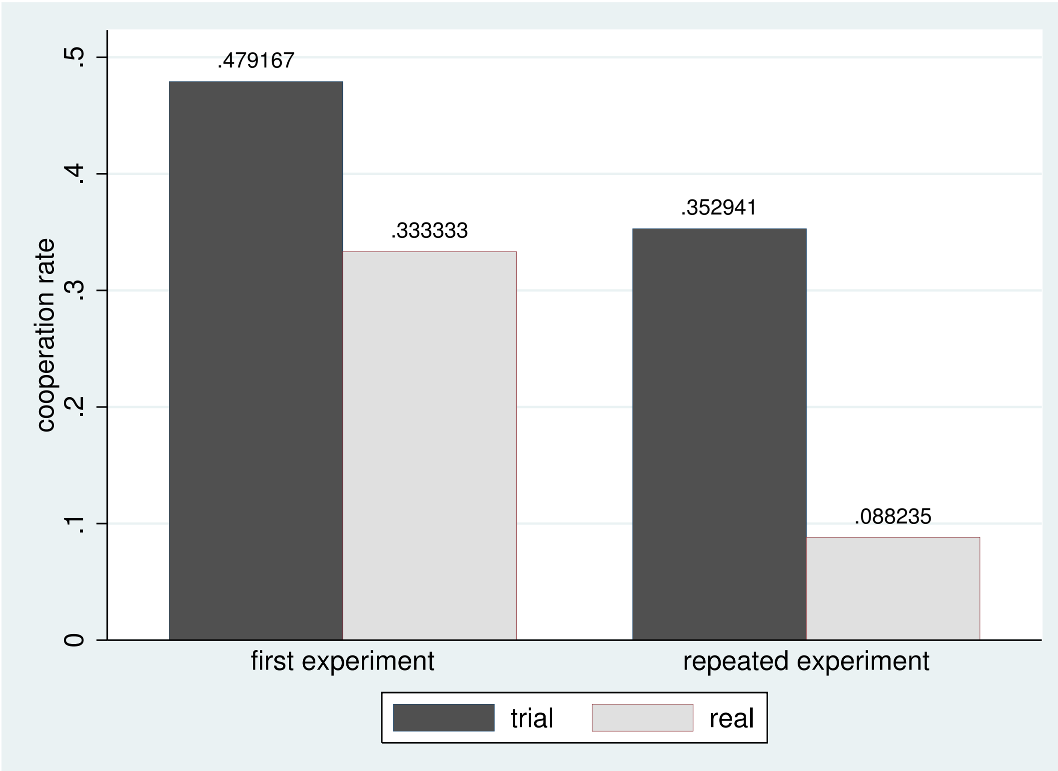

Figure 4: Cooperation rates in the trial and in the real decision for the first (n=48) and the repeated experiment (n=34)

4.3 Discussion of results

Above three reasons are given, why subjects do not choose the dominant strategy D in a prisoner's dilemma. First, they indeed do have pro-social preferences, and do expect that the other also are pro-social. This is the Behavioral Game Theory interpretation. It is falsified here because subjects at least do not have robust pro-social preferences. Second, subjects could have learned how to decide rational in the prisoner's dilemma. It is well known that subjects in *repeated decisions* (not experiments!), gradually learn to adapt rational behavior (for overviews cf. Ledyard 1995; Camerer 2003). Third, subjects could have learned that whole experiment was indeed anonymous, and that they were not socially controlled by anybody at any time. This is the confusion hypothesis that is favored here.

To confirm the confusion hypothesis, the second explanation that subjects learned the game must be excluded. Certainly, it does not seem plausible that subjects instantly learn rational behavior as soon as they take a second decision several months after the first one. But this learning hypothesis can also be tested. Though no decision was exactly repeated within one experiment, this was approximately the case for the trial decision at the computer screen and the real decision with monetary consequences. These two decisions were taken within minutes, and subjects could have learned to act rationally from the trial decision to the real one. Figure 4 reports the cooperation rates for the trial and for the real decisions in the double blind and anonymous condition for both experiments.

Indeed, cooperation rates decrease from the first trial decision (47.9%) to the first real decision (33.3%, n=48). There is a similar reduction of the corresponding values in the repeated experiment from 35.3% to 8.8% (n=34). Therefore, the learning effect that happened within minutes is distinguishable from the effect of repetition that happened within months. The difference in difference-estimator (Meyer 1995) amounts to 11.9% and shows that the effect of repetition is substantial, and stronger than the learning effect.

Still, the significant reduction in cooperation rates could be due to an unnoticed historical effect between the first and the repeated experiment. However, if this was true, this again would amplify the doubts about the robustness of laboratory experiments. Because such historical effects could always happen unnoticed with any other economic laboratory experiment.[13]

Only 34 of the 48 subjects from the first experiment took also part in the repeated one. So, it is possible that the reduction of cooperation was due to a systematic self-selection of the reinvited subjects. Due to the double blind procedure it could not be asserted how the individual subjects behaved in the first and in the repeated experiment (this was exactly what was intended). So, as Guillen and Veszteg (2009) found, only successful subjects from the first experiment may have taken part in the repeated one, while unsuccessful subjects may have abstained from a further participation. Indeed, the figures show that if *all* of these 14 (=48 - 34) absent subjects had been cooperative, the cooperation rate would have stayed about the same namely $\frac{3+14}{48} = 35.4\%$. However, if such strong self-selection effects of the subjects should happen in laboratory experiments, this would even cast more doubt on its reliability. Results from laboratory experiments then would strongly be determined by (self)selection of the subjects. Indeed, some further results (Eckel and Grossman 2000; Harrison et al. 2005, Rosenthal and Rosnow 2009[1969]) show that there are such effects. But mainly, the problem of self-selection of subjects in laboratory experiments is not yet studied.

All in all, marginal totals from laboratory experiments seem to be very sensitive to slight changes of the anonymity setting of the entire experiment, including assem-

[13]Besides, this would not only be true for laboratory experiments, but for any other empirical method whose reliability has been confirmed with the test-retest check.

bling and payment procedure. These slight changes may go unnoticed and therefore uncontrolled by the experimenters. In addition, this may not only be true for different experiments in one laboratory, but also for different laboratories. Invariable factors like building conditions, laboratory staff or the like might influence the perceived anonymity of the respective subjects. Therefore, marginal totals from experiments are prone to manifold biases. As mentioned in the introduction, this is textbook knowledge. And it does not disqualify laboratory experiments as a useful tool of social research. Yet, the interpretation of experimental results should focus on the causal interpretation of the experimentally varied stimulus.

5 Summary and outlook

A one-shot prisoners dilemma was played in a laboratory experiment with $2 \times 2 = 4$ different anonymity treatments. Particularly, in one condition the assembling procedure of the subjects was manipulated in such a way that subjects who interacted in the experiment never saw each other. In the other condition the payment procedure was manipulated in such a way that the experimenters never learned about the decisions of individual subjects, i.e. the experiment was carried out double blind. The aim of the combination of these two conditions was to gradually remove feelings of social control (by other subjects or by the experimenters) from the subjects. All four treatments fulfilled the perfect stranger condition which is the strongest anonymity condition normally used in laboratory experiments. So, if there should be any effect of these anonymity treatments on the cooperation rates, such effects could happen and go unnoticed in any other one-shot prisoner's dilemma, too. Indeed, the cooperation rates decreased with increasing anonymity from 29% to 15%. But surprisingly the treatment with the highest anonymity, namely a double blind and anonymous setting, caused the highest cooperation rate of 33.3%. It is assumed that this was due to the complexity of the double blind treatment. Instead of making the subjects feel anonymous, it rather confused them when they experienced it first. In a test-retest design, the entire experiment with the double blind and anonymous treatment and with the same subjects (n=34) was repeated about three months later. In the repeated experiment the cooperation rate fell significantly from 33.3% to 8.8%. This wide range of cooperation rates happens within what in standard experimental terms would be one simple experiment with perfect stranger anonymity. This casts severe doubt on the reliability of the marginal totals in laboratory experiments. Obviously, in accordance to text book interpretation, but in contrast to a very often used interpretation (i.e. Henrich et al. 2004, Roth et al. 1991; Fehr 2009; Camerer 2003), marginal totals in laboratory experiments should not be interpreted. This is especially true for cooperation experiments that are particularly prone to effects of social desirability. May be, marginal totals of non-reactive experimental designs like field experiments can be interpreted (Levitt and List 2009). But this questions also awaits research.

This points to the fact that more methodological research on laboratory experiment is necessary. Nothing is, for instance known about the reliability of treatment effects. Theoretically treatment effects could also be prone to reactivity, as are the marginal totals. For example Hermann et al. (2008) replicated the experiment of Fehr and Gächter (2002) on the effect of punishment on cooperation and showed that treatment effects are not necessarily robust in all circumstances. Hermann et al. (2008) attribute their differing results to different cultural backgrounds of the explored population. But it is also possible to interpret the differing results as (partly) methodological biases.

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