# Do People Punish And Reward Less When The Outcomes Are Risky?

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**EXTENDED ABSTRACT**

We conduct a prisoner's dilemma experiment with risky and non-risky punishment/reward stages. We find that subjects do not change their behavior in the face of risky outcomes. Additionally, we measure risk attitude of subjects. We find that individual risk aversion has no effect on the decision to punish or reward. This is good news for lab experiments which abstract from risky outcomes. From the perspective of social preferences, our results provide evidence for risk neutral inclusion of other player's payoffs in the decision-maker's utility function.

## INTRODUCTION

Suppose two researches are working on a joint project. Both can work hard or free-ride on the work of the other researcher. For a certain set of outcomes, they are stuck in a prisoner's dilemma. The researchers are aware that their action will eventually be revealed to their co-author, so that the opportunity for punishment or reward arises. What could a reward look like? For example, one could reward the other by drafting an excellent letter of recommendation. Punishment could take the form of stopping all further cooperation. However, it is unclear what effect the reward and punishment will have on the co-author. If the punished researcher has plenty of other potential co-authors, losing one might not be so harsh, but if the number of potential co-authors is small, losing one will hurt a lot. Similarly, a letter of recommendation can be the decisive advantage in a close race for a job or to obtain tenure or be almost meaningless if other factors already decided the outcome. Since the person who punishes or rewards does not necessarily know the situation the other is in, the decision to punish or reward is made under risk. We conduct an experiment to test whether more risk in the punishment and reward outcomes influences the decision whether to punish/reward or not.

Social dilemma situations like the prisoner's dilemma have been extensively studied in the economics literature for a long time (see Roth (1988) for an overview). Fehr and Gächter (2000) show that the incentive to defect in a social dilemma can be counteracted by introducing a second stage which allows for a punishment. Despite the punishment being costly, many subjects use that opportunity to deter defection. Initially, the effect on cooperation is small, but the contributions to a public project increase over time in a repeated game. A considerable amount of literature follows this paper and extends the result to non-pecuniary sanctions (Masclet et al. (2003); Noussair and Tucker (2005)) and explores the effectiveness of punishment (Nikiforakis and Normann (2005)) as well as the price of punishment (Anderson and Putterman (2006), Carpenter (2005)). These experiments (and all other experiments that we are aware of) abstract from reality by modeling the second stage without risk. Yet subjects are, in general, not risk-neutral (Cox et al. (1988), Holt and Laury (2002) and many others). That is, the different risk structure present in the lab experiments could potentially lead to outcomes which are different from behavior in the real world. Our treatments Risk and Baseline address this issue. We test the hypothesis that *more risk-averse subjects punish/reward less in the presence of more risky outcomes*. While the expected punishment and reward is the same in both cases, the result of punishment and reward is risky in the Risk treatment, whereas no risk is present in the Baseline. Baseline thus resembles previous experimental studies; Risk connects them to the outside-the-lab world. We find that the decisions to punish and reward are not statistically significantly different in the two treatments. We conclude that the added risk does not change subjects' behavior.

Subjects' risk attitude is elicited at an individual level, allowing us to test whether subjects who are more risk-averse use less punishment or reward in the Risk treatment compared to those subjects who are risk-loving. Again, we find no evidence for an influence of risk: the risk-averse subjects punish and reward just as much as the risk-loving ones do.

Our research also contributes to the discussion on other-regarding behavior. In particular, the experiment sheds light on the way the payoff of other players enter one's own utility function. One of the earliest proposed theories of social preferences is Andreoni's (1990) warm glow. Our results on risk are in line with this theory where the utility from giving to others is derived from the act of giving itself. Risk that affects the payoff of the other player would be disregarded. For theories which incorporate the payoff of others directly (Levine (1998), Fehr and Schmidt (1999), Bolton and Ockenfels (2000)), our results say that risk for the other person is ignored by subjects, even if they are risk-averse. That is, the term describing the other player's payoff enters the utility function of risk-averse subjects in a risk-neutral way.

Next we present the experimental setup and our results, followed by a short discussion. Instructions can be found in the appendix.

## 1. EXPERIMENTAL SETUP

Our experiment was conducted as a classroom experiment at the University of Heidelberg in November 2006. It was run manually under single blind social distance protocol. All treatments took place during one session that lasted approximately an hour. It included the initial instructional period but not the payment of subjects. The subjects were paid their experimental earnings during the break after the lecture that followed the experiment. A total of 125 undergraduates, with economics as primary or secondary field, participated in our two treatments – Baseline and Risk. The students were in the first weeks of their studies, without previous exposure to experimental economics or game theory.

The experiment consists of three parts: In parts 1 and 2 the prisoner's dilemma with subsequent punishment/reward stage which includes the treatment difference is played; part 3 consists of risk elicitation using Holt and Laury (2002) method. At the end subjects fill out a general questionnaire.

### 1.1. Prisoner's Dilemma with punishment and reward stage

In parts 1 and 2 of the experiments, subjects are grouped in anonymous pairs and simultaneously play a one-shot prisoner's dilemma. The game payoffs are presented in Table 1. The row player chooses Top (cooperation) or Bottom (defection), while the column player chooses Left (cooperation) or Right (defection). Payoffs are denoted in euros. After being notified of the results of the prisoner's dilemma, subjects could engage in costly punishment or reward of their partner.

| | Left | Right |
|---|---|---|
| Top | 8,8 | 0,10 |
| Bottom | 10,0 | 2,2 |

**Table 1:** Prisoner's dilemma payoffs

Subjects with a partner who cooperated (i.e., who chose Top, respectively Left) could only decide whether to reward, subjects with a partner who did not cooperate (i.e., who chose Bottom, respectively Right) could either reward or punish.[1] Subjects could punish/reward by spending between zero and five euros (only whole euro amounts) on assigning punishment or reward points. In our Baseline treatment, each assigned point decreases/increases the other player's payoff by one euro with certainty. In the Risk treatment, each assigned point decreases/increases the other player's payoff by two euros. However, the punishment/reward is only carried out with a probability of 0.5. Therefore, the *expected* punishment/reward is the same in both treatments. Note that the costs of assigning a point are incurred by the subject irrespective of the outcome of the probability draw.

In the classical solution for self-regarding preferences, no punishment/reward will ever be observed because it is costly, and players will always choose defect in both Baseline and Risk treatments.

### 1.2. Risk attitude elicitation

In part 3 of the experiments we use the Holt and Laury (2002) method to measure our subjects' risk attitudes. That is, subjects are repeatedly offered a choice between two lotteries, one involving higher risk than the other. From the subjects' choices between ten lottery pairs it is possible to calculate their individual risk aversion parameter. For further details, see Holt and Laury (2002).

### 1.3. Procedures

The sequence of events in a session was the following. (i) Upon entering the lecture hall subjects were randomly seated in one of the four designated rows. Once these rows were filled up the additional subjects were seated into next four rows. Subjects of the same type for a given treatment (e.g., column player in the Risk treatment) were sitting in the same row. (ii) The neutrally framed instructions (in German) and decision forms for part 1 and 2 were handed out. All sheets indicated subjects' ID number. (iii) The subjects made their decisions for part 1. (iv) The experimenters collected the decisions forms, transferred the decision information to their counterparts' decision forms and returned them to subjects. This prevented the exchange of superfluous information and aided in maintaining the anonymity of individual decisions. (v) After learning the decision of the paired player the subjects made their decisions regarding rewards and punishment on the decision form 2. (vi) The experimenters collected the decision sheets for parts 1 and 2.

(vii) The instructions, decision forms for part 3 and general questionnaires were handed out, filled out by subjects, and collected by the experimenters, one at a time. Subjects were informed beforehand that there would be additional individual tasks after the prisoner's dilemma game with reward/punishment, but not about the nature of these tasks. (vii) At the end of the session the experimenters randomly selected 20 subjects (10 prisoner's dilemma pairs) for payment for parts 1 through 3 and additional 20 subjects for part 4 (selected without replacement). (viii) Lecture continued. (ix) After the lecture the randomly selected subjects were paid privately in cash. Each subject selected for payment for the first two parts received the following amount: an endowment of 5 Euro plus the earnings in the prisoner's dilemma plus/minus the reward/punishment minus the reward/punishment costs. Each subject selected for

[1] We chose to disallow punishment of cooperators to prevent subjects from making losses in the overall experiment.

payment for part 3 was paid for one randomly chosen lottery from the risk attitude questionnaire. All risky decisions and lotteries were resolved by flipping a coin/rolling a 10-sided die in front of the subjects at the time of payment.[2]

## 2. RESULTS

In our Baseline treatment, almost half of the subjects chose to defect on their partner in the prisoner's dilemma situation. The fraction of subjects who defected is smaller when the subsequent punishment/reward stage involves risky outcomes (see Table 2). However, this difference is not statistically significant.[3] Similarly, we find no significant difference in the level of punishment or rewards between the two treatments when looking at aggregated levels.

| PD Choices / Treatment | Cooperate | Defect |
|---|---|---|
| Baseline | 32 (51.61%) | 30 (48.39%) |
| Risk | 39 (61.9%) | 24 (38.1%) |

**Table 2:** Prisoner's dilemma choices

At the same time, we think it is more informative to look at subjects who are found to be in the same *situation* in both treatments. When asked whether to punish a defector, subjects who cooperated might decide differently from those who defected themselves. To address this issue, we split the data according to all four possible situations: Having played cooperation while the partner cooperated as well (Cooperation vs. Cooperator), having played cooperation while the partner defected (Cooperation vs. Defector) and similarly for subjects who played defection against the partner who cooperated (Defection vs. Cooperator) or defected (Defection vs. Defector). Comparing subjects in the same situation across treatments shows no significant difference in the punishment/reward with a Mann-Whitney test at a 0.05 significance level.

| Mean / Treatment | Punishment | Reward |
|---|---|---|
| Baseline | -.4412 (1.35) | 1.3258 (1.66) |
| Risk | -.5476 (1.29) | 1.0118 (1.59) |

**Table 3:** Mean Punishment and Reward

Our hypothesis asserts that subjects with higher risk aversion should punish and reward less in the treatment where the outcomes of the punishment/reward decision are risky. We use the risk attitude measures from the third part of our experiment. Using the Holt and Laury method, the risk attitude is determined by the number of safe choices made while choosing between the safe and risky lottery. Never choosing the safe lottery (zero safe choices) corresponds to extremely risk-loving subjects. The higher the number of safe choices, the more risk-averse the subject is. Risk neutrality corresponds to choosing the safe lottery exactly four times.[4]

The distribution of safe choices is shown in Figure 1. A Kolmogorov-Smirnov Z-test confirms that the random allocation of subjects to treatments yielded two subject groups with similar distributions of risk attitude (Kolmogorov-Smirnov Z of 0.694, two-tailed). Overall, our subjects show considerable amount of risk aversion, while almost none are risk-loving.

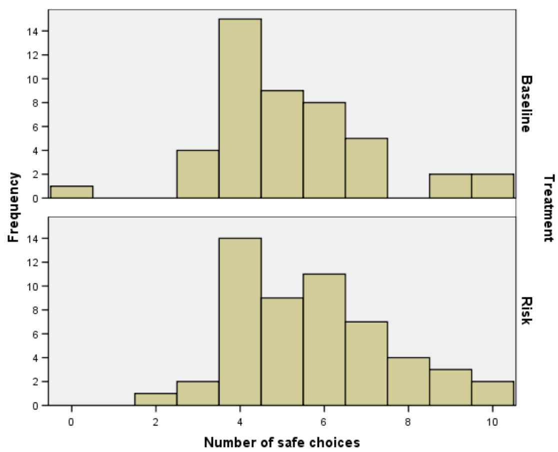


**Figure 1:** Risk attitudes

[2] A potential criticism is that because of random payment, all subjects are making decisions under risk, not just those in the Risk treatment. However, even with random payment, there is *more* risk in the Risk treatment compared to Baseline, thus Hypothesis 1 can be tested. An additional advantage of having random payments is that subject's answers in the risk aversion questionnaire are less likely to be influenced by their achievements in parts 1 and 2.

[3] We conduct a two-sample test of proportions (Sincich, 1987) yielding a p-value of 0.2455 for the two-sided test.

[4] Definite statements about the risk attitude are only possible if the choices are monotonously ordered, that is when there is one lottery such that the subject always chooses the safe lottery for lower ranked lottery pairs and the more risky lottery for higher ranked lottery pairs. 79.5% of our subject displays such monotonous choice behavior; we only use these subjects when making statements about risk attitudes.

To test the research hypothesis, we compare the mean value of punishment and reward points for each group of risk attitude. Zero points mean that neither a punishment nor a reward was chosen. Subjects could not reward and punish at the same time. Contrary to the hypothesis, we do not find a lower mean value of punishment and reward among the risk-averse subjects in the Risk treatment than in the Baseline. This finding is also supported by the insignificant correlation between the number of safe choices in the Risk treatment and the punishment and reward points (Spearman correlation coefficient of 0.084 with a one-tailed significance level of 0.275). For the hypothesis to be true this correlation would have to be negative and significant.

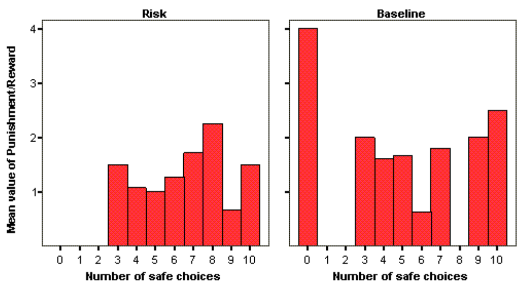


**Figure 2:** Mean value of punishment/reward

We also run a Tobit regression including the variables gathered by our questionnaires. The results show no significant effect of the number of safe choices on subjects' punishment/reward decision. We find a strong influence of the fact whether cooperating subjects played against other cooperators or defectors.

Furthermore, we find no significant difference between the overall mean value of punishment and reward points between our two treatments using a Mann-Whitney test (two-tailed significance level of 0.486). Thus we conclude that the hypothesis is rejected by our data and that more risk does not lead to lower punishment and reward among risk-averse subjects.

## 3. DISCUSSION

We conduct an experiment to test the influence of risk on the punishment and reward behavior of subjects. We find no evidence that risk is a factor in that decision. There are several potential explanations for our findings.

Another explanation is given by Andreoni's (1990) theory of warm glow (and a possible theory of "cold glow" for punishment). His theory states that the utility of the rewarding person (punisher) from influencing her partner's payoff is solely derived from the fact that she gives up some of her own assets and not from the fact that something arrives at (is taken away from) her partner's assets. Recall that in our setup, the risk influences the arrival, but not what is given up by the decision maker, to see that the warm glow is supported by the experimental data.

Our subjects might also derive their own utility from affecting the *utility* of the other person and might see the risk as being incorporated into the partner's utility. Combined with a belief of risk neutrality about the other person, this would also take away any difference between our treatments. Lastly, punishing and rewarding demands the complex capability of being able to empathize with the other person, to guess what the other person will feel in different situations. To be able to do so is a non-trivial accomplishment for the human brain. If the brain is only able to perform a certain number of tasks at a time, the use of this complex mechanism might crowd out other mechanisms, like the one used to assess risk. Subjects might only take the simple, risk neutral, average outcome into account because their brain is busy empathizing.

The fact that we find no influence of risk on punishment and reward decisions increases the external validity of the experiments which are using certain punishment or reward. The risk structure of real world decisions often differs in that aspect, but our findings suggest that this might not be of importance when drawing conclusions from those experiments towards other settings.

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