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Erte Xiao
University of Pennsylvania, exiao@andrew.cmu.edu

Daniel Houser
George Mason University

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ERTE XIAO[1] DANIEL HOUSER[2]

[1]PROGRAM IN PHILOSOPHY, POLITICS AND ECONOMICS & WHARTON SCHOOL
UNIVERSITY OF PENNSYLVANIA
EXIAO@SAS.UPENN.EDU

[2]INTERDISCIPLINARY CENTER FOR ECONOMIC SCIENCE & ECONOMICS DEPARTMENT
GEORGE MASON UNIVERSITY
DHOUSER@GMU.EDU

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Abstract: Convergent evidence for detrimental effects of punishment on cooperation has been obtained in a wide variety of environments, ranging from American students facing punishment in laboratory experiments, to Israeli parents facing fines for arriving late to their child's day care. We show here that enhancing the norm salience role of punishment can eliminate its detrimental effects. In a public goods game, privately implemented punishment reduces cooperation in relation to a baseline treatment without punishment. However, when that *same incentive* is implemented publicly, but anonymously to avoid shame, cooperation is sustained at significantly higher rates than in both baseline and private punishment treatments. Our data provide evidence that publicly implemented punishment enhances the salience of the violated social norm to both the punished and those who observe punishment, and that this increased norm salience promotes group members' norm obedience. Our findings have important efficiency implications for the design of mechanisms intended to deter misconduct.

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I. Introduction

Punishment is widely used to enforce cooperation in social and economic exchange (see, e.g. Andreoni, et. al., 2003; Fehr and Fischbacher, 2004; Fehr and Gächter, 2000; Fowler, 2005; Ostrom, et. al., 1992; Sefton, et. al., 2002; Xiao and Houser, 2005;Yamagishi, 1988). When punishment is sufficiently severe, so that it overwhelms the expected benefit of defection, opportunistic behavior can be prevented. However, as a practical matter, severe punishment usually requires costly monitoring and can be extremely time-consuming to implement[1]. Consequently, many naturally occurring punishments are weak in the sense that the expected cost of a violation is less than its expected benefit.

At the same time, recent prominent results in economics and psychology make clear that weak incentives can have detrimental effects on cooperation. Convergent evidence for such effects have been obtained in a variety of environments, ranging from students in experiments (see, e.g., Fehr and Rockenbach, 2003; Fehr and Falk, 2002; Frey and Felix, 1997; Gneezy and Rustichini, 2000a, Houser et. al., 2006), to Israeli parents facing small fines for arriving late to their child's day care (Gneezy and Rustichini, 2000b). Using experiments with human participants, we here show that detrimental effects of weak punishment can be eliminated by implementing punishment publicly.

With the important exception of violent crimes, incentives designed to deter misconduct are often weak, and in some cases seemingly necessarily so. A frequently cited example is copyright enforcement. Historically, it has been very hard and extremely costly to detect noncompliance of copyright, while potential profits to a violator can be quite large (see, e.g., Tyler, 1997). Advances in technology ease detection of some forms

[1] A mechanism based exclusively on severe sanctions would also suffer from an absence of marginal deterrence for serious crimes (see e.g., Stigler, 1970).

of copyright violation (especially passages lifted from copyrighted books), but also provide new ways to appropriate others' intellectual property. International film and software piracy are ready examples[2], and seem limited only by the fact that excessive competition drives piracy profits to zero. Another technology-driven example is online auction fraud, the explosion of which is a particular worry for internet intermediaries like eBay (see, e.g., Houser and Wooders, 2006).

For our purposes it is interesting to note that in cases such as these a significant part of the enforcement strategy involves publicly implementing weak incentives. For example, Microsoft prominently displays recent cases of software piracy and the type of lawsuit filed (see http://www.microsoft.com/ piracy/partners/alerts). Similarly, and in addition to their publicly observable feedback pages, eBay has launched an entire program (VeRO, http://pages.ebay.com/ help/tp/programs-vero-ov.html), in which public punishment plays a prominent role, to promote buyer and seller trust.

Publicly and privately implemented punishment can have different effects because norms direct behavior more effectively when they are more salient (see, e.g. Berkowitz, 1972; Cialdini et al, 1990). Scholars in law and economics have argued that one important function of punishment is to express norms (see, e.g., Cooter, 1998; Sunstein, 1996; Tyran and Feld, 2006). Public implementation expresses the relevant norm not only to those who receive punishment but also to observers, thereby increasing the salience of the norm. Thus, we hypothesize that publicly implemented punishment is more effective in enforcing norm obedience than its privately implemented counterpart.

[2] The Business Software Alliance trade group pegged international losses due to software piracy in 2004 at more than $29 billion (see, http://news.com.com/Software+piracy+Hype+versus+reality/2008-1001_3-5291273.html), and suggests that more than 1/3 of all installed software is counterfeit.

Supporting our hypothesis, we show that, in a public goods game, privately implemented weak punishment reduces cooperation in relation to a baseline treatment without punishment. However, when that *same incentive* is implemented publicly, but anonymously, cooperation is sustained at economically and statistically significantly higher rates than in both the baseline and private punishment treatments.

We take care to ensure clean inferences regarding norm salience effects of interest. For example, publicly implemented punishments can shame punishees (see, e.g., Rush, 1954; Smith, et. al., 2002), and while shame effects have been heavily studied they remain controversial (see, e.g. Braithwaite, 1989; Elster, 1999; Lewis, 1971; Posner, 2000; Whitman, 1998). Many public punishment systems in the naturally occurring world attempt to avoid shame by announcing a punishment, but maintaining the anonymity of the person who received the punishment (see. e.g., Trevino and Ball, 1992). In our experiment we avoid shame by following exactly this strategy.

Moreover, if the severity and likelihood of punishment are not common information, then public implementation could provide relatively more information about the nature of punishment. We control this by ensuring that each of the punishment mechanisms we consider provides identical information, thus ruling out learning as an explanation for our results. Finally, to avoid potential signaling confounds, we use exogenous rather than peer-to-peer punishment.

II. Detrimental Effects of Punishment

Festinger (1957) was first to posit cognitive dissonance theory and the crowding out effect of incentives. According to Festinger, people avoid dissonance by maintaining beliefs that are consistent with their behavior. Thus, absent external incentives people understand their behavior as a function of their internal drives. However, when an external incentive is present it can become their salient behavioral justification. In principle, this can crowd out internal motivations for desirable conduct (see also, e.g. Deci, Koestner and Ryan, 1999; Lepper and Greene, 1978).

Applying Festinger (1957) to a normative environment implies that, in the absence of external incentives, people make decisions within an ethical context. On the other hand, when a punishment threat exists people make decisions based on that incentive. Thus, if a punishment's cost exceeds the benefit of defection, people will cooperate in order to avoid punishment. If punishment is weak, then defection is predicted.

Substantial recent research supports this prediction and finds that incentives can reduce cooperation (e.g. Kreps, 1997; Frey and Oberholzer-Gee, 1997; Frey and Jegen, 2001; Benabou and Tirole, 2003; Fehr and Falk, 2002; Tenbrunsel and Messick, 1999). Gneezy and Rustichini (2000b), for example, found that the number of late-coming parents increased when a small fine was levied on those who arrived late to their child's day care. Analogous results are found in the laboratory. Houser, et. al. (2006) extend Fehr and Rockenbach (2003) and show that punishments in a trust game can lead to more income-maximizing decisions regardless of whether punishments are imposed by investors intentionally or randomly by nature. When punishment is weak, more trustees return zero to investors than when there is no punishment.[3]

[3] Bohnet, Frey and Huck (2001) investigate a dynamic environment where reducing punishment crowds-in norm-based behaviors. Loosely speaking, the reason is that in weak-punishment environments people will not enter imperfectly enforceable contracts with counterparts who do not have sufficiently strong reputations for honesty. Thus, each agent in this environment has an incentive to develop a reputation for honesty and in this way maximize profits. Note that the detrimental effect we discuss stems from profit maximizing motivations crowding-out norm-based motivations. In Bohent, Frey and Huck (2001), crowding-in occurs for a similar reason: people desire to obtain contracts and maximize profits.

III. Publicly Implemented Punishment and Norm Salience

Economic research on norms and behavior is beginning to emerge (see, e.g., Fehr and Fischbacher, 2004), and research in law and economics specifically argues that norm expression is an important function of punishment (see, e.g. Kahan, 1998, Cooter, 1998; Sunstein, 1996; Tyran and Feld, 2006). This function is important because even a strong personal commitment to a norm does not predict behavior if that norm is not "activated", or a focus of attention (Bicchieri, 2006). Of course, economists have long argued that attention is a scarce resource (see, e.g. Simon, 1971) and that the allocation of attention can significantly impact decisions (e.g., Gabaix et al., 2006). Norm-activation provides a new perspective on the importance of attention in economic decision making.

The role of norm activation in directing behavior has been heavily researched by psychologists. For example, drawing from Collins and Loftus' (1975) theory of semantic memory, Harvey and Enzle (1981) proposed a cognitive model of social norms and norm-directed behavior. Important for our purposes is that their model predicts cooperative (helping) behavior is more likely after observing a transgression. The reason is that observing a transgression activates a relevant cooperation norm.

Another important result on norm-directed behavior was obtained by Cialdini et al., (1990). They report data from field experiments used to study propensities to litter in public areas. They hypothesized that focusing people on the "injunctive" norm (i.e., that one ought not to litter) should decrease littering. To test this, the experimenters tucked handbills with different messages under the driver's side windshield wipers of cars in a community library parking lot. The messages included normative content, but they drew different degrees of attention to the no-littering norm. Supporting their hypothesis, they found that subjects littered less when the message was more related to the no-littering norm (e.g., “April is Keep Arizona Beautiful Month. Please Do Not Litter”) than when the message was less related (e.g., “April is Arizona’s Fine Arts Month. Please Visit Your Local Art Museum”).

Overall, previous research suggests that public implementation can increase norm obedience because norms are more salient when punishment is observed more often. Naturally, whenever punishment is used both crowding-out and norm salience can affect behavior, and empirical studies provide evidence on conditions under which different effects direct decisions. This paper takes an initial step in that direction by experimentally investigating the hypothesis that, because of norm salience effects, weak sanctions promote cooperation more effectively when they are publicly implemented.

IV. Design of Experiment

IV.A. Overview

We report data from novel public goods games. These games are popular for punishment studies because they reflect social dilemma situations often faced by companies and communities (see, e.g., Ledyard, 1995; Anderson and Putterman, 2006; Bochet, Page, and Putterman, 2006; Carpenter, forthcoming; Dickinson, 2001; Masclet, et. al., 2003; Sefton, et. al., 2002). Our experiments consist of a baseline treatment without punishment, as well as one private and one public punishment treatment. In each treatment, subjects play a game for 30 rounds in groups of four. The groups remain fixed for the entire 30 rounds, and subjects know this is the case. We use a “partners” design because repeated interaction is a common feature of naturally occurring environments (e.g., businesses or collectives) in which punishment often occurs.[4]

To provide clean evidence on the role of norm salience, we use exogenous punishment in order to eliminate signaling associated with endogenous sanctions[5]. Specifically, in all punishment treatments subjects are informed that each round has a 50% chance of being monitored, and that if the round is monitored then that round's lowest contributor will incur a small sanction. An advantage to keeping the punishment structure under the experimenters' control is that it allows for the monitored rounds and the severity of punishment to be kept fixed through both treatments. This ensures that we can draw clean inference regarding the effect of public, as compared to private, implementation of punishment.

It is worth emphasizing that the economic incentives between public and private treatments are identical. The only difference between these treatments is that in the public case all members of a group are told when a round is monitored, as well as the amount (possibly zero) of the resulting punishment. When punishment is private, only the punished subject knows that information. There are no other differences in subjects' information between treatments (see section IV.E below for discussion). The critical implication of our design's different message structures is that all subjects in the public punishment treatment are reminded 15 times during the course of the game that lowest contributors are punished, while subjects in the private treatment are only reminded of this if they happen to be punished. The median number of such reminders is three.

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[4] Whether our results extend to "strangers" designs is an open question. Previous research finds differences in outcomes between partners and strangers public goods games (e.g., Fehr and Gächter, 2000).
[5]Endogenous punishment can differ from exogenous punishment in many ways. The act of choosing punishment itself might affect individuals' cooperation. Endogenous punishment might also be relatively more effective at conveying a cooperation norm (e.g., Tyran and Feld, 2006).

In order to focus on norm salience effects, our design mitigates possible influences from shame by ensuring subjects remain anonymous. In addition, subjects are given full information about both the likelihood of punishment and the way punishment amounts are determined. As a result, our experiment design provides little room for subjects to learn about these factors.

IV.B. Baseline Treatment

Each round t each subject i is given y experimental dollars (E$) and chooses, simultaneously with other subjects, the amount to invest in the group account g_{it} and the amount to keep in his/her individual account. Each E$ kept is worth one E$, and each E$ invested in the group account yields $\alpha < 1$ E$ to each group member. In a group of n subjects, the payoff π_{it} for each subject i in round t is therefore given by:

$$\pi_{it} = y - g_{it} + \alpha \sum_{j=1}^{n} g_{jt} \,, \qquad 0 < \alpha < 1 < n\alpha \tag{1}$$

It is easy to see from backwards induction in this finite-round game that, if individuals are selfish, the subgame-perfect equilibrium requires each subject to contribute zero to the group account each round. This follows from $\partial \pi_{it} / \partial g_{it} = -1 + \alpha < 0$. However, the restriction $1 < n\alpha$ ensures $\partial \sum_{i=1}^{n} \pi_{it} / \partial g_{it} = -1 + n\alpha > 0$, so that the aggregate group payoff $\sum_{i=1}^{n} \pi_{it}$ is maximized if every subject contributes everything to the public good. In our experiment, $\alpha = 0.5, n = 4$ and $y = 10$.

IV.C. Punishment Mechanism

As noted above, in both punishment treatments each round is monitored with 50% probability. When a round is monitored, the earnings of the lowest group account investor are reduced. The amount of the reduction is not distributed to the other group members, and other group members bear no cost for any punishment. If there are multiple lowest contributors, then one of them is randomly selected to be punished and the others receive no sanction. If everyone contributes the entire endowment, there is no punishment when the round is monitored.

The magnitude of punishment depends on the difference between the punished subject's group account investment and the average group account investment of her/his group members. When punished, a subject's payoff will be deducted by $D\%$, where D is given by:

$$D = d \cdot (\overline{g_{it}} - g_{it}), \text{ where } \overline{g_{it}} = \sum_{j \neq i} g_{jt} / (n-1) \qquad (2)$$

Note the amount of the punishment becomes larger as the difference becomes larger, and the rate of increase is determined by the positive constant d. Note also that, because punishment occurs only to a lowest contributor, D is necessarily non-negative.

In our experiment we set d to unity.[6] So, for example, the maximum sanction occurs when a subject makes a zero contribution in a monitored round and all others contribute 10E$, and this results in a 10% reduction in that lowest contributor's round's

[6]Fehr and Gächter (2000) find that cooperation is promoted by peer-to-peer punishment opportunities. They also find that individuals are punished more if their contributions deviate more from the average of others' contributions, as in our equation (2). They use an endowment of 20, while we use an endowment of 10. The data they report imply that a subject who contributes 15 E$s (75% of the endowment) less than other subjects has their earnings cut by 70% on average; if the difference is 10 E$s (50% of the endowment) then the expected cut is 50%; a six E$ difference (30%) leads to an expected 30% earnings cut; and a two E$ difference (10% of endowment) to a 10% expected earnings cut. Consequently, our punishment mechanism matches their data well if d=10. Our use of d=1 means that our subjects faced a punishment only 10% as severe as Fehr and Gächter's (2000) subjects.

earnings. Our design’s sanctions are weak, in the sense that standard theory based on self-interested per-round earnings maximizers implies that the subgame-perfect equilibrium is to contribute zero each round, just as in the baseline treatment.

To see this, note that if subject i is the sole lowest contributor to the group account, then his/her expected payoff is:

$$
\begin{aligned}
E(\pi_{it}) &= \frac{1}{2}\pi_{it}(1-D\%)+\frac{1}{2}\pi_{it} \\
&= (y-g_{it}+\alpha\sum_{j=1}^{n}g_{jt})-\frac{1}{2}(y-g_{it}+\alpha\sum_{j=1}^{n}g_{jt})\cdot d\cdot(\overline{g_{it}}-g_{it})\%
\end{aligned}
\tag{3}
$$

In our case with y =10, α =0.5 and d =1, it is trivial to verify that

$\partial E(\pi_{it})/\partial g_{it} = -0.45+0.01\overline{g_{it}}-0.005g_{it}$. Then, because both g_{it} and $\overline{g_{it}}$ lie between zero and 10, it follows that the derivative is strictly negative regardless of others’ or one’s own contributions. Consequently, subjects maximize expected per-round earnings by contributing zero to the group account. Moreover, because the probability of being punished decreases when there are multiple lowest contributors, it is immediate that in this case subjects also maximize expected earnings by contributing zero.

It is important to emphasize that the target norm enforced by this punishment mechanism is to contribute as much as other group members. Therefore, in relation to the private punishment treatment, the norm salience effect is predicted to increase the importance of one’s group members’ contributions on one’s own contribution decisions.

IV.D. Public and Private Punishment

In all punishment treatments subjects see a “Payoff Cut Information” box on their screen (see Appendix B). The message in that box, and only that message, differs between treatments. The details of the message in the "Payoff Cut Information" box are listed in Table 1. As described there, in the public treatment all members of a group are told when a round is monitored and the amount of the punishment. In contrast, only punished subjects know that there was monitoring and punishment in the private treatment. It follows that the public punishment treatment reinforces the salience of the cooperation norm to a substantially greater degree than occurs in the private punishment case[7].

Excepting these messages, the information available to subjects in the public and private punishment treatments is identical (as discussed in the next section). In particular, in all treatments (including the baseline) subjects know precisely how much each member of their group contributed to the public account, and consequently whether they were the lowest contributor. Anonymity is ensured, thus mitigating shame effects.

IV.E. Other Information

In both the baseline and the punishment treatments, subjects are informed that they will be in the same group for 30 rounds. The payoff function (1), along with the values of y and α, are common information. In the punishment treatments, all details regarding the punishment mechanism are common information.

In all treatments, subjects are shown all of their group members' contributions in the "Outcome of Round…" box on their decision screen. The instructions in Appendix A describe how to subjects accessed the information box. Appendix B is a subject's screen shot. Group members' contributions are listed from high to low and are not connected to a subject's number. Consequently, subjects cannot develop individual reputations.

[7] Public messages might reinforce the presence of non-cooperation. If so, this works against our hypothesis.

The "Outcome of Round…" box also includes information related to subjects' earnings, as well as the difference between their group account contribution and the average contribution of their other group members. It is worthwhile to emphasize that all the above information is provided in all treatments. Finally, in punishment treatments the box also indicates any punishment amount a subject might have received.

As the experiment proceeded, all information subjects received at the end of each round was preserved in a "History" box. Subjects were able to access previous rounds' decisions and results at any time. Subjects were reminded about the experiment's key features in a "Note" box that appeared on the bottom right-hand side of their screens.

IV.F. Procedures

72 subjects participated in our initial experiments with 24 subjects in each treatment (two sessions with 12 subjects each). All subjects were recruited from George Mason University's general undergraduate population, using standard recruiting procedures in place at the Interdisciplinary Center for Economic Science. Subjects earned a $5 show up bonus for arriving to the lab on time. Subjects earned E$ during the experiment, and at the end of the experiment E$ were exchanged for dollars at the rate of 20 E$ = $1. On average, subjects were in the lab for about 90 minutes and earned about $22 in addition to the show-up bonus.

Prior to the first round of each session, the 12 participants were randomly arranged into three groups of four and told they would be in the same group for the entire experiment. Subjects then read computerized instructions and answered embedded questions. The experiment started after all subjects successfully completed the instructions. At the beginning of each round group members received their endowment and made simultaneous investment decisions. Our specific procedures are detailed in the instructions reproduced in Appendix A.

V. Results

V.A. Cooperative Decisions by Groups in Baseline and Punishment Treatments

We here provide cogent evidence that, when privately implemented, the punishment described above has detrimental effects on cooperation. Moreover, we show that this same incentive promotes cooperation when it is implemented publicly.

Figure 1 details our contribution data by group and treatment. Each panel describes, for a particular treatment, the average contribution percentage of each group over the first, second and third ten round blocks. We aggregate the data in this way to ensure the charts remain legible. Figure 1 reveals that, in each treatment, different groups start at different contribution amounts and exhibit different patterns of cooperative decay. Between-group differences are interesting, and have been traced to individual differences in cooperative propensities by a variety of researchers (see, e.g., Kurzban and Houser, 2005; Ashley, et. al., 2005). However, pursuing the source of group differences in the present data is beyond the scope of this paper.

Panel (A) of Figure 1 describes decisions in the standard public goods game, and reflect usual findings. In the initial rounds groups contribute between 45 and 90 percent of the endowment to the public good, and the amount tends to decay over time. Panel (B) shows average contributions in the private punishment treatment, with initial round contributions are shifted lower than the baseline case, and all groups experiencing cooperative decay. Decisions by groups in the public punishment treatment are found in panel (C). In stark contrast to the other treatments, three groups sustain contribution at levels above 80% on average during the final rounds of the experiment, and only two groups contribute less than 50% on average in the last third of the experiment.

Figure 2 describes round-by-round overall mean contributions to the group account in the baseline and two punishment treatments. Data in the baseline treatment reflect typical findings (Ledyard, 1995). In particular, contributions begin around 2/3 of the endowment and decline to about 1/3 by round 30. Also, subjects knew the game included exactly 30 rounds, and there is an apparent end-game effect across treatments.

Cooperation in the two punishment treatments provides approximate bounds for baseline levels of cooperation. In the private punishment treatment, cooperation is below baseline every round. Also, it decays more quickly and falls further: by the final round, average contributions are just 1/5 of endowment. In contrast, cooperation in the public treatment is above baseline in 26 of 30 rounds.

The visually apparent differences in aggregate cooperation among treatments are also statistically significant and there are many ways to demonstrate this. For example, treating groups as the unit of observation, and using the mean contribution over the last 10 rounds for each group (yielding a total of 18 independent observations, six in each treatment), a K-sample medians test rejects the null hypothesis that the contribution distributions are identical among treatments (p=0.048)[8]. Also, one can show that the rate of cooperative decay in the public treatment is statistically significantly lower than the

[8] The null hypothesis of identical contribution distributions among treatments implies that the probabilities with which contributions exceed 50% over the last 10 rounds are identical among treatments. In fact, the number of times this occurred out of six independent samples from each treatment was three, zero and four for the baseline, private and public treatments, respectively. The K-sample test here was run on these data.

rate of decay in the baseline, which is itself statistically significantly lower than the rate of decay in the private treatment (see Xiao and Houser, 2006, for this analysis). Rather than pursuing additional tests on aggregated data, we will turn in the next section to exploring and explaining these aggregate differences with an individual-level analysis.

One explanation we have heard for the overall lower level of cooperation in the private punishment treatments is that they happened to start at a (statistically insignificantly) lower level. This is not an implausible suggestion. Many report evidence of conditional cooperation (e.g. Kurzban and Houser, 2005; Fischbacher, et al., 2001), and this could be consistent with somewhat lower initial cooperation spiraling down to significantly lower cooperation over rounds. Our analysis below, however, casts doubt on this possibility. We are confident in attributing differences in cooperation to the fact that, in relation to the private case, public implementation results in a five-fold increase in the number of times punishment is experienced (received or observed).

V.B. Individual Decisions in Public and Private Treatments

This section reports an individual-level, random-effects censored regression analysis of cooperation decisions. We specify our model as follows. The dependent variable is individual *i*'s round *t* contribution, g_{it}, which is censored below at zero and above at ten. In light of the discussion above, we explain this contribution with the following variables. First, we noted that the enforced norm is to contribute as much as one's group members. Hence, we include the lagged (equally weighted) mean of other group members' contributions, $\overline{g_{i,t-1}}$, as an explanatory variable. Next, to capture immediate punishment effects, we include whether an individual was punished in the previous round, $P_{i,t-1}$, and, if not punished, whether in the previous round the individual observed punishment, $O_{i,t-1}$. These variables account for immediate reactions to an exogenously imposed punishment.

We argued above that norms are more salient when punishment is observed or received more often. To account for this norm-saliency effect, we include in our analysis the accumulated number of times a subject either observed or experienced punishment, NS_{it}. In the private treatment, the number of observed punishments (i.e., the number of times a subject received punishment) varies substantially, with a median of three, and ranging from 0 to 11. There is of course much less variation in the public treatment, with all subjects experiencing 15 reminders (i.e., either receiving or observing punishment). In order to eliminate the possibility that norm-salience in the public treatment is simply accounting for deterministic round effects (e.g., learning about the game's incentives), we also include in our model both the round t and its square t^2.

To summarize, we model a current round's (censored) contribution as a function of a random individual effect to account for individual differences in contribution propensities, the round, the previous round's mean contribution by one's group members, whether one was punished or observed punishment in the previous round, and the accumulated number of times one has received or observed punishment (the norm-salience effect).

Our arguments above regarding norm-salience and incentive effects imply clean qualitative hypotheses regarding coefficient estimates. First, if norm-salience has a positive effect on cooperation, then the coefficient on norm-salience will be positive. At the same time, previous research on detrimental effects of weak punishment suggests the coefficient on receiving or observing punishment in the previous round will be negative.

We estimate the model using the punishment treatments' data only, because punishment variables are not defined in our baseline standard public goods game. Our analysis includes all punishment-treatment data except round 30. The reason is that punishment, it turns out, was randomly chosen to be implemented in round 29. Thus, including in our analysis round 30 (the final round) necessarily conflates nuisance end game effects with the punishment reactivity effects of interest[9].

Specification testing proceeded as follows. We began by running a disaggregated model in which we allowed different coefficients for each variable in each punishment treatment with the exception of $O_{i,t-1}$, whether punishment was observed in the previous round, which is only defined for the public treatment. Standard F-tests are unable to reject the restriction that the coefficients on the punishment, norm-salience and round variables in the public and private punishment treatments variables are identical. This is intuitively plausible and indicates that, all else equal, incentives and norm-salience operate quantitatively identically in both treatments[10]. Moreover, lagged group effects $\overline{g_{i,t-1}}$ were found to be statistically significantly positive and higher in the public than in the private treatment. We discuss below that this is consistent with public punishment enforcing the norm to contribute as much as one's group members. Last, we found that the quadratic round effect is both economically and statistically insignificant.

We improved our model in light of the above, and Table 2 reports the results of our final analysis. First, the coefficients of $O_{i,t-1}$ and $P_{i,t-1}$ are statistically significantly

[9] Alternatively one could include final-round dummy variables in an effort to control for this effect. Doing this does not substantively change our results. Our data are available on request.

[10] Some have suggested that the norm-salience variable in the public treatment might somehow reflect round effects, because its value evolves in a very similar way among all subjects. However, this argument cannot explain results in the private treatment. Thus, the fact that norm-salience effects are statistically and (nearly) point-wise identical between treatments, with coefficient estimates of 0.23 and 0.24 respectively, provides crucial support for our hypothesis connecting norm-salience, public punishment and cooperation.

negative. Moreover, the magnitudes of these effects are the same ($O_{i,t-1}$ is insignificantly different from $P_{i,t-1}$ (t-test, p=0.65). The interpretation is that, holding all else fixed, observing or receiving weak punishment in the previous round has a negative effect on contemporaneous cooperation. Absent other factors, this detrimental effect would lead cooperation to spiral towards zero, as people reduce cooperation in the face of weak punishment, and then reciprocate to each others' reduced cooperation.

Turn now to norm-salience. Table 2 shows NS_{it} is statistically significant and positive (and, we noted, insignificantly different between our public and private treatments). Moreover, it is only half as large in magnitude as the coefficients on incentive effects. The interpretation is that the first couple of times that punishment is received it will have an overall negative effect on cooperation in the next round. However, experiencing punishment more than this will have a positive effect on cooperation, because of norm-salience. Thus, because the median number of times punishment is received or observed is 15 for the public treatment, but only three for the private case, norm-salience provides an explanation for significantly greater cooperation in the public treatment. Indeed, evaluated at point estimates, about 90% of the mean contribution difference between the public and private treatments in the final rounds of the game can be explained by norm-salience effects.

Finally, recall that the norm enforced by our punishment is to contribute as much as one's group members. Table 2 reveals that, in both treatments, the lagged mean of other group members' contributions $\overline{g_{i,t-1}}$ is positively related to an individual's contemporaneous contribution. However, this effect is significantly higher and near unity in the public treatment (0.98 vs 0.40, t-test, p=0.000). This is further evidence that publicly implemented punishment generates increased norm-obedience.

We mentioned that contributions in the public punishment treatment begin at an insignificantly higher level than in the private treatment, and that some have speculated that this might be the source of the different cooperation patterns between treatments. To investigate this we simulated individual-level contributions using the estimated regression model detailed in Table 2, and under various configurations for initial round contributions. This analysis, available on request, clearly reveals that differences in initial contributions cannot explain the differences in data patterns between treatments.

V.C. Voluntary Cooperation and Free-Riding

For each treatment we calculated the mean proportion of times that subjects contributed their full endowment to the group account, and the proportion of times that subjects contributed zero, over the entire 30 rounds (see Figure 3). Compared to the baseline, private punishment is associated with a significant decrease in the proportion of full cooperation: it occurs with less than one-tenth of the baseline frequency (3% and 34%, respectively, $p=0.01$, two-tailed Mann-Whitney test). Again, this result is consistent with the hypothesis that external incentives crowd out internal motivations, leaving subjects less willing to cooperate voluntarily. However, while extents of zero and full cooperation under public punishment are lower than baseline (10% vs. 21%, and 27% vs. 34%, respectively), neither difference is significant ($p=0.15$ and $p=0.52$, respectively, two-tailed Mann-Whitney test). This is yet further evidence that public implementation eliminates detrimental effects of punishment on cooperation.

V.D. Availability Heuristic and Public Punishment

Publicly implemented punishment promotes the cooperation norm to both punished subjects and other group members. An alternative explanation for its success in promoting cooperation, and one that can be independent of social norm activation effects, appeals to the "availability heuristic" (see, e.g. Tversky and Kahneman, 1973; Croson and Sundali, 2005; Camerer, 1989). Tversky and Kahneman (1973) argued that peoples' subjective estimates of the probability of an event are increasing in the ease with which that event comes to mind. As a result, salient examples may bias peoples' judgments about events. Kunreuther et. al. (1978) describe an example of this phenomenon. They report that a substantial number of people buy earthquake insurance after an earthquake, even though the objective chance of a subsequent large quake has not increased.

Punishment is more salient when it is implemented publicly. Due to the availability heuristic, people might form incorrect subjective beliefs that the likelihood of punishment is higher than its actual (known) probability, and therefore become more likely to contribute more to the public good. In our case the punishment amount is so small that, even if implemented with probability one, the earnings maximizing strategy is to free-ride regardless of expectations regarding others' contributions. But people need not hold earnings maximizing preferences. In particular, if people exhibit sufficient aversion to punishment, then even a small increase in its perceived likelihood could significantly increase cooperation.

To obtain evidence on the availability heuristic explanation we conducted a private punishment treatment that is identical to the earlier private treatment, except that monitoring occurred every round with probability one and subjects were told this was the case. Data from this treatment are nearly identical to those from the earlier private punishment case (see Figure 4). It follows that group cooperation is higher when public punishment is implemented with 50% chance than when punishment is implemented privately but with probability one. This evidence casts doubt on the availability heuristic as an independent explanation for high cooperation under public punishment. It also has the interesting implication that, in the typical case when monitoring is costly, public punishment can achieve greater cooperation at lower cost.

VI. Conclusion

This paper provides, to our knowledge, the first systematic evidence comparing the effects of publicly and privately implemented punishment on enforcing cooperation. Earlier punishment studies made pathbreaking contributions to our understanding of incentives, and in particular the potentially detrimental effects of weak punishment. We provided convergent evidence that small sanctions reduce cooperation when implemented privately. However, we showed that these same sanctions promote and sustain cooperation in groups when implemented publicly. These data support our hypothesis that public punishment promotes norm-obedience by reinforcing cooperation norms to both the punished and to those who observe punishment.

These findings have useful application within any community or organization that relies on cooperation. We discussed examples including online trading and internet fraud. Our results suggest that, even in the largely anonymous settings that characterize internet markets, publicly implemented sanctions can effectively deter misconduct and promote trust. Another example relates to enforcing individual codes of honor (see, e.g., McCabe et. al., 2001). Many organizations (e.g., West Point and Kellogg Graduate School of Management) provide feedback to the community when an honor-code violation occurs, but do not name the one guilty of the violation. The results of this paper offer an explanation for the use and value of such strategies.

Our analysis was limited in many ways, and represents only a first step towards an improved understanding of links between the efficiency and process of punishment. It would be useful in future research to explore factors such as shame, learning, justice judgments and emotional responses to receiving and observing punishment, all of which potentially influence punishment's efficacy (see. e.g., Eslter, 1999; Bandura, 1977; Ball, Trevino and Sim, 1994; Lind and Tyler, 1988; O'Reilly and Puffer, 1989).

The message of this paper is to punish in public. To adapt existing punishment institutions to accommodate this approach would seem straightforward, and doing so could generate benefits including greater cooperation at substantially lower cost. Such benefits might be especially significant in large firms, as punishment observers would likely include highly productive employees (see, e.g., Trevino and Ball, 1992). Continued research on punishment's process and its social consequences will result in the discovery of improved institutions for efficient deterrence of misconduct in social and economic exchange environments.

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Table 1.
Payoff Cut Information in Public and Private Punishment Treatments

Subjects	Punishment	Payoff Cut Information	
		Not Monitored	Monitored
Punishment Receiver	Public / Private	N/A	In this round, your payoff was cut by…% (…E$)
Others	Public	In this round, no one's payoff was cut	In this round, the payoff of a lowest Group Account investor (NOT you) was cut by…% (…E$)
	Private	In this round, your payoff was not cut	

Note: In the event that everybody contributes the same amount, one member is randomly selected to receive a punishment of zero. In both the private and the public treatment, the receiver sees the message, "In this round, your payoff was cut by 0% (0E$)." In the public treatment everybody who was not punished sees, "In this round, the payoff of a lowest Group Account investor (NOT you) was cut by 0% (0E$)." The single exception to this rule is when every group member contributes the entire endowment, in which case punishment has no role to play in enforcing cooperation. Therefore, punishment is not implemented and, in both treatments, everyone receives the message, "In this round, no one's payoff was cut."

Table 2.

Individual Contribution Dynamics: Random Effect Censored Regression Model

Independent Variables	Individual *i*'s contribution in round *t* (g_{it}) **Coefficient**
Round (*t*)	-0.12 (0.017)
$\boldsymbol{O_{i,t-1}}$ (=1 if observed punishment in previous round; =0, o.w)	-0.46 (0.230)
$\boldsymbol{P_{i,t-1}}$ (=1 if observed punishment in previous round; =0, o.w)	-0.60 (0.240)
$\boldsymbol{NS_{i,t}}$ (accumulated observed or received punishments)	0.23 (0.041)
Public* $\overline{g_{i,t-1}}$ (public=1 if private treatment; =0, o.w.)	0.98 (0.060)
Private* $\overline{g_{i,t-1}}$ (private=1if in private treatment; =0, o.w.)	0.40 (0.060)
Private	2.70 (0.562)
Constant	1.00 (0.454)

Wald chi2(7) = 597.36

Figure 1. Mean Group Contribution to Public Good by Treatment and Round

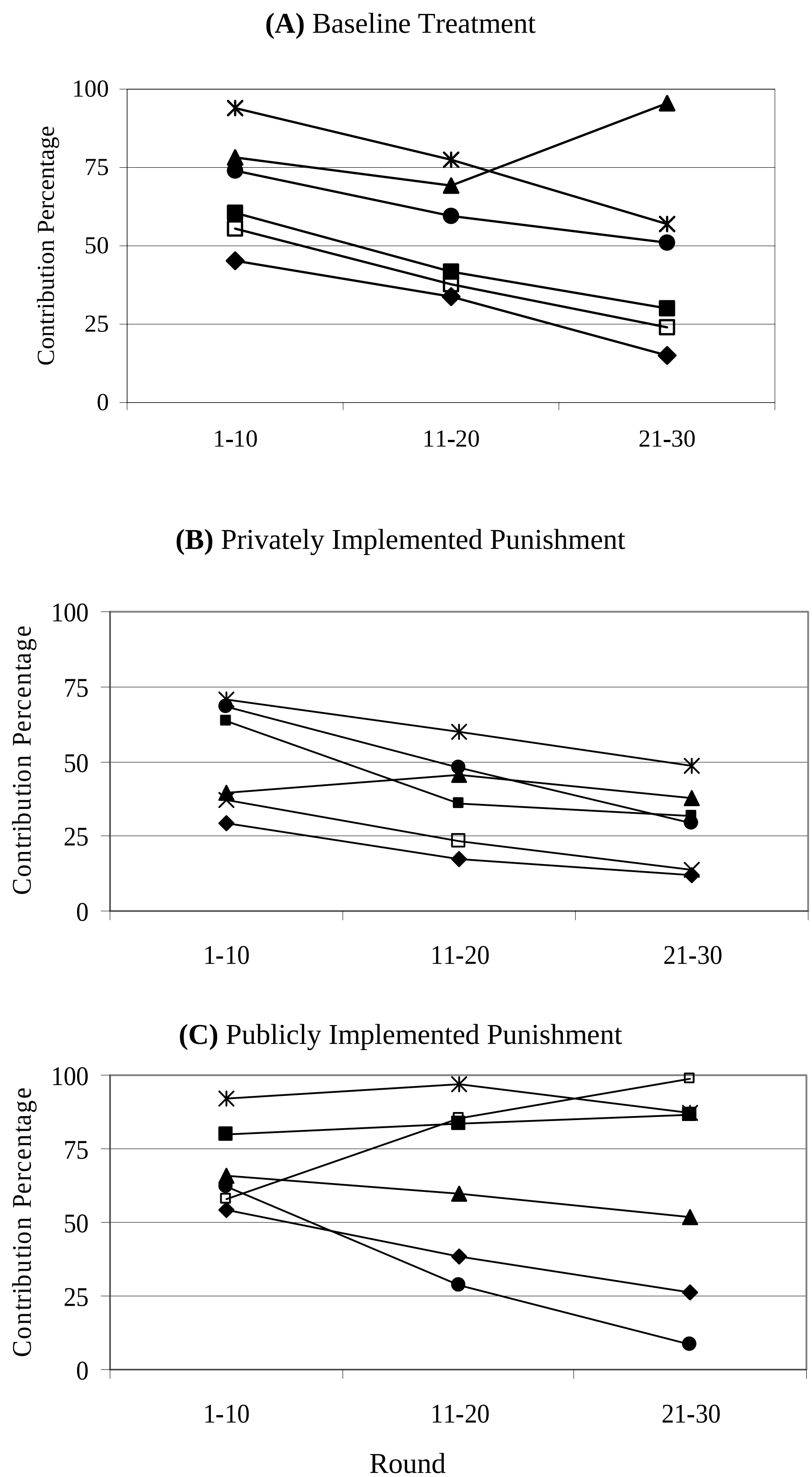


Figure 2. Mean Group Account Contribution by Round and Treatment

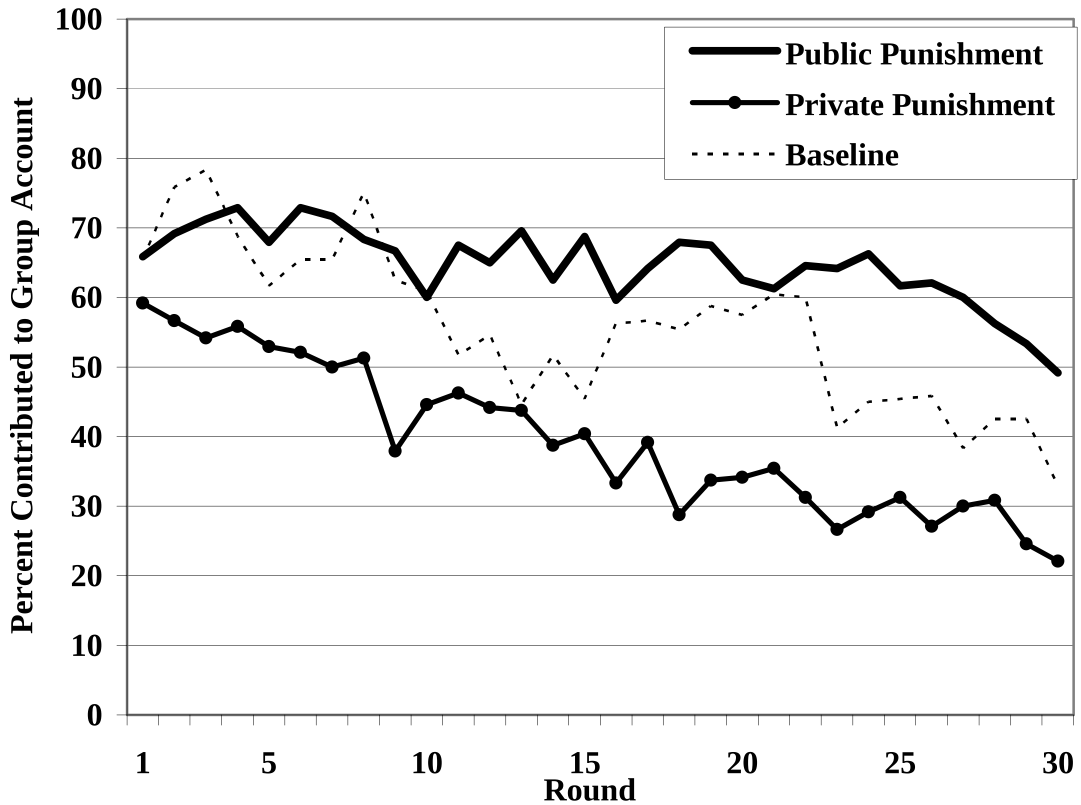


Figure 3. Effect of Treatments on Full Cooperation (100% contribution) and Perfect Free-Riding (0% contribution)

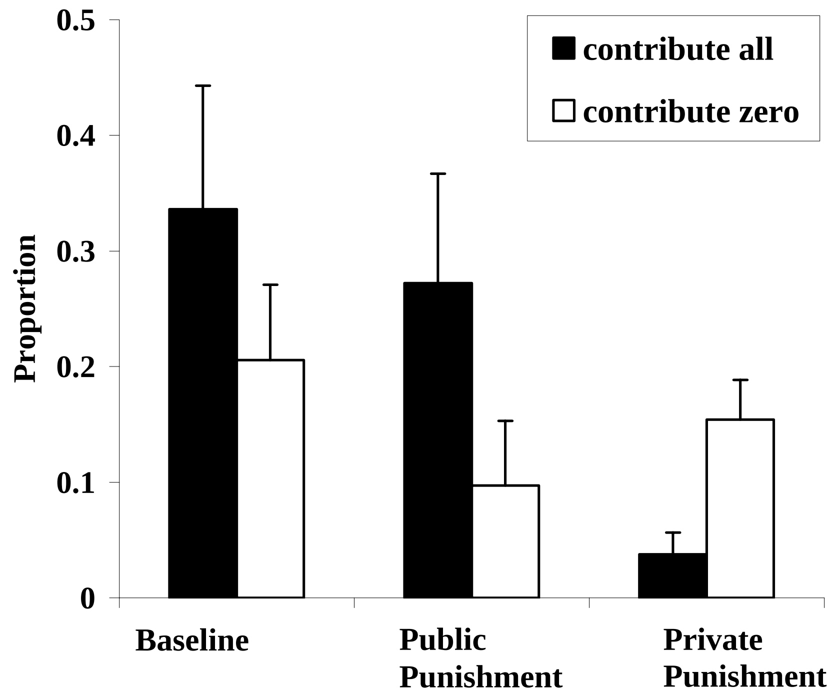
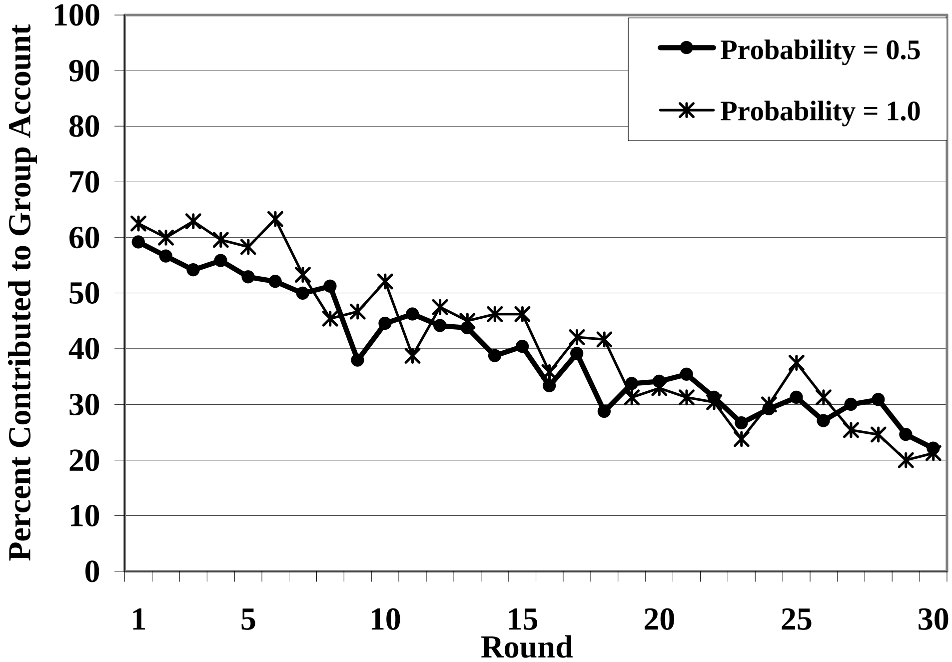


Figure 4. Mean Group Account Contribution in Private Punishment Treatments



Appendix A.

I. Private Punishment Treatment

Thank you for coming! You've earned $5 for showing up on time, and the instructions explain how you make decisions to earn more money. So please read these instructions carefully! There is no talking at any time during this experiment. If you have a question please raise your hand, and an experimenter will assist you.

The experiment is divided into different rounds. In all, the experiment consists of 30 rounds. You will be randomly assigned to a group with 3 other participants. **The composition of each group will NOT change during the experiment.** You won't know the identities of your group members.

At the beginning of each round each participant receives **10 E$**. At the end of the experiment the total number of E$ you have earned will be converted to dollars at the following rate:

20 E$ = $1

In each round, you will decide how to allocate your E$s. After each member in your group makes her decision, the computer will **randomly** decide whether to monitor the group this round or not. If the group is monitored, then one person in that round might receive a payoff cut. Additional information about the monitoring and payoff cuts is given below.

At the beginning of each round, you decide how many of your 10 E$ to invest in the **Group Account(G)** and how many to invest in your **Individual Account (I)**. These two accounts are explained below.

Individual Account (I)

Every E$ you assign to the Individual account will return one E$ at the end of the round.
For example, if you invested all 10E$ in your Individual account, you would earn 10E$ from the individual account at the end of the round. If you invested 5E$ in your Individual account, you would earn 5E$ from the individual account at the end of the round.

Group Account (G)

Your earnings from the Group Account depend on the number of E$ that **you and your other group members** invest in the Group Account. All E$s that you and your group members invest in the Group account are added together and form the group investment. The group investment generates return of **2** E$ for every one E$ invested. These earnings are then divided equally among all group members. Your group has **4** members (including yourself). So, every E$ invested in the Group account will return **half of an E$** to each group member at the end of the round.

Some examples of returns to group investment are illustrated in the table below. The left column lists various amounts of group investment; the right column contains the corresponding personal earnings for each group member:

Total Group investment amount by your group (TG)	Return to each group member (from Group investment)
0	0
8	4
10	5
14	7
28	14
40	20

As you can see, it does not matter who invests E$s in the Group account. Everyone will get the same return from every E$ invested there-whether they invested E$ in the Group account or not.

Monitoring

After all members of your group have made their decisions, the computer will **randomly** decide whether to monitor the round. **Each round has a 50% chance of being monitored, and whether a round is monitored does not depend on whether other rounds were or were not monitored.**

Here is what monitoring means. If the round is monitored, then the lowest investor in the Group Account will have his or her payoff for that round cut by some amount. If two or more group members invest the same lowest amount in the Group Account, then the computer will randomly choose one of them to receive the payoff cut. If all the group members invest all their 10E$ to the Group account, no one will receive a payoff cut when the round is monitored.

Payoff cut

Here is how the payoff cut amount is determined. When a subject's payoff is cut, his or her payoff in that round will be reduced by a certain percentage. This percentage is determined by the difference between his/her Group investment (**G**) and the average Group investment of his/her other three group members (**OG**). The specific formula used to determine the amount of the payoff cut is:

Payoff cut Percentage=(**OG-G**)%

Payoff Cut = **Original Payoff (before cut)** × **Payoff cut Percentage**

You have been given a chart that shows the payoff cut percentage for different values of **G** and **OG. From the chart you can see that the payoff cut percentage becomes increasingly larger as G becomes increasingly smaller than OG**. Please raise your hand if you do not understand this chart.

Example: If a subject receives a payoff cut, his/her Group investment is 2 and other three members' average Group investment is 6, then his/her payoff cut percentage will be (**6-2**)%=4%. You can double check this answer with the chart. It shows that when OG-G=4, the payoff cut percentage=4%. This means that 4% of the subject's original payoff (for that round only) will be cut.

If a subject receives a payoff cut, his/her Group investment is 1 and other three members' average Group investment is 7, then his/her payoff cut percentage will be (**7-1**)%=6%. You can double check with the chart which shows that when **OG-G**=6, the payoff cut percentage=6%. This also means that 6% of the original payoff will be cut in that round.

Important: Each round you will only be told whether you received a payoff cut. No group members will know if any other group member's payoff was cut.

Your earnings in each round

The total E$s you earn at the end of each round is the sum of your earnings from each of the two accounts:

1) E$s earned from your Individual account = amount of E$s you invest in the Individual account.(**I**)

2) E$s earned from the Group account = 0.5 × the total invested E$s of all 4 Group members to this account.(**TG**)

So your earnings at the end of each round =

I + 0.5×**TG**, if there is no payoff cut, and

I + 0.5×**TG - Payoff Cut amount**, if there is a payoff cut.

Example

Suppose that you invested 8 E$s in your Individual account and 2 E$s in the Group account, and the three other members invested a total of 18 E$s in the group account. This means there is a total of 20 E$s in the group account. Then your earnings from the Group account would be 20*0.5=10 E$. Each other subject in your group would also earn 10 E$s from the group account. If the computer does not monitor the round, or if the round is monitored but you are not the lowest investor in the Group account, then your total E$s earned would be 8 (from your Individual account) + 10 (from the group account) = 18 total E$s earned.

However, if the round was monitored and you were the lowest investor in the Group account, then your final earnings in this round would be deducted by some amount, (from the chart, as OG-G=6-2=4, the payoff cut percentage is 4%), so the payoff cut amount will be 18×4%=0.72 and then your total earnings in this round would be 18-0.72=17.28E$

How to Make Your Decisions in Each Round

You will make decisions by entering numbers into boxes on your computer screen (If you want to see what the screen looks like, please click the button on the left corner and you will be able to return to the instructions by clicking "**Click for instructions**" button). The screen will also give you important messages and other information. It is important that you understand the information on the screen. If after reading these instructions you still do not understand your screen, then please raise your hand and an experimenter will assist you.

The round number appears in the top left corner of the screen. In this experiment there will be exactly 30 rounds. The screen will show you both the current round, and how many rounds there are in this experiment in total.

The upper left part of the screen also includes a box that shows your "endowment," which is the number of E$ that you are given each round. In this experiment your endowment is 10E$ each round. You have to decide on the number of E$ to place in both the Individual and in the Group accounts.

To invest in the Individual account, use the mouse to move your cursor to the box labeled "Individual Account", click on the box and enter the number of E$ you wish to allocate to this account. Do the same for the box labeled "Group Account" to make your group investment. Entries in the two boxes must be positive whole numbers that sum to your endowment (10 E$). To change any of your entries, use the mouse to select what you have previously typed in that box and simply overwrite. To submit your investment, click on the "Submit" button. Once you have done this, your decision can no longer be revised. You will then wait until everyone else has submitted his or her investment decisions.

Seeing your results

Once every member of your group has entered a decision, the outcome of the round will be displayed directly below the boxes where you entered your investment amounts. There are two information boxes on the left. One is the "**Payoff Cut Message**", from which you will see whether your payoff will be cut by some amount. **Again, this message only shows you whether you received a payoff cut or not. You won't know whether any other of your group members received a payoff cut. Similarly, your group members will not know whether you received payoff cut.**

The other information box is labeled "**Outcome of This Round**" and will show you:

(1) how much each of your group members invested in the Group Account (IDs are NOT listed);

(2) your Individual investment(I) and Group investment(G);

(3) the difference between your **G** and the average investment amount of your other 3 group members(**OG**). This is listed in the column titled as **OG-G ;**

(4) if you received a payoff cut, the payoff cut amount;

(5) your final earnings for this round.

You can move your mouse to the information box and it will extend to display all of this information.

The **History Record** on the left side of the window records the data from all of the rounds you've played so that you can review previous rounds' outcomes anytime. Again, you might need to move your mouse to the box to see the complete information. You might also have to scroll up to see early records. The right bottom box will show you the current status of the experiment. In addition, several important things to know about the experiment will be listed there for your easy reference.

After you finish reading the information, please click the "**Click when ready**" button. Once every subject clicks the button, you will begin the next round.

At the end of the experiment, your E$s earned in each round will be added together, and you will be paid privately at the rate 20E$ =$1.

Summary

1. Your task: Decide how to invest your 10E$ in each round.

2. Monitoring: Each round has 50% chance being monitored. If monitored, the lowest Group account investor will receive a payoff cut.

3. The amount of payoff cut percentage is determined by the difference between the average of your other 3 group members' Group account investment (OG) and your Group account investment (G). When the difference OG-G is bigger, the payoff cut (if any) will be larger.

4. At the end of each round, each member will be informed whether he/she received a payoff cut. No investor will know if a different member received a payoff cut.

II. Public Punishment Treatment

Thank you for coming! You've earned $5 for showing up on time, and the instructions explain how you make decisions to earn more money. So please read these instructions carefully! There is no talking at any time during this experiment. If you have a question please raise your hand, and an experimenter will assist you.

The experiment is divided into different rounds. In all, the experiment consists of 30 rounds. You will be randomly assigned to a group with 3 other participants. **The composition of each group will NOT change during the experiment.** You won't know the identities of your group members.

At the beginning of each round each participant receives **10 E$**. At the end of the experiment the total number of E$ you have earned will be converted to dollars at the following rate:

20 E$ = $1

In each round, you will decide how to allocate your E$s. After each member in your group makes her decision, the computer will **randomly** decide whether to monitor the group this round or not. If the group is monitored, then one person in that round might receive a payoff cut. Additional information about the monitoring and payoff cuts is given below.

At the beginning of each round, you decide how many of your 10 E$ to invest in the **Group Account(G)** and how many to invest in your **Individual Account (I)**. These two accounts are explained below.

Individual Account (I)

Every E$ you assign to the Individual account will return one E$ at the end of the round.

For example, if you invested all 10E$ in your Individual account, you would earn 10E$ from the individual account at the end of the round. If you invested 5E$ in your Individual account, you would earn 5E$ from the individual account at the end of the round.

Group Account (G)

Your earnings from the Group Account depend on the number of E$ that **you and your other group members** invest in the Group Account. All E$s that you and your group members invest in the Group account are added together and form the group investment. The group investment generates return of **2** E$ for every one E$ invested. These earnings are then divided equally among all group members. Your group has **4** members (including yourself). So, every E$ invested in the Group account will return **half of an E$** to each group member at the end of the round.

Some examples of returns to group investment are illustrated in the table below. The left column lists various amounts of group investment; the right column contains the corresponding personal earnings for each group member:

Total Group investment amount by your group (TG)	**Return to each group member (from Group investment)**
0	0
8	4
10	5
14	7
28	14
40	20

As you can see, it does not matter who invests E$s in the Group account. Everyone will get the same return from every E$ invested there-whether they invested E$ in the Group account or not.

Monitoring

After all members of your group have made their decisions, the computer will **randomly** decide whether to monitor the round. **Each round has a 50% chance of being monitored, and whether a round is monitored does not depend on whether other rounds were or were not monitored.**

Here is what monitoring means. If the round is monitored, then the lowest investor in the Group Account will have his or her payoff for that round cut by some amount. If two or more group members invest the same lowest amount in the Group Account, then the computer will randomly choose one of them to receive the payoff cut. If all the group members invest all their 10E$ to the Group account, no one will receive a payoff cut when the round is monitored.

Payoff cut

Here is how the payoff cut amount is determined. When a subject's payoff is cut, his or her payoff in that round will be reduced by a certain percentage. This percentage is determined by the difference between his/her Group investment (**G**) and the average Group investment of his/her other three group members (**OG**). The specific formula used to determine the amount of the

payoff cut is:
Payoff cut Percentage=(**OG-G**)%
Payoff Cut = **Original Payoff (before cut)** × **Payoff cut Percentage**

You have been given a chart that shows the payoff cut percentage for different values of **G** and **OG.** **From the chart you can see that the payoff cut percentage becomes increasingly larger as G becomes increasingly smaller than OG**. Please raise your hand if you do not understand this chart.

Example: If a subject receives a payoff cut, his/her Group investment is 2 and other three members' average Group investment is 6, then his/her payoff cut percentage will be (**6-2**)%=4%. You can double check this answer with the chart. It shows that when OG-G=4, the payoff cut percentage=4%. This means that 4% of the subject's original payoff (for that round only) will be cut.

If a subject receives a payoff cut, his/her Group investment is 1 and other three members' average Group investment is 7, then his/her payoff cut percentage will be (**7-1**)%=6%. You can double check with the chart which shows that when **OG-G**=6, the payoff cut percentage=6%. This also means that 6% of the original payoff will be cut in that round.

Important: Each round you will be told whether you received a payoff cut. In addition, you will know if the least group account investor's payoff was cut.

Your earnings in each round

The total E$s you earn at the end of each round is the sum of your earnings from each of the two accounts:

1) E$s earned from your Individual account = amount of E$s you invest in the Individual account.(**I**)

2) E$s earned from the Group account = 0.5 × the total invested E$s of all 4 Group members to this account.(**TG**)

So your earnings at the end of each round =

I + 0.5×**TG**, if there is no payoff cut, and

I + 0.5×**TG - Payoff Cut amount**, if there is a payoff cut.

Example

Suppose that you invested 8 E$s in your Individual account and 2 E$s in the Group account, and the three other members invested a total of 18 E$s in the group account. This means there is a total of 20 E$s in the group account. Then your earnings from the Group account would be 20*0.5=10 E$. Each other subject in your group would also earn 10 E$s from the group account. If the computer does not monitor the round, or if the round is monitored but you are not the lowest investor in the Group account, then your total E$s earned would be 8 (from your Individual account) + 10 (from the group account) = 18 total E$s earned.
However, if the round was monitored and you were the lowest investor in the Group account, then your final earnings in this round would be deducted by some amount, (from the chart, as

OG-G=6-2=4, the payoff cut percentage is 4%), so the payoff cut amount will be 18×4%=0.72 and then your total earnings in this round would be 18-0.72=17.28E$

How to Make Your Decisions in Each Round

You will make decisions by entering numbers into boxes on your computer screen (If you want to see what the screen looks like, please click the button on the left corner and you will be able to return to the instructions by clicking "**Click for instructions**" button). The screen will also give you important messages and other information. It is important that you understand the information on the screen. If after reading these instructions you still do not understand your screen, then please raise your hand and an experimenter will assist you.

The round number appears in the top left corner of the screen. In this experiment there will be exactly 30 rounds. The screen will show you both the current round, and how many rounds there are in this experiment in total.

The upper left part of the screen also includes a box that shows your "endowment," which is the number of E$ that you are given each round. In this experiment your endowment is 10E$ each round. You have to decide on the number of E$ to place in both the Individual and in the Group accounts.

To invest in the Individual account, use the mouse to move your cursor to the box labeled "Individual Account", click on the box and enter the number of E$ you wish to allocate to this account. Do the same for the box labeled "Group Account" to make your group investment. Entries in the two boxes must be positive whole numbers that sum to your endowment (10 E$). To change any of your entries, use the mouse to select what you have previously typed in that box and simply overwrite. To submit your investment, click on the "Submit" button. Once you have done this, your decision can no longer be revised. You will then wait until everyone else has submitted his or her investment decisions.

Seeing your results

Once every member of your group has entered a decision, the outcome of the round will be displayed directly below the boxes where you entered your investment amounts. There are two information boxes on the left. One is the "**Payoff Cut Message**", from which you will see whether your payoff will be cut by some amount. **Again, this message shows you not only whether you received a payoff cut but also whether any other of your group members received a payoff cut. Similarly, every one of your group members will know whether anyone received a payoff cut.**

The other information box is labeled "**Outcome of This Round**" and will show you:
(1) how much each of your group members invested in the Group Account (IDs are NOT listed);
(2) your Individual investment(I) and Group investment(G);
(3) the difference between your **G** and the average investment amount of your other 3 group members(**OG**). This is listed in

the column titled as **OG-G ;**

(4) if you received a payoff cut, the payoff cut amount;

(5) your final earnings for this round.

You can move your mouse to the information box and it will extend to display all of this information.

The **History Record** on the left side of the window records the data from all of the rounds you've played so that you can review previous rounds' outcomes anytime. Again, you might need to move your mouse to the box to see the complete information. You might also have to scroll up to see early records. The right bottom box will show you the current status of the experiment. In addition, several important things to know about the experiment will be listed there for your easy reference.

After you finish reading the information, please click the "**Click when ready**" button. Once every subject clicks the button, you will begin the next round.

At the end of the experiment, your E$s earned in each round will be added together, and you will be paid privately at the rate 20E$ =$1.

Summary

1. Your task: Decide how to invest your 10E$ in each round.

2. Monitoring: Each round has 50% chance being monitored. If monitored, the lowest Group account investor will receive a payoff cut.

3. The amount of payoff cut percentage is determined by the difference between the average of your other 3 group members' Group account investment (OG) and your Group account investment (G). When the difference OG-G is bigger, the payoff cut (if any) will be larger.

4. At the end of each round, each member will be informed whether anyone in his/her group received a payoff cut.

Appendix B

Decision Screen for Public Punishment Treatment