

Direct and indirect punishment among strangers in the field

Loukas Balafoutas^{a,1}, Nikos Nikiforakis^b, and Bettina Rockenbach^c

^aDepartment of Public Economics, University of Innsbruck, A-6020 Innsbruck, Austria; ^bSocial Science Division, New York University Abu Dhabi, Abu Dhabi, United Arab Emirates; and ^cDepartment of Economics, University of Cologne, D-50923 Cologne, Germany

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Many interactions in modern human societies are among strangers. Explaining cooperation in such interactions is challenging. The two most prominent explanations critically depend on individuals' willingness to punish defectors: In models of direct punishment, individuals punish antisocial behavior at a personal cost, whereas in models of indirect reciprocity, they punish indirectly by withholding rewards. We investigate these competing explanations in a field experiment with real-life interactions among strangers. We find clear evidence of both direct and indirect punishment. Direct punishment is not rewarded by strangers and, in line with models of indirect reciprocity, is crowded out by indirect punishment opportunities. The existence of direct and indirect punishment in daily life indicates the importance of both means for understanding the evolution of cooperation.

cooperation | field experiment | indirect reciprocity | punishment | social norms

The extent of human cooperation is unique in the animal world (1). This is remarkable given that many interactions in large modern societies are one-shot encounters between strangers. Cooperation in these instances cannot be explained by the benefits that accrue from repeated encounters (1–5). The two most prominent explanations for cooperation in such instances both rely on individuals' willingness to punish those who fail to cooperate (2, 3). The difference lies in the form punishment takes and its material consequences. The first mechanism involves the direct punishment of those behaving antisocially (6–11). Direct (or altruistic) punishment is individually costly, e.g., because it requires time and effort to enact, and the punisher bears the risk of retaliation when confronting a noncooperator (12–14). As a result, explaining how the propensity to punish directly may have evolved constitutes a major evolutionary puzzle (7, 15–20): “We seem to have replaced the problem of explaining cooperation with that of explaining [costly] punishment” (21).

In contrast to models of direct punishment, cooperation in models of indirect reciprocity is supported by the threat of indirect punishment (22–26): Individuals who come across others who are known to have behaved selfishly punish them by withholding reward (27–29). The key difference is that, unlike direct punishment, indirect punishment need not be costly as individuals may gain by withholding reward. Thus, explaining its evolution is less challenging. The ability to punish indirectly, however, raises the question of how instances of direct punishment may be explained (23). Why would individuals use direct costly punishment when they can withhold reward? The typical explanation is that direct punishers are rewarded by others who value the social norm and wish to maintain it: “In reality, ... most punishment actions among humans are associated with the expectation of a delayed material gain” (23). Reward may take, for example, the form of a gift, positive feedback or an offer to help. This increases the punisher's benefit from enforcing cooperation and may help offset the associated costs (4, 5, 24). In other words, direct punishment need not be costly in net terms for the punisher. However, there is little empirical evidence that strangers reward direct punishment (30, 31). If direct

punishment is not rewarded in daily life, evolutionary forces will lead cooperators to use indirect punishment (23, 25).

For settling the debate on the importance of direct vs. indirect punishment for the evolution of cooperation among strangers, field experimental evidence from natural interactions is essential (2, 32, 33). From a theoretical perspective, the persistence of direct punishment is puzzling because it is assumed to be individually costly for the punisher, whereas this usually is not the case for indirect punishment. It is not obvious, however, that this holds true in daily life, in which direct punishment may be rewarded sufficiently (5, 23, 24) and in which indirect punishment by withholding reward also may involve substantial psychological or social costs (34, 35). Previous studies have explored direct punishment (9) and indirect reciprocity (36) in natural field settings, but in isolation from each other.

To our knowledge, this study presents the first evidence from a natural field experiment exploring the demand for direct and indirect punishment, separately and jointly. We address the following three questions: (i) Are punishers rewarded by strangers in one-shot interactions? (ii) Do individuals punish antisocial behavior indirectly by withholding reward? (iii) How is the propensity to punish directly affected by the opportunity to withhold reward? These questions are key to understanding how the propensity to punish selfish behavior may have evolved and, subsequently, the evolution of cooperation.

Testing Direct and Indirect Punishment in One-Shot Interactions in the Field

Our natural field experiment combines the advantages of the experimental approach with the advantages of studying behavior in a field environment. The experimental approach ensures that

Significance

Why do humans cooperate in one-time interactions with strangers? The most prominent explanations for this long-standing puzzle rely on punishment of noncooperators, but differ in the form punishment takes. In models of direct punishment, noncooperators are punished directly at personal cost, whereas indirect reciprocity assumes that punishment is indirect by withholding rewards. To resolve the persistent debate on which model better explains cooperation, we conduct the first field experiment, to our knowledge, on direct and indirect punishment among strangers in real-life interactions. We show that many people punish noncooperators directly but prefer punishing indirectly by withholding help when possible. The occurrence of direct and indirect punishment in the field shows that both are key to understanding the evolution of human cooperation.

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¹To whom correspondence should be addressed. Email: loukas.balafoutas@uibk.ac.at.

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Act/Treatment	HelpPunisher	BaseHelp	HelpViolator	BasePun
Act 1: norm violation	Violator litters	—	Violator litters	Violator litters
Act 2: punishment	Punisher punishes	—	—	—
Act 3: needing help	Punisher drops books	Confederate drops books	Violator drops books	—
Dependent variable (observer's behavior)	Helping	Helping	Direct punishment and helping	Direct punishment
<i>N</i>	108	131	102	106

each observation is gathered under an identical script, allowing us to perform *ceteris paribus* comparisons. The advantage of the field environment is that it allows us to study the demand for direct and indirect punishment under their real costs and benefits without having to make any assumptions about them. Moreover, we can examine reactions to violations of an existing, widely known and well-established social norm (nollittering). Finally, because our participants are observed in their natural environment and are unaware of participating in an experimental study, we avoid both demand and selection effects.

The experiment was run on various platforms in the two large international train stations in Cologne, Germany. The location is a major European intersection with more than 1,200 trains and 280,000 passengers a day, which implies that the probability interactions are not between strangers is minimal. In the experiment, a team of confederates simulated certain social interactions according to a fixed prespecified script and recorded the behavior of passengers who observed these interactions (henceforth, observers). Twelve confederates worked in groups of three. Each group consisted of two drama students, who enacted various scenarios depending on the treatments based on a prespecified script, and one supervisor, who collected data on the behavior of the observers. All confederates were unaware of the research hypotheses. Both actors were male in two of the groups, and both actors were female in the other two groups. In total, we collected 447 observations. Detailed notes on the experimental procedures are available in [Supporting Information](#).

The four different treatments are summarized in Table 1. In treatment HelpPunisher, the interaction began with one of the confederates (called violator) noticeably dropping an empty coffee cup on the platform, thus violating the norm of not littering in public areas (Act 1: norm violation). After a few seconds, a second confederate (called punisher) approached the violator and said firmly but in a civil manner “Would you please pick up your garbage? The platform is not a garbage bin” (Act 2: punishment). The violator was instructed to always comply with this request calmly, pick up the cup without responding, and quietly leave the scene. Finally, the punisher reached for something inside her/his shoulder bag, dropping the entire content of seven books and booklets in front of an observer who had been standing alone near the scene (Act 3: needing help). This means that only one person (the observer) could help the punisher pick up the books. To answer our first research question (i.e., whether punishers of norm violators are rewarded) we compare helping rates in this treatment to the ones in BaseHelp—one of the two control treatments. In BaseHelp, we recorded helping rates in the absence of a norm violation or punishment. We say that an observer helped if s/he picked up at least one book or booklet. We say that direct punishment is rewarded if the helping rates are significantly higher in the HelpPun than in the BaseHelp treatment. See [Supporting Information](#) for pictures of the three acts.

Treatment Help/Violator was identical to treatment Help-Punisher, except for the punishment act: After littering, the violator dropped the books in front of the observer. Hence, direct punishment by the observer (for instance by asking the violator to pick up the cup or expressing disapproval of the norm violation)

and the observer's offer to help are the measurable outcome variables. To address our second research question (i.e., whether individuals withhold rewards as a means of indirect punishment of norm violators) we compare helping rates in treatment Help-Violator with those in BaseHelp. If helping rates are significantly lower in the HelpViolator than in the BaseHelp treatment, we will have evidence that observers punish indirectly. Finally, we can answer our third research question regarding the interaction between direct and indirect punishment and the extent to which the former is crowded out by the latter by comparing direct punishment rates in HelpViolator with those in the second control treatment, BasePun. In BasePun, we measured the frequency with which violations of the nonlittering norm were punished by an observer standing alone near the scene of the violation. If direct punishment is less frequent in HelpViolator, in which indirect punishment opportunities exist, than in BasePun, we will have evidence that indirect punishment crowds out direct punishment.

To complement the field experiment, we conducted a survey study (see [Supporting Information](#) for details). We asked 232 different people in the same two train stations questions about their attitudes toward norm violators and norm enforcers in a hypothetical littering scenario that resembled the experimental situation.

Punishment of Norm Violators Is Not Rewarded

Fig. 1 shows that 39.7% of observers in the control treatment BaseHelp offered their help to the confederate who dropped the books in front of them. The rate of observers helping the punisher in treatment HelpPunisher is only slightly higher, 44.4%, and statistically indistinguishable from that in BaseHelp ($N = 239$, $\chi^2(1) = 0.55$, $P = 0.511$, two-sided Fisher's exact test). We also did not observe any other form of reward, such as kind words, friendly facial expressions, or gift giving, from the observer toward the punisher. Thus, there is no significant evidence of rewards for those who punish norm violators directly in one-shot interactions. The robustness of this finding is confirmed in

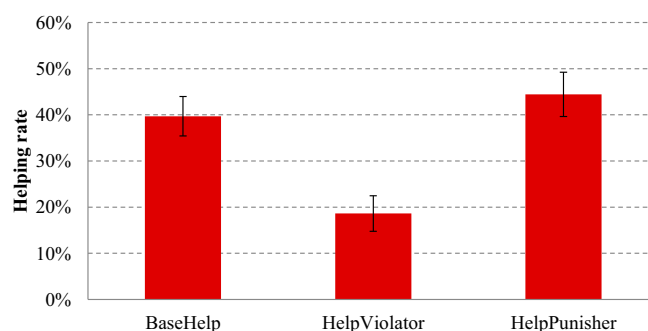


Fig. 1. Helping rates by treatment. Help is offered more frequently in treatment BaseHelp than in HelpViolator, indicating that observers apply indirect punishment of norm violators by means of withholding help. Helping rates in HelpPunisher are not significantly different from treatment BaseHelp (i.e., no reward is given to punishers). Error bars indicate 95% confidence intervals. See main text for statistics.

to be applied to female than male norm violators also points to this direction, if women are perceived as less likely to retaliate punishment or as less dangerous in the event of such retaliation. Indirect punishment opportunities, however, do not completely crowd out direct punishment. A small fraction of observers (6.8%) use direct punishment even when less costly means of punishment exist.

As with all experimental studies, more empirical evidence is needed to establish the extent to which our conclusions can be generalized. The norm violation in our experiment, for example, resembles free riding in public good experiments (6–8, 10–14, 40) as littering involves a negative externality shared by multiple individuals, including the punisher. Perhaps people will be willing to reward punishers if the violation affects a third party and not the punisher directly—as in third-party punishment experiments (28, 29, 41). It also will be interesting to investigate whether punishers are rewarded in repeated encounters (e.g., by friends, colleagues) and, if so, how this affects the extent to which indirect punishment crowds out direct punishment. In any case, the existence of direct and indirect punishment in our experiment indicates that both are important for understanding the evolution of cooperation.

Materials and Methods

All aspects of the study, including ethical acceptability, were reviewed by the Vice-Rectorate for Research at the University of Innsbruck, and permission was granted to conduct the experiment. The Deutsche Bahn also gave consent to running the experiment, which took place in May 2013 on various platforms in the two large (long-distance) train stations in Cologne, Germany. The data collection occurred between 9:00 AM and 5:00 PM. Four teams of three confederates each (two actors and one supervisor) simulated the social

interactions outlined in Table 1 according to a precise prespecified script. To control for sex, both actors were male in two of the groups and both actors were female in the other two groups.

Acts were performed with single and standing observers only, to ensure there was no second-order public-good problem and that rewarding was costly for individuals who had to bend to pick up the books. Observers were randomly assigned into treatments. The supervisor recorded only acts in which the observer did not leave the scene and no other passenger approached. Moreover, the supervisor controlled that the various acts were performed correctly and that the observer witnessed the interaction in Acts 1 and 2 (Table 1), and recorded whether the observer helped pick up the books in Act 3 (in BaseHelp, HelpViolator, and HelpPunisher) and whether he or she applied direct punishment against the violator (in BasePun and HelpViolator).

Whenever an observer picked up at least one book, his or her action was recorded as help. Whenever an observer explicitly asked the violator to pick up the cup or expressed disapproval of the norm violation—for instance, by reprimanding the violator for his or her action—this was recorded as direct punishment. The supervisor also recorded the time of day the observation was collected and an estimate of the observer's approximate age. After the interaction was completed, the team moved to a different platform.

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Supporting Information

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Regression Analysis of Helping Rates

The probit regression in Table S1 analyzes helping rates in treatments BaseHelp, HelpViolator, and HelpPunisher using the following independent variables: dummy variables for treatments HelpViolator and HelpPunisher, sex and approximate age of the observer, and sex of the norm violator. The regression includes day and (confederate) group fixed effects. SEs are clustered by group. The results are robust to time-of-day effects, which are never statistically significant.

The negative and significant coefficient on HelpViolator confirms the finding that norm violators are punished indirectly by receiving much less help from observers on average. In addition, no significant difference is detected for treatment HelpPunisher, which suggests that punishers are not rewarded by means of higher helping rates. Some other interesting insights from this regression are that the willingness to offer help decreases with the observer's approximate age, and that female confederates are about 17% more likely to receive help on average than male ones.

Regression Analysis of the Relationship Between Indirect Punishment and Sex

Table S2 presents the Poisson log-linear regression results that examine the relationship among helping rates, sex, and treatment to infer how indirect punishment (help withdrawal) is used against men and against women. To evaluate the existence of indirect punishment, the regression uses data from treatments BaseHelp and HelpPunisher. The differential effect by sex is captured by the negative and significant interaction term "HelpViolator x male confederate." In particular, this term indicates that the extent to which help is withdrawn from norm violators is greater for men than for women, or in other words, that indirect punishment is used more extensively against men. For the entire group of (male and female) confederates, the effect of treatment HelpViolator on help rates is given by the joint coefficient $\text{HelpViolator} + \text{HelpViolator} * \text{male confederate}$, which—in line with the results in Table S1—is negative and significant [$\chi^2(1) = 8.48, P < 0.01$].

Survey Questions (Translated from German)

Including Mean Responses (in the Respective Boxes). Good afternoon. We are a team of researchers from the Universities of Cologne and Innsbruck, and the Max Planck Institute in Bonn. In agreement with Deutsche Bahn, we are conducting a survey regarding the condition of the train stations. Could you please spare us two minutes of your time until your train arrives and answer a few questions?

1. How often do you usually travel by train?

Five days a week or more	37%	Three to four days a week	7%
One to three days a week	19%	Less than once a week	37%

2. Imagine the following situation: You notice someone who is throwing an empty plastic cup in front of you on the platform. Would this bother you?

No	4%
Yes, a little	20%
Yes, quite a lot	25%
Yes, a lot	51%

3. [If the answer to (2) is YES] Would you reproach this person?

No	53%
Yes	41%
It depends	6%

4. [If the answer to (3) is NO] For which reason? (Note: Answers were presented to respondents in randomized order, four different versions)

Because that could lead to tension or a fight	55%
Because no-one reprimands those who throw garbage	5%
Because there is cleaning staff for this purpose	4%
Because it is not proper to tell others how they should behave	17%
Other: _____	19%

(Version 1 of question 5, $N = 126$) 5. How would you characterize the behavior of this passenger?

Unacceptable	64%
Relatively unacceptable	16%
Relatively acceptable	10%
Acceptable	5%
I could not judge	5%

(Version 2 of question 5, $N = 106$) 5. Now imagine a second passenger comes and tells this person, "Would you please pick up your garbage? The platform is not a garbage bin." How would you characterize the behavior of this second passenger?

Unacceptable	11%
Relatively unacceptable	0%
Relatively acceptable	19%
Acceptable	64%
I could not judge	6%

6. Sex

Male	60%
Female	40%

7. Age: _____ (mean = 37)

Date and time: _____

Interviewer: _____

Discussion. The vast majority of respondents reveal that they would be bothered by the norm violation, with 76% saying they would be bothered "a lot" or "quite a lot." At the same time, among those respondents, less than half state they would be willing to punish the litterer, mostly out of fear of being engaged in a fight or generally creating tension. This finding gives credibility to a basic premise of our study, namely that direct punishment of norm violators generally is perceived as a costly action in expectation.

A further interesting insight from the surveys is the distribution of responses in the two different versions of question 5, which asked respondents about the degree of social acceptability they

attribute to the (hypothetical) norm violators and punishers. In line with the finding that norm violators are punished indirectly by means of help withdrawal in the experiment, the large majority judge the norm violation as “unacceptable” (64%) or at least “relatively unacceptable” (16%) behavior

from a social perspective. Norm enforcement, on the other hand, is viewed much more favorably by the surveyed individuals, even if this does not lead to more help being offered to norm enforcers compared with the baseline treatment BaseHelp.



Fig. S1. Norm violation (Act 1).

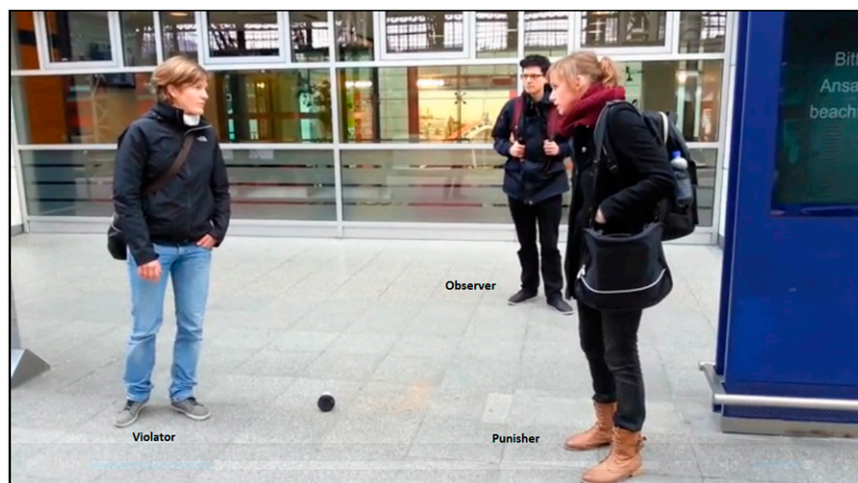


Fig. S2. Punishment (Act 2).

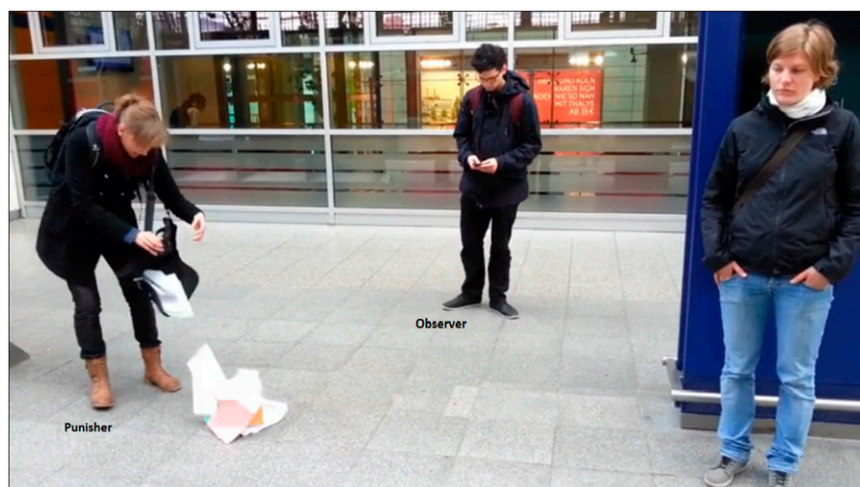


Fig. S3. Book drop (Act 3).

Table S1. Regression analysis, helping rates

Independent variable	Coefficient (SE)
HelpViolator	−0.254* (0.043)
HelpPunisher	0.013 (0.031)
Male observer	0.010 (0.054)
Age of observer	−0.008 [†] (0.003)
Male confederate	−0.169* (0.009)
<i>N</i>	341

Dependent variable: Help. It equals 1 if observer picked up at least one book and 0 otherwise. Probit regression, marginal effects reported, SEs in parentheses.

*Statistical significance at the 1% level.

[†]Statistical significance at the 5% level.

Table S2. Regression analysis, indirect punishment and sex

Independent variable	Coefficient (SE)
HelpViolator	−0.376 (0.254)
Male confederate	−0.197 (0.227)
HelpViolator × male confederate	−1.125 [†] (0.575)
Constant	−0.847* (0.132)
<i>N</i>	233

Dependent variable: Help. It equals 1 if observer picked up at least one book and 0 otherwise. Poisson log-linear regression, SEs in parentheses.

*Statistical significance at the 1% level.

[†]Statistical significance at the 5% level.