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【要旨】
社会における協力規範の醸成には第三者による自発的罰則が有効である。一方で、複数の第三者が同時に規範逸脱に直面した時には、第三者は互いに相手の行動にただ乗りをする誘惑に駆られる。本論文では、囚人ジレンマゲーム実験を行い行動データを収集することで、（A）第三者罰則に関する人々のただ乗り性向を分析するとともに、（B）第三者間での高度の罰則が果たす役割を考察した。人々の第三者としての罰則行動には血族関係の強さや文化が影響すると主張する人類学・理論生物学・経済学の知見をもとに、その度合いが強いと知られる『インド』と、弱いと知られる『英国』の二地域を研究実施地に選び実験を行った。実験結果によると、どちらの社会でも、囚人ジレンマゲームで裏切りを選択しパートナーを搾取したものが強い罰則を受け、また、そのような罰則を科さなかった第三者は別の第三者から高次の罰則を受けた。一方で、地域間比較の分析からは、英国における第三者罰則がインドよりも強いという結果が得られた。この行動パターンは、祖先からの血縁関係が弱い社会ほど第三者罰則性向が強いと主張する人類学・理論生物学・経済学における主張と整合的である。一方で、同文献における主張や社会的選好理論とは異なり、「グループサイズ効果」に関するインドと英国での明確な違いも確認された。英国では、第三者は、他の第三者が複数いる環境では他の第三者にただ乗りをする性向を持つ（自身は罰則額を減らそうとする）一方で、インドでは、第三者は、他の第三者が周りにいることによって自身が罰則額を増やそうとする性向があった。

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Collective Sanction Enforcement: New Experimental Evidence from Two Societies

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Abstract: Sanction enforcement offers the potential to mitigate free riding on punishment among multiple third parties. Cross-societal differences in the effectiveness of sanction enforcement may be explained by factors rooted in cultural evolution. This paper provides the first experiment to study third-party enforcement of punishment norms with and without opportunities for higher-order punishment by selecting two different societies in terms of the degree of ancestral kinship ties: India and the United Kingdom. In both societies, third parties strongly inflict punishment when they encounter a norm violation, and a third party's failure to punish the norm violator invites higher-order punishment from their fellow third parties. These behavioral patterns are consistent with a model of social preferences and literature from anthropology and theoretical biology. On the other hand, two clear cross-societal variation emerges. First, third-party enforcement is stronger in the UK than in India. Parallel to this behavioral pattern, a supplementary survey also validates the conjecture that people in a society with looser ancestral kinship ties (the UK) are relatively more willing to engage in pro-social punishment. Second, intriguingly, the group size effect varies across the two societies: whereas third parties free ride on others' punitive acts in the UK, they punish more when in the presence of other third parties in India.

JEL codes: C92, H41, D01, D91

Keywords: Experiment; Cross-societal variation; Public Goods; Third-party punishment; Higher-order

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1. Introduction

How to achieve cooperation in society remains an enduring question in the social sciences. Societal cooperation and self-governance can be achieved without a centralized governing body if the threat of punishment is strong enough (Ostrom, 1990). Informal punishment inflicted by independent parties helped in promoting cooperation and trust before the emergence of states, such as in medieval Iceland and Europe, gold rush California (e.g., Hadfield and Weingast, 2013), and agency relations between Maghribi traders in the eleventh century (e.g., Grief, 1993). More recently, decentralized punishment underpinned trading agreements among nonstate firms in Vietnam at the end of the twentieth century (McMillan and Woodruff, 1999a, b), and substituted for formal institutions during warfare among nomadic societies in East Africa (Mathew and Boyd, 2011). Voluntary altruistic sanctions to enforce social norms are also prevalent on social media platforms.[1] Due to its importance, recent theoretical research has studied how costly (third-party) norm enforcement may sustain cooperative behaviors in societies or organizations (e.g., Acemoglu and Wolitzky, 2020, 2021; Dixit, 2003; Levine and Modica, 2016; Acemoglu and Jackson, 2017). However, there is little empirical work on the *coordination* of decentralized collective punishment, i.e., punishment where there is no direct material gain to the norm enforcer.

Norm enforcement by uninvolved parties is a second-order public good, typical for a collective action problem (Olson, 1965; Ostrom, 1990). As free-riding problems can arise in third parties' sanctioning behaviors, to ensure efficient punishment, it is necessary to establish institutions that assist them in coordinating punitive acts. Existing theory thus emphasizes the role of second-order punishment: punishment of the failure to sanction a norm violator (e.g., Acemoglu and Wolitzky, 2020, 2021; Axelrod, 1986; Hadfield and Weingast, 2013; Hechter, 1987; Henrich, 2004; Henrich and Boyd, 2001) or punishment for committing an unjustified punishment act (e.g., Kamei and Putterman, 2015). However, it is *a priori* unclear how serious free riding among multiple third parties would be and how second-order norm enforcement among third parties mitigates free riding or deters anti-social punishment of a cooperator.[2]

To address this question in a setting with high internal validity, a novel laboratory experiment was conducted to study higher-order sanction enforcement among uninvolved individuals in anonymous interactions. In addition to providing the first empirical evidence on this issue, the paper contributes to the wider literature on norm enforcement in social dilemmas by carefully implementing a cross-societal design. Prior research by social scientists has found that human altruistic tendencies differ markedly across societies and reflect the emergence of variable norms and institutions over time (e.g., Herrmann *et al.*, 2008; Henrich *et al.*, 2006; Marlowe *et al.*, 2008; Henrich *et al.*, 2010). Further, recent research has

[1] Consider online content moderation and information sharing, which is often conducted voluntarily by a subset of community members with no direct benefit to the act of enforcement for any one individual. The prevailing norms and the quality of information on digital platforms rely on sanction enforcement, another public good.

[2] While there is a rich research agenda on higher-order punishment in the context of direct (peer-to-peer) punishment, i.e., norm enforcement by involved parties, which has been shown to either drastically undermine or effectively boost cooperation norms (e.g., Denant-Boemont *et al.*, 2007; Nikiforakis, 2008; Hopfensitz and Reuben, 2009; Kamei and Putterman, 2015), surprisingly there is no experimental research on higher-order enforcement among third parties.

revealed systematic variation in the perceived restrictiveness ("tightness") of social norms in different societies (e.g., Gelfand *et al.*, 2011; Harrington and Gelfand, 2014).[3] The evidence suggests that differences in the historical tightness of kin-based institutions across countries persist till the present day (Schulz *et al.*, 2019). In a breakthrough study, Enke (2019) linked cross-cultural data sets and information in the Ethnographic Atlas to argue that contemporary societies with loose ancestral kinship ties may display a greater willingness to engage in third-party punishment than those societies with historically tight kinship ties. Building on these observations, the present study provides new evidence on cross-societal variation by selecting two societies at opposite ends of the tight-loose kinship spectrum (Enke, 2019): India, a country with relatively tight ancestral kinship ties, and the United Kingdom (UK), a country with relatively loose ancestral kinship ties.

In the experiment, groups of two players engaged in a cooperation dilemma in the presence of either a single third party or multiple third parties. The distinctive feature of the design is that it varies across treatments the number of third parties confronted with a norm violation *and* the opportunities available to third parties to punish each other after observing their peers' norm enforcement acts (i.e., the availability of higher-order norm enforcement). The experimental results reveal three intriguing cross-societal differences in punishment.

First, third parties punish a norm violator in the cooperation dilemma significantly more frequently and strongly in the UK than in India, and this behavioral pattern is correctly anticipated by people in each society. Second, different group size effects are detected across the two societies. In the UK, a third-party punishment of a norm violator is significantly *less* frequent and *less* strong when there are other third-party peers confronting the norm violation. Thus, consistent with the theoretical research, the availability of higher-order punishment opportunities plays a crucial role in resolving the free-riding dilemma among third parties. On the other hand, in India, the *opposite* group size effect emerges in that having fellow third parties present *encourages* a third party to punish a norm violator significantly more frequently and more strongly. Having higher-order sanction enforcement opportunities does not alter this pattern. Third, "efficient" higher-order enforcement, i.e., punishment of a third party's failure to punish a norm violator or of their "mis-directed" punishment in the primary cooperation dilemma, is more prevalent in the UK than in India.

The cross-societal differences in the relative strength of pro-social first-order punishment and efficient higher-order enforcement quantitatively support Enke's (2019) conjecture that people in a contemporary society with loose ancestral kinship ties (the UK) display a greater willingness to engage in pro-social (first-order) and efficient (higher-order) altruistic punishment acts relative to those in a contemporary society with tight ancestral kinship ties (India). There is evidence to suggest that the cross-societal difference in the group size effect can be explained by cooperation/trust. A survey conducted as a part of the experiment project indicates that generalized trust underpins productive economic interactions

[3] In his book, "The WEIRDest People in the World," Henrich (2020) discussed the evolutionary approaches to explaining this variation, such as the kin-based morality versus universalist morality theme.

in loose kinship societies, but not in tight kinship societies; however, the relationship in the former is fragile when third-party peers are present, due to free-riding tendencies.

The findings of this study significantly advance our understanding of the conditions under which decentralized collective punishment is likely to be effective at promoting cooperative behaviors when there is no direct material gain to the enforcer and provide useful policy implications. Under these conditions, in a society with loose ancestral kinship ties, free riding on punishment may arise among third parties. Thus, appropriate higher-order institutions should be in place to deter free riding. While in the experiment the higher-order institution was implemented as a costly punishment action, in practice the higher-order institution may also constitute social rewards (e.g., “Likes” on social media platforms). Under this interpretation, the threat of second-order peer punishment - or the anticipation of peer rewards - may sustain social norm enforcement in large groups; the relative strength of each remains an open empirical question.

The cross-societal component of this study, however, suggests caution in generalizing about free riding tendencies and desirable policies across diverse populations: although punishment is a second-order public good, the results presented here suggest that in a society with tight ancestral kinship ties, introducing multiple third parties may even *reduce* free-riding on punishment, which could be driven by the baseline level of norm enforcement. In such cases, introducing a mechanism to increase the number of independent third parties – perhaps through increased visibility of transactions – may improve cooperative behavior. This finding has broader implications for the study of cooperation, sanction enforcement, and social norms: researchers should more carefully consider the effects of culture and historical backgrounds in determining contemporary patterns of sanction enforcement and designing desirable policies to promote pro-social norms.

A central challenge for policymakers and researchers is to design institutions that can successfully coordinate the actions of diverse actors to enforce cooperative behaviors (Ostrom, 2010). Previous experimental work in the public goods literature has considered the coordination of direct punishment by *involved* individuals to improve cooperation and deter anti-social punishment. A coordination mechanism that has to date been found quite effective in repeated interaction settings is a democratic commitment to a particular punishment rule (e.g., Ertan *et al.*, 2009; Kosfeld *et al.*, 2009; Sutter *et al.*, 2010; Dal Bó *et al.*, 2010; Putterman *et al.*, 2011; Andreoni and Gee, 2012; Markussen *et al.*, 2014, Kamei *et al.*, 2015; Ambrus and Greiner, 2019; Nicklisch *et al.*, 2016; Fehr and Williams, 2018). However, voting institutions may be less effective in coordinating punishment to sustain cooperation when there are heterogeneous actors (Noussair and Tan, 2011) or in one-shot settings (see Van Miltenburg *et al.*, 2014). Moreover, such democratic institutions may not be available for coordination among *uninvolved* parties. The present study is the first to study an alternative higher-order punishment mechanism to coordinate decentralized collective punishment among multiple uninvolved individuals in anonymous one-shot interactions, such as online, where alternative sanctioning mechanisms may not be feasible to implement and where there is no fear of retaliation (for example, because anonymity precludes reputation building). The experiment data demonstrate that such a coordination mechanism can be effective in certain contexts, without relying on formal institutions.

The rest of the paper proceeds as follows: Section 2 briefly explains the related literature, and Section 3 summarizes the experimental design and implementation. Section 4 formulates hypotheses based on theoretical analyses and related literature (the details of the theoretical analyses can be found in Appendix B). Section 5 reports the results, and Section 6 concludes.

2. Related Literature

This study speaks to and builds upon two branches of the literature: (a) third-party enforcement of social norms, and (b) direct (peer-to-peer) punishment.

Third-party Enforcement of Social Norms. Most research uses a prisoner's dilemma game to examine norm enforcement. In their seminal study, Fehr and Fischbacher (2004) found that third parties are willing to incur a private cost to punish a defector who exploited a cooperator. Several subsequent experiments confirmed the robustness of human third-party punishment tendencies by varying the experimental environment. First, third-party punishment tendencies have been seen to be stronger for in-group than out-group settings (e.g., Bernhard *et al.*, 2006; Lieberman and Linke, 2007) and when their acts are observed rather than anonymous (e.g., Kurzban *et al.*, 2007; Kamei, 2018). Second, while Fehr and Fischbacher (2004) demonstrated that third-party punishment is driven by outcome-based preferences, such as inequity aversion (Fehr and Schmidt, 1999), it is also driven by emotions, such as anger (Nelissen and Zeelenberg, 2009). Third, while most experiments were held for adults, the willingness of others to take costly action to enforce cooperation norms is also widespread among children (e.g., Lergetporer *et al.*, 2014; McAuliffe *et al.*, 2015). Fourth, a third party inflicts stronger punishment on a norm violator when s/he is democratically elected than otherwise (e.g., Marcin *et al.*, 2019). Fifth, while third-party punishment is ubiquitous, its tendencies differ by society (e.g., Henrich *et al.*, 2006; Marlowe *et al.*, 2008; Henrich *et al.*, 2010). Sixth, two recent papers, Martin *et al.* (2019) and Krügel and Maaser (2020), examined how the punishment decision of a third party is judged and is punished by an uninvolved bystander ("fourth party"), both finding that failure to punish the respective norm violation is punished by a fourth party.

Although there are many experiments on third-party punishment, all except Kamei (2020) were conducted by letting a single third-party player face a norm violation. In contrast, Kamei (2020) studied third-party punishment when multiple third parties are faced with a norm violation in a small-scale experiment. Third-party punishment was still observed in such environments. The present experiment explores for the first time the tendency of *higher-order* punishment *among third parties*, such that higher-order punishment acts *are also subject to free riding*. This study is novel as the experiment is conducted at two different societies in terms of the degree of ancestral kinship ties, considering that Enke (2019) proposes that societies with loose ancestral kinship ties display a greater willingness to engage in third-party rather than peer-to-peer punishment. To the best of the authors' knowledge, no study has previously compared third parties' free-riding and higher-order sanction enforcement tendencies across societies.

Direct (Peer-to-peer) Punishment. Although higher-order enforcement among third parties is to date understudied, higher-order punishment has been examined in the context of direct (peer-to-peer) punishment. A typical experimental design in this area adopts a repeated public goods game setup that includes additional punishment opportunities among peers immediately after a direct punishment stage (Fehr and Gächter 2000, 2002). Higher-order punishment has two opposing effects. On the one hand, human motives for revenge may lead to counter-punishment, thereby worsening group atmospheres and cooperation norms (e.g., Denant-Boemont *et al.*, 2007; Nikiforakis, 2008; Bolle *et al.*, 2014; Nikiforakis and Engelmann, 2011). On the other hand, efficient higher-order punishment acts, i.e., punishment of those who failed to punish a norm violation, and punishment of those who committed "mis-directed" punishment (e.g., punishing a cooperator), or the mere visibility of punishment acts, may help discipline punishment activities and promote cooperation norms (e.g., Denant-Boèmont *et al.*, 2007; Kamei and Putterman, 2015; Fu *et al.*, 2017). Revenge is not applicable to the context of higher-order punishment among third parties, as the third parties are not the victims of a norm violation in the primary cooperation problem. The efficient form of higher-order punishment act described above, however, remain relevant if the punitive phenomenon is driven by humans' other regarding preferences (see, e.g, Fehr and Schmidt [2006] and Sobel [2005] for a survey). Thus, similar positive effects of sanction enforcement may emerge in the context of third-party punishment when higher-order punishment is allowed.

3. Experimental Design and Implementation

The experiment is designed based on a prisoner's dilemma game with third-party punishment (Fehr and Fischbacher, 2004; Kamei, 2020). Three treatments are designed by changing the number of third parties per group and the possibility of higher-order punishment among third parties. The three treatments are named as the "Baseline", "Trio", and "Higher-Order" treatments. Groups in the Baseline treatment have three subjects each, while groups in the Trio and Higher-Order treatments have five subjects each. Two subjects in each group are randomly assigned to play a prisoner's dilemma game – the PD players hereafter, and the rest (either one or three depending on the treatment) are assigned the role of a third-party player.[4] The experiment begins with a stage in which the PD players decide whether to cooperate (Section 3.1). This is the same for all treatments, after which third parties make punishment decisions. The punishment stage differs by the treatment (Section 3.2).

3.1. Prisoner's Dilemma Game

Two PD players are endowed with 40 points each (5 points = £1), and then simultaneously decide whether to send 16 points to one another. Amounts sent will be tripled and become the payoff of the recipient. This is the only decision to make for the PD players. The possible payoffs of the two PD players can be summarized in the form of payoff matrix in Figure 1. This framing of the prisoner's dilemma game is frequently adopted in the experimental research on third-party punishment (e.g., Fehr and Fischbacher, 2004; Kamei, 2020).

The PD player who sent (did not send) 16 points is called a "cooperator" ("defector") hereafter. The third-party players have no decision to make in this stage. They are instead asked to submit their belief, in increments of 10 percentage points, about the percentage of cooperators in the groups that they

[4] The PD player is called Player A, while the third-party player is called Player B in experiment instructions.

do not belong to.[5,6] They can earn one point if the difference between their guess and the actual percentage is less than or equal to five percentage points.

Figure 1: *Payoff Matrix in the Prisoner's Dilemma Game*

		Player 2	
		Send	Not send
Player 1	Send (cooperate)	(a) 72, 72	(c) 24, 88
	Not send (defect)	(b) 88, 24	(d) 40, 40

This stage is called "Stage 1" in the experiment instructions. Once PD players make sending decisions and third-party players submit their beliefs, Stage 2 begins. The PD players' decisions to send remain anonymous throughout. In Stage 2, third-party players make punishment decisions utilizing a strategy method (Section 3.2).

3.2. Third Parties' Decisions

Third-party players are each endowed with 60 points in the experiment. In Stage 2, they decide how many punishment points they wish to assign to each of the two PD players in their own group under each contingency (in the Trio and Higher-Order treatments, three third parties in each group simultaneously and independently make the punishment decisions). Specifically, they make four decisions as there are four possible interaction outcomes in Stage 1 regarding the following:[7,8]

(a) how many punishment points to impose on a *cooperator* (a PD player who sent 16 points) while the other PD player is also a *cooperator*.

(b) how many punishment points to impose on a *defector* (a PD player who did not send 16 points) while the other PD player is a *cooperator*.

(c) how many punishment points to impose on a *cooperator* while the other PD player is a *defector*.

(d) how many punishment points to impose on a *defector* while the other PD player is also a *defector*.

A third-party player can assign up to ten punishment points (in increments of 2s) to a PD player in each scenario. For each punishment point assigned, the punisher needs to pay one point, but the payoff of the recipient (PD player) is then reduced by three points. The cost ratio of 1:3 is commonly used in

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[5] The inclusion of the task helps make subjects equally busy in the experiment, thereby retaining high anonymity.
[6] The two PD players' decisions in their own group are excluded from the reference group to avoid hedging.
[7] Third-party punishment decisions are known to be robust to using the strategy method (e.g., Jordan *et al.*, 2016).
[8] The four questions are randomly ordered on a computer screen that a third-party player sees, to control for the possibility of spill-over effects between scenarios.

third-party punishment experiments (e.g., Fischbacher and Fehr, 2004; Kamei, 2020). Scenarios (a), (b), (c) and (d) are referred to as "mutual cooperation", "betrayal", "victim", and "mutual defection," respectively. Punishment of a PD player in the "betrayal" or "mutual defection" scenario is called "pro-social," while third-party punishment in the "mutual cooperation" or "victim" scenario is called "anti-social".[9] There are no decisions for PD players to make in Stage 2. They are instead asked to submit their belief about the average number of punishment points assigned by third parties in each of the four scenarios, in the groups they do not belong to.[10]

Decisions in two of the four scenarios will be applied based on the two PD players' actual sending decisions in their own group. For example, if (cooperate, defect) is the realized outcome, the third-party player's decision in "victim" and "betrayal" will be applied. The third-party players (PD players) will not be informed of which scenarios are realized (how they are punished) until the decision-making portion of the experiment ends. The decision-making experiment is over once Stage 2 ends in the Baseline and Trio treatments. In contrast, there is an additional stage (Stage 3) for higher-order punishment among third parties in the Higher-Order treatment.

In Stage 3 of the Higher-Order treatment, each third-party player will be presented with 30 possible scenarios from Stages 1 and 2 in sequence; and they will then decide how to reduce the payoffs of the other two third-party players in their own group based on their punishment decisions in Stage 2 (see Appendix A.4 for a screen image of one scenario). The punishment technology is the same as in Stage 2: the punishment points to another third-party player is from {0, 2, 4, 6, 8, 10} and the cost ratio is 1:3. 30 scenarios include (a) 29 randomly constructed hypothetical scenarios by the computer and (b) one real one, in which third parties' Stage 3 punishment decisions will be applied to determine the final payoffs of the three third parties in their group.[11]

Considering the literature on direct punishment (Section 2), it can be assumed that both higher-order punishment of those who failed to punish a norm violation, and of those who committed "mis-directed" punishment, i.e., punishing a cooperator, may undermine the establishment of first-order punitive norms that encourage socially optimal PD interactions. For this reason, higher-order punishment from i to j when j pro-socially punished a defector less than i in "betrayal" or "mutual defection," or when j anti-socially punished a cooperator more than i in "mutual cooperation" and "victim" are called "efficient" higher-order punishment. In all other cases, higher-order punishment is referred to here as "inefficient."

There are no decisions for PD players to make in Stage 3. To retain high levels of anonymity, and also to collect the data on prevailing norms, they are instead presented with 30 possible scenarios from Stage 1 and 2 that third-party players in other groups were presented. They are then asked to submit their

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[9] In the experimental literature on punishment, the anti-social/pro-social classification is usually made by taking the punisher's own contribution into account (e.g., Herrmann *et al.*, 2007). This paper simply defines that punishing any cooperator in a one-shot PD is anti-social and punishing any defector is pro-social without considering a third party's payoff, because the third party is not materially affected by the PD interactions.
[10] The presence of the task makes subjects equally occupied in Stage 2. See footnote 7 also.
[11] For "mutual cooperation" and "mutual defection", the scenario is applied twice, once for each of the PD players; for "betrayal" and "victim", there are two real scenarios, each of which is applied once.

beliefs regarding how the third-party players will inflict punishment in Stage 3. Four out of 30 scenarios will be randomly selected for payment based on the accuracy of the guesses.[12]

3.3. Payoffs

The payoff of a PD player depends on their own sending decision, their partner's sending decision and first-order punishments given by third-party player(s) in their own groups. If the payoff is negative, it is set at zero. The payoff of PD player $i \in \{1,2\}$ is therefore expressed by:

$$\pi_i = \max\{\pi_{1,i} - 3p_i, 0\}, \tag{1}$$

where $\pi_{1,i}$= 72, 88, 24, or 40 (Stage 1 payoff), p_i is punishment points received by i, and $p_i = \sum_{j=3}^{n} p_{j\to i}$, where $p_{j\to i}$ is punishment from third-party player $j \in \{3,4,5\}$ to PD player i and n is the group size, i.e., n = 3 for the Baseline treatment (n = 5 for the Trio and Higher-Order treatments).

By contrast, the payoff of third-party player j depends on their punishment activities, and is expressed as follows:

$$\pi_j = 60 - \textstyle\sum_i p_{j\to i} \text{ for the Baseline and Trio Treatments; and}$$

$$\pi_j = \max\{60 - \textstyle\sum_i p_{j\to i} - \sum_k pp_{j\to k} - 3\sum_k pp_{k\to j}, 0\} \text{ for the Higher-Order treatment,} \tag{2}$$

where $pp_{j\to k}$ is second-order punishment from third-party player j to k.

As shown in Equations (1) and (2), the payoff is set at zero if their payoff is negative due to punishment activities.[13] As explained in Section 3.2, both PD players and third-party players can earn additional points from the questions about beliefs.

3.4. Additional Data Collection

This experiment consists of three parts. In Part 1, all subjects take a short intelligence test consisting of 12 questions –see Appendix A.1 for the instructions. The questions are taken from Raven's progressive matrices (see Raven, 2000). A total of 40 seconds is allocated to complete each question. The subjects can earn one point for every correct answer, while they are not penalized for wrong answers. Part 2 begins after everyone finishes the intelligence test; this part is the decision-making experiment summarized in Sections 3.1 to 3.3. Part 3 is a post-experiment questionnaire, which includes a battery of questions from contemporary surveys that measure moral variables –see Appendix A.5 for details of the questionnaire.

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[12] Each scenario askes two guessing questions as there are two targets for each third-party player. If the difference between guess about average punishment points and the peers' actual punishment points is less than or equal to one point, they will receive one point. Since four scenarios will be used for payments, they can earn up to eight points.
[13] It is commonly set that an experimenter does not take money from a subject even if the subject receives a negative payoff in experiments on decentralized punishment in general —see, e.g., Fehr and Gächter (2000, 2002) for direct punishment, and Fehr and Fischbacher (2004) and Kamei (2020) for third-party punishment.

3.5. Experimentation

3.5.1. Selection of the Two Societies

Prior research suggests that the extent to which people in pre-industrial societies were embedded in extended and interconnected family networks is positively related to societal patterns of cooperation and trust for in-groups, and inversely related to the willingness of people to engage in productive economic interactions with strangers (see, e.g., Alesina and Giuliano, 2013). The present research uses a conventional lab experiment and targets two theoretically relevant subject pools to measure punitive tendencies. This approach has an advantage that enables us to achieve the highest internal validity of a laboratory setup.

Selection of the two societies (India and the UK, see Figure 2) for the present experiment was based on the observation that these differences in the organization of economic activities across societies may have engendered different moral systems to regulate behavior. Building on ethnographic datasets (Murdock, 1967; Giuliano and Nunn, 2018), Enke (2019) constructed a normalized index of historical kinship tightness (scale from zero to one) and mapped the index to contemporary country-level population distributions. Historical kinship tightness is found to be a strong predictor of variation in contemporary cross-country moral behaviors. People in societies with loose ancestral kinship ties (index score < 0.25) are relatively more willing to engage in third-party punishment relative to direct (peer-to-peer) punishment.

To explore cross-societal differences in sanction enforcement further, two countries classified as "loose" or "tight" based on Enke's (2019) kinship tightness index were selected for the present study: the UK (index score of 0.023) and India (index score of 0.776). There were two practical reasons for selecting these societies in which to implement the experiments: (a) strong English language abilities in India,[14] and (b) the access to an established behavioral economics laboratory that ensures high internal validity in each research site. To check whether the subjects in these two locations have different tendencies consistent with the literature, as shown in Table 1, z-scores of stated willingness to engage in third-party relative to direct punishment for the selected societies were calculated based on responses to survey questions from the GPS, implemented in the post-experiment questionnaire (Part 3 of the experiment). It shows that, consistent with the observation in Enke (2019), respondents in the UK report a greater willingness to engage in third-party punishment relative to direct punishment. This suggests that subjects in the two research sites exhibit the expected cross-country differences in attitudes towards sanction enforcement.

[14] India is the largest member state of the Commonwealth, an association of countries which are connected through their use of the English language and shared democratic values. Maintaining some similarities on these dimensions is desirable to explore the relationship between historical kinship tightness and punitive behaviors.

(a) Contains OS data © Crown copyright and database right (2023); (b) Made with Natural Earth.

(a) UK (Newcastle) (b) India (Sonipat)

Figure 2: *Selection of the Two Societies*

Table 1: *Kinship Tightness and Stated Punishment Preferences in the Experiment Sample*

Society	UK (Newcastle)	India (Sonipat)	Difference
a. Kinship tightness index (Enke 2018)	0.023	0.776	
b. Third-party vs. direct punishment (Experiment sample)	0.086	-0.078	-0.164**

Notes: Row *a* is computed based on the country-level score published in Enke (2018). Row *b* is a z-score constructed based on subjects' responses to post-experiment survey questions from the GPS in the present experiment (see Appendix A.5 for details on construction of this variable). The Diff column is the coefficient of a linear regression of society on the variable for our experiment sample (N=501). Stars indicate whether this difference is significant. ** two-sided p <0.05.

3.5.2. Implementation

The experiment sessions were conducted face to face at the Experimental and Behavioural Economics Laboratory, Newcastle University in Newcastle upon Tyne, the UK, from December 2021 to June 2022, and at the Behavioural Laboratory, Ashoka University in Sonipat, India from April to October 2022. Subjects voluntarily registered for and participated in the experiment sessions.[15] No subject participated in more than one session. The experimental procedures were identical at the two research

[15] Invitations were sent using *hroot* (Bock *et al.*, 2014) in Newcastle, and via campus advertisements in Sonipat.

sites. The number of subjects in Newcastle is 254, and that in Sonipat is 262 (Table 2).[16] To check whether key demographic information is balanced between the two subject pools, the information on gender and academic major was collected from the subjects. The percentages of female subjects nor economics majors are significantly different between India (Sonipat) and UK (Newcastle).[17] Further, the two universities are highly selective in their admissions processes. The average score of Raven's progressive matrix supports this assumption: the average score in Newcastle was 5.34, insignificantly different at two-sided p = 0.646 (Mann-Whitney test) from that in Sonipat, 5.17 – see Appendix Figure C.1. This implies that cognitive ability is also balanced between the two research sites.

The experiment was computerized based on oTree (Chen *et al.*, 2016). As explained, there are three parts (Part 1, Part 2 and Part 3) in the experiment. At the onset of each part, subjects were given instructions for that part only; and were given instructions for the next part only after the current part was over.[18] The experiment sessions lasted around 60 minutes on average. The average per-subject payments were £14.93 pounds sterling in Newcastle and INR 1022 Indian Rupees (approx. £10.20 at the prevailing exchange rate) in Sonipat, respectively.[19]

Table 2: *Treatment and Number of Subjects*

Treatment	# of third parties per group	Higher-order punishment	# of subjects	# of groups
A. United Kingdom (Newcastle)				
Baseline	1	No	69	23
Trio	3	No	90	18
Higher-Order	3	Yes	95	19
Total	---	---	254	60
B. India (Sonipat)				
Baseline	1	No	57	19
Trio	3	No	105	21
Higher-Order	3	Yes	100	20
Total	---	---	262	60
Total	---	---	516	120

[16] Sessions were conducted with an aim to collect around 20 independent observations per treatment in each subject pool. One session of 15 subjects for the Higher-Order treatment in Newcastle experienced a server outage at the end of the 27th scenario in Stage 3. For this reason, data for the final three scenarios and for the post-experiment questionnaire are missing for these subjects.

[17] The percentage of female subjects in Newcastle was 48.9%, which is not significantly different at two-sided p = 0.209 (Fisher exact test) from that in Sonipat, 43.3%. The percentages of economics majors are 30.4% and 29.5% in the two samples, respectively; these two percentages are not significantly different according to two-sided p = 0.845 (Fisher exact test).

[18] This kind of gradual learning is often used in an experimental design with many components or with complex decisions to avoid cognitive overload (e.g., Ertan *et al.*, 2009; Kamei *et al.*, 2015).

[19] The payment size in each subject pool was decided following the laboratory norm in each research site. The minimum daily wage for skilled labour in Haryana state (in which Sonipat is located) at the time of experiment was INR 503 (https://storage.hrylabour.gov.in/uploads/labour_laws/Y2022/Oct/W2/D14/1665746988.pdf, last accessed April 2023).

4. Hypotheses

Standard theoretical predictions based on players' self-interest and common knowledge of the self-interested preferences are straightforward in this experiment as third-party punishment is costly and non-enforceable. The logic of backward induction can be applied to all the three treatments. First, in the Baseline treatment, a third-party player inflicts no punishment on a PD player in the second stage (final stage) as punishment activities cost the punisher. Knowing this, it is privately optimal for the PD player to defect. Second, this prediction of the Baseline treatment does not change when there are three third parties per group, as again no third parties punish their PD players due to the costliness of punishment acts. Thus, in the Trio treatment, defection continues to be the strictly dominant strategy for the PD players. Lastly, the possibility of third parties' higher-order punishments does not change anything, as it is costly for a third party to higher-order punish another third party. The Higher-Order treatment is essentially the same as the Trio treatment for self-interested players, due to the no higher-order punishment activities.

Hypothesis 1 (Self-interested preferences): *(a) Every PD player chooses to defect (i.e., not to send 16 points to each other) in the first stage. (b) Third parties neither first-order punish PD players nor higher-order punish their fellow third parties in the punishment stages.*

As summarized in Section 2, experiments over the past 20 years have consistently documented that third parties do inflict altruistic punishment, thereby enforcing cooperation norms effectively under certain conditions (e.g., Fehr and Fischbacher, 2004). This is inconsistent with Hypothesis 1. Although there are several social preference theories in the behavioral literature (for surveys, see Sobel, 2005; Fehr and Schmidt, 2006), inequality-averse preferences are known to explain such punishment behaviors effectively (e.g., Fehr and Fischbacher, 2004; Kamei, 2020). Online Appendix B summarizes theoretical analyses conducted to obtain insights for subjects' behaviors in the present experimental framework, using the inequity-averse preference model by Fehr and Schmidt (1999):[20]

$$U_i(x) = \pi_i - \frac{\alpha_i}{n-1}\sum_{j\neq i}\max\{\pi_j - \pi_i, 0\} - \frac{\beta_i}{n-1}\sum_{j\neq i}\max\{\pi_i - \pi_j, 0\}, \quad (3)$$

where n is the number of players per group (= 3 or 5), x is the list of the n players' payoffs, α_i indicates player i's aversion to disadvantageous inequality, while β_i indicates player i's aversion to advantageous inequality, satisfying $\beta_i \leq \alpha_i$ and $0 \leq \beta_i < 1$. An analysis focused on symmetric equilibria provides four useful lessons.

First, unlike Hypothesis 1, some PD players choose to cooperate with their paired PD players, driven by their inequality concern or by the threat of punishment. Second, third parties only inflict punishment on their PD players in the "mutual cooperation," "victim" and "mutual defection" scenarios under very stringent conditions.[21] On the other hand, they are more likely to inflict punishment on a PD

[20] The theoretical analyses extend the approach of Kamei (2018). In Appendix B, the four scenarios in the prisoner's dilemma game, "mutual cooperation," "victim," "betrayal," and "mutual defection," are denoted as, respectively, scenarios CC, CD, DC, and DD, for consistency with the mathematical expressions.

[21] More precisely, it predicts that a third party never punishes a PD player in the "victim" and "mutual defection" scenario in all three treatments. In contrast, the third party is predicted to punish a PD player in the "mutual cooperation" scenario if and only if $\alpha_i > 2$ in the Baseline treatment, and $\alpha_i/2 + \beta_i > 2$ in the Trio and Higher-

player in the "betrayal" scenario if they are sufficiently averse to inequality in each treatment condition.[22] The behavioral patterns just described fit quite well with prior related experiments on third-party punishment with a single third-party player (e.g., Fehr and Fischbacher, 2004) as well as with multiple third-party players (Kamei, 2020). Third, punishment of a "betrayal" defector per third-party player is weaker in the Trio and Higher-Order treatments than in the Baseline treatment. This tendency is the so-called "group size effect" similar to Olson (1965): having multiple third parties triggers incentives among third parties to free ride on the peers' punishment acts. Fourth, a comparison between the Trio and Higher-Order treatments suggests that higher-order punishment opportunities do not affect any predicted behaviors in the Trio treatment. Notice that, in any symmetric equilibrium of the Trio treatment, using higher-order punishment opportunities worsens inequality, as higher-order punishment activities reduce the payoffs of the punisher and the punished, thus making a deviation from the no punishment situation unbeneficial.

Hypothesis 2 (Social preferences): *(a) Some PD players choose to cooperate (i.e., send 16 points to their paired PD players) in the first stage in each treatment. (b) Third parties are more likely to punish a defector in the "betrayal" scenario than in any other scenario. (c) The punishment of a defector is weaker in the Trio and Higher-Order treatments than in the Baseline treatment.*

The assumption of inequality-averse preferences does not postulate the higher-order punishment opportunities to alter or improve (first-order) punitive norms among third parties in groups as a symmetric equilibrium outcome. However, higher-order punishment behaviors can also be predicted under the assumption of social preferences, once deviating from the symmetry in behaviors (see Appendix B for the detailed mathematical analyses).[23]

First, under the assumption of inequality aversion, a third party's failure to (first-order) punish a defector invites higher-order punishments from their peers. Notice that when first-order punishments of a defector are heterogeneous in the "betrayal" scenario, a third party that punished less (informally, "non-punisher," hereafter) has an advantage in terms of interim payoff levels. Thus, the peers' higher-order punishment of the non-punisher mitigates inequality by decreasing the non-punisher's payoff advantage. Likewise, a non-punisher in the "mutual defection" scenario invites higher-order punishments from their peers due to receiving the highest interim payoff in the group after the first punishment stage. Higher-order punishment of the non-punisher thus again reduces inequality among the group members. Second, a third party's punishment of a cooperator in the "victim" scenario also invites higher-order punishments,

Order treatments – see Appendix B. The two conditions, $\alpha_i > 2$ and $\alpha_i/2 + \beta_i > 2$, are restrictive, however. Almost all people do not satisfy the conditions if using the distribution of α_i and β_i calibrated by Fehr and Schmidt (2010).

[22] A third party is predicted to punish a defector in the "betrayal" scenario if $\alpha_i + \beta_i/2 > 1$ in the Baseline treatment, and $\alpha_i/2 + 3\beta_i/4 > 1$ in the Trio and Higher-Order treatments. These conditions are less restrictive than the ones reported in footnote 23.

[23] These predictions on higher-order punishments are formally derived by examining how the average higher-order punishment amount in a given scenario (Figure B.4 for the "mutual cooperation" scenario, Figure B.6 for the "betrayal" and "victim" scenarios, and Figure B.8 for the "mutual defection" scenario) depends on their fellow third parties' punishment amounts in the second stage – see Remarks 1 to 4 in Appendix B.3.

because doing so reduces inequality between the cooperator (a person who receives a very low payoff) and the third parties.

These off-equilibrium predictions complement a substantial literature in theoretical biology and anthropology in which scholars argue for the emergence of free-riding problems in third parties' sanctioning behaviors when there are multiple third-party peers in a group. Existing theoretical work in this area emphasizes the role of efficient higher-order punishment among third parties to enforce pro-social first-order punitive norms. Such punishment takes a form of punishment of the failure to sanction a norm violator (e.g., Hadfield and Weingast, 2013; Axelrod, 1986; Henrich, 2004; Henrich and Boyd, 2001) or punishment for commission, i.e., inflicting unjustified sanctions (e.g., Kamei and Putterman, 2015). Axelrod (1986) used the term "meta-norm" to refer to the punishment of non-punishers, and Henrich and Boyd (2001) and Henrich (2004) argue that such punishments effectively stabilize cooperation. Higher-order punishment for commission is also crucial to maintain cooperation norms, as anti-social punishment is widespread in our societies (e.g., Herrmann *et al.*, 2007; Cinyabuguma *et al.*, 2006).

The theoretical analysis and these discussions on higher-order punishment can be summarized as Hypothesis 3 below:

Hypothesis 3 (Social preferences and arguments in theoretical biology and anthropology): *(a) A third party's failure to punish a defector invites higher-order punishment from their fellow third parties. (b) A third party's punishment of a cooperator invites higher-order punishment from the peers.*[24]

How do the third parties' punitive tendencies differ by society? As discussed in Section 3.5.1, the present experiment carefully selected two countries, India and the UK, with an aim to investigate cross-societal differences in people's punitive behaviors. The final hypothesis of the present experiment follows from the literature discussed therein.

Hypothesis 4: *(a) Subjects in the loose kinship society (the UK) display a greater willingness to engage in pro-social (first-order) and efficient (higher-order) third-party punishment acts relative to subjects in the tight kinship society (India). (b) Anticipating these variable punitive norms, PD players in the UK exhibit a higher inclination to cooperate than those in India.*

---

[24] A theoretical analysis using the social preference model does not always provide a reasonable prediction. As shown in Appendix B, it predicts perverse reactions among inequality-averse third parties in the "mutual cooperation" scenario, which is at odds with Hypothesis 3. Specifically, it states that a failure to inefficiently punish a cooperator in the second stage attracts more higher-order punishment from the peers. The mechanism is that in the "mutual cooperation" scenario, some third parties may wish to punish cooperators if they are strongly averse to inequality, as a cooperator receives the highest payoff after the first stage (72 > 60). However, the third parties then care about inequality between themselves and the non-punisher in the third stage. The predicted perverse reactions among third parties are at odds with well-known behavioral patterns and motives for punishment in the literature (e.g., Fehr and Gächter 2000, 2002, Denant-Boemont *et al.* 2007, Kamei and Putterman 2015).

5. Results

5.1. Cooperation and first-order punishment

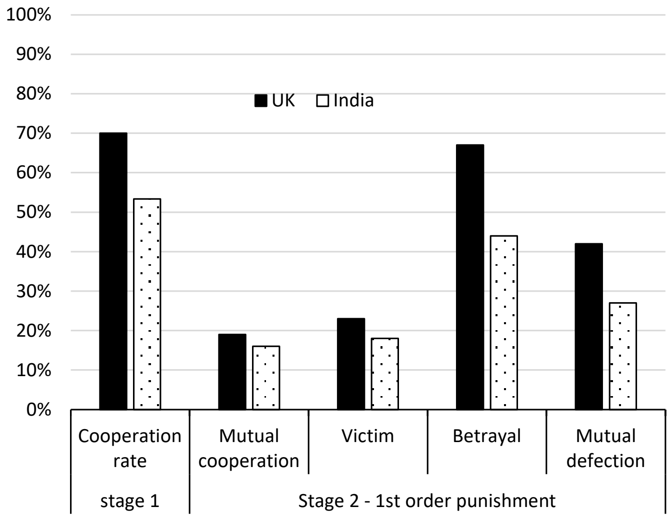
A first view of the cross-societal differences in cooperation and first-order punishment is summarized in Panel A of Figure 3. The numbers reported in this figure were calculated by using data from all three treatments so that the general patterns can be seen with the full dataset. An across-scenario comparison suggests two clear patterns that support the predictions from social preferences. First, consistent with Hypothesis 2.a (not Hypothesis 1.a), many PD players selected cooperation. The cooperation rates were more than 50%, which are significantly positive at two-sided $p < 0.001$ for both the subject pools.[25] Second, third-party punishment of a defector in "betrayal" is much more frequent and is stronger than in any other scenario for both the subject pools. The higher frequency and stronger punishment intensity in "betrayal" are both significant at the 1% level compared with any other scenarios for each subject pool – see Part A of Appendix Table C.1. This pattern is consistent with Hypothesis 2.b (not Hypothesis 1.b).

Two interesting cross-societal differences also emerge – see again Figure 3.A and also Appendix Table C.2. First, third parties' punishment of a defector in "betrayal" is more frequent and stronger in the UK (Newcastle) than in India (Sonipat). The differences are significant at the 1% level for both the punishment frequency and the per-third-party strength. In addition, punishment of a defector in "mutual defection" is significantly more frequent in the UK than in India at the 5% level. In sharp contrast, third-party punishment of a cooperator (whether in "mutual cooperation" or "victim") is slightly stronger in the UK than in India; the difference is not significant. Second, PD players' cooperation rate is larger in the UK (Newcastle) than in India (Sonipat) by more than 15 percentage points. The difference is significant at the 1% level. These cross-societal differences in cooperation and first-order punishment are in line with Hypothesis 4 that underlines the role of kinship tightness in affecting human altruistic punishment.

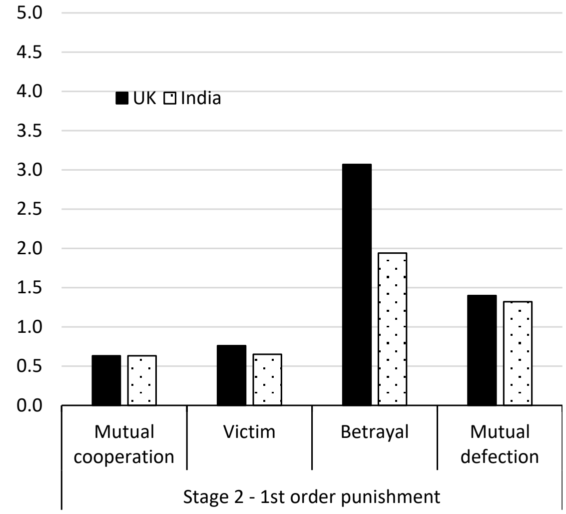
As explained in Section 3, third parties answered about their beliefs of PD players' decisions to cooperate in the first stage; and PD players answered their beliefs on third parties' punitive behavior in the second round. This provides a measure of empirical expectations about punishment norms in our experiment. Panel B of Figure 3 summarizes the average beliefs in the two stages. While the punishment anticipated was stronger than the actual decision in each scenario (Panel B.ii), qualitatively similar tendencies hold for beliefs (also see Part Bs of Appendix Tables C.1 and C.2). First, PD players in both research sites believed that third parties inflict punishment in "betrayal" significantly more frequently and significantly more strongly than in any other scenario. Second, PD players in the UK (Newcastle) anticipated significantly more frequent and significantly stronger third-party punishment in "betrayal" than those in India (Sonipat). Third, third parties in the UK anticipated significantly higher cooperation rates among PD players than those in India.

[25] The null hypothesis of no cooperation is rejected at two-sided $p < 0.001$ according to a two-sided z test based on the marginal effects from a Probit regression with no constant in each subject pool.

Figure 3: *Cooperation and the First-Order Punishment by Society*

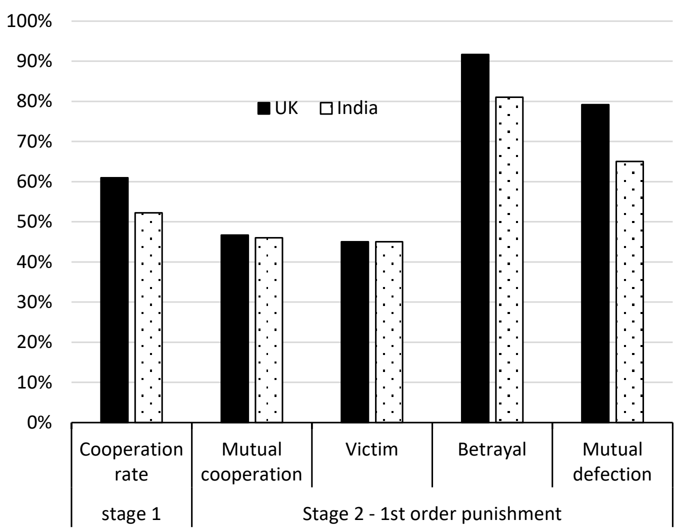


(i) Frequency

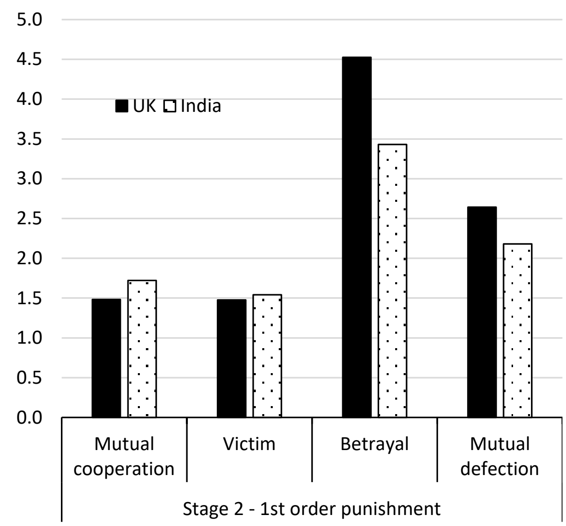


(ii) Average punishment given

A. Actual Decisions



(i) Frequency



(ii) Average punishment given

B. Beliefs

Notes: Each Panel i reports the cooperation rates of PD players, and the percentages of third-party players that inflicted punishment. Each Panel ii reports average punishment points given per third-party player. See Appendix Tables C.1 and C.2 for testing of the cross-societal and across-scenario differences.

Figure 4 reports the first-order punishment patterns by treatment. The figures are drawn separately for the UK (Newcastle) and India (Sonipat). The decision data (Panel Is) reveals first that third-party punishment of a defector in "betrayal" or "mutual defection" is more frequent and stronger than that of a cooperator in "mutual cooperation" or "victim" for all three treatment conditions, whether in the UK (Newcastle) or India (Sonipat). The differences in the per-third-party punishment strength are significant at least at the 5% level for almost all comparisons in the three treatments, in both the research sites (see

Table 3).[26] In addition, the difference in the punishment frequency is also large and significant for almost all comparisons in the UK (Newcastle).[27] Second, third-party punishment of defector is significantly more frequent and significantly stronger in “betrayal” than in “mutual defection” for both the research sites (again see Table 3). These results are robust to including demographic controls (Appendix Table C.3). The behavioral patterns detected resonate with the idea (from social preferences) that when punishing a norm violator, third parties are concerned about the welfare of his/her opponent.

The observed first-order punitive tendencies are again in line with the prevailing norms in the societies. Panels A.II and B.II of Figure 4 indicate almost similar belief patterns to the decision data, i.e., anticipated stronger third-party punishment of a defector, especially in “betrayal,” in all three treatments, and these are supported by panel regression models as shown in Table 3 and Appendix Table C.3.

Result 1: *(i) Whether in India (Sonipat) or in the UK (Newcastle), consistent with Hypothesis 2.b (not Hypothesis 1.b), third parties' first-order punishment is significantly more frequent and stronger in “betrayal” than in any other scenario in all three treatments. (ii) Consistent with Hypothesis 4.a, the third-party punishment in “betrayal” is significantly more frequent and stronger in the UK than in India. (iii) The behavioral patterns in (i) and (ii) were correctly anticipated by the subjects in each society.*

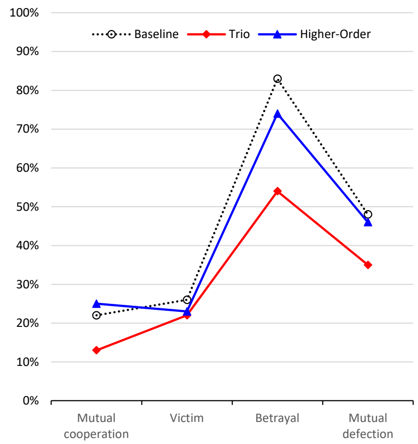
5.2. Group Size Effect

A close look at the treatment difference in first-order punishment decisions (Panel A.I and B.I of Figure 4, Table 4) uncovers three intriguing cross-societal differences. First, a clear group size effect parallel to the theoretical analysis result was detected in the UK (Newcastle). The punishment frequency and the per-third-party punishment strength in the “betrayal” scenario are both much lower in the Trio than in the Baseline treatment (Figures 3.A.I). As shown in column II of Table 4.A, and column II of Table 4.B, the negative group size effect is significant at least at the 5% level. This is consistent with Hypothesis 2.c.

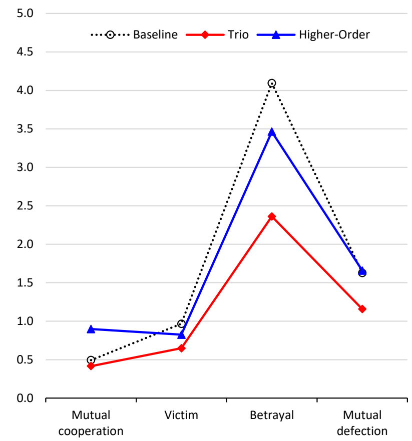
Second, however, having fellow third parties in the Trio treatment *increases* a third-party player's punishment in “betrayal” in India (Sonipat). The opposite group size effect was seen both for the data of the punishment frequency and strength (Figures 3.B.I), and the effect is significant at least at the 5% level (column II in Tables 5.A and 5.B). Further, the opposite group size effect was also observed in the Higher-Order treatment (see again Figure 4.B.I). These patterns in the Trio and Higher-Order treatments are inconsistent with Hypothesis 2.c.

[26] The punishment strengths are significantly different at least at the 5% level for all comparisons except three cases. The two cases are the differences between “victim” and “mutual defection” in the UK's Trio treatment, and in the India's Higher-Order treatment; These differences are significant at the 10% level. The third case is the difference between “victim” and “mutual defection” in the UK's Baseline treatment; and the difference is not significant.
[27] The punishment frequencies are significantly different at least at the 5% level for all but two comparisons. The exception is a comparison between “victim” and “mutual defection” in the Trio treatment (significantly different at the 10% level) and in the Baseline treatment (insignificantly different).

Figure 4: *(First-Order) Third-Party Punishment by Treatment*

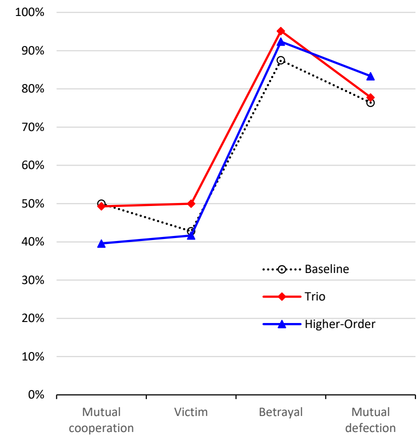


i. Frequency

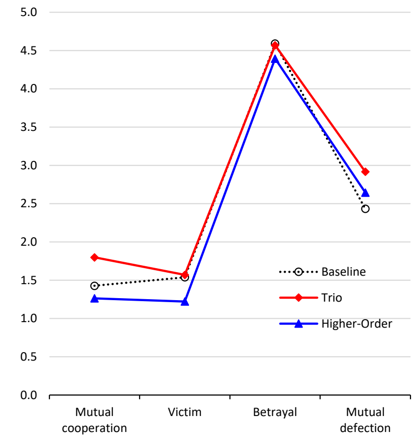


ii. Avg. per-third-party punishment points given

I. Actual Decisions



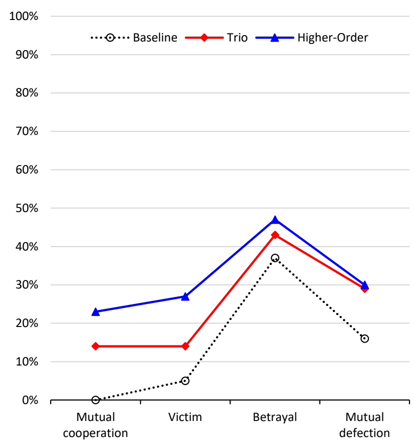
i. Frequency



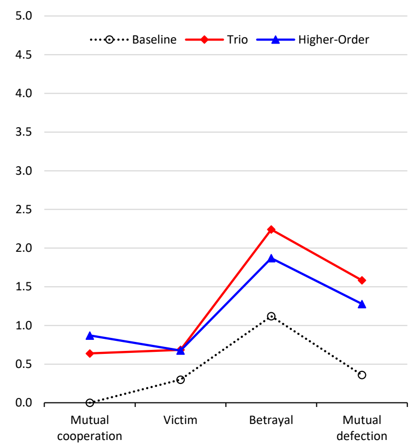
ii. Avg. per-third-party punishment points given

II. Beliefs

A. UK (Newcastle)

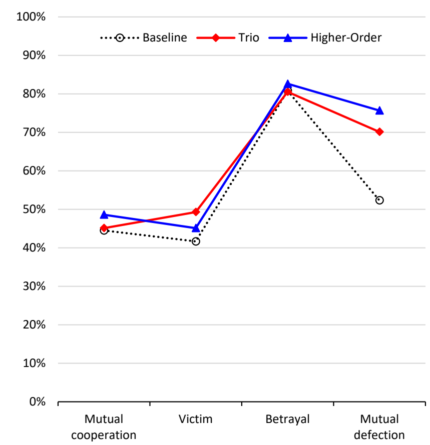


i. Frequency

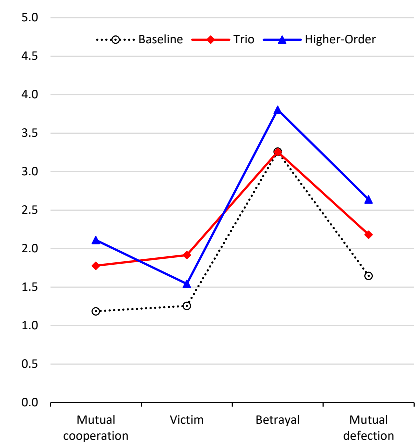


ii. Avg. per-third-party punishment points given

I. Actual Decisions



i. Frequency



ii. Avg. per-third-party punishment points given

II. Beliefs

B. India (Sonipat)

Table 3: *Across-Scenario Difference in First-Order Punishment by Treatment*

(A) Frequency of first-order punishment given to PD players

	Baseline[#1]		Trio		Higher-Order	
Dependent variable:	Decisions	Beliefs	Decisions	Beliefs	Decisions	Beliefs
Independent Variable:	(1)	(2)	(3)	(4)	(5)	(6)
India (Sonipat)	-0.979*	-0.132	0.061	-0.050	-0.040	0.136
	(0.561)	(0.277)	(0.293)	(0.287)	(0.255)	(0.287)
Betrayal	1.720***	1.233***	1.221***	1.663***	1.322***	1.611***
	(0.374)	(0.252)	(0.241)	(0.359)	(0.207)	(0.318)
Mutual defection	0.727***	0.781***	0.748***	0.834***	0.578***	1.099***
	(0.267)	(0.248)	(0.254)	(0.298)	(0.195)	(0.243)
Victim	0.140	-0.164	0.363	0.070	-0.057	-0.000
	(0.426)	(0.197)	(0.238)	(0.232)	(0.206)	(0.235)
Sonipat × Betrayal	-0.296	-0.202	-0.334	-0.752*	-0.678**	-0.614
	(0.602)	(0.347)	(0.323)	(0.429)	(0.268)	(0.394)
Sonipat × Mutual defection	0.031	-0.583*	-0.246	-0.284	-0.375	-0.361
	(0.591)	(0.303)	(0.330)	(0.353)	(0.252)	(0.314)
Sonipat × Victim		0.097	-0.363	-0.010	0.162	-0.063
		(0.298)	(0.342)	(0.282)	(0.275)	(0.288)
Constant	-0.781***	-0.000	-1.128***	-0.070	-0.688***	-0.199
	(0.296)	(0.186)	(0.217)	(0.210)	(0.182)	(0.206)
Observations	149	336	468	312	468	312
Loglikelihood	-76.50	-199.7	-254.1	-183.2	-280	-176.6
Pseudo R2	0.206	0.113	0.0810	0.108	0.0885	0.138
H_0: Betrayal = Mutual defection						
(Do third parties punish defectors differently between "betrayal" and "mutual defection in the UK?)						
Chi-squared-stat.	10.424	3.806	9.422	6.903	17.234	2.792
p-value (2-sided)	0.001***	0.051*	0.002***	0.009***	0.000***	0.095*
H_0: Sonipat = Sonipat + Betrayal + Sonipat × Betrayal						
(Do third parties punish more strongly in "betrayal" than in the reference "mutual cooperation" in India?)						
Chi-squared-stat.	4.899	18.715	17.157	15.019	14.417	18.473
p-value (2-sided)	0.027**	0.000***	0.000***	0.000***	0.000***	0.000***
H_0: Betrayal + Sonipat × Betrayal = Mutual defection + Sonipat × Mutual defection						
(Do third parties punish defectors differently between "betrayal" and "mutual defection in India?)						
Chi-squared-stat.	4.774	13.992	8.115	2.897	9.334	3.238
p-value (2-sided)	0.029**	0.000***	0.004***	0.089*	0.002***	0.072*

Notes: Probit regressions with robust standard errors in parentheses clustered by subject ID. The dependent variable is an indicator variable for a third-party player *i*'s decision (or a PD player's beliefs about a third-party player *i*'s decision) to first-order punish. The results are qualitatively the same when demographic variables are added – see Appendix Table C.3 for the detail. [#1] The interaction Sonipat × Victim is omitted because Sonipat × Mutual cooperation is empty (Figure 4). *** p<0.01, ** p<0.05, * p<0.1

(B) Punishment strength (punishment points given) per third-party player

	Baseline		Trio		Higher-Order	
Dependent variable:	Decisions	Beliefs	Decisions	Beliefs	Decisions	Beliefs
Independent Variable:	(1)	(2)	(3)	(4)	(5)	(6)
India (Sonipat)	-19.378***	-0.478	0.585	0.024	-0.053	1.155
	(2.357)	(0.894)	(1.965)	(1.175)	(1.227)	(1.038)
Betrayal	7.171***	4.501***	8.096***	4.348***	5.655***	4.675***
	(1.850)	(0.645)	(1.782)	(0.861)	(0.803)	(0.662)
Mutual defection	3.230***	1.970***	4.615***	2.389**	2.348***	2.563***
	(1.013)	(0.603)	(1.623)	(1.079)	(0.873)	(0.591)
Victim	0.939	-0.068	2.245	-0.107	-0.318	-0.136
	(1.819)	(0.675)	(1.531)	(0.839)	(1.012)	(0.803)
Sonipat × Betrayal	14.397***	-1.150	-1.533	-1.686	-2.756**	-1.942**
	(2.213)	(0.947)	(2.117)	(1.073)	(1.077)	(0.962)
Sonipat × Mutual defection	15.346***	-1.047	-0.274	-1.313	-1.266	-1.164
	(2.830)	(0.832)	(2.239)	(1.172)	(1.189)	(0.861)
Sonipat × Victim	15.666***	-0.034	-1.803	0.219	0.275	-0.650
	(3.367)	(0.967)	(2.331)	(0.985)	(1.308)	(1.025)
Constant	-3.422**	0.014	-8.011***	0.142	-3.049***	-0.348
	(1.538)	(0.609)	(1.920)	(0.866)	(0.920)	(0.725)
Observations	168	336	468	312	468	312
# left-censored obs.	116	132	338	115	297	114
# right-censored obs.	3	8	16	12	7	6
Loglikelihood	-188	-633	-549.8	-625.4	-655.5	-608.8
Pseudo R2	0.138	0.0518	0.0405	0.0301	0.0422	0.0478
H_0: Betrayal = Mutual defection						
(Do third parties punish defectors differently between “betrayal” and “mutual defection” in the UK?)						
F-stat.	8.361	25.594	13.369	10.307	29.985	24.327
p-value (2-sided)	0.004***	0.000***	0.000***	0.001***	0.000***	0.000***
H_0: Sonipat = Sonipat + Betrayal + Sonipat × Betrayal						
(Do third parties punish more strongly in “betrayal” than in the reference “mutual cooperation” in India?)						
F-stat.	54.287	22.627	14.373	15.601	13.613	16.421
p-value (2-sided)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
H_0: Betrayal + Sonipat × Betrayal = Mutual defection + Sonipat × Mutual defection						
(Do third parties punish defectors differently between “betrayal” and “mutual defection in India?)						
F-stat.	6.553	10.058	7.511	8.185	7.824	16.558
p-value (2-sided)	0.011***	0.002***	0.006***	0.005***	0.005***	0.000***

Notes: Tobit regressions with robust standard errors in parentheses clustered by subject ID. The dependent variable is a third-party player *i*’s punishment points (or a PD player’s beliefs about a third-party player *i*’s punishment points) given to a PD player. The results are qualitatively the same even when demographic variables are added – see Appendix Table C.3 for the detail. *** p<0.01, ** p<0.05, * p<0.1

Table 4: *Across-Treatment, and Cross-societal Difference in First-Order Punishment*

(A) Frequency of cooperation and first-order punishment given to PD players

Dependent var.	PD players' decision to cooperate		Third parties' decision to first-order punish							
			Scenario							
			I. "mutual cooperation"		II. "betrayal"		III. "victim"		IV. "mutual defection"	
Independent Var.	(1)	(2)	(3)[#1]	(4)[#1]	(5)	(6)	(7)	(8)[#1]	(9)	(10)
India (Sonipat)	-0.517*	-0.484	-0.040	-0.078	-1.275***	-1.611***	-0.979*	0.072	-0.949**	-1.328***
	(0.280)	(0.299)	(0.255)	(0.306)	(0.426)	(0.479)	(0.555)	(0.294)	(0.435)	(0.505)
Trio	0.411	0.360	-0.347	-0.624	-0.846**	-1.125***	-0.124	-0.404	-0.326	-0.537
	(0.308)	(0.320)	(0.365)	(0.395)	(0.353)	(0.394)	(0.340)	(0.371)	(0.315)	(0.330)
Higher-Order	-0.115	0.099	0.093	-0.012	-0.305	-0.327	-0.105	-0.286	-0.056	-0.200
	(0.283)	(0.328)	(0.345)	(0.376)	(0.357)	(0.410)	(0.337)	(0.370)	(0.310)	(0.331)
Sonipat × Trio	-0.225	-0.250	0.100	0.365	1.002**	1.463***	0.676	-0.236	0.763	1.271**
	(0.417)	(0.435)	(0.388)	(0.438)	(0.486)	(0.532)	(0.618)	(0.409)	(0.498)	(0.556)
Sonipat × HO	0.370	0.131			0.558	0.678	1.101*		0.534	0.948*
	(0.402)	(0.448)			(0.490)	(0.549)	(0.610)		(0.496)	(0.563)
Constant	0.451**	-0.191	-0.781***	-1.121	0.939***	1.394	-0.641**	0.548	-0.055	-1.267
	(0.192)	(0.596)	(0.293)	(1.130)	(0.308)	(0.970)	(0.282)	(1.106)	(0.262)	(0.928)
Observations	240	217	257	224	276	242	276	224	276	242
Control	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Loglikelihood	-154.3	-132.4	-123.1	-101.9	-177.7	-149.5	-137	-109.4	-172.9	-146.4
Pseudo R2	0.0344	0.0728	0.0170	0.0447	0.0640	0.0990	0.0257	0.0381	0.0271	0.0667
H_0: Trio + Sonipat × Trio = Sonipat (Do the behaviors differ between the Trio and Baseline treatments in India?)										
Chi-squared-stat.	2.05	1.27	0.11	0.07	4.39	6.67	2.28	1.10	3.31	5.23
p-value (2-sided)	0.15	0.26	0.74	0.80	0.04**	0.01***	0.13	0.29	0.07*	0.02**
H_0: Higher-Order + Sonipat × Higher-Order = Sonipat (Do the behaviors differ between the Higher-Order and Baseline treatments in India?)										
Chi-squared-stat.	2.45	1.82	0.07	0.01	4.99	6.82	3.82	0.41	3.51	5.37
p-value (2-sided)	0.12	0.18	0.79	0.91	0.03**	0.01***	0.05**	0.52	0.06*	0.02**
H_0: Sonipat + Sonipat × Trio = Trio (Do the behaviors differ between the UK and India in the Trio treatment?)										
Chi-squared-stat.	4.35	3.69	0.53	2.13	1.38	3.35	0.12	0.18	0.09	0.94
p-value (2-sided)	0.04**	0.05**	0.47	0.14	0.24	0.07*	0.73	0.67	0.76	0.33
H_0: Sonipat + Sonipat × Higher-Order= Higher-Order (Do the behaviors differ between the UK and India in the Higher-Order treatment?)										
Chi-squared-stat.	0.00	0.58	0.07	0.01	0.68	1.03	0.21	0.41	0.62	0.12
p-value (2-sided)	0.95	0.45	0.79	0.91	0.41	0.31	0.65	0.52	0.43	0.72

Notes: Probit regressions with robust standard errors in parentheses. The control variables in the even-numbered columns include a dummy for female, age, number of siblings, income rank and the Raven's test score. [#1] The interaction Sonipat × Higher-Order is omitted due to collinearity in columns (3), (4) and (8). *** p<0.01, ** p<0.05, * p<0.1

(B) Punishment strength per third-party player

Dependent var.	A third-party player's punishment points given to a PD player							
	Scenario							
	I. "mutual cooperation"		II. "betrayal"		III. "victim"		IV. "mutual defection"	
Independent Var.	(1)	(2)	(3)	(4)	(5)	(6)[#1]	(7)	(8)
India (Sonipat)	-25.718***	-25.159***	-5.573***	-6.110***	-4.867	-27.555***	-4.963**	-6.202**
	(2.497)	(2.887)	(1.716)	(1.836)	(3.271)	(3.558)	(2.178)	(2.488)
Trio	-1.507	-2.821	-2.925**	-3.423**	-0.712	-1.523	-1.517	-2.178
	(1.928)	(1.976)	(1.306)	(1.379)	(1.811)	(1.959)	(1.422)	(1.432)
Higher-Order	0.956	0.440	-1.188	-1.020	-0.523	-1.018	-0.275	-0.653
	(1.816)	(1.893)	(1.189)	(1.251)	(1.806)	(1.965)	(1.365)	(1.370)
Sonipat × Trio	26.238***	26.863***	4.850**	6.123***	3.899	26.988***	5.348**	7.366**
	(3.105)	(3.439)	(2.098)	(2.214)	(3.710)	(4.334)	(2.624)	(2.865)
Sonipat × HO	25.623***	24.643***	2.628	3.065	5.171	27.417***	3.409	4.941*
	(2.737)	(2.842)	(1.949)	(2.068)	(3.504)	(3.765)	(2.494)	(2.770)
Constant	-4.953***	-4.767	3.709***	1.104	-3.789**	2.848	-0.927	-7.021*
	(1.724)	(5.715)	(1.006)	(3.670)	(1.661)	(5.268)	(1.215)	(4.216)
Observations	276	242	276	242	276	245	276	242
Control	No	Yes	No	Yes	No	Yes	No	Yes
# left-censored obs.	227	201	124	106	219	199	181	157
# right-censored obs.	1	1	17	17	2	2	6	6
Loglikelihood	-229.1	-188.9	-526.8	-464.4	-259.7	-209.1	-386.4	-338.5
Pseudo R2	0.0255	0.0375	0.0177	0.0256	0.00856	0.0319	0.00856	0.0216
H_0: Trio + Sonipat × Trio = Sonipat (Do the behaviors differ between the Trio and Baseline treatments in India?)								
F-stat.	120.63	81.92	6.08	7.07	1.68	56.00	4.62	5.69
p-value (2-sided)	0.00***	0.00***	0.01***	0.01**	0.20	0.00***	0.03**	0.03**
H_0: Higher-Order + Sonipat × Higher-Order = Sonipat (Do the behaviors differ between the Higher-Order and Baseline treatments in India?)								
F-stat.	128.73	89.67	5.52	6.44	2.48	69.16	4.06	5.03
p-value (2-sided)	0.00***	0.00***	0.02**	0.01***	0.12	0.00***	0.04**	0.03**
H_0: Sonipat + Sonipat × Trio = Trio (Do the behaviors differ between the UK and India in the Trio treatment?)								
F-stat.	0.43	1.91	1.08	2.37	0.01	0.10	0.66	2.03
p-value (2-sided)	0.51	0.17	0.30	0.12	0.93	0.75	0.42	0.16
H_0: Sonipat + Sonipat × Higher-Order= Higher-Order (Do the behaviors differ between the UK and India in the Higher-Order treatment?)								
F-stat.	0.15	0.10	1.01	1.04	0.10	0.09	0.36	0.07
p-value (2-sided)	0.70	0.75	0.32	0.31	0.75	0.77	0.55	0.79

Notes: Tobit regressions with robust standard errors in parentheses. The control variables in the even-numbered columns include a dummy for female, age, number of siblings (except for column 6 due to collinearity), income rank and the Raven's test score. *** p<0.01, ** p<0.05, * p<0.1.

Third, higher-order punishment opportunities mitigate the negative group size effect in the UK. Figure 4.A.I shows that a third-party player inflicts punishment more strongly in the Higher-Order than in the Trio treatment; and the former frequency is close to the Baseline treatment. A two-sided z test indicates that the punishment frequency is not significantly different between the Higher-Order and Baseline treatment (column II of Table 4.A). As there are three third parties per group in the Higher-Order treatment, this means that a PD player will be punished far more frequently in the Higher-Order than in the Baseline treatment. Figure 4.B.I also indicates that higher-order punishment opportunities almost resolve third parties' free riding on peers' first-order punishing in terms of strength; and the effect is significant (column II of Table 4.B), parallel to the results of the punishment frequency.

Figure 4 and Table 4 also indicate that, in India (Sonipat), having fellow third parties in a group can even increase anti-social punishment in "mutual cooperation" and "victim."[28]

Result 2: *(i) In the UK (Newcastle), a third party inflicts punishment on a defector in "betrayal" significantly less frequently and less strongly when having multiple third parties in the Trio treatment than in the Baseline treatment, consistent with Hypothesis 2.c. Having higher-order punishment opportunities in the Higher-Order treatment overcomes the negative group size effect. (ii) In India (Sonipat), the opposite group size effect emerges in that having multiple third parties in the Trio treatment encourages a third party to inflict punishment in "betrayal" significantly more frequently and more strongly, relative to the Baseline treatment, at odds with Hypothesis 2.c. (c) In India, having multiple third parties can exacerbate anti-social punishment among third parties.*

Panels A.II and B.II of Figure 4 report subjects' beliefs on cooperation and punishment in each of the three treatments. It again indicates that subjects' beliefs are larger than actual cooperation and punishment observed in the experiment. This behavioral pattern is not surprising, however, because while people are conditionally cooperative, they are known to be imperfect conditional cooperators on average in choosing a contribution level (e.g., Fischbacher *et al.*, 2001; Fischbacher and Gächter, 2010); and likewise, they tend to punish conditionally upon their peers' punitive activities, but somewhat less than the peers' punishment amounts (e.g., Kamei, 2014; Kamei, 2020). In addition, theoretically, third parties can free ride on peers' punishment acts when there are other third parties in their group, thus having further incentives to reduce altruistic punishments in comparison with their beliefs in the Trio and Higher-Order treatments.

Unlike in Result 1.iii, there is a discrepancy between prevailing beliefs and third parties' behaviors for the group size effect. The first-order punishment frequencies and strengths are both similar for the three treatments; and, respectively, negative and positive group size effects appear to be absent in India (Sonipat) and the UK (Newcastle) regarding beliefs–see again Panels A.II and B.II of Figure 4. This is also statistically supported. Appendix Table C.4 reports a regression analysis whose specifications are

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[28] Third-party punishment in "victim" is significantly more frequent in the Higher-Order than in the Baseline treatment (Table 4.B). The per-third-party punishment strength is significantly stronger in the Trio and Higher-Order treatments than in the Baseline (Table 4.B).

the same as Table 4 but using beliefs as the dependent variables. The results indicate almost no group size effect for beliefs in all four scenarios, in both the UK and India.

However, a calculation of observed punishment frequencies and strengths as the percentages of beliefs formed by the PD players ("punishment-belief ratio" hereafter) reinforces Result 2. Table 5 summarizes the calculations. There, while the punishment-belief ratios are always below (in most cases far below) 1, large cross-societal differences are evident. First, the punishment-belief ratios in the Baseline treatment can be thought of as reflecting subjects' conditional preferences, without having the effects of multiple third parties. In this treatment, third parties punished a defector in "betrayal" almost similarly to the prevailing beliefs in the UK (Newcastle). In clear contrast, the punishment-belief ratio under "betrayal" is only 45.8% and 34.4% for the frequency and strength, respectively, in India (Sonipat). This suggests that, consistent with Hypothesis 4, conditional preferences (the slopes of conditional punishment preferences in relation to the prevailing beliefs) are weaker in India than in the UK.[29] Second, parallel to Result 2.i (the negative group size effect in the UK), the punishment-belief ratios are in general lower in the Trio than in the Baseline treatment, but these are similar for the Baseline and Higher-Order treatments. On the other hand, the positive group size effect was detected in India; the punishment-belief ratios are larger in the Trio than in the Baseline treatment.

Result 3: *Consistent with Hypothesis 4, the punishment-belief ratios in the Baseline treatments are smaller in India (Sonipat) than in the UK (Newcastle).*

Table 5: *First-order Punishment as the Percentage of Belief*

A. UK (Newcastle)

	Punishment Frequency				Avg Per-Third-Party Punishment Points Given			
Treatment	mutual coop.	victim	betrayal	mutual defect.	mutual coop.	victim	betrayal	mutual defect.
Baseline	44.0%	60.8%	94.9%	62.8%	34.6%	62.8%	89.2%	66.9%
Trio	26.4%	44.0%	56.8%	45.0%	23.2%	41.3%	51.7%	39.7%
Higher-Order	63.2%	55.2%	80.1%	55.2%	71.1%	67.4%	78.8%	62.6%

B. India (Sonipat)

	Punishment Frequency				Avg Per-Third-Party Punishment Points Given			
Treatment	mutual coop.	victim	betrayal	mutual defect.	mutual coop.	victim	betrayal	mutual defect.
Baseline	0.0%	12.0%	45.8%	30.6%	0.0%	23.9%	34.4%	21.9%
Trio	31.0%	28.4%	53.4%	41.3%	35.9%	35.7%	68.8%	72.6%
Higher-Order	47.3%	59.8%	56.9%	39.6%	41.2%	43.8%	49.1%	48.4%

5.3. Discussion – Possible Drivers behind the Cross-Societal Differences in First-Order Punishment

What mechanism drives the interesting contrast in group size effect between India (Sonipat) and the UK (Newcastle)? One possible explanation is that third parties' punitive inclinations differ markedly between the two research sites. As shown in Panel A.I and B.I of Figure 4 and Table 5, while punishment

[29] Conditional willingness to punish can be interpreted as the strength of people's normative influence in driving compliance as discussed in Bicchieri (2017).

frequency and per-third-party strength are much lower in India than in the UK in the Baseline treatment where third-party peers are absent, the levels of punishment are similar for the two locations in the Trio treatment where multiple third parties decide.

In addition to differences in the punitive inclinations, Enke (2019, Table I) discussed five further domains of moral beliefs that characterize societies in terms of kinship tightness: cooperation/trust, religion, moral values, moral emotions and emotion/value. A regression analysis was conducted to explore how these five domains affected third parties' first-order punishment decisions of defectors in the Baseline and Trio treatments. The present experiment included a post-experiment questionnaire to construct proxy variables following his paper. Cooperation/trust is measured using the following question from the World Values Survey: "Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?". Religious beliefs are measured using the following question from the World Values Survey: "How important is God in your life?". Moral values are measured as the relative importance of universal over communal moral values based on responses to the Moral Foundations Questionnaire. Moral emotions are measured based on reactions designed to elicit guilt in the Test of Self-Conscious Affect. Finally, emotion/value is measured as the moral relevance of purity and disgust based on responses to the Moral Foundations Questionnaire.

Table 6 reports the regression results. Results from religious beliefs, moral values, moral emotions and emotion/value provide some, but weak predicted relation between these variables and third parties' punitive inclinations. First, there is mixed evidence that religious beliefs are positively associated with third parties' inclinations to punish. In the UK, religious beliefs are a positive predictor of punishment frequency and strength in the Trio treatment (significant at the 5% level); no relationship is observed in the Baseline treatment. In India, the findings are qualitatively similar but statistically weaker. Second, there is no systematic statistical relationship between the importance subjects place on universal over communal moral values and punishment frequency or strength in either society. Third, there is weak evidence (significant at the 10% level) that stronger moral emotions of internalized guilt drive higher punishment frequencies and strength in the Baseline treatment in the UK. This relationship disappears - even reverses for punishment strength - in the Trio treatment. No relationship between internalized guilt and punishment behaviors is observed in India. Finally, there is some evidence that the emotion/value of moral purity and disgust is a positive predictor of punishment frequency (significant at the 10% level) and punishment strength (significant at the 5% level) in the Trio treatment in the UK. No such relationship is observed in the Baseline treatment in this society, or in either treatment in India.

The findings on cooperation/trust provide interesting nuance to Results 2 and 3. In the UK, higher generalized trust is a strong positive predictor of punishment frequency and strength in the Baseline treatment, significant at the 5% level. However, this relationship disappears (reverses for punishment strength) in the Trio treatment. Generalized trust has no significant effect on punishment strength or frequency in either treatment in India. Historically, generalized trust underpins productive economic interactions in loose kinship societies, such as the UK, which may require third-party punishment systems to regulate (Alesina and Giuliano, 2013). The finding suggests that this relationship may be more fragile when multiple third parties decide independently in a group due to free-riding tendencies.

Table 6: *Determinants of Cross-societal Difference in First-Order Punishment of Defectors between the Baseline and Trio treatments: Moral beliefs.*

Dependent var.:	Third parties' decision to first-order punish		A third-party player's punishment points given to a PD player	
Treatment:	Baseline	Trio	Baseline	Trio
Domain	(1)	(2)	(3)	(4)
India (Sonipat)	-8.524	-1.227	-22.415	-7.460
	(13.698)	(1.847)	(27.543)	(10.373)
Cooperation/trust	0.375**	-0.094	1.339**	-0.592*
	(0.174)	(0.073)	(0.602)	(0.352)
Sonipat × Cooperation/trust	-0.132	0.032	-0.865	0.473
	(0.433)	(0.098)	(1.215)	(0.639)
Religious beliefs	-0.023	0.141**	0.008	0.813**
	(0.049)	(0.056)	(0.154)	(0.315)
Sonipat × Religious beliefs	0.139	-0.046	0.402	-0.336
	(0.087)	(0.076)	(0.336)	(0.468)
Moral values	-0.056*	-0.009	-0.127	0.008
	(0.030)	(0.022)	(0.115)	(0.104)
Sonipat × Moral values	0.151**	0.024	0.398**	0.070
	(0.068)	(0.030)	(0.193)	(0.170)
Moral emotions	0.128*	-0.046	0.352*	-0.355**
	(0.071)	(0.030)	(0.208)	(0.159)
Sonipat × Moral emotions	0.031	0.019	0.111	0.122
	(0.176)	(0.040)	(0.377)	(0.241)
Emotion/value	-0.002	0.075*	0.050	0.472**
	(0.052)	(0.042)	(0.172)	(0.235)
Sonipat × Emotion/value	0.381	-0.039	0.969	-0.111
	(0.303)	(0.066)	(0.646)	(0.412)
Constant	-6.886**	1.237	-21.348*	9.277
	(3.317)	(1.399)	(10.734)	(6.750)
Observations	82	234	82	234
# left-censored obs.			44	141
# right-censored obs.			3	14
Loglikelihood	-40.17	-141.6	-124.2	-356.5
Pseudo R2	0.291	0.0994	0.117	0.0368
H_0: Domain + Sonipat × Domain = 0 (Does the domain have a significant effect in India?)				
Cooperation/trust (*p*-values, two-sided)	0.540	0.347	0.657	0.823
Religious beliefs	0.108	0.065*	0.167	0.171
Moral values	0.121	0.445	0.081*	0.564
Moral emotions	0.321	0.302	0.146	0.211
Emotion/value	0.204	0.468	0.117	0.293

Notes: Columns (1) and (2) are Probit regressions with robust standard errors in parentheses clustered by subject ID. The dependent variable is an indicator for a third-party player *i*'s decision to first-order punish. Columns (3) and (4) are Tobit regressions with robust standard errors in parentheses clustered by subject ID. The dependent variable is a third-party player *i*'s punishment points given to a PD player. The independent variables proxy for five domains of moral beliefs as defined in Enke (2019, Table I). Cooperation/trust is measured using the following question from the World Values Survey: "Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?". Religious beliefs are measured using the following question from the World Values Survey: "How important is God in your life?". Moral values are measured as the relative importance of universal over communal moral values based on responses to the Moral Foundations Questionnaire. Moral emotions are measured based on reactions designed to elicit guilt in the Test of Self-Conscious Affect. Emotion/value is measured as the moral relevance of purity and disgust based on responses to the Moral Foundations Questionnaire. For more details on the post-experiment questionnaire, see Appendix A.5.

5.4. Higher-Order Punishment

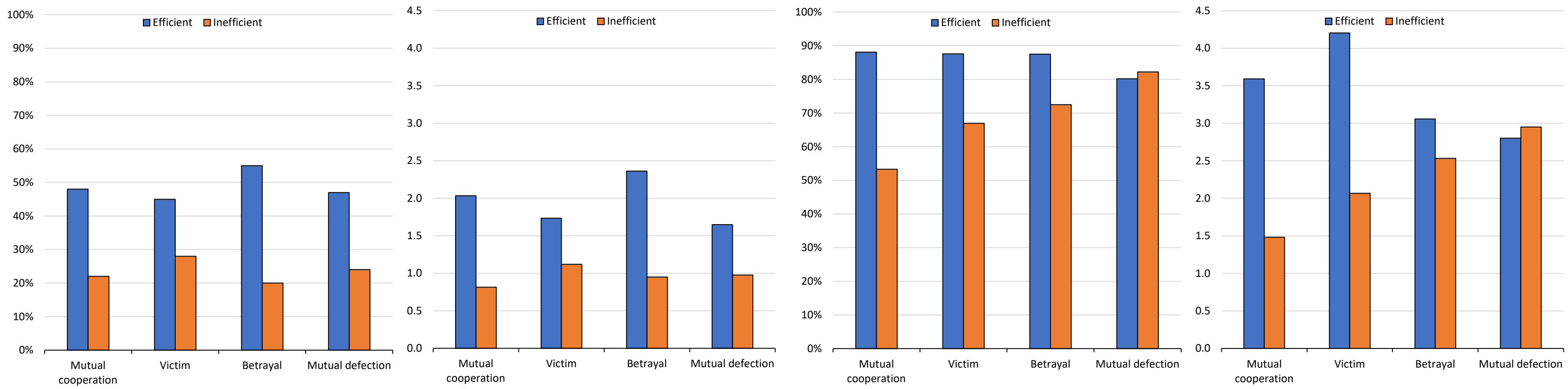
As discussed in Section 4, higher-order punishment, i.e., punishment of the failure to sanction a norm violator and punishment for committing an unjustified punishment act (Hypothesis 3), has a vital role in enforcing pro-social first-order punitive norms in societies. Recall that, theoretically, while punishment of a defector in "betrayal" may deter an opportunistic PD player from violating a norm through reducing material gains of defection, the first-order punishment is subject to second-order free riding in a group setting unless higher-order punishment is credible. Panels A.I and B.I of Figure 5 report the frequency and the per-third-party strength of higher-order punishment by scenario in the Higher-Order treatment. The data reveal that, whether in India (Sonipat) or in the UK (Newcastle), efficient forms of higher-order punishment are more frequent, and stronger, than inefficient forms in all stage-two scenarios, in support of Hypothesis 3. Efficient higher-order punishment in "betrayal," i.e., higher-order punishment of failure to punish a defector who exploited a cooperator, is the strongest among the four scenarios. In "betrayal," the corresponding frequency and per-third-party strength are both significantly different from those of inefficient higher-order punishment for each of the two research sites (column II in each panel of Table 7). Thus, Hypothesis 3.a is statistically supported for the "betrayal" scenario, and it underscores the ubiquitous role of humans' social preferences in reinforcing punitive norms, regardless of the degree of kinship tightness.

Scholars in anthropology and theoretical biology have argued that the emergence of punishment norms may depend on the ability of individuals to engage in collective higher-order punishment of those who do not sanction free-riding behavior in the first instance (e.g., Hechter, 1987). If the costs of being punished are sufficiently large to act as a deterrent, then moralistic strategies enforced by punishment of those who fail to punish free riders can be evolutionary stable (Boyd and Richerson, 1992). The social interactions introduced by the availability of punishment mechanisms increase the likelihood of multiple stable equilibria (Boyd and Richerson, 2010). Thus, it is plausible that different societies converge on different equilibria, which are underpinned by variable social environments and norms (Boyd and Richerson, 2009).

In our experiment data, efficient higher-order punishment norms are stronger in the UK (Newcastle) than in India (Sonipat), in support of the cross-societal difference predicted in Hypothesis 4 – see again Table 7. First, under "mutual defection," higher-order punishment of failure to punish a defector is significantly more frequent and stronger than the inefficient one in the UK (Newcastle), but not in India (Sonipat). Second, in "mutual cooperation" and "victim," consistent with Hypothesis 3.b, efficient higher-order punishment, i.e., higher-order punishment of a first-order anti-social punisher, is significantly different from inefficient punishment for subjects in the UK, but not for subjects in India.

It should be remarked that, as was the case for the cooperation and first-order punishment decisions, third parties' actual higher-order punishments were lower than their beliefs. This is again consistent with the idea that people are imperfect conditional punishers (e.g., Fischbacher *et al.*, 2001; Fischbacher and Gächter, 2010; Kamei, 2014 and 2020). Nevertheless, the overall patterns in the beliefs are qualitatively similar to those in the decisions: i.e., anticipated stronger efficient punishment than inefficient ones (Panels A.II and B.II of Figure 5, Appendix Table C.5).

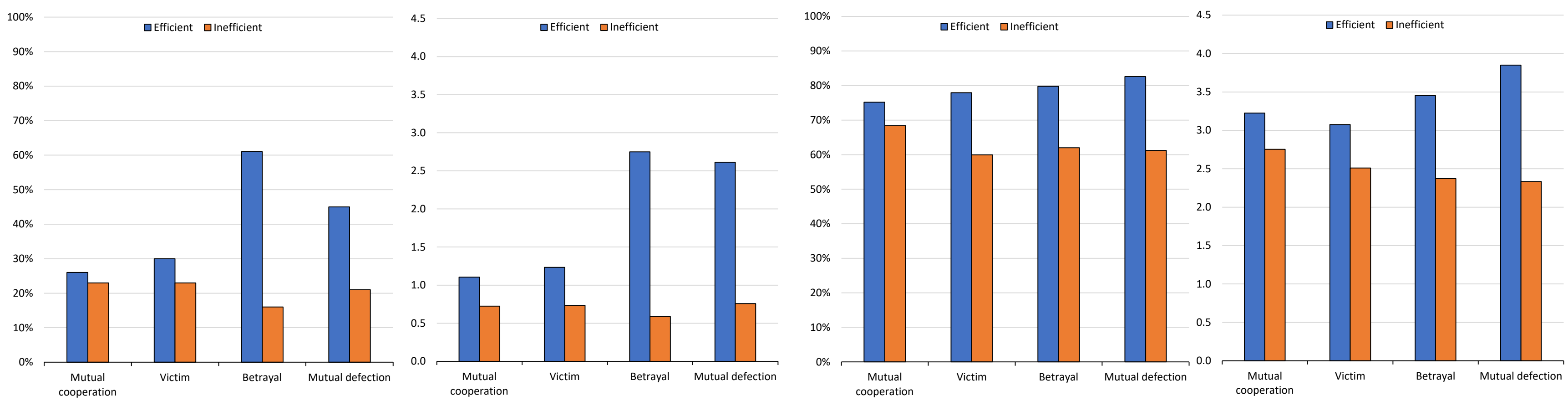
Figure 5: *Efficient versus Inefficient Higher-order Punishment in the Higher-Order treatment*



i. Frequency | ii. Avg. per-third-party punishment points given | i. Frequency | ii. Avg. per-third-party punishment points given

I. Actual Decisions | II. Beliefs

A. India (Sonipat)



i. Frequency | ii. Avg. per-third-party punishment points given | i. Frequency | ii. Avg. per-third-party punishment points given

I. Actual Decisions | II. Beliefs

B. India (Sonipat)

Note: Higher-order punishment from i to j when j pro-socially punished a defector less than i in "betrayal" or "mutual defection," or when j anti-socially punished a cooperator more than i in "mutual cooperation" and "victim" are called "efficient" higher-order punishment. In all other cases, higher-order punishment is referred to as "inefficient."

Table 7: *Cross-societal Difference in Efficient and Inefficient Higher-Order Punishment*

(A) Frequency of higher-order punishment given to other third parties

Dependent var.	Third parties' decision to higher-order punish							
	Scenario*							
	I. "mutual cooperation"		II. "betrayal"		III. "victim"		IV. "mutual defection"	
Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
India (Sonipat)	0.038	0.090	-0.146	-0.098	-0.144	-0.039	-0.102	0.019
	(0.262)	(0.312)	(0.212)	(0.240)	(0.270)	(0.328)	(0.209)	(0.236)
Efficient	0.724***	0.749***	0.980***	1.073***	0.472*	0.602**	0.621***	0.549*
	(0.170)	(0.200)	(0.192)	(0.210)	(0.245)	(0.274)	(0.240)	(0.295)
Sonipat × Efficient	-0.649**	-0.548*	0.288	0.208	-0.262	-0.364	0.042	0.048
	(0.275)	(0.307)	(0.304)	(0.343)	(0.299)	(0.333)	(0.414)	(0.476)
Constant	-0.766***	-0.336	-0.843***	0.031	-0.597***	-0.050	-0.695***	-1.399
	(0.158)	(1.089)	(0.154)	(1.062)	(0.210)	(1.069)	(0.139)	(1.108)
Observations	1,682	1,372	1,794	1,462	1,736	1,434	1,754	1,432
Control	No	Yes	No	Yes	No	Yes	No	Yes
Loglikelihood	-1017	-823.5	-922.9	-719.1	-1084	-862	-972.7	-762
Pseudo R2	0.0462	0.0619	0.113	0.156	0.0250	0.0557	0.0250	0.0563
H_0: Sonipat + Constant = 0 (Is the frequency of inefficient higher-order punishment behavior significant in India?)								
Chi-squared-stat.	12.09	0.06	45.65	0.00	18.84	0.01	26.06	1.62
p-value (two-sided)	0.00***	0.81	0.00***	0.95	0.00***	0.93	0.00***	0.20
H_0: Sonipat = Efficient + Sonipat × Efficient (Is efficient higher-order punishment more frequent than inefficient punishment in India?)								
Chi-squared-stat.	0.01	0.05	14.13	10.11	0.91	0.43	2.79	1.32
p-value (two-sided)	0.93	0.82	0.00***	0.00***	0.34	0.51	0.09*	0.25

Notes: Probit regressions with robust standard errors in parentheses clustered by subject ID. The control variables in the even-numbered columns include a dummy for female, age, number of siblings, income rank and the Raven's test score. Higher-order punishment from *i* to *j* when *j* pro-socially punished a defector less than *i* in "betrayal" or "mutual defection," or when *j* anti-socially punished a cooperator more than *i* in "mutual cooperation" and "victim" are called "efficient" higher-order punishment. In all other cases, higher-order punishment is referred to as "inefficient." *** p<0.01, ** p<0.05, * p<0.1

(B) Punishment strength per third-party player

Dependent var.	A third-party player's punishment points given to another third-party player							
	Scenario							
	I. "mutual cooperation"		II. "betrayal"		III. "victim"		IV. "mutual defection"	
Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
India (Sonipat)	-0.082	0.236	-0.870	-0.297	-1.022	-0.315	-0.515	0.313
	(1.467)	(1.641)	(1.217)	(1.266)	(1.496)	(1.702)	(1.202)	(1.325)
Efficient	3.534***	3.525***	5.234***	5.433***	1.987*	2.656**	3.877**	3.634*
	(0.919)	(1.052)	(1.072)	(1.134)	(1.182)	(1.316)	(1.783)	(1.868)
Sonipat × Efficient	-2.704*	-2.061	1.488	1.120	-0.611	-1.194	0.859	0.936
	(1.479)	(1.516)	(1.734)	(1.921)	(1.532)	(1.652)	(3.085)	(3.281)
Constant	-4.147***	-3.569	-4.685***	-3.501	-3.044***	-1.818	-4.283***	-10.164
	(1.078)	(6.357)	(1.037)	(5.620)	(1.157)	(5.202)	(1.037)	(6.308)
Observations	1,682	1,372	1,794	1,462	1,736	1,434	1,754	1,432

Control	No	Yes	No	Yes	No	Yes	No	Yes
# left-censored obs.	1128	908	1316	1068	1147	956	1305	1072
# right-censored obs.	43	35	28	24	43	33	32	28
Loglikelihood	-2248	-1849	-2004	-1604	-2383	-1908	-1950	-1535
Pseudo R2	0.0177	0.0248	0.0554	0.0781	0.00852	0.0228	0.0173	0.0379
H_0: Sonipat + Constant = 0 (Are inefficient punishment behaviors significant in India?)								
F-stat.	9.65	0.30	28.90	0.47	13.89	0.19	17.20	2.50
p-value (two-sided)	0.00***	0.58	0.00***	0.49	0.00***	0.67	0.00***	0.11
H_0: Sonipat = Efficient + Sonipat × Efficient (Is efficient punishment stronger than inefficient punishment in India?)								
F-stat.	0.14	0.23	10.87	7.64	1.32	0.59	2.53	1.45
p-value (two-sided)	0.71	0.63	0.00***	0.01**	0.25	0.44	0.11	0.23

Notes: Tobit regressions with robust standard errors in parentheses clustered by subject ID. The control variables in the even-numbered columns include a dummy for female, age, number of siblings, income rank and the Raven's test score. Higher-order punishment from *i* to *j* when *j* pro-socially punished a defector less than *i* in "betrayal" or "mutual defection," or when *j* anti-socially punished a cooperator more than *i* in "mutual cooperation" and "victim" are called "efficient" higher-order punishment. In all other cases, higher-order punishment is referred to as "inefficient." *** p<0.01, ** p<0.05, * p<0.1

In addition, a calculation of the punishment-belief ratios finds that the ratios are the strongest for the efficient punishment under "betrayal" than in any other scenario in both research sites: the former ratios were, respectively, 62.9% (76.5%) and 77.3% (79.6%), in the punishment frequency and per-third-party strength in the UK (India). Hence, it follows that third parties recognize the role of punishment of failure to punish a defector in enforcing pro-social punitive norms as first-order punishment in "betrayal" is a key to deter PD players' opportunism in the group.

Result 4: *(i) Failure to punish a defector who exploited a cooperator in "betrayal" attracted significantly more frequent and stronger higher-order punishment than in any other scenario irrespective of the research site, consistent with Hypothesis 3.a. (ii) Efficient higher-order punishment is significantly more frequent and stronger than inefficient higher-order punishment in each of the other three scenarios in the UK (Newcastle), but not in India (Sonipat), consistent with Hypothesis 4.*

6. Conclusions

Situations in which multiple (uninvolved) third parties encounter a norm violation are ubiquitous in contemporary societies. Prior theoretical research argues that punishment inflicted informally by multiple independent third parties helped advance human societies by enforcing social norms, not only before the emergence of states (Grief, 1993; Hadfield and Weingast, 2013), but also in more recent times (McMillan and Woodruff, 1999a, b; Mathew and Boyd 2011). Although free-riding problems may conceptually arise in the third parties' sanctioning activities, existing theory in law and theoretical biology emphasizes the role of second-order punishment in disciplining first-order punishment: i.e., punishment of the failure to sanction a norm violator (e.g., Hadfield and Weingast, 2012; Axelrod, 1986; Henrich, 2004; Henrich and Boyd, 2001) or punishment for committing an unjustified punishment act (e.g., Kamei and Putterman, 2015). Surprisingly, however, to date there is minimal experimental research into third parties' free riding tendencies when there are multiple third parties per group. Further, to the authors' knowledge, there is no previous research that experimentally studies third parties' higher-order punishment activities.

The present paper reports on a novel set of experiments conducted in both India (Sonipat) and the UK (Newcastle). The study aimed not only to investigate the free-riding tendencies of third parties and the potential impact of higher-order punishments when multiple third parties are present but also to compare the enforcement of sanctions across the two societies. To achieve this aim, the two societies were purposely selected based on Enke's (2019) kinship tightness index: the UK with a low score indicating loose kinship ties and India scoring highly.

The experiment results first uncovered punishment patterns of third parties that are consistent with earlier experiments (e.g., Fehr and Fischbacher, 2004): third parties punished a defector who exploited his/her matched cooperator in "betrayal" more frequently and strongly than in any other scenario. However, notable cross-societal differences were observed for the first-order punishment behaviors. Specifically, the frequency and strength of third-party punishment in response to "betrayal" was higher in the UK than in India, and this behavior was correctly anticipated by the subjects in each society. This finding supports previous research suggesting that individuals in contemporary societies with loose ancestral kinship ties, such as the UK, are more likely to engage in pro-social first-order third-party punishment than those in contemporary societies with tight ancestral kinship ties, such as India.

Second, and equally important, there was a clear contrast in the group size effect between the two societies. Although third-party punishment of a defector in "betrayal" was less frequent and weaker when having multiple third parties per group than a single third party in the UK, the opposite effect was observed in India. While third parties' free riding can be rationalized by a model of social preferences such as inequity aversion, the latter effect cannot. Subjects' survey responses administered in the experiment provide some tentative evidence that this contrast in the group size effect could be driven by the different impact of generalized trust by society.

Further, the treatments with higher-order punishment opportunities revealed that third parties' failure to sanction a defector in "betrayal" did attract more frequent and stronger higher-order punishment than in any other first-order punishment scenario, irrespective of the research site. This pattern resonates with arguments in anthropology and theoretical biology. However, such efficient higher-order punishment is more salient in the UK than in India. In particular, efficient higher-order punishment was significantly more frequent and stronger than inefficient higher-order punishment in every first-order punishment scenario in the UK (Newcastle). Hence, the cross-societal difference in the higher-order punishment is again consistent with the conjecture that people in a society with relatively looser ancestral kinship ties are more willing to engage in costly punishment acts to regulate cooperation behaviors.

It can therefore be concluded that, in the study of human third-party punishment activities, researchers may wish to consider the effects of culture and historical backgrounds in determining contemporary patterns of sanction enforcement. The present study provides new experimental evidence in this domain of moral systems and on how this relates to third parties' free riding tendencies and their inclinations to higher-order punish when there are multiple third parties. Further research is needed to establish the generalizability of these findings in other contexts.

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Supplementary material: NOT FOR PUBLICATION

Appendix A: Experiment Instructions

A.1. General Instructions and Part 1

[At the onset of the experiment, the following instructions were read aloud, while the participants were also given printed copies of the instructions. The instructions at this stage were the same for all three treatments:]

Experimental Instructions

Welcome. You are now taking part in a decision-making experiment. You were randomly selected from the Experimental and Behavioural Economics Laboratory's pool of subjects to be invited to participate in this session. There will be several pauses for you to ask questions. During such a pause, please raise your hand if you want to ask a question. Apart from asking questions in this way, you must not communicate with anybody in this room or make any noise.

Depending on your decisions and the decisions of other participants, you will be able to earn money in addition to the £3 [INR 200 for the experiment sessions in India] guaranteed for your participation. During the experiment, your earnings will be calculated in points. At the end of the experiment your points will be converted to pounds sterling [Indian Rupees] at the following rate:

5 points = £1 [INR 70]

(or each point will be exchanged for 20 pence [INR 14] of real money). At the end of the experiment your total earnings obtained in the experiment and the £3 [INR 200] participation fee will be paid to you in cash [electronic payment]. Your payment will be rounded up to the nearest 10 pence [Rupees] (e.g., £9.40 if it is £9.33 [INR 550 if it is INR 544]). In case that your total earnings from the experiment are negative, you will receive the £3 [INR 200] participation fee.

The session is made up of 3 parts. In the first part you will complete the task described below.

I will describe the second part of the session after you have completed the first part.

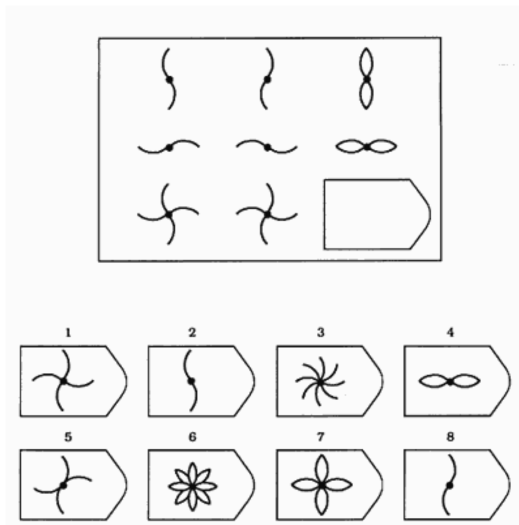
The third part of the session is a questionnaire (your responses to the questionnaire will not affect your earnings in the experiment). At the end of today's session, you will be informed of the outcome of your decisions and your total cash payment.

[Pause for questions]

Instructions for Part I

I will now describe the task which makes up the first part of the session. The task is made up of 12 questions. For every question, there is a pattern with a piece missing and a number of pieces below the pattern. You must choose which of the pieces below is the right one to complete the pattern, both along the rows and down the columns, but NOT the diagonals. You will see 8 pieces that might complete the pattern. In every case, one and only one of these pieces is the right one to complete the pattern.

For example (see pattern and pieces below):



The correct answer for this example is piece number 7.

For each question, please choose the piece that best fits the pattern. You will score 1 point for every correct answer. You will not be penalized for wrong answers. You will have 40 seconds to complete each question. The top of the screen will display the time remaining (in seconds).

[Pause for questions]

[Subjects complete Part I]

A.2. Instructions for Part 2

[Instructions for Part 2 differ by treatment. Once Part 1 is over, the following instructions were read aloud, while the participants were also given printed copies of the instructions:]

(a) Baseline Treatment:

Instructions for Part II

A. The Nature of Interactions

In this part of the session, you will be randomly assigned to a group of 3 persons. In each group, two persons will be randomly assigned the role of player A, and the third person will be assigned the role of player B. This part consists of two stages. **During this part, you will NOT communicate with any other player when making your decisions**.

Stage 1:

Two player As will interact with each other in their group. Specifically, **each player A will be given an endowment of 40 points, and then simultaneously decides whether or not to send 16 points to the other player A**. We will refer to the two player As in a group as "Player A1" and "Player A2." If Player A1 sends 16 points to Player A2, the 16 points will be tripled and becomes earnings of Player A2. Likewise, if Player A2 sends 16 points to Player A1, the 16 points will be tripled and becomes the earnings of Player A1. The possible payoffs from stage 1 are presented in the following decision matrix:

		Player A2	
		Send	Not send
Player A1	Send	(a) 72, 72	(c) 24, 88
	Not send	(b) 88, 24	(d) 40, 40

Note: The first number in each cell is Player A1's payoff, and the second number in each cell is Player A2's payoff.

Suppose that you are Player A1. There are 4 possible situations:

(a) Both you and Player A2 send 16 points to each other. In this situation, each player obtains 40 – 16 + (3 × 16) = 72 points.

(b) Player A2 sends 16 points to you, but you do not send 16 points to Player A2. In this situation, your earnings are 88 points. Player A2's earnings are 24 points.

(c) You send 16 points to Player A2, but Player A2 does not send 16 points to you. In this situation, your earnings are 24 points. Player A2's earnings are 88 points.

(d) Neither you nor Player A2 sends 16 points to each other. In this situation, you and Player A2 each obtain earnings of 40 points.

As indicated in the calculations above, your own earnings will be maximized when you do not send 16 points but Player A2 sends 16 points. However, if both players send 16 points to each other, the total earnings of the 2 players will be maximized and will be 72 × 2 points = 144 points; and each player obtains 72 points as earnings. Your earnings will be minimized if you send 16 points to Player A2 but Player A2 does not send 16 points to you.

[Pause for questions]

Stage 2:

In this stage, player Bs will be asked to decide how many points they want to reduce from the earnings of the two player As in their group.

Each player B will be given an endowment of 60 points. Each reduction point player B allocates to reduce a player A's earnings **reduces the player B's earnings by 1 point** and **reduces the player A's earnings by 3 points**. The reduction points targeted at each player A must be a multiple of 2, between zero and 10. If the Player B chooses zero as reduction points to a player A, the player A's earnings remain unchanged from Stage 1.

Specifically, each player B will be asked to make decisions for the following **four scenarios**:

(a) how many reduction points he or she would like to assign to a Player A1 who **sent** 16 points to Player A2 when Player A2 **also sent** 16 points to Player A1.

(b) how many reduction points he or she would like to assign to a Player A1 who **did not send** 16 points to Player A2 when Player A2 **sent** 16 points to Player A1.

(c) how many reduction points he or she would like to assign to a Player A1 who **sent** 16 points to Player A2 when Player A2 **did not send** 16 points to Player A1.

(d) how many reduction points he or she would like to assign to a Player A1 who **did not send** 16 points to Player A2 when Player A2 **also did not send** 16 points to Player A1.

Two of the four scenarios will be applied based on the two player As' actual sending decisions. For example, suppose that Player A1 did not send 16 points while Player A2 did. In this case, player Bs' decisions in (b) and (c) would be applied. Alternatively, suppose that both Player A1 and Player A2 did not send 16 points. In this case, player Bs' decisions in (d) would be applied twice, i.e., **to both Player As**.

Note:

Some further questions will appear on your screen during this part of the session when your role (either player A or player B) does not have a decision to make. In some cases, you will have an opportunity to add to your payoff based on the accuracy of your answers. Instruction for these will be provided to you on the computer screen.

[Pause for questions]

B. Your Earnings

If you are assigned the role of player A, your earnings for this part will be calculated as:

Your earnings in Stage 1 (= 24, 40, 72 or 88)

minus

total reduction amounts you received from player B

Total reduction amounts you received from player B are sum of reduction points from the player B in your group times 3. If the net amount becomes negative, then the payoff will be 0.

In addition, player As may receive points from stage 2 based on the accuracy of their answers to some questions that appear on the computer screen in this stage.

If you are assigned the role of player B, your earnings for this part will be calculated as:

Your endowment from Stage 2 (= 60)

minus

the sum of reduction points you assigned to player As

For instance, if a player B assigns 4 reduction points to Player A1 and 10 reduction points to the Player A2, then the player B obtains a payoff after stage 2 of 46 points (= 60 – 4 – 10).

In addition, player Bs may receive points from stage 1 based on the accuracy of their answers to some questions that appear on the computer screen in this stage.

Any questions? We will now move on to the comprehension quiz, which will appear on your computer screen. Once everyone has successfully completed this, Stage 1 will begin. During the quiz, please raise your hand if you are stuck on any question.

[Subjects complete the comprehension question – see Section A.3 of the Appendix]

[Subjects complete Part II]

[Instructions for Part III on screen]

(b) Trio Treatment:

Instructions for Part II

A. The Nature of Interactions

In this part of the session, you will be randomly assigned to a group of 5 persons. In each group, two persons will be randomly assigned the role of player A, and the rest of persons will be assigned the role of player B. Thus, the number of persons who will be assigned the role of player B is three. This part consists of two stages. **During this part, you will NOT communicate with any other player when making your decisions**.

<u>*Stage 1*</u>*:*

Two player As will interact with each other in their group. Specifically, **each player A will be given an endowment of 40 points, and then simultaneously decides whether or not to send 16 points to the other player A**. We will refer to the two player As in a group as "Player A1" and "Player A2." If Player A1 sends 16 points to Player A2, <u>the 16 points will be tripled and becomes earnings of Player A2</u>. Likewise, if Player A2 sends 16 points to Player A1, <u>the 16 points will be tripled and becomes the earnings of Player A1</u>. The possible payoffs from stage 1 are presented in the following decision matrix:

		Player A2	
		Send	Not send
Player A1	Send	(a) 72, 72	(c) 24, 88
	Not send	(b) 88, 24	(d) 40, 40

Note: The first number in each cell is Player A1's payoff, and the second number in each cell is Player A2's payoff

Suppose that you are Player A1. There are <u>4 possible situations</u>:

(a) <u>Both</u> you and Player A2 <u>send</u> 16 points to each other. In this situation, each player obtains 40 – 16 + (3 × 16) = 72 points.

(b) Player A2 <u>sends</u> 16 points to you, but you <u>do not</u> send 16 points to Player A2. In this situation, your earnings are 88 points. Player A2's earnings are 24 points.

(c) You <u>send</u> 16 points to Player A2, but Player A2 <u>does not</u> send 16 points to you. In this situation, your earnings are 24 points. Player A2's earnings are 88 points.

(d) <u>Neither</u> you <u>nor</u> Player A2 sends 16 points to each other. In this situation, you and Player A2 each obtain earnings of 40 points.

As indicated in the calculations above, your own earnings will be maximized when you do not send 16 points but Player A2 sends 16 points. However, if both players send 16 points to each other, the total earnings of the 2 players will be maximized and will be 72 × 2 points = 144 points; and each player obtains 72 points as earnings. Your earnings will be minimized if you send 16 points to Player A2 but Player A2 does not send 16 points to you.

[Pause for questions]

Stage 2:

In this stage, player Bs will be asked to decide how many points they want to reduce from the earnings of the two player As in their group. **The number of player Bs in a group is 3** and player Bs **simultaneously** make such reduction decisions.

Each player B will be given an endowment of 60 points. Each reduction point player B allocates to reduce a player A's earnings **reduces the player B's earnings by 1 point** and **reduces the player A's earnings by 3 points**. The reduction points targeted at each player A must be a multiple of 2, between zero and 10. If all three player Bs choose zero as reduction points to a player A, the player A's earnings remain unchanged from Stage 1.

Specifically, each player B will be asked to make decisions for the following **four scenarios**:

(a) how many reduction points he or she would like to assign to a Player A1 who **sent** 16 points to Player A2 when Player A2 **also sent** 16 points to Player A1.

(b) how many reduction points he or she would like to assign to a Player A1 who **did not send** 16 points to Player A2 when Player A2 **sent** 16 points to Player A1.

(c) how many reduction points he or she would like to assign to a Player A1 who **sent** 16 points to Player A2 when Player A2 **did not send** 16 points to Player A1.

(d) how many reduction points he or she would like to assign to a Player A1 who **did not send** 16 points to Player A2 when Player A2 **also did not send** 16 points to Player A1.

Two of the four scenarios will be applied based on the two player As' actual sending decisions. For example, suppose that Player A1 did not send 16 points while Player A2 did. In this case, player Bs' decisions in (b) and (c) would be applied. Alternatively, suppose that both Player A1 and Player A2 did not send 16 points. In this case, player Bs' decisions in (d) would be applied twice, i.e., **to both Player As**.

Note:

Some further questions will appear on your screen during this part of the session when your role (either player A or player B) does not have a decision to make. In some cases, you will have an opportunity to add to your payoff based on the accuracy of your answers. Instruction for these will be provided to you on the computer screen.

[Pause for questions]

B. Your Earnings

If you are assigned the role of player A, your earnings for this part will be calculated as:

Your earnings in Stage 1 (= 24, 40, 72 or 88)

minus

total reduction amounts you received from player Bs

Total reduction amounts you received from player Bs are sum of reduction points from all three player Bs in your group times 3. If the net amount becomes negative, then the payoff will be 0.

In addition, player As may receive points from stage 2 based on the accuracy of their answers to some questions that appear on the computer screen in this stage.

If you are assigned the role of player B, your earnings for this part will be calculated as:

Your endowment from Stage 2 (= 60)

minus

the sum of reduction points you assigned to player As

For instance, if a player B assigns 4 reduction points to Player A1 and 10 reduction points to the Player A2, then the player B obtains a payoff after stage 2 of 46 points (= 60 – 4 – 10).

In addition, player Bs may receive points from stage 1 based on the accuracy of their answers to some questions that appear on the computer screen in this stage.

Any questions? We will now move on to the comprehension quiz, which will appear on your computer screen. Once everyone has successfully completed this, Stage 1 will begin. During the quiz, please raise your hand if you are stuck on any question.

[Subjects complete the comprehension question – see Section A.3 of the Appendix]

[Subjects complete Part II]

[Instructions for Part III on screen]

(c) Higher-Order Treatment:

Instructions for Part II

A. Nature of Interactions

In this part of the session, you will be randomly assigned to a group of 5 persons. In each group, two persons will be randomly assigned the role of player A, and the rest of persons will be assigned the role of player B. Thus, the number of persons who will be assigned the role of player B is three. This part consists of three stages. **During this part, you will NOT communicate with any other player when making your decisions**.

Stage 1:

Two player As will interact with each other in their group. Specifically, **each player A will be given an endowment of 40 points, and then simultaneously decides whether or not to send 16 points to the other player A**. We will refer to the two player As in a group as "Player A1" and "Player A2." If Player A1 sends 16 points to Player A2, the 16 points will be tripled and becomes earnings of Player A2. Likewise, if Player A2 sends 16 points to Player A1, the 16 points will be tripled and becomes the earnings of Player A1. The possible payoffs from stage 1 are presented in the following decision matrix:

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">Player A2</td></tr>
<tr><td>Send</td><td>Not send</td></tr>
<tr><td rowspan="2">Player A1</td><td>Send</td><td>(a)
72, 72</td><td>(c)
24, 88</td></tr>
<tr><td>Not send</td><td>(b)
88, 24</td><td>(d)
40, 40</td></tr>
</table>

Note: The first number in each cell is Player A1's payoff, and the second number in each cell is Player A2's payoff

Suppose that you are Player A1. There are 4 possible situations:

(a) Both you and Player A2 send 16 points to each other. In this situation, each player obtains 40 – 16 + (3 × 16) = 72 points.

(b) Player A2 sends 16 points to you, but you do not send 16 points to Player A2. In this situation, your earnings are 88 points. Player A2's earnings are 24 points.

(c) You send 16 points to Player A2, but Player A2 does not send 16 points to you. In this situation, your earnings are 24 points. Player A2's earnings are 88 points.

(d) Neither you nor Player A2 sends 16 points to each other. In this situation, you and Player A2 each obtain earnings of 40 points.

As indicated in the calculations above, your own earnings will be maximized when you do not send 16 points but Player A2 sends 16 points. However, if both players send 16 points to each other, the total earnings of the 2 players will be maximized and will be 72 × 2 points = 144 points; and each player obtains 72 points as earnings. Your earnings will be minimized if you send 16 points to Player A2 but Player A2 does not send 16 points to you.

[Pause for questions]

Stage 2:

In this stage, player Bs will be asked to decide how many points they want to reduce from the earnings of the two player As in their group. **The number of player Bs in a group is 3** and player Bs **simultaneously** make such reduction decisions.

Each player B will be given an endowment of 60 points. Each reduction point player B allocates to reduce a player A's earnings **reduces the player B's earnings by 1 point** and **reduces the player A's earnings by 3 points**. The reduction points targeted at each player A must be a multiple of 2, between zero and 10. If all three player Bs choose zero as reduction points to a player A, the player A's earnings remain unchanged from Stage 1.

Specifically, each player B will be asked to make decisions for the following **four scenarios**:

(a) how many reduction points he or she would like to assign to a Player A1 who **sent** 16 points to Player A2 when Player A2 **also sent** 16 points to Player A1.

(b) how many reduction points he or she would like to assign to a Player A1 who **did not send** 16 points to Player A2 when Player A2 **sent** 16 points to Player A1.

(c) how many reduction points he or she would like to assign to a Player A1 who **sent** 16 points to Player A2 when Player A2 **did not send** 16 points to Player A1.

(d) how many reduction points he or she would like to assign to a Player A1 who **did not send** 16 points to Player A2 when Player A2 **also did not send** 16 points to Player A1.

Two of the four scenarios will be applied based on the two player As' actual sending decisions. For example, suppose that Player A1 did not send 16 points while Player A2 did. In this case, player Bs' decisions in (b) and (c) would be applied. Alternatively, suppose that both Player A1 and Player A2 did not send 16 points. In this case, player Bs' decisions in (d) would be applied twice, i.e., **to both Player As**.

[Pause for questions]

Stage 3:

In this stage, player Bs will be asked to decide how many points they want to reduce from the earnings of the other two player Bs in the group, based on their reduction decisions in Stage 2. The player Bs **simultaneously** make such reduction decisions (they will not be informed of the other player Bs' reduction decisions at the decision stage).

The reduction schedule in Stage 3 is the same as in Stage 2. Specifically, each reduction point player B allocates to reduce another player B's earnings **reduces his or her own earnings by 1 point** and **reduces the target's earnings by 3 points**. The reduction points targeted at each of the other player Bs must be a multiple of 2, between zero and 10.

Each player B will be asked to assign reduction points to the other player Bs in the group for **thirty randomly chosen scenarios** from stages 1 and 2. Each scenario consists of one of the four possible situations from stage 1 and a pair of player B reduction decisions from stage 2.

The thirty scenarios include the real scenarios you have in your group after Stage 2. For example, suppose that one Player A in your group did not send 16 points while the other Player A did. In this case, one scenario would include your peers' reduction decisions in (b), and another scenario would include your peers' reduction decisions in (c). Alternatively, suppose that the two Player As in your group did not send 16 points. In this case, only your peers' reduction decisions in (d) are relevant.

You will not be informed of which are the real scenarios when you make your reduction decisions in this stage. Your reduction decision in the real scenarios will affect the earnings of you and the other Player Bs. Since there are two other Player Bs in your group, your decisions will be applied to **both player Bs.**

Note:

Some further questions will appear on your screen during this part of the session when your role (either player A or player B) does not have a decision to make. In some cases, you will have an opportunity to add to your payoff based on the accuracy of your answers. Instruction for these will be provided to you on the computer screen.

[Pause for questions]

B. Your Earnings

If you are assigned the role of player A, your earnings for this part will be calculated as:

Your earnings in Stage 1 (= 24, 40, 72 or 88)

minus

total reduction amounts you received from player Bs

Total reduction amounts you received from player Bs are sum of reduction points from all three player Bs in your group times 3. If the net amount becomes negative, then the payoff will be 0.

In addition, player As may receive points from stages 2 and 3 based on the accuracy of their answers to some questions that appear on the computer screen in these stages.

If you are assigned the role of player B, your earnings for this part will be calculated as:

Your endowment from Stage 2 (= 60)

minus

(i) the sum of reduction points you assigned to player As

minus

(ii) the sum of reduction points you assigned to other player Bs

minus

(iii) total reduction amounts you received from other player Bs

Total reduction amounts you received from other player Bs (term (iii)) are the sum of reduction points assigned to you by the other two player Bs in your group times 3. If the net amount becomes negative, then the payoff will be 0.

For instance, let us refer to the three player Bs in a group as "Player B1," "Player B2" and "Player B3." If Player B1:

(i) assigns 4 reduction points to Player A1 and 10 reduction points to Player A2,

then Player B1 obtains a payoff after stage 2 of 46 points (=60 – 4 – 10). If, in stage 3, Player B1:

(ii) assigns a sum of 0 reduction points to Player B2,
assigns a sum of 8 reduction points to Player B3; and
(iii) receives total reduction amounts of 18 from Players B2 and B3,

then Player B1 obtains a final payoff of 20 points (=46 – 0 – 8 – 18).

In addition, player Bs may receive points from stage 1 based on the accuracy of their answers to some questions that appear on the computer screen in this stage.

Any questions? We will now move on to the comprehension quiz, which will appear on your computer screen. Once everyone has successfully completed this, Stage 1 will begin. During the quiz, please raise your hand if you are stuck on any question.

[Subjects complete the comprehension question – see Section A.3 of the Appendix]

[Subjects complete Part II]

[Instructions for Part III on screen]

A.3. Comprehension Questions for Part 2 Instructions

1. How many persons in each group will be assigned the role of player A? *Answer – 2.*
2. How many persons in each group will be assigned the role of player B? *Answer – 1 [3].*

Suppose that Player A1 sends 16 points to Player A2, and Player A2 does not send 16 points to Player A1.

3. What is the Stage 1 payoff of Player A1? *Answer – 24.*
4. What is the Stage 1 payoff of Player A2? *Answer – 88.*

5. How much does it cost a player B to reduce the earnings of another player by 9 points? *Answer – 3.*

Suppose that Player A1 obtains 40 points in Stage 1 and receives total reduction amounts of 18 from player B[s] in Stage 2.

6. What are Player A1's earnings? *Answer – 22.*

[Baseline/Trio treatment:]

Each player B is endowed with 60 points. Suppose that a player B assigns 6 reduction points to Player A1 and 4 reduction points to Player A2.

7. What are the player B's earnings? *Answer – 50.*

[Higher-Order treatment:]

Each player B is endowed with 60 points. Let us refer to the three player Bs in a group as "Player B1," "Player B2" and "Player B3." Suppose that Player B1:

(i) assigns 6 reduction points to Player A1 and 4 reduction points to Player A2,
(ii) assigns a sum of 10 reduction points to Player B2,
assigns a sum of 0 reduction points to Player B3; and
(iii) receives total reduction amounts of 12 from Players B2 and B3.

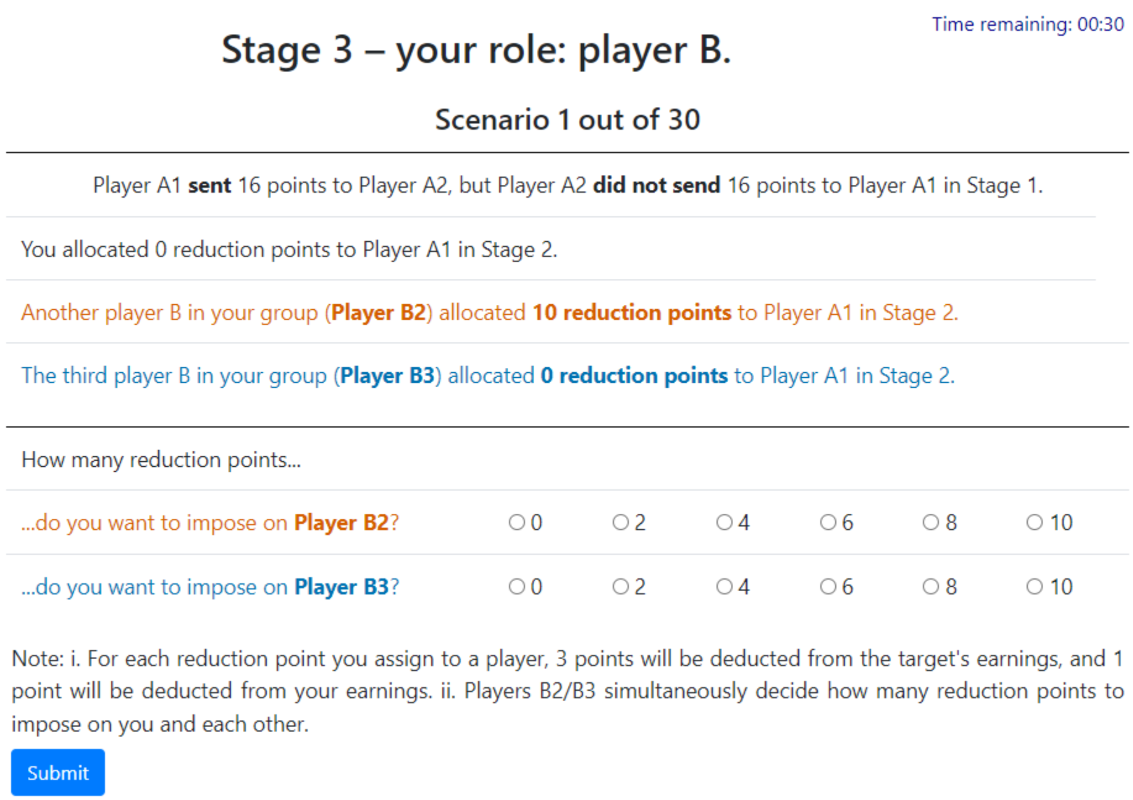
7. What are Player B1's earnings? *Answer – 28.*

A.4. A Screen Image in Stage 3 of the Higher-Order treatment

Third-party player's screen:

The following is a screen image for a third-party player in Stage 3 of the Higher-Order treatment. In this example, Stage 1 is a scenario of "victim."

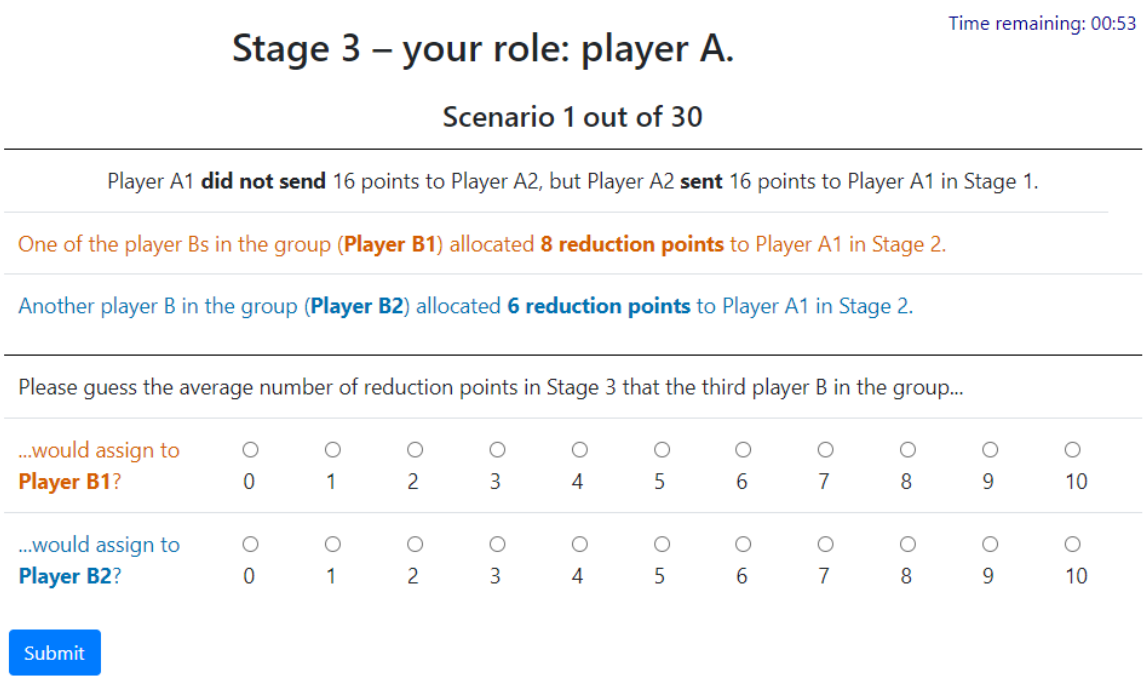
Each third-party player will be presented with 30 scenarios from Stage 1 and 2 like this one (i.e., two PD players' decisions in Stage 1, and the third-party player's and the other two third-party players' punishment decisions in Stage 2). One scenario is a real one. You will then decide how to punish the other two third-party players in your group.



Note: Decisions in the screen image are for illustrations only.

<u>PD player's screen</u>:

In Stage 3, each PD player will be presented with 30 scenarios from Stage 1 and 2 like the one below, and then will be asked about their guess on their third-party players' second-order punishment decisions. The following screenshot is one example.


Time remaining: 00:53

Stage 3 – your role: player A.

Scenario 1 out of 30

Player A1 **did not send** 16 points to Player A2, but Player A2 **sent** 16 points to Player A1 in Stage 1.

One of the player Bs in the group (**Player B1**) allocated **8 reduction points** to Player A1 in Stage 2.

Another player B in the group (**Player B2**) allocated **6 reduction points** to Player A1 in Stage 2.

Please guess the average number of reduction points in Stage 3 that the third player B in the group...

...would assign to **Player B1**?	0	1	2	3	4	5	6	7	8	9	10
...would assign to **Player B2**?	0	1	2	3	4	5	6	7	8	9	10

Submit

Note: Decisions in the screen image are for illustrations only.

A.5. Part 3: Post-Experiment Questionnaire

The post-experiment questionnaire contained the following modules.

Global Preferences Survey

Risk preferences

Please tell me, in general, how willing or unwilling you are to take risks. Please use a scale from 0 to 10, where 0 means "completely unwilling to take risks" and a 10 means you are "very willing to take risks". You can also use any numbers between 0 and 10 to indicate where you fall on the scale, like 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

Social preferences

How well do the following statements describe you as a person? Please indicate your answer on a scale from 0 to 10. A 0 means "does not describe me at all" and a 10 means "describes me perfectly".

> *When someone does me a favor, I am willing to return it.*
>
> *If I am treated very unjustly, I will take revenge at the first occasion, even if there is a cost to do so.*
>
> *I assume that people have only the best intentions.*

We now ask you for your willingness to act in a certain way. Please again indicate your answer on a scale from 0 to 10. A 0 means "completely unwilling to do so," and a 10 means "very willing to do so."

> *How willing are you to punish someone who treats you unfairly, even if there may be costs for you?*
>
> *How willing are you to punish someone who treats others unfairly, even if there may be costs for you?*
>
> *How willing are you to give to good causes without expecting anything in return?*

World Values Survey

Generalized trust

Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people? Please indicate on a scale from 1 to 10. 10 means "most people can be trusted" and 1 means "need to be very careful".

In-/out-group trust

We are interested in how much you trust people from various groups. For each of the below, please fill in whether you trust people from this group completely, somewhat, not very much or not at all?

1. Trust completely
2. Trust somewhat
3. Do not trust very much
4. Do not trust at all

[In-group:]

- Your family
- Your neighbourhood
- People you know personally

[Out-group:]

- People you meet for the first time
- People of another religion
- People of another nationality

Religious beliefs

How important is God in your life? Please indicate on a scale from 1 to 11. 11 means “very important” and 1 means “not at all important.” [or prefer not to say]

Which, if any, of the following do you believe in? Yes/No [or prefer not to say]

- God
- Life after death
- Hell
- Heaven

Confidence

Below are listed a number of organizations. For each one, please indicate how much confidence you have in them: is it a great deal of confidence, quite a lot of confidence, not very much confidence or none at all?

- The armed forces.
- The police.
- The courts.
- The government.
- Political parties.
- Parliament.

Family ties

How important would you say that family is in your life?

1. Very important
2. Rather important
3. Not very important
4. Not at all important

<u>Social norms in a community</u>

Norm adherence

Due to M. J. Gelfand et al., Differences between tight and loose cultures: A 33-nation study. Science (80-.). 332, 1100–1104 (2011).

The following statements refer to the United Kingdom as a whole. Please indicate to what extent you agree or disagree with each statement.

1. There are many social norms that people are supposed to abide by in this country.

2. In this country, there are very clear expectations for how people should act in most situations.

3. People agree upon what behaviours are appropriate versus inappropriate in most situations in this country.

4. People in this country have a great deal of freedom in deciding how they want to behave in most situations. (Reverse coded)

5. In this country, if someone acts in an inappropriate way, others will strongly disapprove.

6. People in this country almost always comply with social norms.

Moral Foundations Questionnaire[1]

Relative importance of communal over universal moral values:

First, sum responses to all questions that belong to the communal values "Ingroup" and "Authority"; then, subtract responses to all questions that belong to the universal moral values of "Fairness" and "Harm".

Moral relevance of purity and disgust:

Questions that belong to the dimension "Purity".

Big Five model

Please evaluate the following statements, to complete the sentence:

Scale: 1 ("disagree strongly") to 5 ("agree strongly")

I see myself as someone who ...

is original, comes up with new ideas

values artistic experiences

has an active imagination

does a thorough job

does things effectively and efficiently

tends to be lazy

is communicative, talkative

is outgoing, sociable

is reserved

has a forgiving nature

is considerate and kind to others

[1] Moral Foundations Questionnaire: 20-Item Short Version Item Key, July 2008, https://moralfoundations.org/questionnaires/

is sometimes somewhat rude to others

worries a lot

gets nervous easily

is relaxed, handles stress well

<u>Test of Self-Conscious Affect</u>

Due to Tangney J. P., Dearing R. L., Wagner P. E., Gramzow R. (2000). The Test of Self-Conscious Affect-3 (TOSCA-3). Fairfax, VA: George Mason University.

Guilt and Shame

Series of scenarios with possible emotional reactions on five-point Likert scale; the reactions designed to elicit guilt/shame are used to construct the measures.

<u>Demographics</u>

Age: Years. [or prefer not to say].

Gender: Male/Female/Other/Prefer not to say

Siblings: Number of.

Country of birth:

Central and Eastern Asia; Central and Western Africa; Central, South America and the Caribbean; Europe (excl. UK); Middle East and North Africa; North America; Oceania; South and Eastern Africa; South-East Asia; Southern Asia; UK.

Country of hometown: Free text.

Field of studies:

Arts and Education; Economics and Finance; Business and Management; Law and Social Sciences; Medicine and Health Sciences; Engineering and Natural Sciences; Not a Student.

Income: When you were 16 years of age, what was the income of your parents in comparison to the average income in your hometown?

Far below average; Below average; Average; Above average; Far above average.

A.6. Sample Characteristics

Table A.1: *Cross-Societal Subject Pool Characteristics.*

	Newcastle			Sonipat			
	n	mean	sd.	n	mean	sd.	Diff
Positive reciprocity	239	8.80	1.42	262	8.92	1.68	0.125
Trust intentions	239	4.72	2.40	262	4.63	2.92	-0.090
Generalized trust	239	5.50	2.19	262	4.49	2.29	-1.014***
Trust in-group	239	3.20	0.37	262	3.12	0.47	-0.078*
Trust out-group	239	2.68	0.46	262	2.43	0.58	-0.249***
Communal vs. universal values (z-score)	239	0.07	0.96	262	-0.06	1.03	-0.132
Moral purity and disgust	239	10.56	4.12	262	9.85	4.36	-0.714
Guilt	239	45.20	5.44	261	45.13	6.33	-0.070
Shame	239	33.90	6.77	261	32.81	8.15	-1.087
Third-party vs. direct punishment (z-score)	239	0.09	0.89	262	-0.08	1.06	-0.164**
Charitable giving	239	7.40	2.07	262	7.41	2.42	0.011
Importance of God	239	3.92	3.30	262	5.49	3.43	1.572***
Family ties	239	3.67	0.58	262	3.65	0.60	-0.024
Risk preference	239	6.29	2.08	262	6.38	2.16	0.089
Norm adherence	239	4.43	0.71	262	4.07	0.75	-0.363***
Confidence in institutions	239	2.74	0.49	262	2.82	0.53	0.082
Female	237	0.49	0.50	261	0.43	0.50	-0.057
Econ major	237	0.30	0.46	261	0.30	0.46	-0.009
Age	225	21.48	3.55	243	20.44	5.27	-1.036*
Num. siblings	232	1.72	1.33	256	1.23	1.44	-0.481***
Relative income at 16	237	3.22	0.94	258	3.34	1.09	0.122
Openness	239	3.71	0.79	262	4.07	0.79	0.360***
Conscientiousness	239	3.54	0.77	262	3.32	0.77	-0.222***
Extraversion	239	3.47	0.88	262	3.22	1.01	-0.257***
Agreeableness	239	3.82	0.71	262	3.68	0.79	-0.133**
Neuroticism	239	3.51	1.02	262	3.48	1.00	-0.034
Raven’s test score	254	5.34	2.53	262	5.17	2.38	-0.167

Table shows averages pooled across treatments. The Diff column is the coefficient of a linear regression of subject pool on the variable. Stars indicate whether this difference is significant. *** p<0.01, ** p<0.05, * p<0.1

Appendix B: Theoretical Analysis based on the Fehr-Schmidt (1999) model

Below, we summarize how the inequity-averse preference model by Fehr and Schmidt (1999) predicts the punishment behaviors of third-party players in our experiment.

The Fehr-Schmidt (1999) utility function is given as follows: for a list of *n* players' material payoffs (*x*), player *i* receives the following utility:

$$U_i(x) = x_i - \frac{\alpha_i}{n-1}\sum_{j\neq i} \max\{x_j - x_i, 0\} - \frac{\beta_i}{n-1}\sum_{j\neq i} \max\{x_i - x_j, 0\}, \quad \text{(B1)}$$

where x_i is the payoff of player *i*, $\beta_i \leq \alpha_i$ and $0 \leq \beta_i < 1$. α_i indicates player *i*'s aversion to disadvantageous inequality, while β_i indicates player *i*'s aversion to advantageous inequality. For simplicity, we use a continuous interval for *i*'s punishment activities, although a discrete interval {0, 2, 4, …, 10} is used as the choice space in the experiment.

B.1. *Baseline* Treatment

For the *Baseline* treatment, in which there is a single third-party player in Stage 2 ($n = 3$), the insights of the analysis are summarized as follows:

a. *Scenario CC: i* punishes a cooperator ($P_{CC} = 10$) iff $\alpha_i > 2$.

b. *Scenario CD/DC: i* never punishes a cooperator; *i* punishes a defector ($P_{DC} = 10$) iff $\alpha_i + \beta_i / 2 > 1$.

c. *Scenario DD: i* never punishes a defector.

d. Some PD players choose to cooperate with their paired PD players, driven by their inequality concern or by the threat of punishment.

(a) *i*'s Punishment Behavior in Scenario CC

Given the strategy method implementation, *i* will impose the same punishment points on two cooperators and receive the following utility in Scenario CC:

$$U_i(x) = 60 - 2P_{CC} - \alpha_i \max\{(72 - 3P_{CC}) - (60 - 2P_{CC}), 0\} - \beta_i \max\{(60 - 2P_{CC}) - (72 - 3P_{CC}), 0\}. \quad \text{(B2)}$$

where $x = (72 - 3P_{CC}, 72 - 3P_{CC}, 60 - 2P_{CC})$ and P_{CC} is punishment points assigned by *i* to a cooperator. Since $P_{CC} < 12$, we obtain:

$$U_i(x) = 60 - 12\alpha_i + (\alpha_i - 2)P_{CC}. \quad \text{(B3)}$$

Thus, equation (B3) suggests that *i* will punish a cooperator and $P_{CC} = 10$ (not punish a cooperator) in Scenario CC if and only if $\alpha_i > 2$ (< 2).

(b) *i*'s Punishment Behavior in Scenario CD/DC

In Scenario CD/DC, the three players' payoffs are $x = (24 - 3P_{CD}, 88 - 3P_{DC}, 60 - P_{CC} - P_{DC})$, where

P_{CD} is punishment points from *i* to the cooperator and P_{DC} is punishment points from *i* to the defector in *i*'s group. The third-party player will receive the following utility:

$$U_i(x) = 60 - P_{CD} - P_{DC}$$

$$-\frac{\alpha_i}{2}\max\{(-36 - 2P_{CD} + P_{DC}), 0\} - \frac{\alpha_i}{2}\max\{(28 + P_{CD} - 2P_{DC}), 0\} \quad \text{(B4)}$$

$$-\frac{\beta_i}{2}\max\{(36 + 2P_{CD} - P_{DC}), 0\} - \frac{\beta_i}{2}\max\{(-28 - P_{CD} + 2P_{DC}), 0\}.$$

By design, $P_{DC} \leq 10$ and so it must be the case that $28 + P_{CD} - 2P_{DC} > 0$. In this case, $36 + 2P_{CD} - P_{DC} > 0$ because $36 + 2P_{CD} - P_{DC} > 36 + 2P_{CD} - 14 - \frac{P_{CD}}{2} = 22 + \frac{3P_{CD}}{2} > 0$. Thus, equation (B4) reduces to:

$$U_i(x) = 60 - 14\alpha_i - 18\beta_i - \left(1 + \frac{\alpha_i}{2} + \beta_i\right)P_{CD} + \left(\alpha_i + \frac{\beta_i}{2} - 1\right)P_{DC}. \quad \text{(B5)}$$

Since $\frac{dU_i}{dP_{CD}} < 0$, *i* never punishes a cooperator in Scenario CD. However, *i* will punish a defector and P_{DC} = 10 (not punish a defector) in Scenario DC if and only if $\alpha_i + \beta_i/2 > 1$ (< 1).

(c) *i*'s Punishment Behavior in Scenario DD

Analogous to scenario (a) above, *i* will impose the same punishment points on two defectors and receive the following utility in Scenario DD:

$$U_i(x) = 60 - 2P_{DD} - \alpha_i \max\{(40 - 3P_{DD}) - (60 - 2P_{DD}), 0\} - \beta_i \max\{(60 - 2P_{DD}) - (40 - 3P_{DD}), 0\}. \quad \text{(B6)}$$

where $x = (40 - 3P_{DD}, 40 - 3P_{DD}, 60 - 2P_{DD})$ and P_{DD} is punishment points assigned by *i* to a defector. Since $P_{DD} \geq 0$, we obtain:

$$U_i(x) = 60 - 15\beta_i - (\beta_i + 2)P_{DD}. \quad \text{(B7)}$$

Since $\frac{dU_i}{dP_{DD}} < 0$, *i* never punishes a defector in Scenario DD.

(d) Cooperate/defect decision

Let $F(\alpha)$ denote the CDF of the distribution over disadvantageous inequality held by PD players. By the definition of a CDF, *F*(.) is an increasing function. To simplify the exposition, we assume that β = 0. Based on the preceding analysis, the expected payoffs to a PD player are given in Table B.2. If (*F*(2) – *F*(1)) > 8/15, then the social dilemma becomes a coordination game with a second equilibrium in pure strategies of mutual cooperation. Notice that if the PD player were to be averse to advantageous inequality (i.e., $\beta > 0$), then the threshold would be strictly lower than 8/15 and so the probability of choosing cooperation would increase.

Table B.2: *Expected payoffs to Player 1's cooperate/defect decision in the Baseline treatment under the threat of punishment.*

		Player 2	
		Send	Not send
Player 1	Send (cooperate)	(a) $F(2)(72) + (1 - F(2))(42)$	(c) 24
	Not send (defect)	(b) $F(1)(88) + (1 - F(1))(58)$	(d) 40

B.2. *Trio* Treatment

For the *Trio* treatment, in which there are three third-party players in Stage 2 (n = 5), we denote $P_{s,i}$, where the indices denote scenario $s \in \{CC, CD, DC, DD\}$ and third-party player $i \in \{1,2,3\}$. As the identities of third-party players in the experiment are anonymous, we assume the symmetric punishment situation: for any player i and scenario s, (i) $P_{s,j} = P_{s,k}$ for $j, k \neq i$, and (ii) i's belief about the punishment choice of another third-party player in each scenario P_s' is correct ($P_s' = P_{s,j}$, $j \neq i$). For ease of notation, we suppress the subscript i such that $P_{s,i} = P_s$. The symmetric equilibria are characterized as follows:

a. *Scenario CC: i* punishes a cooperator iff $\alpha_i/2 + \beta_i > 2$ and $0 < P_{CC}' \leq 12/7$; this condition implies a group size effect. The condition on social preference parameters is more restrictive, and the per third-party player punishment strength is weaker, than in the *Baseline* treatment.[2]

b. *Scenario CD/DC: i* never punishes a cooperator; *i* punishes a defector iff $\alpha_i/2 + 3\beta_i/4 > 1$ and $0 < P_{DC}' \leq 7/2$; this condition implies a group size effect. The condition on social preference parameters is more restrictive, and the per third-party player punishment strength is weaker, than in the corresponding scenario of the *Baseline* treatment; however, these conditions are less restrictive than in Scenario CC.[3]

c. *Scenario DD: i* never punishes a defector.

d. Some PD players choose to cooperate with their paired PD players, driven by their inequality concern or by the threat of punishment.

(a) *i*'s Punishment Behavior in Scenario CC

A third-party player *i*'s utility in Scenario CC is given by:

$$U_i(x) = 60 - 2P_{CC} \quad \text{(B8)}$$

[2] $4 - 2\beta_i > 2$ for all $\beta_i < 1$.
[3] $2 - \beta_i > 1$ for all $\beta_i < 1$.

$$-\frac{\alpha_i}{2}\max\{(72-3P_{CC}-6P'_{CC})-(60-2P_{CC}),0\}$$

$$-\frac{\beta_i}{2}\max\{(60-2P_{CC})-(72-3P_{CC}-6P'_{CC}),0\}$$

$$-\alpha_i\max\{P_{CC}-P'_{CC},0\}-\beta_i\max\{P'_{CC}-P_{CC},0\}.$$

where $x=(72-3P_{CC}-6P'_{CC},72-3P_{CC}-6P'_{CC},60-2P_{CC},60-2P'_{CC},60-2P'_{CC})$. Equation (B8) means we need to consider four cases to analyze *i*'s punishment behavior:

<u>Case 1</u>: $12-P_{CC}-6P'_{CC}\geq 0$ and $P_{CC}\geq P'_{CC}$

In this case, equation (B8) reduces to:

$$U_i(x)=60-6\alpha_i-\left(\frac{\alpha_i}{2}+2\right)P_{CC}+4\alpha_iP'_{CC}. \quad \text{(B9)}$$

Since $\frac{dU_i}{dP_{CC}}<0$, the smaller punishment *i* inflicts, the higher utility *i* receives. That is, $P_{CC}=P'_{CC}$. Note that *i*'s utility is increasing in P'_{CC} whenever *i* is averse to disadvantageous inequality.

<u>Case 2</u>: $12-P_{CC}-6P'_{CC}<0$ and $P_{CC}\geq P'_{CC}$

In this case, equation (B8) reduces to:

$$U_i(x)=60+6\beta_i-\left(\alpha_i+\frac{\beta_i}{2}+2\right)P_{CC}+(\alpha_i-3\beta_i)P'_{CC}. \quad \text{(B10)}$$

Since $\frac{dU_i}{dP_{CC}}<0$, equation (B10) suggests that the smaller punishment *i* inflicts, the higher utility *i* receives. In other words, $P_{CC}=\max\{P'_{CC},12-6P'_{CC}\}$. Note that *i*'s utility is increasing in P'_{CC} if *i* is sufficiently averse to disadvantageous inequality and not too averse to advantageous inequality.

<u>Case 3</u>: $12-P_{CC}-6P'_{CC}\geq 0$ and $P_{CC}<P'_{CC}$

In this case, equation (B8) reduces to:

$$U_i(x)=60-6\alpha_i+\left(\frac{\alpha_i}{2}+\beta_i-2\right)P_{CC}+(3\alpha_i-\beta_i)P'_{CC}. \quad \text{(B11)}$$

Thus, equation (B11) suggests that *i* will punish (not punish) a cooperator in Scenario CC if $\alpha_i/2+\beta_i>2$ (<2), up to:

$$P_{CC}=\min\{P'_{CC},12-6P'_{CC}\}.$$

Note that *i*'s utility is increasing in P'_{CC} if *i* is sufficiently averse to disadvantageous inequality and not too averse to advantageous inequality.

<u>Case 4</u>: $12-P_{CC}-6P'_{CC}<0$ and $P_{CC}<P'_{CC}$

In this case, equation (B8) reduces to:

$$U_i(x) = 60 + 6\beta_i - \left(2 - \frac{\beta_i}{2}\right) P_{CC} - 4\beta_i P'_{CC}. \tag{B12}$$

Since $\frac{dU_i}{dP_{CC}} < 0$, the smaller punishment *i* inflicts, the higher utility *i* receives. That is,

$$P_{CC} = \max\{0, 12 - 6P'_{CC}\}.$$

Note that *i*'s utility is decreasing in P'_{CC} whenever *i* is averse to advantageous inequality.

Summary: These four cases can be summarized as in Figure B.1:

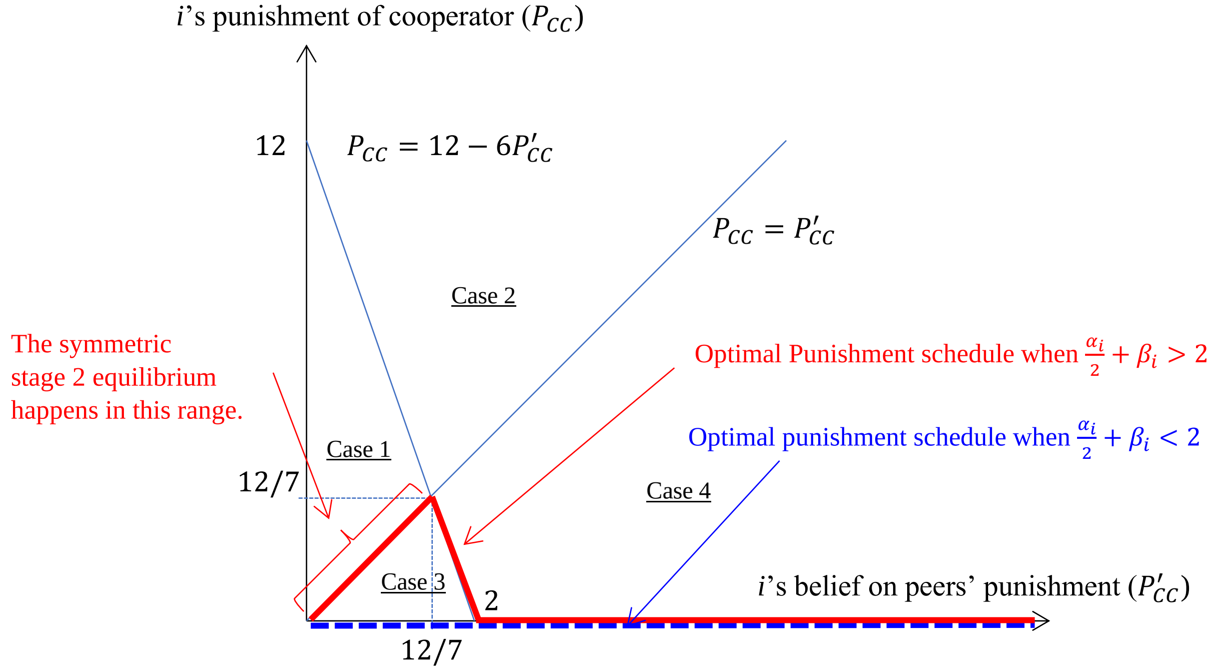


Figure B.1. *Optimal punishment schedule in Trio Scenario CC*

(b) *i*'s Punishment Behavior in Scenario CD/DC

A third-party player *i*'s utility in Scenario CD/DC is given by:

$$\begin{aligned} U_i(x) &= 60 - P_{CD} - P_{DC} \\ &- \frac{\beta_i}{4}(36 + 2P_{CD} - P_{DC} + 6P'_{CD}) \\ &- \frac{\alpha_i}{4}\max\{(28 + P_{CD} - 2P_{DC} - 6P'_{DC}), 0\} \\ &- \frac{\beta_i}{4}\max\{(-28 - P_{CD} + 2P_{DC} + 6P'_{DC}), 0\} \end{aligned} \tag{B13}$$

$$-\frac{\alpha_i}{2}\max\{(P_{CD}+P_{DC})-(P'_{CD}+P'_{DC}),0\}$$

$$-\frac{\beta_i}{2}\max\{(P'_{CD}+P'_{DC})-(P_{CD}+P_{DC}),0\}.$$

where $x=(24-3P_{CD}-6P'_{CD}, 88-3P_{DC}-6P'_{DC}, 60-P_{CD}-P_{DC}, 60-P'_{CD}-P'_{DC}, 60-P'_{CD}-P'_{DC})$. Equation (B13) means we need to consider four cases to analyze *i*'s punishment behavior:

<u>Case 1</u>: $28+P_{CD}-2P_{DC}-6P'_{DC}\geq 0$ and $(P_{CD}+P_{DC})\geq(P'_{CD}+P'_{DC})$

In this case, equation (B13) reduces to:

$$\begin{aligned}U_i(x)&=60-P_{CD}-P_{DC}\\&-\frac{\beta_i}{4}(36+2P_{CD}-P_{DC}+6P'_{CD})\\&-\frac{\alpha_i}{4}(28+P_{CD}-2P_{DC}-6P'_{DC})\\&-\frac{\alpha_i}{2}\big((P_{CD}+P_{DC})-(P'_{CD}+P'_{DC})\big).\end{aligned}\tag{B14}$$

which can be further simplified to:

$$U_i(x)=60-9\beta_i-7\alpha_i-\left(1+\frac{\beta_i}{2}+\frac{3\alpha_i}{4}\right)P_{CD}-\left(1-\frac{\beta_i}{4}\right)P_{DC}+\left(\frac{\alpha_i}{2}-\frac{3\beta_i}{2}\right)P'_{CD}+2\alpha_iP'_{DC}.\tag{B15}$$

Since $\frac{dU_i}{dP_{CD}}<0$ and $\frac{dU_i}{dP_{DC}}<0$, equation (B15) suggests that the smaller punishment *i* inflicts, the higher utility *i* receives. Note that *i*'s utility is increasing in P'_{CD} if *i* is sufficiently averse to disadvantageous inequality and not too averse to advantageous inequality and is increasing in P'_{DC} whenever *i* is averse to disadvantageous inequality.

<u>Case 2</u>: $28+P_{CD}-2P_{DC}-6P'_{DC}<0$ and $(P_{CD}+P_{DC})\geq(P'_{CD}+P'_{DC})$

In this case, equation (B13) reduces to:

$$\begin{aligned}U_i(x)&=60-P_{CD}-P_{DC}\\&-\frac{\beta_i}{4}(36+2P_{CD}-P_{DC}+6P'_{CD})\\&-\frac{\beta_i}{4}(-28-P_{CD}+2P_{DC}+6P'_{DC})\\&-\frac{\alpha_i}{2}\big((P_{CD}+P_{DC})-(P'_{CD}+P'_{DC})\big).\end{aligned}\tag{B16}$$

which can be further simplified to:

$$U_i(x) = 60 - 2\beta_i - \left(1 + \frac{\beta_i}{4} + \frac{\alpha_i}{2}\right)(P_{CD} + P_{DC}) + \left(\frac{\alpha_i}{2} - \frac{3\beta_i}{2}\right)(P'_{CD} + P'_{DC}). \qquad \text{(B17)}$$

Since $\frac{dU_i}{dP_{CD}} < 0$ and $\frac{dU_i}{dP_{DC}} < 0$, equation (B17) suggests that the smaller punishment *i* inflicts, the higher utility *i* receives. Note that *i*'s utility is increasing in P'_{CD} and in P'_{DC} if *i* is sufficiently averse to disadvantageous inequality and not too averse to advantageous inequality.

Case 3: $28 + P_{CD} - 2P_{DC} - 6P'_{DC} \geq 0$ and $(P_{CD} + P_{DC}) < (P'_{CD} + P'_{DC})$

In this case, equation (B13) reduces to:

$$\begin{aligned} U_i(x) &= 60 - P_{CD} - P_{DC} \\ &- \frac{\beta_i}{4}(36 + 2P_{CD} - P_{DC} + 6P'_{CD}) \\ &- \frac{\alpha_i}{4}(28 + P_{CD} - 2P_{DC} - 6P'_{DC}) \\ &- \frac{\beta_i}{2}\left((P'_{CD} + P'_{DC}) - (P_{CD} + P_{DC})\right). \end{aligned} \qquad \text{(B18)}$$

which can be further simplified to:

$$U_i(x) = 60 - 9\beta_i - 7\alpha_i - \left(1 + \frac{\alpha_i}{4}\right)P_{CD} + \left(\frac{\alpha_i}{2} + \frac{3\beta_i}{4} - 1\right)P_{DC} - 2\beta_i P'_{CD} + \left(\frac{3\alpha_i}{2} - \frac{\beta_i}{2}\right)P'_{DC}. \qquad \text{(B19)}$$

Since $\frac{dU_i}{dP_{CD}} < 0$, equation (B19) suggests that the smaller punishment *i* inflicts on the cooperator, the higher utility *i* receives. Equation (B19) suggests that *i* will punish (not punish) a defector in Scenario DC if $\alpha_i/2 + 3\beta_i/4 > 1$ (< 1), up to:

$$P_{DC} = \min\ \{14 - 3P'_{DC}, P'_{DC}\}.$$

Note that *i*'s utility is decreasing in P'_{CD} whenever *i* is averse to advantageous inequality and is increasing in P'_{DC} if *i* is sufficiently averse to disadvantageous inequality and not too averse to advantageous inequality.

Case 4: $28 + P_{CD} - 2P_{DC} - 6P'_{DC} < 0$ and $(P_{CD} + P_{DC}) < (P'_{CD} + P'_{DC})$

In this case, equation (B13) reduces to:

$$\begin{aligned} U_i(x) &= 60 - P_{CD} - P_{DC} \\ &- \frac{\beta_i}{4}(36 + 2P_{CD} - P_{DC} + 6P'_{CD}) \\ &- \frac{\beta_i}{4}(-28 - P_{CD} + 2P_{DC} + 6P'_{DC}) \end{aligned} \qquad \text{(B20)}$$

$$-\frac{\beta_i}{2}\left((P'_{CD} + P'_{DC}) - (P_{CD} + P_{DC})\right).$$

which can be further simplified to:

$$U_i(x) = 60 - 2\beta_i + \left(\frac{\beta_i}{4} - 1\right)(P_{CD} + P_{DC}) - 2\beta_i(P'_{CD} + P'_{DC}). \quad \text{(B21)}$$

Since $\frac{dU_i}{dP_{CD}} < 0$ and $\frac{dU_i}{dP_{DC}} < 0$, equation (B21) suggests that the smaller punishment *i* inflicts, the higher utility *i* receives. Note that *i*'s utility is decreasing in P'_{CD} and in P'_{DC} whenever *i* is averse to advantageous inequality.

Summary: $\frac{dU_i}{dP_{CD}} < 0$ for all four cases, which means that $P_{CD} = 0$. As any other third party *j* faces the same incentive structure as *i* and we assumed that *i*'s belief on *j*'s punishment activities are correct ($P'_s = P_{sj}, j \neq i$), $P'_{CD} = 0$. The conditions for the third party's optimal punishment schedule P_{DC} can be summarized as in Figure B.2. Third parties inflict punishment under weaker conditions in Scenario DC than in Scenario CC (7/2 > 12/7).

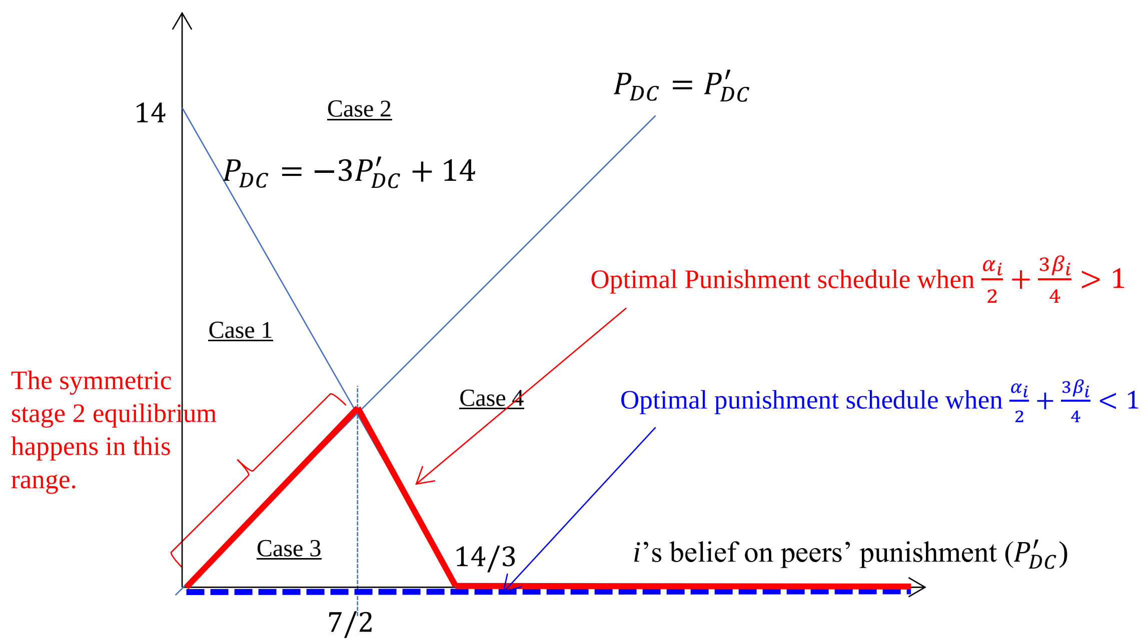


Figure B.2. *Optimal punishment schedule in Trio Scenario DC*

(c) *i*'s Punishment Behavior in Scenario DD

A third-party player *i*'s utility in Scenario DD is given by:

$$U_i(x) = 60 - 2P_{DD} \quad \text{(B22)}$$

$$-\frac{\beta_i}{2}\max\{(60-2P_{DD})-(40-3P_{DD}-6P'_{DD}),0\}$$

$$-\alpha_i\max\{P_{DD}-P'_{DD},0\}-\beta_i\max\{P'_{DD}-P_{DD},0\}.$$

where $x=(40-3P_{DD}-6P'_{DD},40-3P_{DD}-6P'_{DD},60-2P_{DD},60-2P'_{DD},60-2P'_{DD})$. Since the expression $20+P_{DD}+6P'_{DD}\geq 0$, equation (B22) means we need to consider two cases to analyze *i*'s punishment behavior:

Case 1: $P_{DD}\geq P'_{DD}$

In this case, equation (B22) reduces to:

$$U_i(x)=60-10\beta_i-\left(\alpha_i+\frac{\beta_i}{2}+2\right)P_{DD}+(\alpha_i-3\beta_i)P'_{DD}. \quad \text{(B23)}$$

Since $\frac{dU_i}{dP_{DD}}<0$, equation (B23) suggests that *i* never punishes a defector in Scenario DD more than P'_{DD}. Note that *i*'s utility is increasing in P'_{DD} if *i* is sufficiently averse to disadvantageous inequality and not too averse to advantageous inequality.

Case 2: $P_{DD}<P'_{DD}$

In this case, equation (B22) reduces to:

$$U_i(x)=60-10\beta_i-\left(2-\frac{\beta_i}{2}\right)P_{DD}-4\beta_iP'_{DD}. \quad \text{(B24)}$$

Since $\frac{dU_i}{dP_{DD}}<0$, equation (B24) *i* never punishes a defector in Scenario DD. Note that *i*'s utility is decreasing in P'_{DD} whenever *i* is averse to advantageous inequality.

Summary: Regardless of the beliefs that *i* holds in Scenario DD, *i* never punishes a defector.

(d) Cooperate/defect decision

Analogous to the analysis for the *Baseline* treatment, the expected payoffs to a PD player in the *Trio* treatment are given in Table B.3. As (72 – 9*P_{CC}) ≥ (60 – 2*P_{CC}) for all P_{CC} ≤ 12/7, the PD player remains in the region of advantageous inequality in any symmetric equilibrium of Scenario CC. Likewise, as (88 – 9*P_{DC}) ≥ (60 – 2*P_{DC}) for all P_{DC} ≤ 7/2, the PD player remains in the region of advantageous inequality in any symmetric equilibrium of Scenario DC. Mutual cooperation is an equilibrium outcome if (1– *F*(2))P_{DC} – (1– *F*(4))P_{CC} > 16/9.

Table B.3: *Expected payoffs to Player 1's cooperate/defect decision in the Trio treatment under the threat of punishment.*

		Player 2	
		Send	Not send
Player 1	Send (cooperate)	(a) F(4)(72) + (1 – F(4))(72 – 9*P_{CC}), where $P_{CC} \leq 12/7$	(c) 24
	Not send (defect)	(b) F(2)(88) + (1 – F(2))(88 – 9*P_{DC}), where $P_{DC} \leq 7/2$	(d) 40

B.3. ***Higher-Order*** Treatment

In the *Higher-Order* treatment, there are three third-party players (n = 5) each of whom can inflict higher-order punishment on each other in Stage 3 after observing the first-order punishment decisions from Stage 2. We denote higher-order punishment by $H_{s,o,t}$, $o \neq t$, where the indices denote the third-party originator $o \in \{1,2,3\}$ and the third-party target $t \in \{1,2,3\}$ in scenario $s \in \{CC, CD, DC, DD\}$.

We search for symmetric equilibria. Specifically, we assume that for any player i and scenario s, (i) $P_{s,j} = P_{s,k} = P_s^*$ for $j, k \neq i$, (ii) $H_{s,i,j} = H_{s,i,k} = H_{s,i}$ for $j, k \neq i$, (iii) $H_{s,j,i} = H_{s,k,i} = H_{s,j,k} = H_{s,k,j}$ for $j, k \neq i$, and (iv) i's beliefs about the higher-order punishment choice of another third-party player in each scenario, H_s', are correct. For ease of notation, we suppress the subscript i such that $P_{s,i} = P_s$ and $H_{s,i} = H_s$.

We consider the possibility of efficient or inefficient higher-order punishment due to the relative difference between P_s and P_s^*, which we denote as $\hat{P}_s = P_s - P_s^*$. We define higher-order punishment from i to j, $H_{s,i,j}$ where $j \neq i$, to be efficient (inefficient) if $\hat{P}_s < (\geq)\ 0$ for scenario $s \in \{CC, CD\}$, and $\hat{P}_s > (\leq)\ 0$ for scenario $s \in \{DC, DD\}$. The symmetric equilibria are characterized as follows:

a. *Scenario CC:* i punishes a cooperator iff $\alpha_i/2 + \beta_i > 2$ and $0 < P_{CC}' \leq 12/7$; this condition implies a group size effect. The condition on social preference parameters is more restrictive, and the per third-party player punishment strength is weaker, than the corresponding conditions in the Baseline treatment. Regarding Stage 3, i never imposes higher-order punishment on another third party.

b. *Scenario CD/DC:* i never punishes a cooperator; i punishes a defector iff $\alpha_i/2 + 3\beta_i/4 > 1$ and $0 < P_{DC}' \leq 7/2$; this condition implies a group size effect. The condition on social preference parameters is more restrictive, and the per third-party player punishment strength is weaker, than the corresponding conditions in the Baseline treatment. Regarding Stage 3, i never imposes higher-order punishment on another third party.

c. *Scenario DD:* i never punishes a defector; i imposes higher-order punishment on another third party in Scenario DD iff: $\alpha_i/2 + \beta_i > 2$ and $0 < H'_{DD} \leq 5/4$.

d. Some PD players choose to cooperate with their paired PD players, driven by their inequality concern or by the threat of punishment.

Outside of the symmetric equilibria, efficient or inefficient higher-order punishment is feasible in all scenarios.

(a) *i*'s Punishment Behavior in Scenario CC

A third-party player *i*'s utility in Scenario CC is given by:

$$\begin{aligned} U_i(x) &= 60 - 2P_{CC} - 4H_{CC} - 12H'_{CC} \\ &-\tfrac{\alpha_i}{2}\max\{(72 - 3P_{CC} - 6P^*_{CC}) - (60 - 2P_{CC} - 4H_{CC} - 12H'_{CC}), 0\} \\ &-\tfrac{\beta_i}{2}\max\{(60 - 2P_{CC} - 4H_{CC} - 12H'_{CC}) - (72 - 3P_{CC} - 6P^*_{CC}), 0\} \\ &-\alpha_i \max\{P_{CC} - P^*_{CC} - H_{CC} + H'_{CC}, 0\} \\ &-\beta_i \max\{P^*_{CC} - P_{CC} - H'_{CC} + H_{CC}, 0\}, \end{aligned} \tag{B25}$$

where $x = (72 - 3P_{CC} - 6P^*_{CC}, 72 - 3P_{CC} - 6P^*_{CC}, 60 - 2P_{CC} - 4H_{CC} - 12H'_{CC}, 60 - 2P^*_{CC} - 10H'_{CC} - 6H_{CC}, 60 - 2P^*_{CC} - 10H'_{CC} - 6H_{CC})$. Equation (B25) means we need to consider four cases to analyze *i*'s higher-order punishment behavior:

<u>Case 1</u>: $12 - P_{CC} - 6P^*_{CC} + 4H_{CC} + 12H'_{CC} \geq 0$ and $P_{CC} - H_{CC} \geq P^*_{CC} - H'_{CC}$

In this case, equation (B25) reduces to:

$$U_i(x) = 60 - 6\alpha_i - \left(\tfrac{\alpha_i}{2} + 2\right)P_{CC} + 4\alpha_i P^*_{CC} - (4 + \alpha_i)H_{CC} - (12 + 7\alpha_i)H'_{CC}. \tag{B26}$$

Since $\frac{dU_i}{dH_{CC}} < 0$, the smaller higher-order punishment *i* inflicts, the higher utility *i* receives.

<u>Case 2</u>: $12 - P_{CC} - 6P^*_{CC} + 4H_{CC} + 12H'_{CC} < 0$ and $P_{CC} - H_{CC} \geq P^*_{CC} - H'_{CC}$

In this case, equation (B25) reduces to:

$$\begin{aligned} U_i(x) = 60 + 6\beta_i - \left(\alpha_i + \frac{\beta_i}{2} + 2\right)P_{CC} + (\alpha_i - 3\beta_i)P^*_{CC} - (4 - \alpha_i - 2\beta_i)H_{CC} \\ -(12 + \alpha_i - 6\beta_i)H'_{CC}. \end{aligned} \tag{B27}$$

Equation (B27) suggests that *i* will higher-order punish (not higher-order punish) in Scenario CC if $\alpha_i/2 + \beta_i > 2$ (< 2), up to:

$$H_{CC} = \min\left\{\tfrac{3P^*_{CC}}{2} + \tfrac{P_{CC}}{4} - 3(H'_{CC} + 1), H'_{CC} + \hat{P}_{CC}\right\}.$$

Conditional on the vector of punishment decisions (P_{CC}^*, P_{CC}), the arguments of the minima define the upper envelope of the higher-order punishment schedule as a function of i's beliefs about the higher-order punishment choice of another third-party player, H'_{CC}. The upper envelope is a piecewise linear function of H'_{CC}, where the slope of the first argument is negative three and the slope of the second argument is positive one. Thus, for higher-order punishment to be associated with a non-empty subset of first-order punishment vectors, we require that either of the following conditions must hold: (i) $\hat{P}_{CC} > -P_{CC}^*/2 - P_{CC}/12 + 1$ if $\hat{P}_{CC} < 0$ (i.e., if the vertical intercept of the second argument is negative in the H'_{CC}-H_{CC} plane), or (ii) $P_{CC}^*/2 + P_{CC}/12 - 1 > 0$ if $\hat{P}_{CC} \geq 0$ (i.e., if the vertical intercept of the second argument is non-negative in the H'_{CC}-H_{CC} plane).

Solving the system of inequalities for efficient ($\hat{P}_{CC} < 0$) and inefficient ($\hat{P}_{CC} \geq 0$) higher-order punishment respectively, we obtain the following necessary conditions:

- Efficient: $P_{CC} > 12/13 + 6P_{CC}^*/13$; and
- Inefficient: $P_{CC} > 12 - 6P_{CC}^*$.

In Figure B.3, we plot the feasible regions for higher-order punishment in (P_{CC}^*, P_{CC}) space and overlay the optimal first-order punishment schedule from the *Trio* treatment. This implies that the symmetric equilibrium still exists for $0 < P_{CC}, P_{CC}^* < 12/7$ with $H_{CC} = 0$. Outside of the symmetric equilibrium, inefficient or efficient higher-order punishment is feasible.

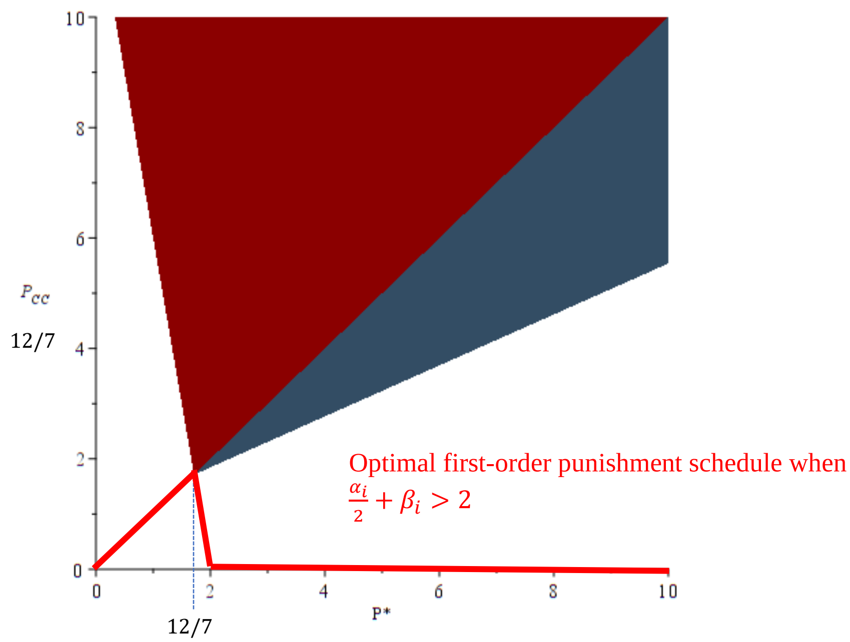


Figure B.3. *Feasible region for higher-order punishment in Scenario CC. The blue (red) region reflects efficient (inefficient) punishment.*

Case 3: $12 - P_{CC} - 6P_{CC}^* + 4H_{CC} + 12H'_{CC} \geq 0$ and $P_{CC} - H_{CC} < P_{CC}^* - H'_{CC}$

In this case, equation (B25) reduces to:

$$U_i(x) = 60 - 6\alpha_i + \left(\frac{\alpha_i}{2} + \beta_i - 2\right)P_{CC} + (3\alpha_i - \beta_i)P^*_{CC} - (4 + 2\alpha_i + \beta_i)H_{CC}$$
$$-(12 + 6\alpha_i - \beta_i)H'_{CC}. \tag{B28}$$

Since $\frac{dU_i}{dH_{CC}} < 0$, the smaller higher-order punishment *i* inflicts, the higher utility *i* receives.

Case 4: $12 - P_{CC} - 6P^*_{CC} + 4H_{CC} + 12H'_{CC} < 0$ and $P_{CC} - H_{CC} < P^*_{CC} - H'_{CC}$

In this case, equation (B25) reduces to:

$$U_i(x) = 60 + 6\beta_i - \left(2 - \frac{\beta_i}{2}\right)P_{CC} - 4\beta_i P^*_{CC} - (4 - \beta_i)H_{CC}$$
$$-(12 - 7\beta_i)H'_{CC}. \tag{B29}$$

Since $\frac{dU_i}{dH_{CC}} < 0$, the smaller higher-order punishment *i* inflicts, the higher utility *i* receives.

Summary: The conditions for the third party's optimal higher-order punishment schedule H_{CC} can be summarized as in Figure B.4. Along the optimal punishment schedule, $0 < P_{CC}, P^*_{CC} < 2$, we have $5P^*_{CC}/8 - 3P_{CC}/16 - 3/4 < 0$ and $P_{CC}/12 + P^*_{CC}/2 - 1 \leq 0$ (i.e., the upper envelope of the higher-order punishment schedule is below the x-axis for all positive values of H'_{CC}). In sum, this means that no symmetric higher-order punishment equilibrium exists and so no higher-order punishment is predicted in Scenario CC.

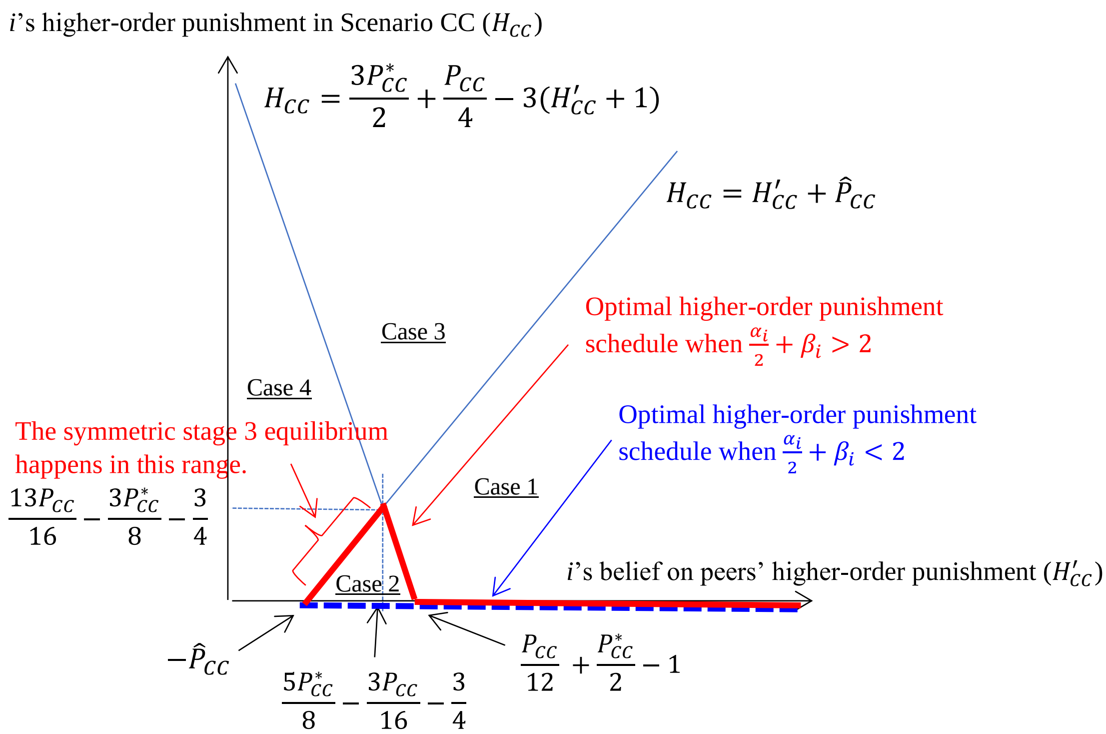


Figure B.4. *Optimal punishment schedule in Higher-Order Scenario CC*

Remark 1. The area for total higher-order punishment in the lower triangle of Scenario CC is given by:

$$\Delta_{CC} = \frac{(13P_{CC} - 6P^*_{CC} - 12)^2}{384}.$$

By the necessary conditions for efficient punishment, the expression in the numerator is strictly positive, and so the total area of efficient higher-order punishment is decreasing in P^*_{CC}.

(b) *i*'s Punishment Behavior in Scenario CD/DC

A third-party player *i*'s utility in Scenario CD/DC is given by:

$$\begin{aligned} U_i(x) &= 60 - P_{CD} - P_{DC} - 2(H_{CD} + H_{DC}) - 6(H'_{CD} + H'_{DC}) \\ &- \frac{\alpha_i}{4}\max\{-36 - 2P_{CD} - 6P^*_{CD} + P_{DC} + 2(H_{CD} + H_{DC}) + 6(H'_{CD} + H'_{DC}), 0\} \\ &- \frac{\beta_i}{4}\max\{36 + 2P_{CD} + 6P^*_{CD} - P_{DC} - 2(H_{CD} + H_{DC}) - 6(H'_{CD} + H'_{DC}), 0\} \\ &- \frac{\alpha_i}{4}\max\{28 - 2P_{DC} - 6P^*_{DC} + P_{CD} + 2(H_{CD} + H_{DC}) + 6(H'_{CD} + H'_{DC}), 0\} \\ &- \frac{\beta_i}{4}\max\{-28 + 2P_{DC} + 6P^*_{DC} - P_{CD} - 2(H_{CD} + H_{DC}) - 6(H'_{CD} + H'_{DC}), 0\} \\ &- \frac{\alpha_i}{2}\max\{(P_{CD} + P_{DC}) - (P^*_{CD} + P^*_{DC}) + (H'_{CD} + H'_{DC}) - (H_{CD} + H_{DC}), 0\} \\ &- \frac{\beta_i}{2}\max\{(P^*_{CD} + P^*_{DC}) - (P_{CD} + P_{DC}) + (H_{CD} + H_{DC}) - (H'_{CD} + H'_{DC}), 0\}, \end{aligned} \tag{B30}$$

where $x = \big(24 - 3P_{CD} - 6P^*_{CD}, 88 - 3P_{DC} - 6P^*_{DC}, 60 - P_{CD} - P_{DC} - 2(H_{CD} + H_{DC}) - 6(H'_{CD} + H'_{DC}), 60 - P^*_{CD} - P^*_{DC} - 5(H'_{CD} + H'_{DC}) - 3(H_{CD} + H_{DC}), 60 - P^*_{CD} - P^*_{DC} - 5(H'_{CD} + H'_{DC}) - 3(H_{CD} + H_{DC})\big)$.

Equation (B30) means we need to consider eight cases to analyze *i*'s higher-order punishment behavior:

<u>Case 1</u>:

i. $-36 - 2P_{CD} - 6P^*_{CD} + P_{DC} + 2(H_{CD} + H_{DC}) + 6(H'_{CD} + H'_{DC}) \geq 0$;

ii. $28 - 2P_{DC} - 6P^*_{DC} + P_{CD} + 2(H_{CD} + H_{DC}) + 6(H'_{CD} + H'_{DC}) \geq 0$; and

iii. $(P_{CD} + P_{DC}) - (P^*_{CD} + P^*_{DC}) + (H'_{CD} + H'_{DC}) - (H_{CD} + H_{DC}) \geq 0$.

From equation (B30), the coefficient on each of H_{CD} and H_{DC} in this case is $-(2 + \alpha_i/2)$, and so the smaller higher-order punishment *i* inflicts, the higher utility *i* receives.

<u>Case 2</u>:

i. $-36 - 2P_{CD} - 6P^*_{CD} + P_{DC} + 2(H_{CD} + H_{DC}) + 6(H'_{CD} + H'_{DC}) < 0$;

ii. $28 - 2P_{DC} - 6P_{DC}^* + P_{CD} + 2(H_{CD} + H_{DC}) + 6(H'_{CD} + H'_{DC}) \geq 0$; and

iii. $(P_{CD} + P_{DC}) - (P_{CD}^* + P_{DC}^*) + (H'_{CD} + H'_{DC}) - (H_{CD} + H_{DC}) \geq 0$.

From equation (B30), the coefficient on each of H_{CD} and H_{DC} in this case is $(\beta_i/2 - 2)$. Given our assumption on β_i, this coefficient is negative and so the smaller higher-order punishment *i* inflicts, the higher utility *i* receives.

<u>Case 3</u>:

i. $-36 - 2P_{CD} - 6P_{CD}^* + P_{DC} + 2(H_{CD} + H_{DC}) + 6(H'_{CD} + H'_{DC}) < 0$;

ii. $28 - 2P_{DC} - 6P_{DC}^* + P_{CD} + 2(H_{CD} + H_{DC}) + 6(H'_{CD} + H'_{DC}) < 0$; and

iii. $(P_{CD} + P_{DC}) - (P_{CD}^* + P_{DC}^*) + (H'_{CD} + H'_{DC}) - (H_{CD} + H_{DC}) \geq 0$.

From equation (B30), the coefficient on each of H_{CD} and H_{DC} in this case is $(\alpha_i/2 + \beta_i - 2)$. Thus, a necessary condition for *i* to higher-order punish in Scenarios CD and DC is $\alpha_i/2 + \beta_i > 2$.

First, we consider the possibility of higher-order punishment in Scenario CD. As we are searching for symmetric equilibria, we assume that $P_{DC} = P_{DC}^*$ and $H_{DC} = H'_{DC} = H_{DC}^*$. Constraint i. is non-binding for all $0 < P_{DC}^* \leq 7/2$ (the range in which the symmetric stage 2 equilibrium happens) and so we proceed under the assumption that constraint ii. binds. In this case, *i* will higher-order punish (not higher-order punish) in Scenario CC if $\alpha_i/2 + \beta_i > 2$ (< 2), up to:

$$H_{CD} = \min\ \{-14 + 4P_{DC}^* - \frac{P_{CD}}{2} - 4H_{DC}^* - 3H'_{CD}, H'_{CD} + \hat{P}_{CD}\}.$$

Conditional on the vector of punishment decisions $(P_{CD}, P_{CD}^*, P_{DC}^*, H_{DC}^*)$, the arguments of the minima define the upper envelope of the higher-order punishment schedule as a function of *i*'s beliefs about the higher-order punishment choice of another third-party player, H'_{CD}. Thus, for higher-order punishment to be associated with a non-empty subset of first-order punishment vectors, we require that either of the following conditions must hold: (i) $\hat{P}_{CD} > 14/3 - 4P_{DC}^*/3 + P_{CD}/6 + 4H_{DC}^*/3$ if $\hat{P}_{CD} < 0$, or (ii) $-14/3 + 4P_{DC}^*/3 - P_{CD}/6 - 4H_{DC}^*/3 > 0$ if $\hat{P}_{CD} \geq 0$. Neither condition is satisfied for any $P_{DC}^* \leq 7/2$ and so the symmetric equilibrium for $P_{CD} = P_{CD}^* = 0$ still exists with $H_{CD} = 0$.

Second, we consider the possibility of higher-order punishment in Scenario DC, given the zero-punishment outcome in Scenario CD. Constraint i. (ii.) binds for all $P_{DC} > (<)\ 64/3\ -\ 2P_{DC}^*$. Thus, *i* will higher-order punish (not higher-order punish) in Scenario DC if $\alpha_i/2 + \beta_i > 2$ (< 2), up to:

$$H_{DC} = \begin{cases} \min\ \{-14 + P_{DC} + 3P_{DC}^* - 3H'_{DC}, H'_{DC} + \hat{P}_{DC}\}, & if\ P_{DC} < \dfrac{64}{3} - 2P_{DC}^*; \\ \min\{18\ - \dfrac{P_{DC}}{2} -\ 3H'_{DC}, H'_{DC} + \hat{P}_{DC}\}, & if\ P_{DC} > \dfrac{64}{3} - 2P_{DC}^*. \end{cases}$$

Conditional on the vector of punishment decisions (P_{DC}, P_{DC}^*), the arguments of the minima define the upper envelope of the higher-order punishment schedule as a function of *i*'s beliefs about the higher-order punishment choice of another third-party player, H'_{DC}. Thus, for higher-order punishment to be associated with a non-empty subset of first-order punishment vectors, we require that either of the following conditions must hold: (i) $\hat{P}_{DC} > \min\{14/3 - P_{DC}/3 - P^*_{DC}, P_{DC}/6 - 6\}$ if $\hat{P}_{DC} \leq 0$, or (ii) $\min\{P_{DC}/3 + P^*_{DC} - 14/3, 6 - P_{DC}/6\} > 0$ if $\hat{P}_{DC} > 0$.

Solving the system of inequalities for efficient ($\hat{P}_{DC} > 0$) and inefficient ($\hat{P}_{DC} \leq 0$) higher-order punishment respectively, we obtain the following necessary conditions:

- Efficient: $P_{DC} > 14 - 3P^*_{DC}$; and
- Inefficient: $P_{DC} > \min\{7/2, -36/5 + 6P^*_{DC}/5\}$.

In Figure B.5, we plot the feasible regions for higher-order punishment in (P^*_{DC}, P_{DC}) space and overlay the optimal first-order punishment schedule from the *Trio* treatment. This implies that the symmetric equilibrium still exists for $0 < P_{DC}, P^*_{DC} < 7/2$ with $H_{DC} = 0$. Outside of the symmetric equilibrium, inefficient or efficient higher-order punishment is feasible.

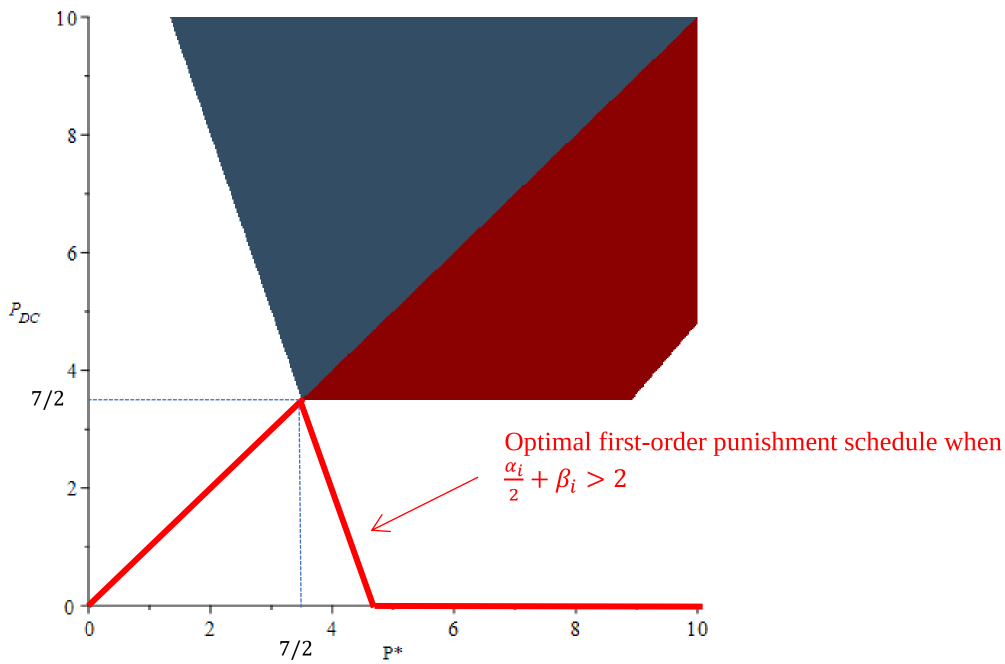


Figure B.5. *Feasible region for higher-order punishment in Scenario CC. The blue (red) region reflects efficient (inefficient) punishment.*

<u>Case 4</u>:

i. $-36 - 2P_{CD} - 6P^*_{CD} + P_{DC} + 2(H_{CD} + H_{DC}) + 6(H'_{CD} + H'_{DC}) < 0$;

ii. $28 - 2P_{DC} - 6P^*_{DC} + P_{CD} + 2(H_{CD} + H_{DC}) + 6(H'_{CD} + H'_{DC}) < 0$; and

iii. $(P_{CD} + P_{DC}) - (P^*_{CD} + P^*_{DC}) + (H'_{CD} + H'_{DC}) - (H_{CD} + H_{DC}) < 0$.

From equation (B30), the coefficient on each of H_{CD} and H_{DC} in this case is $(\beta_i/2 - 2)$. Given our assumption on β_i, this coefficient is negative and so the smaller higher-order punishment *i* inflicts, the higher utility *i* receives.

Case 5:

i. $-36 - 2P_{CD} - 6P^*_{CD} + P_{DC} + 2(H_{CD} + H_{DC}) + 6(H'_{CD} + H'_{DC}) \geq 0$;

ii. $28 - 2P_{DC} - 6P^*_{DC} + P_{CD} + 2(H_{CD} + H_{DC}) + 6(H'_{CD} + H'_{DC}) < 0$; and

iii. $(P_{CD} + P_{DC}) - (P^*_{CD} + P^*_{DC}) + (H'_{CD} + H'_{DC}) - (H_{CD} + H_{DC}) \geq 0$.

From equation (B30), the coefficient on each of H_{CD} and H_{DC} in this case is $(\beta_i/2 - 2)$. Given our assumption on β_i, this coefficient is negative and so the smaller higher-order punishment *i* inflicts, the higher utility *i* receives.

Case 6:

i. $-36 - 2P_{CD} - 6P^*_{CD} + P_{DC} + 2(H_{CD} + H_{DC}) + 6(H'_{CD} + H'_{DC}) \geq 0$;

ii. $28 - 2P_{DC} - 6P^*_{DC} + P_{CD} + 2(H_{CD} + H_{DC}) + 6(H'_{CD} + H'_{DC}) < 0$; and

iii. $(P_{CD} + P_{DC}) - (P^*_{CD} + P^*_{DC}) + (H'_{CD} + H'_{DC}) - (H_{CD} + H_{DC}) < 0$.

From equation (B30), the coefficient on each of H_{CD} and H_{DC} in this case is $-(2 + \alpha_i/2)$, and so the smaller higher-order punishment *i* inflicts, the higher utility *i* receives.

Case 7:

i. $-36 - 2P_{CD} - 6P^*_{CD} + P_{DC} + 2(H_{CD} + H_{DC}) + 6(H'_{CD} + H'_{DC}) < 0$;

ii. $28 - 2P_{DC} - 6P^*_{DC} + P_{CD} + 2(H_{CD} + H_{DC}) + 6(H'_{CD} + H'_{DC}) \geq 0$; and

iii. $(P_{CD} + P_{DC}) - (P^*_{CD} + P^*_{DC}) + (H'_{CD} + H'_{DC}) - (H_{CD} + H_{DC}) < 0$.

From equation (B30), the coefficient on each of H_{CD} and H_{DC} in this case is $-(2 + \alpha_i/2)$, and so the smaller higher-order punishment *i* inflicts, the higher utility *i* receives.

Case 8:

i. $-36 - 2P_{CD} - 6P^*_{CD} + P_{DC} + 2(H_{CD} + H_{DC}) + 6(H'_{CD} + H'_{DC}) \geq 0$;

ii. $28 - 2P_{DC} - 6P^*_{DC} + P_{CD} + 2(H_{CD} + H_{DC}) + 6(H'_{CD} + H'_{DC}) \geq 0$; and

iii. $(P_{CD} + P_{DC}) - (P^*_{CD} + P^*_{DC}) + (H'_{CD} + H'_{DC}) - (H_{CD} + H_{DC}) < 0$.

From equation (B30), the coefficient on each of H_{CD} and H_{DC} in this case is $-(2 + \alpha_i + \beta_i/2)$, and so the smaller higher-order punishment *i* inflicts, the higher utility *i* receives.

Summary: In the symmetric equilibrium, $P_{CD} = P^*_{CD} = 0$ and no higher-order punishment is predicted in

Scenario CD. The conditions for the third party's optimal higher-order punishment schedule H_{DC} can be summarized as in Figure B.6. Along the optimal punishment schedule, $0 < P_{DC}, P^*_{DC} < 7/2$, we have $\min\{P^*_{DC}/4 - 3P_{DC}/8 + 9/2, P^*_{DC} - 7/2\} < 0$, $\min\{P_{DC}/3 + P^*_{DC} - 14/3, 6 - P_{DC}/6\} < 0$. In sum, this means that no symmetric higher-order punishment equilibrium exists and so no higher-order punishment is predicted in Scenario DC.

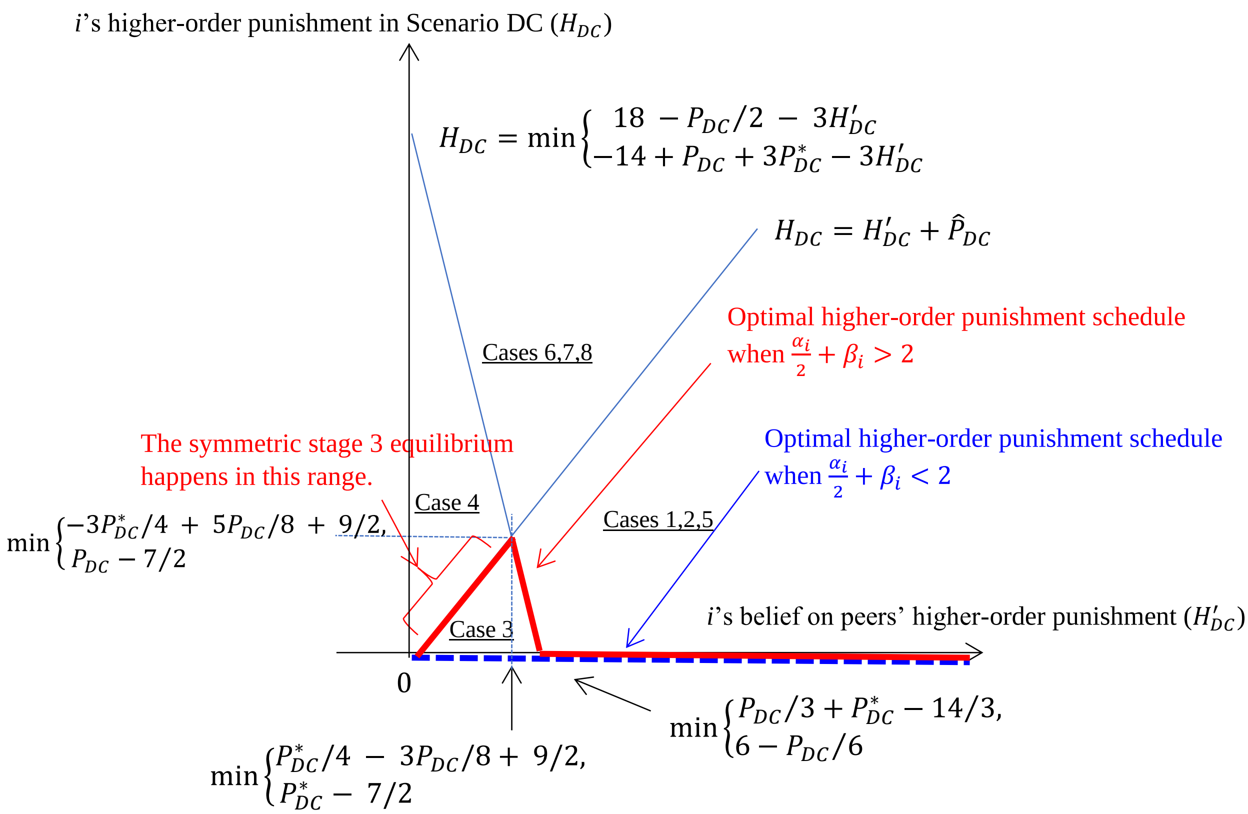


Figure B.6. *Optimal punishment schedule in Higher-Order Scenario DC*

Remark 2. The area for total higher-order punishment in the lower triangle of Scenario CD is given by:

$$\Delta_{CD} = \frac{(6P^*_{CD} - 5P_{CD} + 28 - 8P^*_{DC} + 8H^*_{DC})^2}{96}.$$

The expression in the numerator is strictly positive for any efficient punishment ($P_{CD} < P^*_{CD}$) when $P^*_{DC} \leq 7/2$, in which case the total area of efficient higher-order punishment is increasing in P^*_{CD}.

Remark 3. The area for total higher-order punishment in the lower triangle of Scenario DC is given by:

$$\Delta_{DC} = \min\begin{cases} \frac{(36 + 5P_{DC} - 6P^*_{DC})^2}{96} \\ \frac{(2P_{DC} - 7)^2}{6} \end{cases}.$$

The numerator in the first case is strictly positive for any efficient punishment ($P_{DC} > P^*_{DC}$) because $P^*_{DC} < 36$, and so the total area of efficient higher-order punishment is increasing as P^*_{DC} falls.

(c) *i*'s Punishment Behavior in Scenario DD

A third-party player *i*'s utility in Scenario DD is given by:

$$U_i(x) = 60 - 2P_{DD} - 4H_{DD} - 12H'_{DD}$$

$$-\tfrac{\alpha_i}{2}\max\{(40 - 3P_{DD} - 6P^*_{DD}) - (60 - 2P_{DD} - 4H_{DD} - 12H'_{DD}), 0\}$$

$$-\tfrac{\beta_i}{2}\max\{(60 - 2P_{DD} - 4H_{DD} - 12H'_{DD}) - (40 - 3P_{DD} - 6P^*_{DD}), 0\} \qquad \text{(B31)}$$

$$-\alpha_i \max\{P_{DD} - P^*_{DD} - H_{DD} + H'_{DD}, 0\}$$

$$-\beta_i \max\{P^*_{DD} - P_{DD} - H'_{DD} + H_{DD}, 0\},$$

where $x = (40 - 3P_{DD} - 6P^*_{DD}, 40 - 3P_{DD} - 6P^*_{DD}, 60 - 2P_{DD} - 4H_{DD} - 12H'_{DD}, 60 - 2P^*_{DD} - 10H'_{DD} - 6H_{DD}, 60 - 2P^*_{DD} - 10H'_{DD} - 6H_{DD})$. Mirroring the analysis of Scenario CC, we obtain four cases from equation (B31):

<u>Case 1</u>: $4H_{DD} + 12H'_{DD} - P_{DD} - 6P^*_{DD} - 20 \geq 0$ and $P_{DD} - H_{DD} \geq P^*_{DD} - H'_{DD}$

<u>Case 2</u>: $4H_{DD} + 12H'_{DD} - P_{DD} - 6P^*_{DD} - 20 < 0$ and $P_{DD} - H_{DD} \geq P^*_{DD} - H'_{DD}$

<u>Case 3</u>: $4H_{DD} + 12H'_{DD} - P_{DD} - 6P^*_{DD} - 20 \geq 0$ and $P_{DD} - H_{DD} < P^*_{DD} - H'_{DD}$

<u>Case 4</u>: $4H_{DD} + 12H'_{DD} - P_{DD} - 6P^*_{DD} - 20 < 0$ and $P_{DD} - H_{DD} < P^*_{DD} - H'_{DD}$

It follows directly from our analysis of Scenario CC that, for cases 1, 3 and 4, the smaller higher-order punishment *i* inflicts, the higher utility *i* receives.[4] We thus confine our analysis to case 2.

<u>Case 2</u>: $4H_{DD} + 12H'_{DD} - P_{DD} - 6P^*_{DD} - 20 < 0$ and $P_{DD} - H_{DD} \geq P^*_{DD} - H'_{DD}$

In this case, equation (B31) reduces to:

$$U_i(x) = 60 - 10\beta_i - \left(\alpha_i + \frac{\beta_i}{2} + 2\right)P_{DD} + (\alpha_i - 3\beta_i)P^*_{DD} - (4 - \alpha_i - 2\beta_i)H_{DD}$$

$$-(12 + \alpha_i - 6\beta_i)H'_{DD}. \qquad \text{(B32)}$$

Equation (B32) suggests that *i* will higher-order punish (not higher-order punish) in Scenario DD if $\alpha_i/2 + \beta_i > 2$ (< 2), up to:

$$H_{DD} = \min\ \{5 + \tfrac{3P^*_{DD}}{2} + \tfrac{P_{DD}}{4} - 3H'_{DD}, H'_{DD} + \hat{P}_{DD}\}.$$

Conditional on the vector of punishment decisions (P^*_{DD}, P_{DD}), the arguments of the minima define the upper envelope of the higher-order punishment schedule as a function of *i*'s beliefs about the higher-order punishment choice of another third-party player, H'_{DD}. Thus, for higher-order punishment to be associated

[4] The coefficients on H_{DD} are the same.

with a non-empty subset of first-order punishment vectors, we require that either of the following conditions must hold: (i) $\hat{P}_{DD} > -P^*_{DD}/2 - P_{DD}/12 - 5/3$ if $\hat{P}_{DD} \leq 0$, or (ii) $P^*_{DD}/2 + P_{DD}/12 + 5/3 > 0$ if $\hat{P}_{DD} > 0$.

The condition (ii) for efficient ($\hat{P}_{DD} > 0$) higher-order punishment is always satisfied. Solving the system of inequalities for inefficient ($\hat{P}_{DD} \leq 0$) higher-order punishment, we obtain the necessary condition that $P_{DD} > 6P^*_{DD}/13 - 20/13$. In Figure B.7, we plot the feasible regions for higher-order punishment in (P^*_{DD}, P_{DD}) space. To check whether positive first-order punishment of a defector can be optimal in a symmetric equilibrium with higher-order punishment possibilities, we differentiate equation (B32) with respect to P_{DD}

- $\frac{dU_i}{dP_{DD}}(P_{DD} = P^*_{DD}, H_{DD} = H'_{DD}) = -2 - \alpha_i - \beta_i/2 < 0.$

Here, the restrictions $P_{DD} = P^*_{DD}$ and $H_{DD} = H'_{DD}$ do not affect the derivative as the coefficient of P_{DD} does not have P^*_{DD}. Thus, the smaller punishment *i* inflicts, the higher utility *i* receives. The maximum higher-order punishment value in any symmetric stage 3 equilibrium is 5/4. Then, from our constraints, $P_{DD} \geq 0$ and so *i* never punishes a defector in Scenario DD in any symmetric equilibrium with higher-order punishment possibilities.

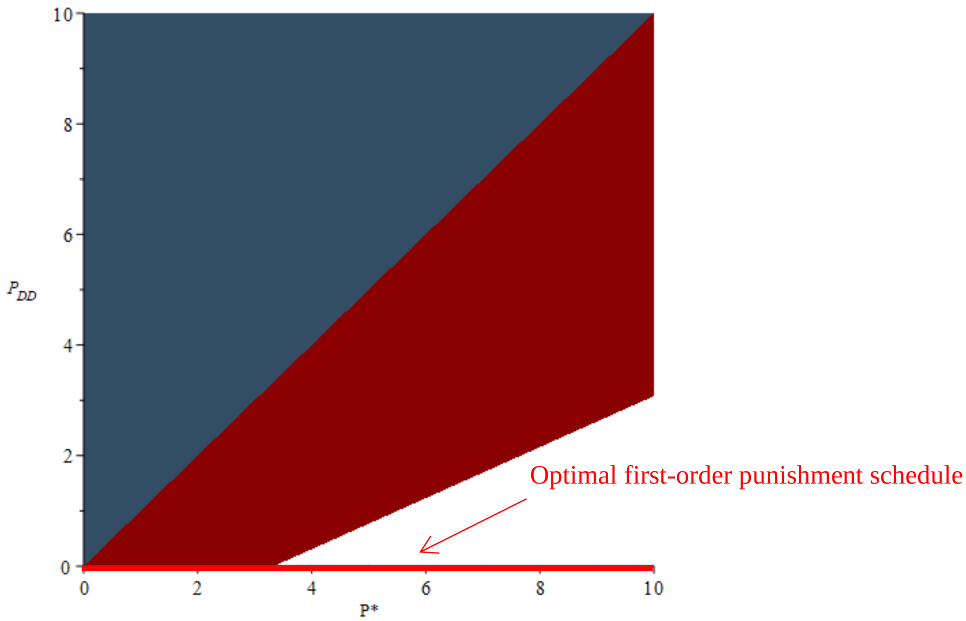


***Figure B.7**. Feasible region for higher-order punishment in Scenario DD. The blue (red) region reflects efficient (inefficient) punishment.*

<u>Summary</u>: Given $P_{DD} = P^*_{DD} = 0$, the conditions for the third party's optimal higher-order punishment schedule H_{CC} can be summarized as in Figure B.8.

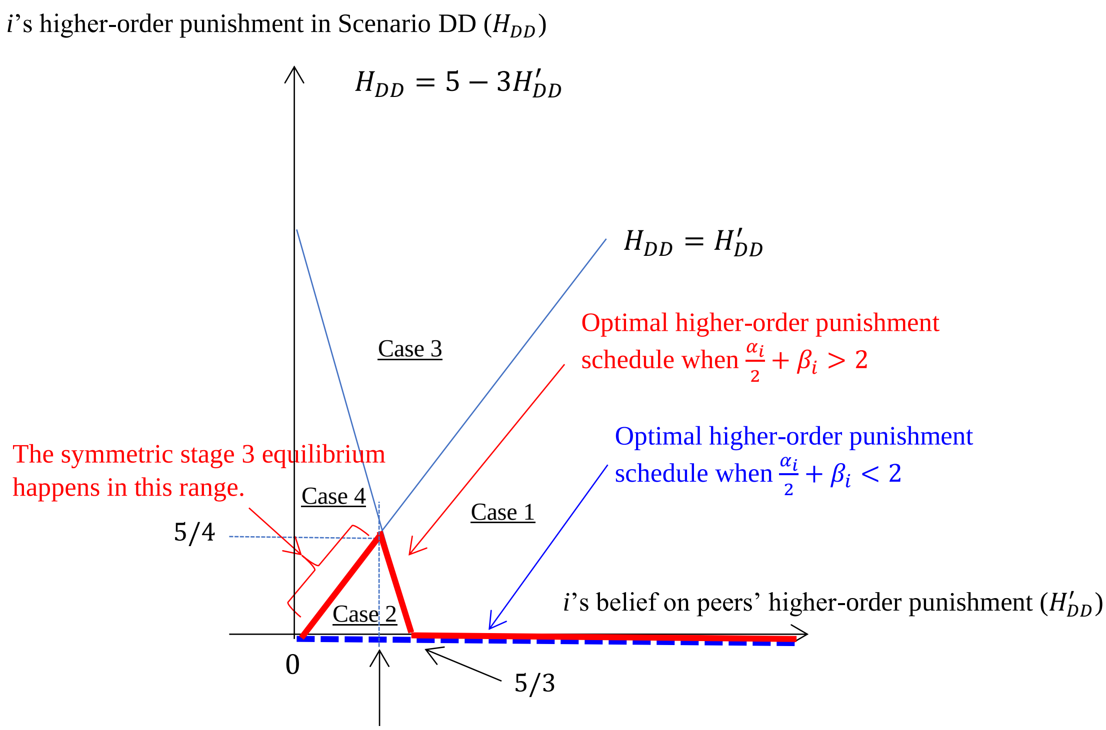


Figure B.8. *Optimal punishment schedule in Higher-Order Scenario DD*

Remark 4. The area for total higher-order punishment in the lower triangle of Scenario DD is given by:

$$\Delta_{DD} = \frac{(13P_{DD} - 6P^*_{DD} + 20)^2}{384}.$$

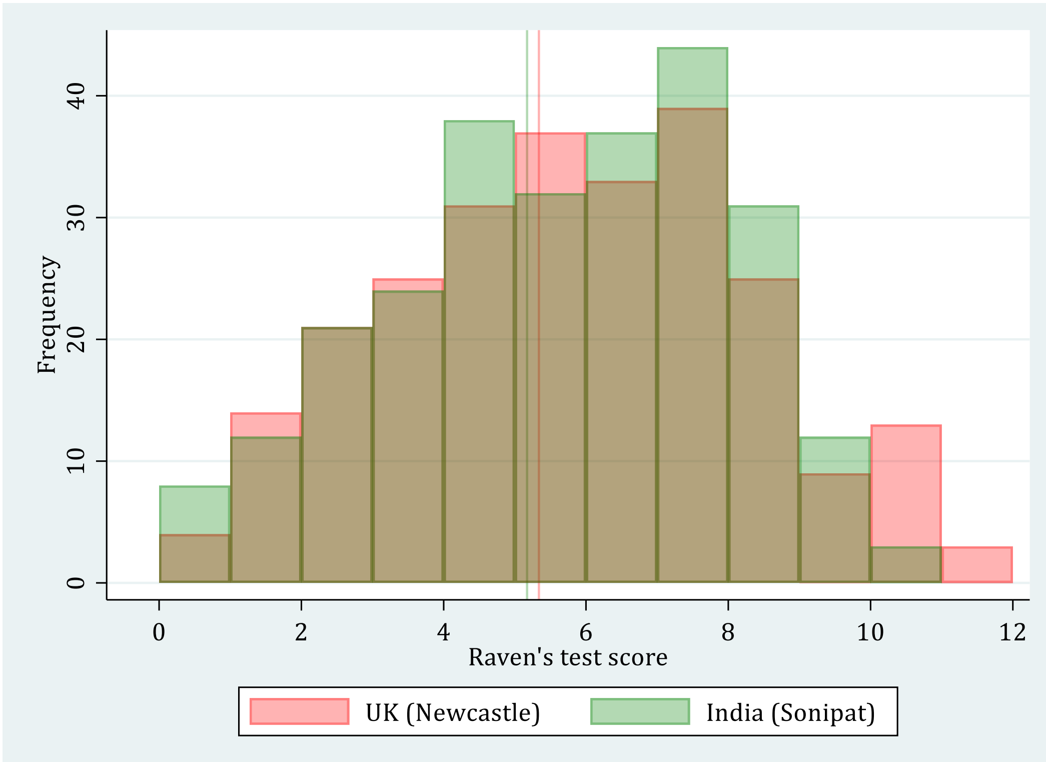
The expression in the numerator is strictly positive for any efficient punishment ($P_{DD} > P^*_{DD}$) and so the total area of efficient higher-order punishment is increasing as P^*_{DD} falls.

(d) Cooperate/defect decision

As the introduction of higher-order punishment opportunities does not influence predicted behaviors in stages 1 or 2, this analysis is unchanged from the *Trio* treatment.

Appendix C: Additional Figures and Tables

Figure C.1: *Raven's Progressive Matrices Test Score Distributions*



Notes: Raven's test score means the number of correct answers in the task. The vertical lines are placed at the mean scores, 5.34 for the Newcastle sample and 5.17 for the Sonipat sample. The standard deviations of the scores are 2.53 for the Newcastle sample and 2.38 for the Sonipat sample. The average Raven's test scores are not significantly different between the two locations with two-sided $p = 0.646$ (Mann-Whitney test).

Table C.1*: Across-Scenario Difference in First-Order Punishment – A Pooled Regression* (supplementing Figure 3 of the paper).

A. Average Decisions

	Punishment frequencies		Punishment points given	
Independent Variable	(1)	(2)	(3)	(4)
Sonipat	-0.123	-0.124	-0.447	-0.296
	(0.177)	(0.193)	(0.975)	(1.052)
Betrayal	1.308***	1.394***	6.792***	7.348***
	(0.140)	(0.159)	(0.768)	(0.879)
Mutual defection	0.656***	0.727***	3.248***	3.609***
	(0.134)	(0.151)	(0.679)	(0.775)
Victim	0.129	0.093	0.664	0.587
	(0.148)	(0.173)	(0.790)	(0.936)
Sonipat * Betrayal	-0.481**	-0.483**	-2.131**	-2.145**
	(0.191)	(0.210)	(0.975)	(1.048)
Sonipat * Mutual defection	-0.268	-0.284	-0.686	-0.628
	(0.183)	(0.202)	(1.019)	(1.105)
Sonipat * Victim	-0.046	-0.027	-0.297	-0.224
	(0.202)	(0.228)	(1.133)	(1.277)
Constant	-0.863***	-1.142	-4.814***	-7.050**
	(0.125)	(0.713)	(0.809)	(3.411)
Observations	1,104	968	1,104	968
Control	No	Yes	No	Yes
# left-censored obs.			751	660
# right-censored obs.			26	26
Loglikelihood	-625.6	-532.3	-1416	-1222
Pseudo R2	0.0958*	0.121	0.0457**	0.0571*
H_0: Betrayal = Mutual defection (Do third parties punish defectors differently between “betrayal” and “mutual defection in the UK?)				
F/Chi-squared-stat.	36.568	33.256	48.521	45.382
p-value (two-sided)	0.000***	0.000***	0.000***	0.000***
H_0: Sonipat = Sonipat + Betrayal + Sonipat*Betrayal (Do third parties punish more strongly in “betrayal” than in the reference “mutual cooperation” in India?)				
F/Chi-squared-stat.	40.470	43.557	34.569	37.966
p-value (two-sided)	0.000***	0.000***	0.000***	0.000***
H_0: Betrayal + Sonipat*Betrayal = Mutual defection + Sonipat*Mutual defection (Do third parties punish defectors differently between “betrayal” and “mutual defection in India?)				
F/Chi-squared-stat.	22.099	21.123	20.297	19.499
p-value (two-sided)	0.000***	0.000***	0.000***	0.000***

Notes: Probit regressions with robust standard errors clustered by subject ID for columns (1) and (2); and Tobit regressions with robust standard errors clustered by subject ID for columns (3) and (4). The dependent variable is an indicator for a third-party player *i*'s decision to first-order punish for columns (1) and (2), and a third-party player *i*'s punishment points given to a PD player for columns (3) and (4). The control variables in the even-numbered columns include a dummy for female, age, number of siblings, income rank and the Raven's test score. *** p<0.01, ** p<0.05, * p<0.1.

B. Beliefs

Independent Variable	Beliefs about punishment frequencies (1)	(2)	Beliefs about punishment points given (3)	(4)
Sonipat	-0.021	-0.070	0.260	0.123
	(0.162)	(0.172)	(0.599)	(0.619)
Betrayal	1.467***	1.466***	4.524***	4.420***
	(0.172)	(0.190)	(0.415)	(0.433)
Mutual defection	0.896***	0.913***	2.293***	2.183***
	(0.152)	(0.170)	(0.436)	(0.453)
Victim	-0.042	-0.072	-0.109	-0.194
	(0.126)	(0.139)	(0.440)	(0.466)
Sonipat * Betrayal	-0.490**	-0.523**	-1.615***	-1.738***
	(0.219)	(0.235)	(0.569)	(0.575)
Sonipat * Mutual defection	-0.406**	-0.398*	-1.136**	-0.992*
	(0.186)	(0.203)	(0.542)	(0.558)
Sonipat * Victim	0.021	0.027	-0.152	-0.205
	(0.164)	(0.175)	(0.565)	(0.581)
Constant	-0.084	-0.074	-0.082	0.487
	(0.115)	(0.328)	(0.419)	(1.039)
Observations	960	868	960	868
Control	No	Yes	No	Yes
# left-censored obs.			361	318
# right-censored obs.			26	24
Loglikelihood	-563	-500.1	-1874	-1703
Pseudo R2	0.114	0.123	0.0406	0.0427
H_0: Betrayal = Mutual defection (Do third parties punish defectors differently between "betrayal" and "mutual defection in the UK?)				
F/Chi-squared-stat.	12.925	9.631	56.571	53.494
p-value (two-sided)	0.000***	0.002***	0.000***	0.000***
H_0: Sonipat = Sonipat + Betrayal + Sonipat*Betrayal (Do third parties punish more strongly in "betrayal" than in the reference "mutual cooperation" in India?)				
F/Chi-squared-stat.	52.035	46.577	54.728	50.758
p-value (two-sided)	0.000***	0.000***	0.000***	0.000***
H_0: Betrayal + Sonipat*Betrayal = Mutual defection + Sonipat*Mutual defection (Do third parties punish defectors differently between "betrayal" and "mutual defection in India?)				
F/Chi-squared-stat.	17.631	13.327	30.173	26.551
p-value (two-sided)	0.000***	0.000***	0.000***	0.000***

Notes: Probit regressions with robust standard errors clustered by subject ID for columns (1) and (2); and Tobit regressions with robust standard errors clustered by subject ID for columns (3) and (4). The dependent variable is an indicator for a PD player's beliefs about a third-party player *i*'s decision to first-order punish for columns (1) and (2), and about a third-party player *i*'s punishment points given to a PD player for columns (3) and (4). The control variables in the even-numbered columns include a dummy for female, age, number of siblings, income rank and the Raven's test score. *** p<0.01, ** p<0.05, * p<0.1

Table C.2: *Cross-Societal Difference in Cooperation and First-Order Punishment – A Pooled Regression (supplementing Figure 3 of the paper).*

A. Average Decisions

I. Cooperation and punishment frequencies

Data:	PD players' decision to cooperate		Third parties' decision to first-order punish							
			Scenario							
			I. "mutual cooperation"		II. "betrayal"		III. "victim"		IV. "mutual defection"	
Independent Variable	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
India (Sonipat) dummy	-0.441***	-0.498***	-0.123	-0.079	-0.604***	-0.640***	-0.169	-0.223	-0.392**	-0.358**
	(0.166)	(0.182)	(0.177)	(0.204)	(0.154)	(0.179)	(0.171)	(0.196)	(0.157)	(0.180)
Constant	0.524***	-0.112	-0.863***	-1.400	0.444***	0.528	-0.734***	0.447	-0.207*	-1.551*
	(0.121)	(0.565)	(0.125)	(1.109)	(0.112)	(0.922)	(0.120)	(1.091)	(0.109)	(0.912)
Observations	240	217	276	242	276	242	276	242	276	242
Control	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Chi-squared-stat.	7.009	19.99	0.483	6.478	15.30	18.40	0.974	7.794	6.230	12.80
p-value (two-sided)	0.008***	0.006***	0.487	0.485	0.000***	0.0103**	0.324	0.351	0.0126**	0.0771*

Notes: Probit regressions with robust standard errors in parentheses. The control variables in the even-numbered columns include a dummy for female, age, number of siblings, income rank and the Raven's test score. *** p<0.01, ** p<0.05, * p<0.1

II. Punishment strength per third-party player

Dependent variable:	A third-party player's punishment points given to a PD player							
	Scenario							
	I. "mutual cooperation"		II. "betrayal"		III. "victim"		IV. "mutual defection"	
Independent Variable	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
India (Sonipat) dummy	-0.489	-0.309	-2.485***	-2.214***	-0.762	-1.083	-1.175	-0.767
	(1.030)	(1.145)	(0.706)	(0.817)	(0.939)	(1.107)	(0.819)	(0.922)
Constant	-5.254***	-6.191	2.052***	-1.141	-4.307***	2.699	-1.679**	-8.582**
	(1.036)	(5.864)	(0.469)	(3.807)	(1.003)	(5.496)	(0.691)	(4.243)
Observations	276	242	276	242	276	242	276	242
Control	No	Yes	No	Yes	No	Yes	No	Yes
F-stat.	0.225	0.742	12.38	2.247	0.660	1.213	2.059	1.236
p-value (two-sided)	0.636	0.637	0.000507***	0.0314**	0.417	0.296	0.152	0.284

Notes: Tobit regressions with robust standard errors in parentheses. The control variables in the even-numbered columns include a dummy for female, age, number of siblings, income rank and the Raven's test score. *** p<0.01, ** p<0.05, * p<0.1.

B. Beliefs

I. Cooperation and punishment frequencies

Data:	Beliefs about PD players' decision to cooperate		Beliefs about third parties' decision to first-order punish							
			Scenario							
			I. "mutual cooperation"		II. "betrayal"		III. "victim"		IV. "mutual defection"	
Independent Variable	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
India (Sonipat) dummy	-0.224***	-0.196**	-0.021	-0.091	-0.511**	-0.569**	0.000	-0.036	-0.427**	-0.453**
	(0.086)	(0.095)	(0.162)	(0.174)	(0.211)	(0.245)	(0.163)	(0.174)	(0.175)	(0.189)
Constant	0.279***	-0.155	-0.084	0.139	1.383***	0.430	-0.126	0.509	0.812***	0.302
	(0.058)	(0.478)	(0.115)	(0.452)	(0.165)	(0.931)	(0.115)	(0.472)	(0.130)	(0.509)
Observations	276	242	240	217	240	217	240	217	240	217
Control	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Chi-squared-stat.	6.850	13.20	0.0167	4.713	5.858	11.29	0	8.911	5.946	9.698
p-value (two-sided)	0.00886***	0.0674*	0.897	0.695	0.0155**	0.126	1.000	0.259	0.0148**	0.206

Notes: Probit regressions with robust standard errors in parentheses (fractional Probit regression for columns (a) and (b)). The control variables in the even-numbered columns include a dummy for female, age, number of siblings, income rank and the Raven's test score. *** p<0.01, ** p<0.05, * p<0.1

II. Punishment strength per third-party player

Dependent variable:	Beliefs about a third-party player's punishment points given to a PD player							
	Scenario							
	I. "mutual cooperation"		II. "betrayal"		III. "victim"		IV. "mutual defection"	
Independent Variable	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
India (Sonipat) dummy	0.254	0.016	-1.306***	-1.568***	0.114	-0.091	-0.829*	-0.769*
	(0.691)	(0.719)	(0.416)	(0.443)	(0.616)	(0.636)	(0.454)	(0.460)
Constant	-0.619	0.534	4.459***	4.349***	-0.477	2.465	2.262***	1.418
	(0.512)	(2.031)	(0.273)	(1.039)	(0.489)	(1.804)	(0.293)	(1.000)
Observations	240	217	240	217	240	217	240	217
Control	No	Yes	No	Yes	No	Yes	No	Yes
F-stat.	0.135	0.519	9.855	2.122	0.0341	1.357	3.337	2.521
p-value (two-sided)	0.714	0.820	0.00191***	0.0426**	0.854	0.225	0.0690*	0.0165**

Notes: Tobit regressions with robust standard errors in parentheses. The control variables in the even-numbered columns include a dummy for female, age, number of siblings, income rank and the Raven's test score. *** p<0.01, ** p<0.05, * p<0.1.

Table C.3: *Across-Scenario Difference in First-Order Punishment by Treatment – with demographic controls* (supplementing Table 3 of the paper).

(A) Frequency of first-order punishment given to PD players

	Baseline[#1]		Trio		Higher-Order	
Dependent variable	Decisions	Beliefs	Decisions	Beliefs	Decisions	Beliefs
Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)
India (Sonipat) dummy	-1.541***	-0.088	0.333	-0.246	-0.101	-0.008
	(0.485)	(0.298)	(0.321)	(0.330)	(0.309)	(0.333)
Betrayal	1.967***	1.362***	1.406***	1.519***	1.524***	1.661***
	(0.392)	(0.279)	(0.284)	(0.360)	(0.254)	(0.405)
Mutual defection	0.847***	0.858***	0.916***	0.779**	0.639***	1.299***
	(0.289)	(0.270)	(0.289)	(0.319)	(0.246)	(0.316)
Victim	0.179	-0.173	0.388	0.002	-0.158	0.007
	(0.465)	(0.211)	(0.294)	(0.245)	(0.253)	(0.298)
Sonipat * Betrayal	-0.220	-0.425	-0.391	-0.621	-0.723**	-0.582
	(0.527)	(0.363)	(0.371)	(0.432)	(0.319)	(0.468)
Sonipat * Mutual defection		-0.629**	-0.330	-0.179	-0.309	-0.533
		(0.317)	(0.369)	(0.378)	(0.307)	(0.376)
Sonipat * Victim		0.018	-0.364	0.063	0.293	-0.074
		(0.303)	(0.400)	(0.299)	(0.329)	(0.352)
Constant	-1.257	-1.253	-1.092	1.341	-0.073	0.124
	(1.147)	(1.512)	(1.416)	(1.604)	(1.042)	(0.571)
Observations	120	312	432	292	380	264
Control	Yes	Yes	Yes	Yes	Yes	Yes
Loglikelihood	-60.17	-177.4	-218.6	-168.6	-212.7	-140.4
Pseudo R2	0.255	0.147	0.144	0.119	0.150	0.177
H_0: Betrayal = Mutual defection						
(Do third parties punish defectors differently between “betrayal” and “mutual defection in the UK?)						
Chi-squared-stat.	10.061	3.617	8.426	5.978	17.482	0.831
p-value (two-sided)	0.000***	0.057*	0.004***	0.014**	0.000***	0.362
H_0: Sonipat = Sonipat + Betrayal + Sonipat*Betrayal						
(Do third parties punish more strongly in “betrayal” than in the reference “mutual cooperation” in India?)						
Chi-squared-stat.	15.152	15.068	18.990	13.765	18.482	19.149
p-value (two-sided)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
H_0: Betrayal + Sonipat*Betrayal = Mutual defection + Sonipat*Mutual defection						
(Do third parties punish defectors differently between “betrayal” and “mutual defection in India?)						
Chi-squared-stat.	6.049	10.352	8.100	1.904	8.190	3.450
p-value (two-sided)	0.014**	0.001***	0.004***	0.168	0.004***	0.063*

Notes: Probit regressions with robust standard errors in parentheses clustered by subject ID. The dependent variable is an indicator for a third-party player *i*’s decision (or a PD player’s beliefs about a third-party player *i*’s decision) to first-order punish. The control variables include a dummy for female, age, number of siblings, income rank and the Raven’s test score. [#1] The interaction Sonipat * Victim is omitted because Sonipat * Mutual cooperation is empty (Figure 4). *** p<0.01, ** p<0.05, * p<0.1

(B) Punishment strength per third-party player

	Baseline		Trio		Higher-Order	
Dependent variable	Decisions	Beliefs	Decisions	Beliefs	Decisions	Beliefs
Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)
India (Sonipat) dummy	-18.368***	-0.244	2.333	-0.471	-0.336	0.465
	(2.602)	(0.921)	(2.116)	(1.231)	(1.414)	(1.067)
Betrayal	6.994***	4.633***	9.264***	3.898***	6.085***	4.503***
	(1.890)	(0.647)	(2.045)	(0.852)	(0.934)	(0.711)
Mutual defection	3.271***	2.004***	5.467***	1.823*	2.524**	2.666***
	(1.007)	(0.618)	(1.841)	(1.026)	(1.044)	(0.681)
Victim	1.056	-0.063	2.541	-0.508	-0.664	-0.084
	(1.789)	(0.694)	(1.891)	(0.823)	(1.208)	(0.938)
Sonipat * Betrayal	13.112***	-1.766*	-2.316	-1.563	-2.466**	-1.638*
	(2.268)	(0.964)	(2.323)	(1.035)	(1.127)	(0.989)
Sonipat * Mutual defection	13.327***	-1.116	-0.792	-0.689	-0.769	-1.217
	(2.822)	(0.825)	(2.396)	(1.122)	(1.343)	(0.945)
Sonipat * Victim	-1.056	-0.561	-1.948	0.536	0.866	-0.575
	(1.789)	(0.899)	(2.621)	(0.971)	(1.514)	(1.153)
Constant	-5.394	-4.483	-8.834	4.293	-1.813	0.019
	(3.954)	(3.970)	(8.988)	(5.211)	(4.377)	(1.606)
Observations	156	312	432	292	380	264
Control	Yes	Yes	Yes	Yes	Yes	Yes
# left-censored obs.	108	120	312	106	240	92
# right-censored obs.	3	8	16	10	7	6
Loglikelihood	-164	-582.8	-498.2	-581.4	-518.3	-516.2
Pseudo R2	0.186	0.0667	0.0578	0.0390	0.0710	0.0584
H_0: Betrayal = Mutual defection						
(Do third parties punish defectors differently between “betrayal” and “mutual defection” in the UK?)						
F-stat.	7.156	26.165	14.147	13.254	27.979	15.365
p-value (two-sided)	0.008***	0.000***	0.000***	0.000***	0.000***	0.000***
H_0: Sonipat = Sonipat + Betrayal + Sonipat*Betrayal						
(Do third parties punish more strongly in “betrayal” than in the reference “mutual cooperation” in India?)						
F-stat.	43.794	16.291	14.898	15.406	20.179	18.740
p-value (two-sided)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
H_0: Betrayal + Sonipat*Betrayal = Mutual defection + Sonipat*Mutual defection						
(Do third parties punish defectors differently between “betrayal” and “mutual defection in India?)						
F-stat.	6.296	7.352	7.290	7.264	7.250	17.465
p-value (two-sided)	0.013**	0.007***	0.007***	0.007***	0.007***	0.000***

Notes: Tobit regressions with robust standard errors in parentheses clustered by subject ID. The dependent variable is a third-party player *i*’s punishment points (or a PD player’s beliefs about a third-party player *i*’s punishment points) given to a PD player. The control variables include a dummy for female, age, number of siblings, income rank and the Raven’s test score. *** p<0.01, ** p<0.05, * p<0.1

Table C.4: *Across-Treatment, and Cross-societal Difference in Beliefs about First-Order Punishment* (supplementing Table 4 of the paper)

(A) Frequency of cooperation and first-order punishment given to PD players

Data:	Beliefs about PD players' decision to cooperate		Beliefs about third parties' decision to first-order punish							
			Scenario							
			I. "mutual cooperation"		II. "betrayal"		III. "victim"		IV. "mutual defection"	
Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
India (Sonipat) dummy	-0.244	-0.201	-0.132	-0.077	-0.334	-0.490	-0.035	-0.039	-0.715**	-0.661**
	(0.218)	(0.234)	(0.276)	(0.289)	(0.342)	(0.366)	(0.277)	(0.290)	(0.291)	(0.307)
Trio	0.080	0.152	-0.070	0.072	0.360	0.209	0.164	0.221	-0.016	-0.011
	(0.153)	(0.168)	(0.280)	(0.292)	(0.421)	(0.448)	(0.280)	(0.294)	(0.312)	(0.329)
Higher-Order	0.036	-0.001	-0.199	-0.081	0.179	0.113	-0.035	0.040	0.118	0.284
	(0.152)	(0.166)	(0.276)	(0.305)	(0.387)	(0.473)	(0.277)	(0.306)	(0.315)	(0.360)
Sonipat * Trio	-0.039	-0.090	0.082	-0.146	-0.468	-0.293	-0.025	-0.154	0.381	0.315
	(0.255)	(0.274)	(0.397)	(0.417)	(0.530)	(0.559)	(0.398)	(0.419)	(0.423)	(0.446)
Sonipat * Higher-Order	0.082	0.107	0.269	0.122	-0.144	0.019	0.109	0.134	0.490	0.251
	(0.255)	(0.275)	(0.397)	(0.426)	(0.510)	(0.586)	(0.398)	(0.434)	(0.433)	(0.479)
Constant	0.231*	-0.256	-0.000	0.162	1.233***	0.418	-0.164	0.475	0.781***	0.324
	(0.121)	(0.487)	(0.185)	(0.473)	(0.247)	(0.917)	(0.186)	(0.496)	(0.207)	(0.535)
Observations	276	242	240	217	240	217	240	217	240	217
Control	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Loglikelihood	-187.8	-163.5	-165.4	-147.6	-92.56	-80.95	-164.8	-144.7	-136.8	-119
Pseudo R2	0.00641	0.0128	0.00185	0.0176	0.0368	0.0715	0.00236	0.0325	0.0373	0.0478
H_0: Trio + Sonipat * Trio = Sonipat (Do the behaviors differ between the Trio and Baseline treatments in India?)										
Chi-squared-stat.	0.52	0.39	0.09	0.00	0.15	0.46	0.13	0.04	4.67	3.28
p-value (two-sided)	0.47	0.53	0.77	0.99	0.69	0.50	0.72	0.84	0.03**	0.07*
H_0: Higher-Order + Sonipat * Higher-Order = Sonipat (Do the behaviors differ between the Higher-Order and Baseline treatments in India?)										
Chi-squared-stat.	0.84	0.53	0.17	0.05	0.40	1.06	0.05	0.16	6.85	4.95
p-value (two-sided)	0.36	0.47	0.68	0.82	0.53	0.30	0.83	0.69	0.01**	0.03**
H_0: Sonipat + Sonipat * Trio = Trio (Do the behaviors differ between the UK and India in the Trio treatment?)										
Chi-squared-stat.	2.27	2.89	0.00	0.32	2.35	1.53	0.20	0.61	0.34	0.34
p-value (two-sided)	0.13	0.09*	0.97	0.57	0.13	0.22	0.65	0.43	0.56	0.56
H_0: Sonipat + Sonipat * Higher-Order= Higher-Order (Do the behaviors differ between the UK and India in the Higher-Order treatment?)										
Chi-squared-stat.	0.68	0.12	0.47	0.05	0.92	0.46	0.05	0.01	0.38	1.11
p-value (two-sided)	0.41	0.73	0.50	0.82	0.34	0.50	0.83	0.92	0.54	0.29

Notes: Probit regressions with robust standard errors in parentheses (fractional Probit regression for columns (1) and (2)). The control variables in the even-numbered columns include a dummy for female, age, number of siblings, income rank and the Raven's test score. *** p<0.01, ** p<0.05, * p<0.1

(B) Punishment strength per third-party player

Dependent variable:	Beliefs about a third-party player's punishment points given to a PD player							
	Scenario							
	I. "mutual cooperation"		II. "betrayal"		III. "victim"		IV. "mutual defection"	
Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
India (Sonipat) dummy	-0.598	-0.313	-1.605**	-2.056***	-0.531	-0.739	-1.474*	-1.352*
	(1.068)	(1.083)	(0.734)	(0.766)	(1.026)	(1.032)	(0.794)	(0.795)
Trio	0.342	0.802	-0.040	-0.234	0.400	0.426	0.605	0.353
	(1.171)	(1.179)	(0.683)	(0.732)	(1.027)	(1.026)	(0.794)	(0.789)
Higher-Order	-0.536	-0.082	-0.192	-0.326	-0.462	-0.054	0.224	0.377
	(1.120)	(1.177)	(0.646)	(0.695)	(1.031)	(1.124)	(0.625)	(0.636)
Sonipat * Trio	0.615	-0.246	0.062	0.245	0.772	0.586	0.290	0.460
	(1.665)	(1.668)	(1.048)	(1.110)	(1.486)	(1.461)	(1.163)	(1.143)
Sonipat * Higher-Order	1.884	1.174	0.842	1.307	1.081	1.238	1.469	1.092
	(1.632)	(1.662)	(1.001)	(1.043)	(1.484)	(1.566)	(1.078)	(1.086)
Constant	-0.539	0.457	4.532***	4.758***	-0.443	2.410	2.015***	1.492
	(0.739)	(2.095)	(0.468)	(1.036)	(0.750)	(1.886)	(0.452)	(1.113)
Observations	240	217	240	217	240	217	240	217
Control	No	Yes	No	Yes	No	Yes	No	Yes
# left-censored obs.	129	113	33	30	132	118	67	57
# right-censored obs.	6	6	10	9	2	2	8	7
Loglikelihood	-404.5	-372.1	-557.2	-500.1	-391.6	-351.5	-504	-458.1
Pseudo R2	0.00242	0.00768	0.00963	0.0163	0.00238	0.0170	0.00831	0.0115
H_0: Trio + Sonipat * Trio = Sonipat (Do the behaviors differ between the Trio and Baseline treatments in India?)								
F-stat.	0.65	0.20	1.46	2.10	0.88	0.92	2.53	2.08
p-value (two-sided)	0.42	0.66	0.23	0.15	0.35	0.34	0.11	0.15
H_0: Higher-Order + Sonipat * Higher-Order = Sonipat (Do the behaviors differ between the Higher-Order and Baseline treatments in India?)								
F-stat.	1.02	0.51	2.87	4.77	0.40	1.09	4.45	3.45
p-value (two-sided)	0.31	0.48	0.09*	0.03**	0.53	0.30	0.04**	0.06*
H_0: Sonipat + Sonipat * Trio = Trio (Do the behaviors differ between the UK and India in the Trio treatment?)								
F-stat.	0.02	0.39	1.49	1.37	0.01	0.10	1.44	0.72
p-value (two-sided)	0.88	0.53	0.22	0.24	0.93	0.75	0.23	0.40
H_0: Sonipat + Sonipat * Higher-Order= Higher-Order (Do the behaviors differ between the UK and India in the Higher-Order treatment?)								
F-stat.	0.80	0.19	0.25	0.11	0.31	0.07	0.04	0.30
p-value (two-sided)	0.37	0.66	0.61	0.74	0.58	0.79	0.84	0.59

Notes: Tobit regressions with robust standard errors in parentheses. The control variables in the even-numbered columns include a dummy for female, age, number of siblings, income rank and the Raven's test score. *** p<0.01, ** p<0.05, * p<0.1.

Table C.5: *Cross-societal Difference in Beliefs about Efficient and Inefficient Higher-Order Punishment (using beliefs about first-order punishment in each scenario as the reference point for efficiency)* – supplementing Table 7 of the paper.

(A) Frequency of higher-order punishment given to other third parties

Data:	Beliefs about third parties' decision to higher-order punish							
	Scenario							
	I. "mutual cooperation"		II. "betrayal"		III. "victim"		IV. "mutual defection"	
Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
India (Sonipat) dummy	0.264	0.089	-0.248	-0.064	-0.089	-0.121	-0.585**	-0.394
	(0.269)	(0.285)	(0.234)	(0.263)	(0.261)	(0.277)	(0.262)	(0.277)
Efficient	0.954***	0.895***	0.568***	0.720***	0.783***	0.794**	-0.112	-0.165
	(0.230)	(0.257)	(0.208)	(0.234)	(0.292)	(0.355)	(0.186)	(0.176)
Sonipat * Efficient	-0.715**	-0.480	-0.140	-0.234	-0.279	-0.152	0.743**	0.746**
	(0.330)	(0.355)	(0.295)	(0.317)	(0.352)	(0.407)	(0.325)	(0.327)
Constant	0.185	0.608	0.576***	0.342	0.381**	0.357	0.851***	0.954*
	(0.190)	(0.492)	(0.169)	(0.560)	(0.189)	(0.412)	(0.191)	(0.557)
Observations	1,180	1,022	1,196	1,018	1,148	986	1,120	934
Control	No	Yes	No	Yes	No	Yes	No	Yes
Loglikelihood	-616.7	-519.6	-667.8	-566.3	-575.6	-470.9	-639	-531.3
Pseudo R2	0.0513	0.0749	0.0373	0.0449	0.0494	0.0939	0.0384	0.0510
H_0: Sonipat + Constant = 0 (Is the frequency of inefficient higher-order punishment behavior significant in India?)								
Chi-squared-stat.	5.62	1.92	4.09	0.24	2.62	0.31	2.18	1.12
p-value (two-sided)	0.02**	0.17	0.04**	0.63	0.11	0.58	0.14	0.29
H_0: Sonipat = Efficient + Sonipat * Efficient (Is efficient higher-order punishment more frequent than inefficient punishment in India?)								
Chi-squared-stat.	0.00	0.55	3.57	2.13	2.38	3.37	7.67	4.49
p-value (two-sided)	0.95	0.46	0.06*	0.14	0.12	0.07*	0.01**	0.03**

Notes: Probit regressions with robust standard errors in parentheses clustered by subject ID. The control variables in the even-numbered columns include a dummy for female, age, number of siblings, income rank and the Raven's test score. *** p<0.01, ** p<0.05, * p<0.1

(B) Punishment strength per third-party player

Data:	Beliefs about a third-party player's punishment points given to another third-party player							
	Scenario							
	I. "mutual cooperation"		II. "betrayal"		III. "victim"		IV. "mutual defection"	
Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
India (Sonipat) dummy	1.462*	1.066	-0.368	0.370	0.695	0.542	-1.189	-0.506
	(0.883)	(0.862)	(0.734)	(0.828)	(0.931)	(0.957)	(0.732)	(0.763)
Efficient	2.906***	2.798***	0.991*	1.802***	2.997***	3.180***	-0.335	-0.378
	(0.630)	(0.655)	(0.572)	(0.646)	(0.737)	(0.855)	(0.483)	(0.528)
Sonipat * Efficient	-2.131**	-1.485	0.420	-0.361	-2.159**	-1.989*	2.406***	2.324**
	(0.974)	(0.962)	(0.831)	(0.896)	(1.039)	(1.160)	(0.910)	(1.001)
Constant	0.525	1.584	1.946***	1.073	1.195**	1.029	2.557***	2.442
	(0.614)	(1.364)	(0.480)	(1.562)	(0.596)	(1.378)	(0.434)	(1.614)
Observations	1,180	1,022	1,196	1,018	1,148	986	1,120	934
Control	No	Yes	No	Yes	No	Yes	No	Yes
# left-censored obs.	283	244	319	274	253	217	314	268
# right-censored obs.	44	39	36	33	61	55	41	40
Loglikelihood	-2635	-2271	-2628	-2210	-2616	-2235	-2443	-1991
Pseudo R2	0.0129	0.0165	0.00577	0.0174	0.0151	0.0209	0.00759	0.0269
H_0: Sonipat + Constant = 0 (Are inefficient punishment behaviors significant in India?)								
F-stat.	9.62	4.46	8.01	0.69	6.98	1.21	5.19	1.43
p-value (two-sided)	0.00**	0.03**	0.00**	0.41	0.01**	0.27	0.02**	0.23
H_0: Sonipat = Efficient + Sonipat * Efficient (Is efficient punishment stronger than inefficient punishment in India?)								
F-stat.	0.23	0.03	2.43	0.77	0.01	0.17	6.18	3.04
p-value (two-sided)	0.63	0.86	0.12	0.38	0.92	0.68	0.01***	0.08*

Notes: Tobit regressions with robust standard errors in parentheses clustered by subject ID. The control variables in the even-numbered columns include a dummy for female, age, number of siblings, income rank and the Raven's test score. *** p<0.01, ** p<0.05, * p<0.1