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Motives for Costly Peer Punishment in a Private-Public Goods Game

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Abstract

Cooperation plays a fundamental role in overcoming shared problems. By pooling resources and working together, individuals can create collective goods that benefit everyone. The creation and maintenance of such goods are threatened not only by free-riding but also by individualism, which is characterized by individuals' striving for solutions that benefit only themselves. The present thesis focused on the importance of costly peer punishment in cooperative contexts. Four hypothetical motives were empirically tested in a private-public goods game: cooperation enforcement, deterrence, norm enforcement, and disadvantageous inequity aversion. The final sample consisted of 138 individuals who participated in a one-shot 2 (player type: free-rider vs. individualist) × 2 (condition: CSR vs. CSF) within-participants design. The study was conducted in survey format and investigated the administration of costly peer punishment from the perspective of cooperators. Hypotheses were tested using linear regression models and a repeated measures ANOVA. Results showed that higher perceived effectiveness of cooperation-enforcing punishment and deterrence punishment, as well as lower perceived norm appropriateness, predicted stronger punishment. Disadvantageous inequity aversion explained punishment directed only at individualists under failure conditions. Overall, the findings demonstrate that peer punishment is selective and motive-driven. Furthermore, results highlight participants' ability to differentiate between free-riders and individualists while also suggesting a potential role of negative emotions in punishment behavior.

Keywords: cooperation, peer punishment, punishment motives, private-public goods game, social decision-making

Zusammenfassung

Kooperation spielt eine grundlegende Rolle beim Bewältigen gemeinsamer Herausforderungen. Durch die Bündelung von Ressourcen und Zusammenarbeit können Individuen kollektive Güter hervorbringen, die allen zugutekommen. Die Schaffung und Aufrechterhaltung dieser Güter werden jedoch nicht nur durch Trittbrettfahren bedroht, sondern auch durch Individualismus, also das Streben Einzelner nach individuellen Lösungen, die ausschließlich ihrem eigenen Vorteil dienen. Die vorliegende Arbeit widmete sich der Bedeutung von kostspieliger Peer-Bestrafung in kooperativen Kontexten. Vier theoretische Bestrafungsmotive wurden in einem Private-Public-Goods-Game empirisch getestet: Erzwingung von Kooperation, Abschreckung, Durchsetzung von Normen sowie Aversion gegenüber nachteiliger Ungleichheit. Die finale Stichprobe bestand aus 138 Personen, die an einer einmaligen 2 × 2 Interaktion im Within-Participants-Design teilnahmen (Spielertyp: Trittbrettfahrer vs. Individualist; Bedingung: CSR vs. CSF). Die Studie wurde im Umfrageformat durchgeführt und betrachtete die Vergabe von kostspieliger Bestrafung ausschließlich aus der Perspektive von kooperierenden Gruppenmitgliedern. Die Hypothesen wurden mittels linearer Regressionsmodelle sowie einer zweifaktoriellen ANOVA mit Messwiederholung getestet. Die Ergebnisse zeigten, dass eine höhere wahrgenommene Wirksamkeit kooperationserzwingender und abschreckender Bestrafung sowie eine geringere wahrgenommene Normangemessenheit mit stärkerer Bestrafung einhergingen. Das Motiv der Aversion gegenüber nachteiliger Ungleichheit erklärte Bestrafung lediglich gegenüber Individualisten in Verlustsituationen. Insgesamt verdeutlichen die Ergebnisse, dass Peer-Bestrafung selektiv und motivgetrieben erfolgt. Darüber hinaus unterstreichen sie die Fähigkeit der Teilnehmenden, zwischen Trittbrettfahrern und Individualisten zu unterscheiden, wobei erlebte negative Emotionen hier möglicherweise eine Rolle für das Bestrafungsverhalten spielen.

Schlüsselbegriffe: Kooperation, Peer-Bestrafung, Bestrafungsmotive, Private-Public-Goods-Game, soziales Entscheidungsverhalten

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Motives for Costly Peer Punishment in a Private-Public Goods Game

Prosocial behavior is one of the cornerstones of human evolution. The ability to collaborate toward common objectives is seen as a pivotal factor enabling humanity to flourish and advance in evolutionary terms (Hare, 2016; Nowak, 2006). Common objectives, often referred to as public goods, can be characterized as solutions for shared problems, such as healthcare, infrastructure, public transport, and environmental protection measures.

Through the contribution of sufficient effort and resources, cooperation enables the creation of public goods to overcome these shared problems, allowing all individuals to access certain goods (Fehr & Gächter, 2000; Parks et al., 2013). Combined efforts of a united group tend to be far more effective than uncoordinated actions taken by individuals alone. As a result, the overall costs for shared commitment are significantly lower than those of isolated initiatives (Gross & De Dreu, 2019). Consequently, individuals benefit significantly from working together when facing shared problems. This is especially true for those with fewer economic resources, as they are more reliant on cooperation compared to wealthier individuals who can afford their own solutions and thus do not solely rely on cooperation (Gross & Böhm, 2020). However, as cooperation is inherently fragile and subject to various external and internal factors, a constant shadow of uncertainty looms over it (Molm et al., 2009; Rocha et al., 2020).

A powerful mechanism that has evolved to promote cooperation under conditions of uncertainty is the administration of costly punishment by cooperative individuals, also referred to as altruistic punishment. In this form, cooperators willingly incur personal costs to sanction defectors without immediate personal gain (Boyd et al., 2003; Santos et al., 2013). However, the administration of costly punishment is subject to various motives apart from the altruistic motive of cooperation enforcement (Claessens et al., 2024; Raihani & Bshary, 2019), such as equity considerations and retribution. Moreover, it is very likely that multiple motives may operate simultaneously, with individuals drawing on a combination of motives when deciding

to engage in costly punishment. As these motives often remain unclear, disentangling the motives that serve the collective good from those driven by personal self-interest is challenging, as they blur the boundary between altruistic promotion of cooperation and strategic self-serving behavior (Claessens et al., 2024).

This is especially the case when facing shared problems, as the success of cooperation depends on individuals' willingness to act in the group's interest, thus pitting self-interest against the collective interest. This trade-off between personal and collective interest lies at the heart of what is known as a social dilemma (Van Lange et al., 2013).

Social Dilemma

A social dilemma is, as Van Lange et al. (2013) describe it, a situation in which "short-term self-interest is at odds with longer-term collective interests" (p. 125). Real-world examples illustrate these dynamics. For instance, consumers who purchase cheap fast-fashion clothing face a social dilemma: the short-term benefits of low prices and instant gratification come at the cost of long-term environmental degradation and the exploitation of workers in precarious conditions. However, the more individuals engage in purchasing cheap clothing, the more dire the consequences for the environment and for the affected workers become.

Social dilemmas take diverse forms. Their time horizon can be brief or extended indefinitely. Sometimes cooperation means contributing to a collective resource; other times it involves refraining from overconsumption of shared goods (Van Lange et al., 2013). Nevertheless, social dilemmas share a core feature: with sufficient cooperation, they can be resolved. However, with insufficient cooperation, efforts break down, trust erodes, and hostile or dysfunctional environments may emerge (Van Lange et al., 2013). As Simpson and Willer (2015) note, "Groups can flourish if their constituent members move beyond narrow self-interest, achieve mutual trust, and invest in collective endeavors. But groups can also founder where individuals fail to overcome these obstacles" (p. 44). A well-documented threat to

collective success in the face of shared problems is free-riding (Fehr & Gächter, 2000; Fischbacher & Gächter, 2010; Gross & De Dreu, 2019, Hardin, 1968).

Free-Riding

Free-riding is characterized by not contributing resources or effort toward solving a shared problem, while simultaneously relying on others to provide the good (Fehr & Gächter, 2000; Gross et al., 2020). Consequently, as "the collective solution shares the property of a public goods dilemma, it is exploitable by free riding" (Gross & De Dreu, 2019, p. 2). Hence, the voluntary decision to contribute to a collective solution is a significant challenge in the provision of public goods, as it allows non-contributing individuals to benefit at the expense of others (Fehr & Gächter, 2000; Fischbacher & Gächter, 2010; Gross & De Dreu, 2019). Moreover, as more individuals choose to free-ride, the pressure on cooperators to compensate for the missing contributions of free-riders increases. It has empirically been demonstrated that free-riding can lead to an erosion of trust among group members and undermine cooperation (Fehr & Gächter, 2000; Nastina & Tormos, 2025; Xu et al., 2024).

Individualism

Another challenge for the creation and maintenance of public goods is individualism, which has lately seen a rise in demand worldwide (Grossmann & Varnum, 2015; Santos et al., 2017). Individualists, like cooperators, actively invest in solutions for shared problems. However, in contrast to cooperators, individualists contribute their resources to private (i.e., individual) solutions instead of public ones (Gross & De Dreu, 2019). Unlike public solutions, private solutions—which come at higher baseline costs (e.g., private insurance or private transport)—can be achieved independently, solely benefiting the contributing individuals.

Consequently, as individualists find individual solutions for shared problems, they do not rely on cooperation to create public goods. Moreover, as individualism prevents individuals from being exploited by free-riders, it offers an appealing alternative to cooperation, which may

come at higher costs but less risk. However, by mitigating cooperation, individualists exacerbate the existing problem of insufficient contributions to the public good caused by free-riding (Fehr & Gächter, 2000; Gross et al., 2020; Hardin, 1968), and thus the risk of a total breakdown in cooperation and infighting further increases (Gross et al., 2020).

Private-Public Goods Games

The private-public goods game is a variation of the standard public goods game. Like its predecessor, it allows researchers to study interactions among group members attempting to solve a common problem by contributing sufficient resources to a shared pool (Thielmann et al., 2021). Both games thus represent a social dilemma as participants can either choose to cooperate or to engage in free-riding (Gross & De Dreu, 2019; Gross et al., 2020). However, in contrast to the public goods game, the private-public goods game introduces a third strategic option—individualism—which is characterized by the tendency to prioritize contributions to an individual solution rather than a public good.

In private-public goods games, a group of players engages in a fixed number of repeated rounds. At the beginning of each round, participants receive a fixed endowment, which they may allocate toward a collective solution or an individual solution. They can also decide to free-ride by retaining their endowments. The collective solution is the most cost-effective if distributed evenly among group members. Meanwhile, the private solution is costlier but independently achievable. If the required collective or private threshold is not met through sufficient resource allocations, the participant forfeits any unspent endowments. Private-public goods games often offer participants the option to engage in costly punishment at the end of each round (Gross & De Dreu, 2019).

Punishment

Raihani and Bshary (2019) explore a wide range of underlying motives for punishment in economic games. They categorize punishment into four overarching types: special

deterrence, general deterrence, egalitarian, and competitive. Building on this framework, Claessens et al. (2024) identify nine more specific sub-motives for punishment: deterrence, norm enforcement, retribution, avoidance of disadvantageous inequity, egalitarian punishment, seeking advantageous inequity, competition, antisocial punishment, and complete avoidance of punishment.

Some studies have shown that punishing non-cooperating individuals can improve the group's overall payoff in public goods games, even though it is costly for the individuals who impose the punishment (Ambrus & Greiner, 2012; Brandt et al., 2005; Fehr & Gächter, 2000; Kroll et al., 2007). Other studies, however, caution against the adverse effects of punishment, as costly punishment can worsen the overall outcome (e.g., Frey & Rusch, 2012; Gross et al., 2020), and excessive punishment may exacerbate the damage to group morale. Therefore, the motives behind punishment play a critical role, as self-serving and cooperation-promoting motives may lead to entirely different outcomes.

Moreover, the threat of reciprocal counter-punishment can play a major role in individuals' considerations in the administration of punishment (Nikiforakis, 2007). As punishment may therefore potentially encourage cooperation, it can also provoke retaliation or escalate into punitive feuds—ultimately diminishing group outcomes (Gross et al., 2020). This makes its effectiveness highly context-dependent (Wang et al., 2017; Otten et al., 2024). Nevertheless, some authors note that while punishment may not improve outcomes in the short term, it can be effective in the long run, especially in games with a large number of repeated interactions, as it potentially deters future free-riding (Egas & Riedl, 2008; Frey & Rusch, 2012; Gächter et al., 2008). Furthermore, moderate punishment seems to be most effective, while both too lenient and too harsh forms of punishment bear a higher risk of producing detrimental outcomes (Helbing et al., 2010). Fehr and Gächter (2000) conclude that simply knowing

punishment is possible improves cooperation, reflected by Aron Nimzowitsch's famous phrase, "The threat is stronger than the execution" (Nimzowitsch, 1929/1991).

Punishment in Private-Public Goods Games

The distinct structure of private-public goods games implies that certain motives for punishment are more likely to occur than others. Drawing on the existing literature, the motives of cooperation enforcement, deterrence, norm enforcement, and disadvantageous inequity aversion have been identified.

Cooperation Enforcement

Cooperation enforcement refers to a motive for punishment aimed at promoting future cooperation by sanctioning current defection. It reflects the intention to increase group-wide cooperation by discouraging behaviors such as free-riding or individualism (Fehr & Gächter, 2000; Raihani & Bshary, 2019). By administering punishment, the cooperating individual signals to the punished party that their behavior is deemed inappropriate and that they are expected to contribute to the collective effort. Consequently, punishment motivated by cooperation enforcement serves the primary function of realigning non-cooperating group members. It operates both as a prompt for behavioral correction and as a deterrent against future defection. Crucially, this form of punishment is targeted specifically at defectors, distinguishing it from deterrence-based punishment, which may be directed at a broader audience (Raihani & Bshary, 2019).

Deterrence

Deterrence refers to a punishment motive aimed at preventing group members from engaging in undesirable behaviors in the future, such as free-riding and individualism. Deterrence punishment and cooperation-enforcing punishment share certain similarities, as both concepts are focused on the punishment of non-cooperative group members. However, the main difference lies in the intended audience of the punishment. Whereas cooperation-

enforcing punishment primarily targets the punished individual, deterrence punishment is directed at other group members by aiming to discourage them from engaging in the same behavior demonstrated by the punished individual (Carlsmith et al., 2002; Claessens et al., 2024). Raihani and Bshary (2019) refer to both concepts as deterrence but further distinguish them into special deterrence—aiming to change the behavior of specific individuals—and general deterrence, which seeks to "deter any would-be offender from committing the same crime" (p. 7). Consequently, while cooperation-enforcing punishment seeks to bring defecting individuals back in line and encourage their contribution to the public good, deterrence punishment aims to prevent others from stepping out of line in the first place (Raihani & Bshary, 2019). Therefore, by punishing defectors such as free-riders or individualists, deterrence punishment enables cooperators to signal to currently non-defecting players that engaging in similar behavior is very likely to lead to the same consequences.

Norm Enforcement

Norm enforcement as a motive for punishment can be characterized as a response to perceived violations of social and fairness norms, independent of personal gain. It therefore reflects an individual's internal standard of norm appropriateness for what is considered acceptable and what is not (Claessens et al., 2024; Fehr & Fischbacher, 2004a; Fehr & Fischbacher, 2004b; Raihani & Bshary, 2019). Past research strongly indicates that the enforcement of norms plays an important role in shaping individuals' contribution decisions in public goods games (Reuben & Riedl, 2012; Villeval, 2020; Xiao, 2018). Fehr and Gächter (2000) argue that the punishment of free-riders is likely driven by a concern for maintaining social norms. However, Gross and De Dreu (2019), employing a private-public goods game, noted that peer punishment led to clashes between cooperators and individualists, with free-riders being largely ignored. Nevertheless, as norm considerations are shown to be of

importance in social dilemmas, norm enforcement is therefore included as a possible motive for punishment in the present study.

Disadvantageous Inequity Aversion

The motive of disadvantageous inequity aversion reflects punishment that is driven by an aversion to being worse off than defecting players (Fehr & Schmid, 2000). Furthermore, according to Fehr and Schmidt (1999), perceived fairness plays a central role in payoff-related fairness evaluations of individuals. The primary aim of punishment motivated by inequity aversion is the equalization of outcomes by leveling the difference in outcomes between the punishing player and the punished individual (Claessens et al., 2024; Fehr & Schmidt, 1999). Contrary to advantageous inequity aversion—which reflects an individual's discomfort with being better off than others—individuals motivated by inequity aversion are willing to incur personal costs and thus decrease their own payoff, solely to reduce disparities in outcomes with others (Claessens et al., 2024; Fehr & Schmidt, 1999; Raihani & Bshary, 2019).

Fehr and Schmidt (1999), after conducting a public goods game, concluded that disadvantageous inequity aversion is not only a stronger motivator than advantageous inequity aversion, but also a very powerful one. As the reduction of the inequality gap between group members by payoff-leveling stems from a strong wish for equality (Johnson et al., 2009; Tamura et al., 2011), it thus reflects the egalitarian motive of punishment postulated by Raihani and Bshary (2019) and Claessens et al. (2024).

Present Research

This study explores the motives underlying costly peer punishment in a one-shot private-public goods game, focusing on the perspective of a cooperating individual. Cooperators, having invested in a collective solution, are directly affected by free-riders and individualists. Consequently, they may have distinct reasons to sanction each type of defector. The research question was therefore: "How do cooperators evaluate individualists vs. free-

riders in private-public goods games?" To address the research question, the study builds on theoretical frameworks—proposed by Raihani and Bshary (2019) and Claessens et al. (2024)—which identify psychological drivers of peer punishment and social evaluation. Drawing on these frameworks, this study empirically tests four motives for punishment in a private-public goods game: cooperation enforcement, norm enforcement, deterrence, and disadvantageous inequity aversion.

Hypotheses

During the conduct of the statistical analyses, it became clear that the original phrasing of H1–H3 did not properly reflect the intended analytical approach, as their wording failed to connect the respective motives to actual punishment. Therefore, the affected hypotheses were revised to align with the analyses and to improve their overall clarity. After rewording, the hypotheses included adequate predictive components for investigating the research question. Additionally, H4a and H4b also underwent rephrasing to improve clarity and conciseness. Importantly, the revisions did not change the theoretical meaning or direction of any hypothesis: H1–H2 remain non-directional, while H3, H4a, and H4b remain directional as originally intended. The revised main hypotheses are as follows:

H1. Differences in perceived effectiveness of cooperation-enforcing punishment for free-riders versus individualists predict differences in punishment between these player types.

H2. Differences in perceived effectiveness of deterrence punishment for free-riders versus individualists predict differences in punishment between these player types.

H3. Greater perceived norm appropriateness of free-riding relative to individualism positively predicts punishment of individualists relative to free-riders.

H4a. More punishment of individualists when the group fails to reach the collective solution compared to when it succeeds is associated with disadvantageous inequity aversion.

H4b. More punishment of free-riders when the group succeeds in reaching the collective solution compared to when it fails is associated with disadvantageous inequity aversion.

Method

Design

An experimental one-shot within-participants survey design was employed to investigate how participants in a private-public goods game evaluate different defecting co-players. The survey was administered in German via Unipark (https://ww3.unipark.de/www). The study was initially preregistered on AsPredicted (aspredicted.org/b3ms-myhg.pdf) and later uploaded to the Open Science Framework. It was approved by the Review Board for the Departments of Occupational, Economic, and Social Psychology at the University of Vienna (DRB number: 2024/W/023). The analysis code and all supplementary files are available at the Open Science Framework (https://osf.io/3y7sa/).

Participants

The required sample size for the study was determined using a power analysis with G*Power. An α level of .05, a power of .80, and a small effect size (Cohen's $f = 0.1$) were used, indicating a required sample size of 138 participants for a repeated measures ANOVA to assess disadvantageous inequity aversion (as planned for testing H4a and H4b).

The study included a mixed sampling approach. Initially, participants were recruited via a convenience sample on social media platforms such as WhatsApp, Instagram, and personal networks. Due to insufficient participation, further participants were recruited in a second step via the survey recruitment platform Prolific to meet the required sample size. The data collection was conducted between January 6 and January 26, 2025. Participants were able to complete the study on a personal computer, tablet, or smartphone. The survey was estimated to take approximately 12 minutes. The financial compensation for the study participation, amounting to approximately £10 per hour, was directly processed via Prolific. Inclusion criteria required that participants be at least 18 years old, proficient in German, and have no missing

data (only fully completed surveys were included). Descriptive statistics for the sample are reported below and in Appendix Tables A1–A4.

The final sample consisted of 138 participants, as only 50.2% of the 275 individuals who took part in the study completed it. Initially, participants were recruited from a convenience sample via social media and personal networks (n = 83). Additional participants (n = 55) were then recruited via Prolific to meet the required sample size. Of the total 138 participants, 47.1% identified as men (n = 65), and 52.9% identified as women (n = 73). The mean age was 31.8 years (SD = 10.2), ranging from 18 to 71 years.

Of the total participants included in the sample, 1.4% had no formal school qualification (n = 2), 1.4% had a basic school leaving certificate (n = 2), 7.2% completed an apprenticeship (n = 10), 5.8% completed a technical or vocational school without a high school diploma (n = 8), 18.1% completed a general or vocational higher school with a high school diploma (n = 25), and 65.9% had a university or college degree (n = 91).

Participants also indicated their contribution preference in the game (see Behavioral Proxy Measure in Materials and Measures). The majority chose the collective solution (73.2%, n = 101), followed by the individual solution (19.6%, n = 27), and free-riding (7.2%, n = 10).

Experimental Task

The game involved a single-round interaction with four players: two simulated cooperators, one free-rider, and one individualist. Participants were instructed to act as a cooperator. Importantly, they did not make contribution decisions themselves. Their role was limited to assigning punishment points and completing questionnaires on punishment motives after the outcomes were presented.

At the beginning of the game, each fictional player received 10 monetary units (MU), resulting in a total amount of 40 MU available to the group. Players could either contribute their MU to a shared pool to reach a collective solution (cooperating strategy), to a private pool to

reach an individual solution (individualistic strategy), or keep their MU (free-riding strategy). To reach the collective solution, the group needed to contribute a total of 16 MU (40% of the total endowment), a requirement met if each player contributed 4 MU. Alternatively, any player could achieve an individual solution by contributing 6 MU (60% of their endowment), reflecting the trade-off of pursuing an independent solution without relying on cooperation among group members. Reaching the collective solution allowed all players to keep their endowments, whereas the individual solution allowed only the contributing individual to retain theirs. Failure to reach a solution resulted in the loss of all endowments.

Payoffs were determined by whether the respective thresholds were reached. The contribution phase was followed by a punishment phase, in which participants took part in the game. Each group member, including the participant, received 5 additional MU, which could either be kept or used for costly peer punishment. Each MU invested in peer punishment was converted into one punishment point, which reduced the punished player's payoff by 3 MU. Each player could assign up to 5 punishment points (i.e., spend up to 5 MU on punishment). However, because the scenarios were fictional, only the punishment assigned by participants was assessed; punishment assigned by other players was not included.

To reduce complexity, player types were simplified based on how they allocated the majority of their endowments: a cooperator was defined as a player who contributed the majority of their units to the collective solution; an individualist was defined as a player who contributed the majority of their units to the individual solution; and a free-rider was defined as a player who kept the majority of their endowment.

Participants observed two different conditions presented in counterbalanced order, each of them resulting in a different outcome: Collective Solution Reached (CSR) and Collective Solution Failed (CSF). In the CSR condition, the group successfully met the collective contribution threshold, and the individualist also fulfilled the individual solution requirement.

Consequently, all players kept their remaining endowments. In the CSF condition, the group failed to reach the collective threshold, while the individualist still achieved the individual solution. As a result, only the individualist retained their remaining endowments, and all other group members forfeited theirs. Thus, the CSR condition reflects both collective and individual success, whereas the CSF condition represents collective failure alongside individual success.

Materials and Measures

An investigation of existing literature revealed that no preexisting items were available to assess the main hypotheses. Therefore, all measures were self-developed to target the hypothesized motives for punishment.

Punishment

Punishment was operationalized as a difference score, computed by subtracting the total punishment assigned to the individualist from the total punishment assigned to the free-rider across both conditions (averaged across CSR and CSF). Positive values indicated stronger punishment of free-riders, while negative values indicated stronger punishment of individualists.

Cooperation Enforcement

Cooperation enforcement as a motive for punishment was assessed by examining participants' perceived effectiveness of punishment in promoting cooperation among free-riders and individualists. Participants responded to two self-formulated items on a 7-point Likert scale (1 = "Very Unlikely," 4 = "Neutral," 7 = "Very Likely"):

1. Assume there is another round after this one. What is the likelihood that punishment will increase a free-rider's contribution to the collective solution?
2. Assume there is another round after this one. What is the likelihood that punishment will increase an individualist's contribution to the collective solution?

A difference score was then computed for each participant by subtracting the individualist rating from the free-rider rating. Scores were averaged across CSR and CSF conditions. Positive values indicated greater perceived effectiveness of cooperation enforcement for free-riders, while negative values indicated greater effectiveness for individualists.

Deterrence

Deterrence as a motive for punishment was operationalized by examining differences in participants' ratings of perceived effectiveness in deterring free-riders and individualists. Participants responded to two self-formulated items on a 7-point Likert scale (1 = "Very Unlikely," 4 = "Neutral," 7 = "Very Likely"):

1. Assume there is another round after this one. Punishing a free-rider would deter others from engaging in what the punishee is doing.
2. Assume there is another round after this one. Punishing an individualist would deter others from engaging in what the punishee is doing.

Afterwards, a difference score was computed for each participant by subtracting the individualist rating from the free-rider rating, and the scores were averaged across CSR and CSF conditions. Positive values indicated stronger perceived deterrence for free-riders, while negative values indicated stronger perceived deterrence for individualists.

Norm Enforcement

Norm enforcement as a motive for punishment was assessed through participants' ratings of the norm appropriateness of free-riding and individualism. Participants responded to two self-formulated items on a 7-point Likert scale (1 = "Strongly Disagree," 4 = "Neutral," 7 = "Strongly Agree"):

1. It is socially appropriate to contribute to the individual solution.

2. It is socially appropriate to neither contribute to the individual solution nor to the collective solution.

The first item reflected participants' attitudes toward individualism, and the second toward free-riding. Importantly, the items assessed attitudes toward the behaviors in general rather than direct evaluations of the player types. However, because free-riding and individualism correspond to the behavioral strategies of the free-rider and individualist in the experimental task, these ratings were used as proxies for attitudes toward the respective player types. Thus, the items did not measure norm enforcement directly but operationalized it indirectly via perceived norm appropriateness. A difference score was computed by subtracting the individualist rating from the free-rider rating, and these difference scores were averaged across the CSR and CSF conditions. Positive values indicate greater perceived appropriateness of free-riding, whereas negative values indicate greater perceived appropriateness of individualism.

Disadvantageous Inequity Aversion

Disadvantageous inequity aversion as a motive for punishment was operationalized as the difference in punishment assigned to the same player type (free-rider or individualist) across the CSR and CSF conditions. The motive is indicated when outcome-related inequities—arising from either failing to reach or successfully reaching the collective solution—are reflected in systematically different punishment of the same player type across conditions. Thus, disadvantageous inequity aversion was assessed by directly comparing the punishment points administered to free-riders and individualists between CSR and CSF conditions.

Behavioral Proxy Measure

After reading the instructions, participants answered one question about their preferred strategy in the game. They read the following prompt:

You have now read the game instructions. The game lasts only one round and is played by people who do not know each other and will not see each other during or after the game. Which strategy would you most likely choose if you had to state a preference?

Participants chose among three options: “Collective Solution,” “Individual Solution,” and “Free-Riding.” This single self-formulated item served as a behavioral proxy for participants’ own inclinations.

Warmth and Competence Questionnaire

As an exploratory measure, participants’ perceptions of warmth and competence for the player types were assessed with the questionnaire developed by Kervyn et al. (2012). Previous research has shown that warmth and competence—often referred to as the “Big Two” dimensions of social perception (Imhoff & Koch, 2017)—play a central role in individuals’ evaluations of others (Fiske et al., 2006; Cuddy et al., 2009). Participants in the present study evaluated each player type (cooperator, individualist, free-rider) on a 7-point Likert scale (1 = “Strongly Disagree,” 4 = “Neutral,” 7 = “Strongly Agree”).

In the original validation studies, the questionnaire demonstrated acceptable to good internal consistency, with Cronbach’s α ranging from .71 to .85 across three separate samples (Kervyn et al., 2012). For the warmth dimension (α = .85), the items were “warm,” “friendly,” “cold” (reverse-coded), and “irritable” (reverse-coded). For the competence dimension (α = .75), the items were “conscientious,” “efficient,” “lazy” (reverse-coded), and “disorganized” (reverse-coded).

Procedure

Participants first provided informed consent and basic demographic information. They then read detailed instructions about the game, including the contribution and punishment phases, and reviewed descriptions of player types and their corresponding strategies. Comprehension questions followed to ensure understanding. Next, participants indicated their

own preferred strategy and studied an example game round, illustrating how different player types contributed and how payoffs were determined.

After this preparation, participants entered the experimental phase. They were randomly assigned to view one outcome condition first (CSR or CSF). After observing that condition's outcome, they completed the questionnaire items on cooperation enforcement, deterrence, and norm appropriateness, and assigned punishment points to both the free-rider and the individualist. They then viewed the other condition and repeated the same ratings and punishment allocations. Finally, participants rated the warmth and competence of each player type.

Data Analysis

Statistical analyses were first performed in JASP (version 0.19.3.0) and subsequently replicated in RStudio (R version 4.4.2). Figures were created in R, and tables were created manually using Microsoft Excel. To test H1–H3, the computed motive difference scores for cooperation enforcement, deterrence, and norm appropriateness were entered as predictors in linear regression models, with the computed punishment difference score as the dependent variable. Each motive was first tested in a separate regression, followed by a multiple regression including all three motives simultaneously. To assess H4, a 2 × 2 repeated measures ANOVA was conducted with player type (free-rider vs. individualist) and condition (CSR vs. CSF) as within-participant factors, and punishment points as the dependent variable.

Assumptions for all analyses were tested where applicable, including Shapiro–Wilk tests for normality and Mauchly's test for sphericity. Although some tests indicated significant deviations from normality ($p < .05$), the sample size was relatively large ($N = 138$), and repeated-measures ANOVAs are considered robust to moderate violations of the normality assumption (Field, 2018). Therefore, analyses were conducted as planned.

Effect sizes are reported and interpreted alongside significance tests, and Bonferroni corrections were applied to control for Type I error in post hoc comparisons. No missing data were present, as only fully completed questionnaires were retained for analysis. Moreover, in contrast to the preregistration, the median absolute deviation (MAD) criterion for outlier exclusion was not applied. Applying this procedure would have excluded responses that, while statistically extreme, nonetheless represent meaningful perspectives on motives for punishment. As these responses are theoretically relevant and not errors, they were retained in the analyses, and no bootstrapped replacements were performed.

The preregistered ANOVAs on cooperation enforcement, deterrence, and norm appropriateness were conducted for completeness. However, because they assessed motive ratings in isolation rather than in relation to punishment behavior, they did not address the core hypotheses of the study and were therefore treated as exploratory. In addition, to examine warmth and competence ratings across player types (cooperator, individualist, free-rider), another repeated measures ANOVA was performed. Finally, total punishment differences between conditions were analyzed using a paired-samples t-test and descriptive statistics.

Results

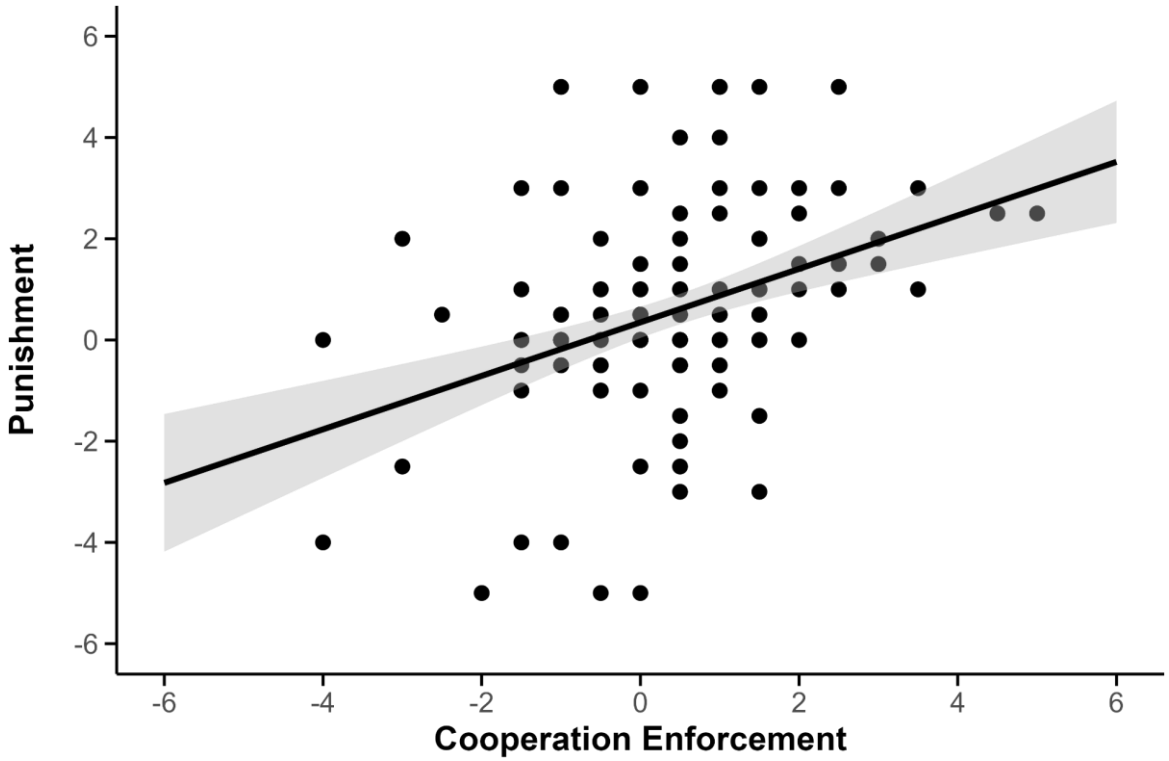
Confirmatory Analyses

Cooperation-Enforcement Motive and Punishment

To test H1, which posits that differences in perceived effectiveness of cooperation-enforcing punishment explain differences in punishment, a simple linear regression was conducted. The model was statistically significant, $F(1, 136) = 25.30$, $p < .001$, and explained 15.7% of the variance in punishment behavior ($R^2 = .16$, adjusted $R^2 = .15$). As outlined in Figure 1, perceived effectiveness of cooperation-enforcing punishment significantly and positively predicted punishment, $\beta = 0.40$, $B = 0.53$, $SE = 0.11$, $t = 5.03$, $p < .001$.

Figure 1

Association Between Cooperation Enforcement and Punishment



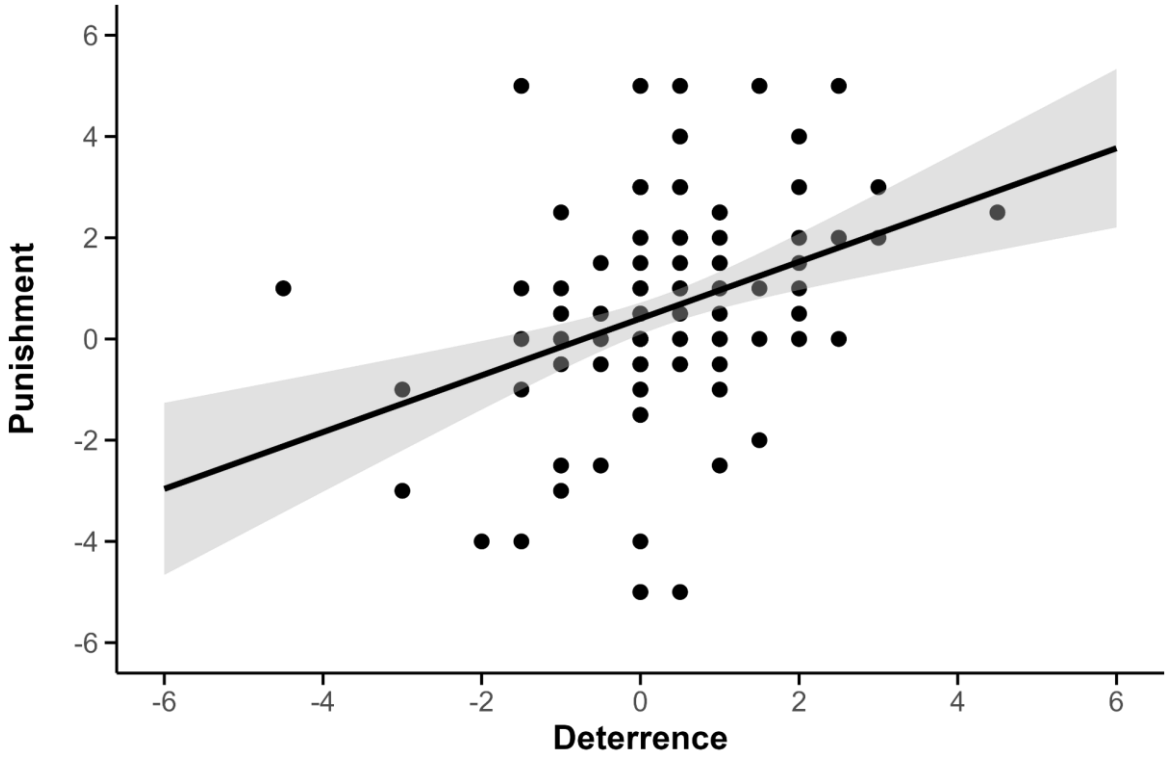
Note. The shaded gray area around the regression line represents the 95% CI.

Deterrence Motive and Punishment

To test H2, which posits that perceived effectiveness of deterrence punishment differs between free-riders and individualists, explaining differences in punishment, a simple linear regression was conducted. The model was statistically significant, $F(1, 136) = 17.24$, $p < .001$, and explained 11.2% of the variance in punishment behavior ($R^2 = .11$, adjusted $R^2 = .11$). As outlined in Figure 2, perceived effectiveness of deterrence punishment significantly and positively predicted punishment, $\beta = 0.34$, $B = 0.56$, $SE = 0.14$, $t = 4.15$, $p < .001$.

Figure 2

Association Between Deterrence and Punishment



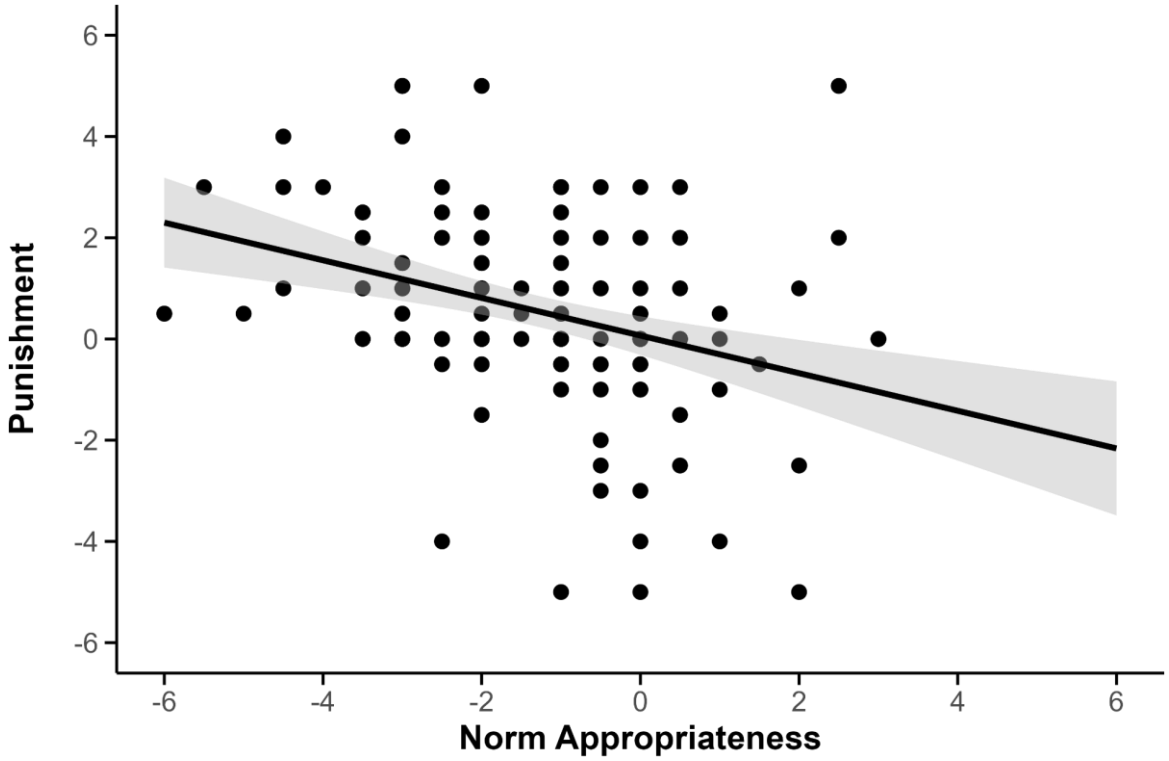
Note. The shaded gray area around the regression line represents the 95% CI.

Norm Enforcement Motive and Punishment

To test H3, which posits that greater perceived norm appropriateness of free-riding relative to individualism predicts greater punishment of individualists, a simple linear regression was conducted. The model was statistically significant, $F(1, 136) = 17.32$, $p < .001$, and explained 11.3% of the variance in punishment behavior ($R^2 = .11$, adjusted $R^2 = .11$). As outlined in Figure 3, perceived norm appropriateness significantly and negatively predicted punishment, $\beta = -0.34$, $B = -0.37$, $SE = 0.09$, $t = -4.16$, $p < .001$.

Figure 3

Association Between Norm Appropriateness and Punishment



Note. The shaded gray area around the regression line represents the 95% CI.

To assess the unique contribution of each predictor, cooperation enforcement, deterrence, and norm appropriateness, a multiple regression analysis was conducted with all

three predictors simultaneously, thereby controlling for their shared variance. The combined model was statistically significant, $F(3, 134) = 13.88$, $p < .001$, accounting for 23.7% of the variance in punishment behavior ($R^2 = .24$, adjusted $R^2 = .22$). All three predictors significantly contributed to the model (see Table 1). Perceived effectiveness of cooperation-enforcing punishment ($\beta = 0.23$, $B = 0.30$, $SE = 0.12$, $t = 2.58$, $p = .011$) and deterrence punishment ($\beta = 0.21$, $B = 0.36$, $SE = 0.14$, $t = 2.57$, $p = .011$) positively predicted punishment. In contrast, perceived norm appropriateness negatively predicted punishment, $\beta = -0.23$, $B = -0.25$, $SE = 0.09$, $t = -2.79$, $p = .006$.

Table 1

Regression Models of Punishment Motives

Model	Predictor	*B*	*SE*	*β*	*t*	*p*	R^2	Adj. R^2	*F*
Single predictor: cooperation							.16	.15	25.30
	Cooperation enforcement	0.53	0.11	0.40	5.03	< .001			
	Intercept	0.35	0.16		2.23	.027			
Single predictor: deterrence							.11	.11	17.24
	Deterrence	0.56	0.14	0.34	4.15	< .001			
	Intercept	0.40	0.16		2.54	.012			
Single predictor: norms							.11	.11	17.32
	Norm appropriateness	-0.37	0.09	-0.34	-4.16	< .001			
	Intercept	0.07	0.19		0.35	.727			
Combined model							.24	.22	13.88
	Cooperation enforcement	0.30	0.12	0.23	2.58	.011			
	Deterrence	0.36	0.14	0.21	2.57	.011			
	Norm appropriateness	-0.25	0.09	-0.23	-2.79	.006			
	Intercept	0.02	0.18		0.11	.915			

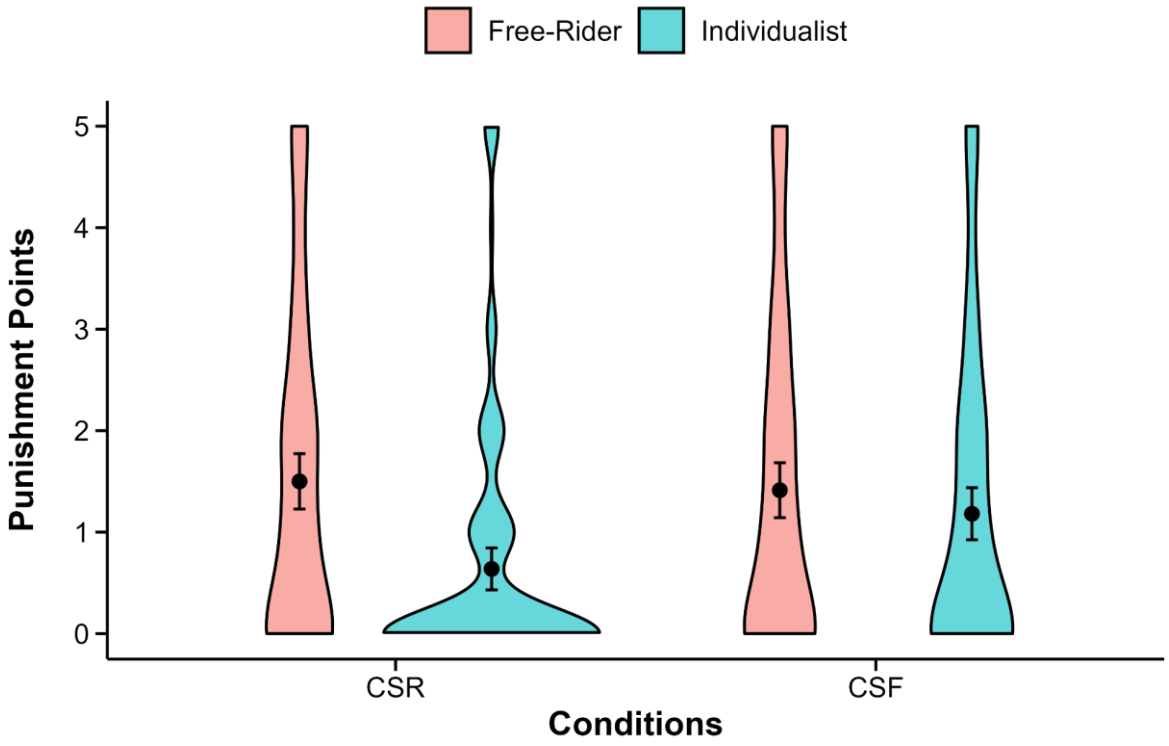
Note. Variance inflation factors (VIFs), not shown in the table indicated no multicollinearity: Cooperation Enforcement = 1.36; Deterrence = 1.20; Norm Appropriateness = 1.15.

Disadvantageous Inequity Aversion

To test H4a and H4b, which predict that punishment of free-riders and individualists varies depending on whether the group succeeds or fails in reaching the collective solution, a 2 (player type: free-rider vs. individualist) × 2 (condition: CSR vs. CSF) repeated measures ANOVA was performed. The analysis revealed significant main effects for player type, $F(1, 137) = 11.17$, $p = .001$, $\eta^2_p = .08$, and condition, $F(1, 137) = 9.70$, $p = .002$, $\eta^2_p = .07$. A significant interaction between player type and condition also emerged, $F(1, 137) = 9.78$, $p = .002$, $\eta^2_p = .07$ (see Appendix, Table A5 for the full ANOVA summary). As shown in Figure 4, in the CSR condition, free-riders were punished more ($M = 1.50$, $SD = 1.64$) than individualists ($M = 0.64$, $SD = 1.24$). In the CSF condition, free-riders again received more punishment points ($M = 1.41$, $SD = 1.62$) than individualists ($M = 1.18$, $SD = 1.53$).

Figure 4

Punishment of Free-Riders and Individualists in CSR and CSF Conditions



Note. Participants could assign up to 5 punishment points per condition. Error bars represent 95% CIs.

Post hoc analyses revealed that this difference was significant in the CSR condition (M_{DIFF} = 0.86, SE = 0.18, p < .001), but not in the CSF condition (M_{DIFF} = 0.23, SE = 0.20, p = 1.000). Additionally, individualists were punished significantly more in the CSF condition than in the CSR condition (M_{DIFF} = -0.54, SE = 0.12, p < .001), while punishment levels for free-riders remained consistent across conditions (M_{DIFF} = 0.09, SE = 0.13, p = 1.000). Bonferroni-corrected comparisons also indicated that, overall, free-riders were punished significantly more than individualists (M_{DIFF} = 0.55, SE = 0.16, p = .001).

Exploratory Analyses

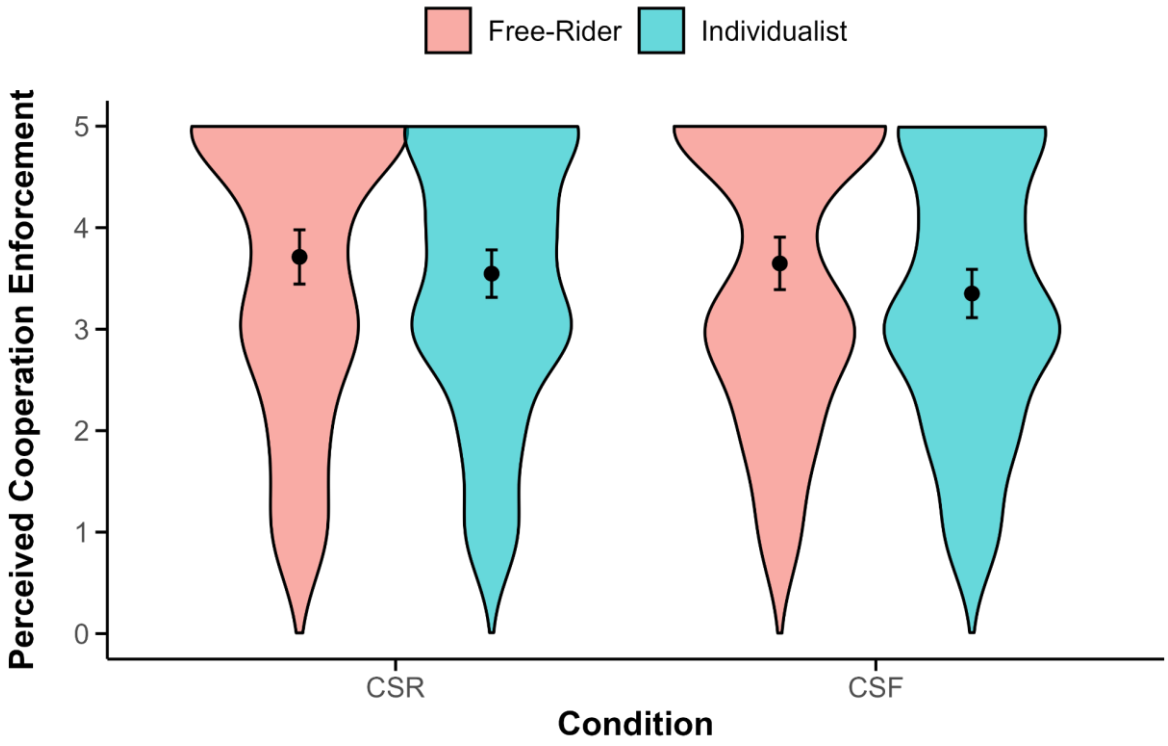
Cooperation Enforcement

To explore the perceived effectiveness of cooperation-enforcing punishment across player types and conditions, an exploratory 2 (player type: free-rider vs. individualist) × 2 (condition: CSR vs. CSF) repeated measures ANOVA was performed. The analysis revealed a significant main effect of player type, $F(1, 137) = 9.44$, $p = .003$, $\eta^2_p = .06$, but no significant main effect of condition, $F(1, 137) = 0.57$, $p = .450$, $\eta^2_p < .01$. The interaction between player type and condition was also non-significant, $F(1, 137) = 0.13$, $p = .723$, $\eta^2_p < .01$ (see Table A6).

As illustrated in Figure 5, in the CSR condition, participants rated cooperation-enforcing punishment as more effective for free-riders ($M = 4.31$, $SD = 1.61$) than for individualists ($M = 3.97$, $SD = 1.57$). A similar pattern emerged in the CSF condition, with higher ratings for free-riders ($M = 4.28$, $SD = 1.64$) compared to individualists ($M = 3.86$, $SD = 1.64$).

Figure 5

Perceived Effectiveness of Cooperation-Enforcing Punishment in CSR and CSF Conditions



Note. Participants rated their agreement on a 7-point Likert scale. Higher values represent higher perceived effectiveness of cooperation-enforcing punishment. Error bars represent 95% CIs.

Post hoc analyses indicated that the differences between free-riders and individualists were not statistically significant within either the CSR condition (M_{DIFF} = 0.34, SE = 0.16, p = .218) or the CSF condition (M_{DIFF} = 0.41, SE = 0.16, p = .059). However, Bonferroni-corrected comparisons showed that, in general across both conditions, participants perceived cooperation-enforcing punishment to be significantly more effective for free-riders than for individualists (M_{DIFF} = 0.38, SE = 0.12, p = .003).

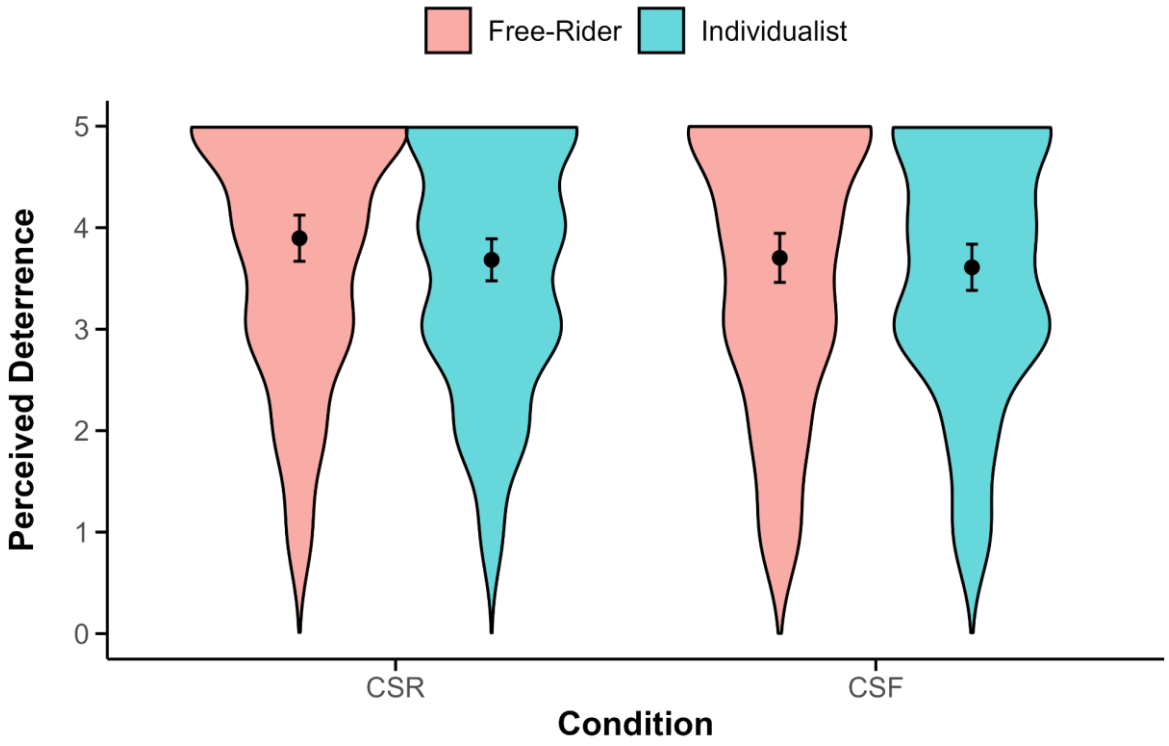
Deterrence

To assess the perceived effectiveness of deterrence punishment across player types and conditions, an exploratory 2 (player type: free-rider vs. individualist) × 2 (condition: CSR vs. CSF) repeated measures ANOVA was conducted. The analysis revealed a significant main effect of player type, $F(1, 137) = 6.91$, $p = .010$, $\eta^2_p = .05$, but no significant main effect of condition, $F(1, 137) = 0.12$, $p = .733$, $\eta^2_p < .01$. A significant interaction between player type and condition was also found, $F(1, 137) = 6.17$, $p = .014$, $\eta^2_p = .04$ (see Table A7).

As illustrated in Figure 6, in the CSR condition, deterrence punishment was rated as more effective for free-riders ($M = 4.44$, $SD = 1.45$) than for individualists ($M = 3.96$, $SD = 1.37$). This trend persisted in the CSF condition, with free-riders rated slightly higher ($M = 4.19$, $SD = 1.54$) than individualists ($M = 4.14$, $SD = 1.54$).

Figure 6

Perceived Effectiveness of Deterrence Punishment in CSR and CSF Conditions



Note. Participants rated their agreement on a 7-point Likert scale. Error bars represent 95% CIs.

Post hoc comparisons indicated a significant difference between player types in the CSR condition (M_{DIFF} = 0.47, SE = 0.13, p = .002), but not in the CSF condition (M_{DIFF} = 0.04, SE = 0.13, p = 1.000). Bonferroni-corrected comparisons further showed that, overall, participants rated deterrence punishment as significantly more effective for free-riders than for individualists (M_{DIFF} = 0.26, SE = 0.10, p = .010).

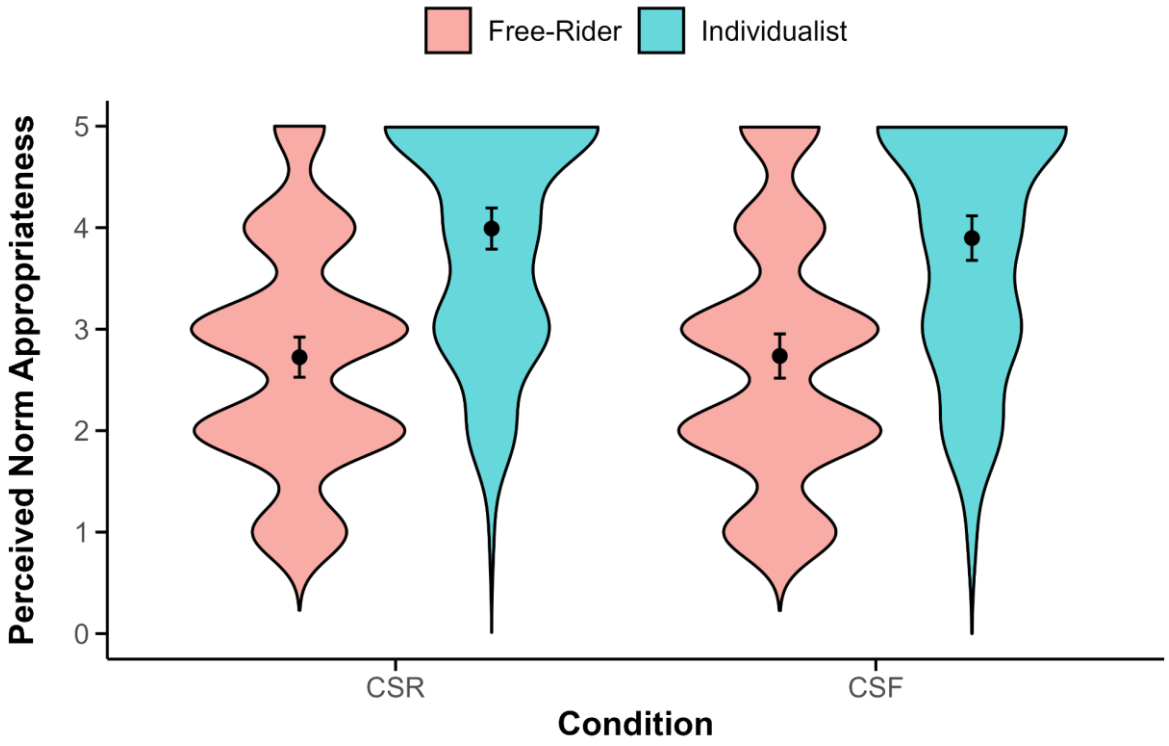
Norm Appropriateness

To explore how participants perceived norm appropriateness of free-riders and individualists across both conditions, an exploratory 2 (player type: free-rider vs. individualist) × 2 (condition: CSR vs. CSF) repeated measures ANOVA was performed. The analysis revealed a significant main effect of player type, $F(1, 137) = 75.99$, $p < .001$, $\eta^2_p = .36$, but no significant main effect of condition, $F(1, 137) = 0.01$, $p = .919$, $\eta^2_p < .01$. The interaction between player type and condition was also not significant, $F(1, 137) = 0.62$, $p = .434$, $\eta^2_p < .01$ (see Table A8).

As illustrated in Figure 7, across both conditions, participants rated norm appropriateness higher for individualists than for free-riders. In the CSR condition, individualists received higher ratings ($M = 4.44$, $SD = 1.36$) than free-riders ($M = 3.12$, $SD = 1.55$); in the CSF condition, this pattern persisted ($M = 4.41$, $SD = 1.41$ vs. $M = 3.16$, $SD = 1.62$).

Figure 7

Perceived Norm Appropriateness in CSR and CSF Conditions



Note. Participants rated their agreement on a 7-point Likert scale. Error bars represent 95% CIs.

Post hoc analyses confirmed significant differences between player types in both CSR (M_{DIFF} = -1.33, SE = 0.15, $p < .001$) and CSF conditions (M_{DIFF} = -1.25, SE = 0.16, $p < .001$). Bonferroni-corrected comparisons further indicated that participants overall rated norm appropriateness significantly higher for individualists than for free-riders (M_{DIFF} = 1.29, SE = 0.15, $p < .001$).

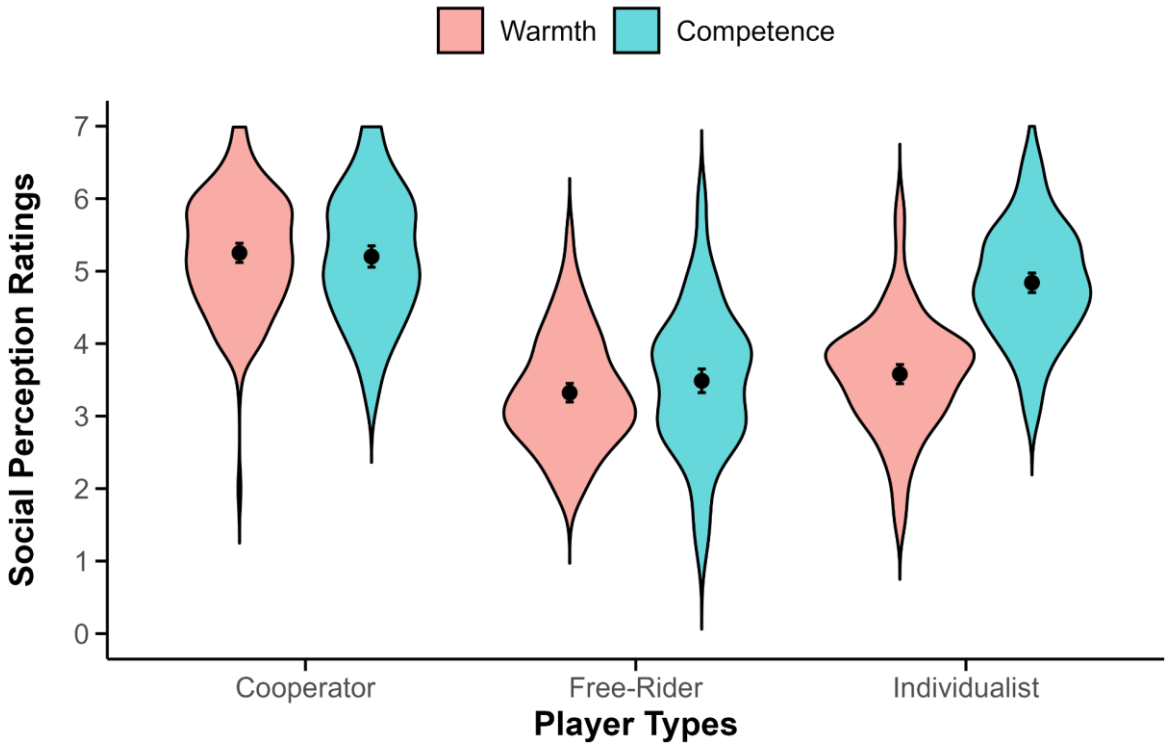
Warmth and Competence

To explore how participants evaluated the different player types (cooperator, free-rider, individualist) across the two dimensions of warmth and competence, a 2 × 3 repeated measures ANOVA was conducted. The analysis revealed significant main effects of dimension, $F(1, 137) = 106.93$, $p < .001$, $\eta^2_p = .44$, and player type, $F(2, 274) = 240.59$, $p < .001$, $\eta^2_p = .64$. In JASP, Mauchly's test indicated a violation of the sphericity assumption ($W = 0.85$, $p < .001$). A significant interaction between dimension and player type also emerged, $F(2, 274) = 64.72$, $p < .001$, $\eta^2_p = .32$ (see Table A9). When the analysis was reconstructed in R, the Greenhouse–Geisser correction was applied automatically, although R does not explicitly display the correction step in the output. The results reported here are therefore based on the corrected values.

As illustrated in Figure 8**,** cooperators received the highest ratings for both warmth ($M = 5.25$, $SD = 0.80$) and competence ($M = 5.20$, $SD = 0.88$). Individualists followed, rated at $M = 3.58$ ($SD = 0.79$) for warmth and $M = 4.84$ ($SD = 0.80$) for competence. Free-riders received the lowest scores across both dimensions, $M = 3.32$ ($SD = 0.77$) for warmth and $M = 3.49$ ($SD = 0.98$) for competence.

Figure 8

Perceived Warmth and Competence of Player Types



Note. Participants rated their agreement on a 7-point Likert scale. Error bars represent 95% CIs.

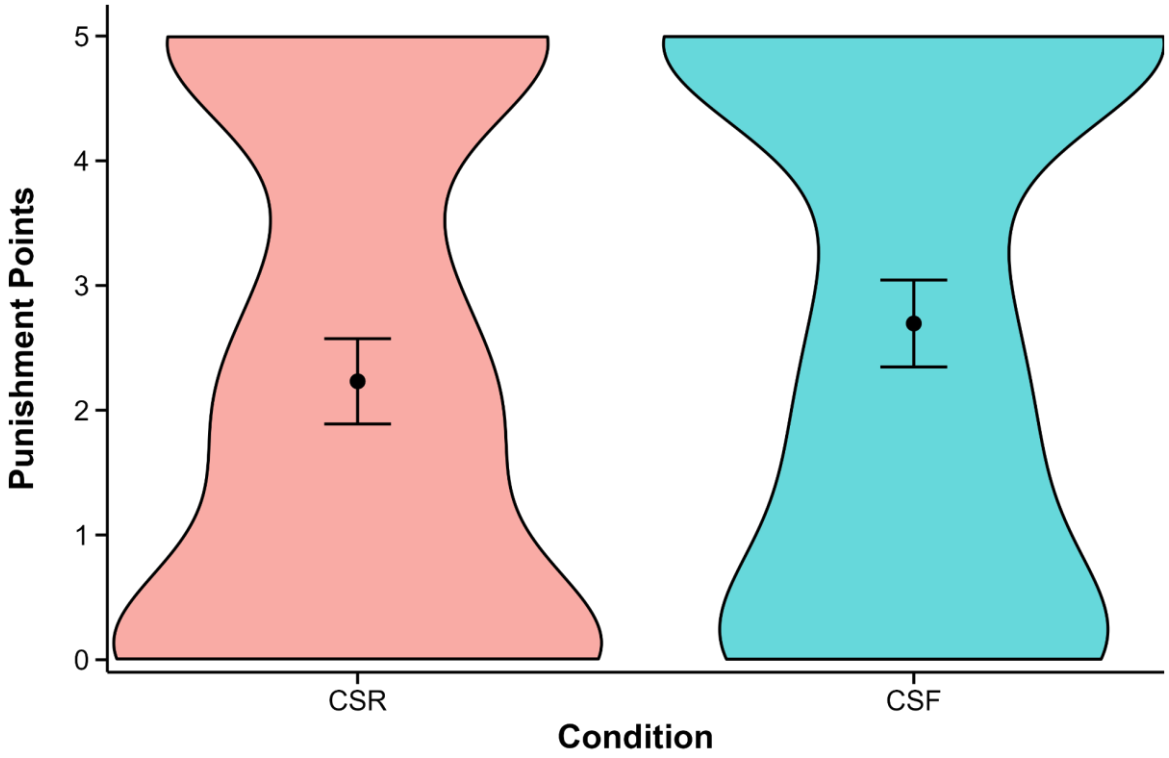
Post hoc comparisons indicated that cooperators were rated significantly higher than both free-riders and individualists on both dimensions. Specifically, cooperators received higher warmth ratings than free-riders (M_{DIFF} = 1.93, p < .001) and individualists (M_{DIFF} = 1.67, p < .001), as well as higher competence ratings than free-riders (M_{DIFF} = 1.76, p < .001) and individualists (M_{DIFF} = 1.62, p < .001). Further post hoc within-player-type comparisons revealed a significant difference between warmth and competence ratings for individualists, with competence being rated higher than warmth (M_{DIFF} = 1.26, SE = 0.09, p < .001). In contrast, no such significant differences were observed for cooperators (M_{DIFF} = -0.05, SE = 0.07, p = 1.000) or free-riders (M_{DIFF} = 0.17, SE = 0.09, p = .973).

Administration of Punishment

A paired-samples t-test (see Figure 9) comparing punishment points assigned in the CSR and CSF conditions revealed a significant difference, $t(137) = -3.12$, $p = .002$, $d = -0.27$, with participants assigning more punishment in the CSF condition ($M = 2.70$, $SD = 2.09$) than in the CSR condition ($M = 2.23$, $SD = 2.05$).

Figure 9

Total Punishment per Condition



Note. Participants could assign up to 5 punishment points per condition. Error bars represent 95% CIs. Punishment points are aggregated across all player types per condition.

Further descriptive analyses showed that, in the CSR condition, 34.1% of participants ($n = 47$)—the largest group—assigned no punishment points, while 28.3% ($n = 39$), the second-largest group, assigned the maximum of 5 punishment points (see Figure A1). The remaining

participants assigned 1 point (9.4%, n = 13), 2 points (15.9%, *n* = 22), 3 points (8.7%, *n* = 12), or 4 points (3.6%, *n* = 5).

In contrast, in the CSF condition, the most common response was to assign 5 punishment points (37.7%, *n* = 52), while 25.4% (*n* = 35) assigned no punishment points (see Figure A2). The remaining participants assigned 1 point (11.6%, *n* = 16), 2 points (11.6%, *n* = 16), 3 points (8.7%, *n* = 12), or 4 points (5.1%, *n* = 7).

Discussion

Confirmatory Results

The present study investigates the reasons for punishment in a private-public goods game. The investigation and application of theoretically established motives for punishment, drawn from the scientific literature and linked to actual punishment assigned to co-players, enabled the study of how these motives translate into behavior. Consequently, individuals' considerations for the administration of punishment—such as cooperation enforcement, deterrence, norm appropriateness, and disadvantageous inequity aversion—were deduced and empirically explored. The present findings now allow for a closer examination of how each of these motives is reflected in punishment behavior, which is discussed in the following subsections.

Cooperation-Enforcing Punishment

The present results indicate that the extent to which participants regarded punishment as an effective means of promoting cooperation among free-riders (as compared to individualists) was positively associated with the amount of punishment administered to free-riders. This effect was of moderate strength, suggesting that cooperation motives played a meaningful role in shaping punishment decisions. This finding therefore supports H1 by showing that differences in the cooperation-enforcing motive translated directly into differential punishment behavior across player types.

More importantly, punishment was not uniformly guided by a general cooperation-enforcing motive, but instead appeared to depend on which type of defector participants believed to work for. Therefore, participants who considered punishment particularly effective in addressing free-riding were more inclined to punish free-riders (relative to individualists). Conversely, participants who indicated a higher effectiveness of cooperation-enforcing punishment for individualists administered more punishment to the latter.

The results for cooperation-enforcing punishment therefore indicate that participants successfully managed to distinguish between different types of defectors and adjusted their punitive responses based on their perceptions of where punishment would yield the greatest benefit for future cooperation.

Deterrence Punishment

The current findings indicate that differences in the perceived effectiveness of deterrence punishment predict corresponding differences in punishment behavior across defecting player types. This effect was of moderate magnitude, underscoring that deterrence considerations substantially shaped participants' punishment choices. Specifically, the more participants believed that punishment would successfully deter future free-riding, the more they punished free-riders relative to individualists. Conversely, when participants rated punishment of individualists as more effective in deterring others from becoming individualists in the future, they assigned more punishment to individualists.

Therefore, the findings not only support H2, but also suggest that punishment was not applied uniformly across defecting player types. Instead, it was adjusted based on perceived effectiveness and directed to where it was expected to be most impactful in deterring future defection. This is in line with an instrumental view of punitive behavior, as participants selectively targeted the player type for whom they believed deterrence would be most crucial for maintaining future cooperation. Thus, as with cooperation-enforcing punishment, the results emphasize participants' ability to distinguish between different types of defectors and underscore that deterrence-based punishment is sensitive to the social context.

Norm-Enforcing Punishment

The present results demonstrate that differences in perceived norm appropriateness were systematically related to punishment behavior across player types. The effect was of moderate size, highlighting that judgments about social acceptability independently influenced

punishment behavior. Consistent with H3, participants directed punishment toward the player type whose behavior they regarded as less socially appropriate. In line with this, punishment levels shifted depending on whether free-riding or individualism was judged to be more acceptable.

Specifically, the more participants perceived free-riding as socially acceptable relative to individualism (positive scores on norm appropriateness), the more punishment was shifted toward individualists, as reflected in the negative regression coefficient. Conversely, when individualism was seen as more normatively appropriate than free-riding, participants punished free-riders more harshly (relative to individualists).

The results thus indicate that punishment was not driven by a uniformly applied norm, but rather was selectively directed at the player type whose behavior was perceived as less socially appropriate. This further underscores participants' ability to distinguish between different types of defectors and separately evaluate their behavior when deciding on punishment. Importantly, perceived norm appropriateness remained a significant negative predictor of punishment even when controlling for deterrence and cooperation-enforcement motives, suggesting that norm-related motives play an independent role in guiding punishment.

Disadvantageous Inequity Aversion

The current findings provide partial support for the disadvantageous inequity aversion account of punishment. As predicted by H4a, individualists were punished more harshly when the group collectively failed to reach the collective solution compared to when it succeeded. This effect was small-to-moderate in size, suggesting that inequity aversion played a noticeable role in guiding punishment. Moreover, it indicates that punishment of individualists was sensitive to outcome-related inequity, as participants reacted to disadvantageous outcomes by directing more punishment at those who could retain their endowments while others lost theirs.

However, the results failed to support H4b, which posits more punishment for free-riders if the group reaches the collective solution compared to when it fails. Interestingly, the results indicated similar levels for free-riding individuals regardless of the context. Hence, it did not matter to participants whether they kept or lost their endowments, even though free-riders were relatively better off in the CSR condition.

This implies that in contrast to individualists, free-riders are perceived as norm-violators irrespective of the relative payoff. Consequently, disadvantageous inequity aversion plays a role in punishment decisions, but primarily when target behavior lies in a gray area of contribution (i.e., individualism), rather than in clear violations such as free-riding.

Exploratory Results

Cooperation Enforcement

The exploratory results show that participants generally perceived cooperation-enforcing punishment as more effective when it addresses free-riding rather than individualism. Furthermore, this perception appears to be present regardless of context (i.e., whether the group reaches the collective solution or fails to do so). The strength of this effect was modest.

A potential explanation for this pattern is that free-riders may be regarded as less motivated than individualists and thus as more susceptible to peer punishment. Individualists, in contrast, already display a high degree of commitment by choosing the individual strategy and actively contributing toward the individual solution. Consequently, because individualists may be seen as more determined in reaching their goal, free-riders may be regarded as more promising candidates who could be swayed into joining the cooperators in a hypothetical future round.

Deterrence

Further exploratory results reveal that perceived effectiveness of deterrence punishment varies across conditions. In the CSR condition, participants rated deterrence as distinctly more

effective for free-riders than for individualists, whereas in the CSF condition it was perceived as equally effective for both player types. This effect was relatively small, pointing to a more context-dependent role in participants' evaluations.

Theoretically, if a group reaches the collective solution, the behavioral gap between cooperators and free-riders is at its widest. Hence, perceiving deterrence as particularly effective for free-riders in the CSR context appears logical and aligns with the idea that free-riding might become especially attractive in a subsequent round due to its recent success. Conversely, when the group fails to reach the collective solution, outcome-related differences should arguably be largest between individualists and the remaining player types. However, the lack of heightened deterrence perception for individualists in the CSF condition suggests that, despite their prior success, an individualistic playstyle is not seen as especially threatening to future cooperation.

Norm Appropriateness

Results regarding norm appropriateness vary across player types, but not across conditions. Individualism is consistently considered more socially appropriate than free-riding regardless of context. Participants' evaluations of non-cooperative playstyles did not change noticeably across CSR and CSF conditions; free-riding was rated similarly inappropriate in both conditions, and the same applied to individualism. The effect was large, showing a strong and consistent differentiation between free-riding and individualism in terms of perceived appropriateness. Thus, in the present private-public goods game, perceived norm appropriateness of both non-cooperative behaviors appears to be largely independent of the outcome context.

A possible explanation for the difference between free-riding and individualism may lie in the perceived willingness to contribute: although individualists behave egoistically, they display a greater degree of agency and willingness to work toward a solution than free-riders.

Warmth and Competence

Results for the exploratory warmth and competence measures further underscore participants' differentiation between player types, as indicated by distinct combinations of warmth and competence. Cooperators were perceived as highest on both dimensions and showed roughly equal values for warmth and competence. Individualists were rated relatively high on competence (although lower than cooperators), but markedly lower on warmth, reflecting a compensation pattern in line with the "high competence, low warmth" stereotype described by Kervyn et al. (2010). Free-riders, in contrast, received the lowest scores on both warmth and competence. The effects were large to very large, reflecting a clear and robust differentiation between player types on warmth and competence.

This general pattern is not surprising given that participants took the perspective of cooperators in the main task. Moreover, the favorable perceptions of cooperators coincide with participants' self-reported preference for a cooperative strategy at the beginning of the study. Interestingly, while both non-cooperative strategies (individualism and free-riding) received relatively low warmth ratings, they appeared to differ in competence, with individualists viewed as more competent than free-riders, potentially reflecting differences in agency and commitment implied by their respective playstyles.

Administration of Punishment

Current results concerning the overall distribution of punishment points reveal an interesting imbalance, both across and within contexts. When the group failed to reach the collective solution (CSF), participants administered more peer punishment compared to when the group succeeded (CSR). This difference may reflect stronger negative emotional reactions, such as frustration or anger, toward non-cooperating players who are held responsible for the failed outcome. Accordingly, peer punishment may represent a measurable behavioral expression of these emotional responses.

Despite the contextual increase in punishment, the distribution pattern was similar across both conditions and characterized by a largely bimodal tendency. In both contexts, most participants either assigned no punishment at all or the maximum number of points. However, omission of punishment was the most frequent response in the CSR condition, followed by maximum punishment. In contrast, in the CSF condition, maximum punishment was most common, followed by complete omission.

Strengths and Limitations

A key strength of the present research lies in its novel examination of punishment motives from the perspective of cooperators within a private-public goods game. By combining a preregistered experimental design with several theoretically derived punishment motives, the study provides an integrative approach to understanding why cooperators sanction non-cooperators. Furthermore, the use of a controlled game structure allows for systematic comparisons between distinct player types. Nonetheless, several limitations should be considered when interpreting the findings.

First, embedding an economic game in a survey format sacrifices immersion and realism, as participants neither engaged in live interactions nor played with real monetary stakes. Punishment and evaluation decisions were therefore hypothetical, which may limit ecological validity.

Second, the one-shot design precluded observation of how punishment motives might evolve over repeated rounds of interaction, cooperation, and reputation formation.

Third, although the study was preregistered, deviations from the preregistered analysis plan (i.e., replacing the ANOVAs with regression models) weaken the confirmatory strength of the results because regression models generally require larger sample sizes to achieve comparable levels of power. This implies that the study may have been underpowered for some of the main analyses (H1–H3), thereby limiting the strength of the confirmatory claims.

Fourth, the reliance on self-developed items introduces uncertainty regarding the psychometric validity of the measures used to capture motives such as cooperation and norm enforcement.

Fifth, the study focused exclusively on the perspective of cooperators. This may limit the generalizability of the results as some participants—who would usually prefer an individualistic or free-riding strategy—may have assigned less punishment to defecting player types, despite their objective failings, due to sympathy.

Sixth, the sample was partly convenience-based and showed a high attrition rate of approximately half the participants. Therefore, it is possible that even those who completed the study encountered difficulties due to its complexity, which may have further limited the validity of the findings. In addition, the lack of performance-based incentives may have affected how seriously participants engaged in the punishment decisions.

Seventh, norm enforcement was assessed via general judgements of free-riding and individualism, rather than direct evaluations of the corresponding player types. While these behaviors correspond to the strategies embodied by the player types in the experiment, future research could measure norm judgments directly for the specific player types themselves.

As more minor considerations, the sample consisted exclusively of German-speaking participants, which may limit cultural generalizability. Furthermore, participants might have adjusted their punishment decisions according to the perceived expectations of the researchers, thus introducing a potential social desirability bias that could have influenced participants' responses.

Conclusions and Outlook

The present study demonstrated that cooperation enforcement, deterrence, and norm appropriateness are systematically associated with punishment behavior in a private-public goods game. Disadvantageous inequity aversion also plays a role, although only partially and

depending on outcome context. Importantly, punishment decisions were not indiscriminate, but varied as a function of how effective punishment was perceived to be and how normatively acceptable non-cooperative behaviors were judged. By uncovering higher levels of punishment in contexts where the group failed to reach the collective solution, the present findings also point toward a potential role of negative emotions as drivers of peer punishment. Furthermore, the pattern that participants distinguished clearly between free-riders and individualists raises the question of the extent punishment is guided by social perceptions (e.g., warmth and competence), but also by people's willingness to attribute agency and responsibility.

Future research should therefore focus on the emotional underpinnings of punishment behavior, particularly on the experience of negative emotions. Moreover, social judgments of player types and individuals' preferred strategies appear to be important variables in private-public goods contexts and should be incorporated into future experimental designs. Expanding this research to multi-round, incentivized game settings and using more diverse samples would further strengthen the ecological validity and generalizability of the present insights.

Artificial Intelligence and Open Science Statement

The author of this thesis declares the use of artificial intelligence tools. Specifically, ChatGPT (GPT 5 and GPT-4o) was used for translating content between German and English, restructuring, rephrasing, proofreading, and repolishing. R-codes were generated with the ChatGPT Data Analyst. Additionally, Scribbr was used for reference generation.

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Appendix

Table A1

Age Distribution

Variable	*n*	*M*	*SD*	*SE*	Min	Max
Age	138	31.8	10.2	0.87	18	71

Note. M = mean; *SD* = standard deviation; *SE* = standard error; Min = minimum age; Max = maximum age.

A2

Table A2

Gender Distribution

Category	*n*	Percent
Male	65	47.1%
Female	73	52.9%

Note. Percentages are based on the total sample ($N = 138$).

Table A3

Educational Attainment

Category	*n*	Percent
No degree	2	1.4%
Basic school leaving certificate	2	1.4%
Apprenticeship	10	7.2%
Technical/vocational school without diploma	8	5.8%
Higher school with diploma	25	18.1%
University or college degree	91	65.9%

Note. Percentages are based on the total sample ($N = 138$).

Table A4

Participants' Contribution Preference

Category	*n*	Percent
Individualism	27	19.6%
Cooperation	101	73.2%
Free-riding	10	7.2%

Note. Percentages are based on the total sample ($N = 138$).

Table A5

ANOVA Results for Punishment Administered (Disadvantageous Inequity Aversion, H4)

Effect	F (1, 137)	p	η^2_p	Post hoc tests
Player type	11.17	.001	.08	Free-riders > Individualists (Overall: M_{DIFF} = 0.55, p = .001)
Condition	9.70	.002	.07	Individualists (CSF) > Individualists (CSR) (M_{DIFF} = 0.54, p < .001)
Player type * condition	9.78	.002	.07	Free-riders > Individualists (CSR: M_{DIFF} = 0.86, p = .001)

Note. Post hoc comparisons are Bonferroni-adjusted. "Overall" indicates effects collapsed across CSR and CSF conditions.

Table A6

ANOVA Results for Cooperation Enforcement (Exploratory Analysis)

Effect	F (1, 137)	p	η^2_p	Post hoc tests
Player type	9.44	.003	.06	Free-riders > Individualists (Overall: M_{DIFF} = 0.38, p = .003)
Condition	0.57	.450	< .01	
Player type * condition	0.13	.723	< .01	

Note. Post hoc comparisons are Bonferroni-adjusted. "Overall" indicates effects collapsed across CSR and CSF conditions.

Table A7

ANOVA Results for Deterrence (Exploratory Analysis)

Effect	F (1, 137)	p	η^2_p	Post hoc tests
Player type	6.91	.010	.05	Free-riders > Individualists (Overall: M_{DIFF} = 0.26, p = .010)
Condition	0.12	.733	< .01	
Player type * condition	6.17	.014	.04	Free-riders > Individualists (CSR: M_{DIFF} = 0.47, p = .002)

Note. Post hoc comparisons are Bonferroni-adjusted. "Overall" indicates effects collapsed across CSR and CSF conditions.

Table A8

ANOVA Results for Norm Appropriateness (Exploratory Analysis)

Effect	F (1, 137)	p	η^2_p	Post hoc tests
Player type	75.99	< .001	.36	Individualists > Free-riders (Overall: M_{DIFF} = 1.29, p < .001) (CSR: M_{DIFF} = 1.33, p < .001) (CSF: M_{DIFF} = 1.25, p < .001)
Condition	0.01	.919	< .01	
Player type * condition	0.62	.434	< .01	

Note. Post hoc comparisons are Bonferroni-adjusted. "Overall" indicates effects collapsed across CSR and CSF conditions.

Table A9

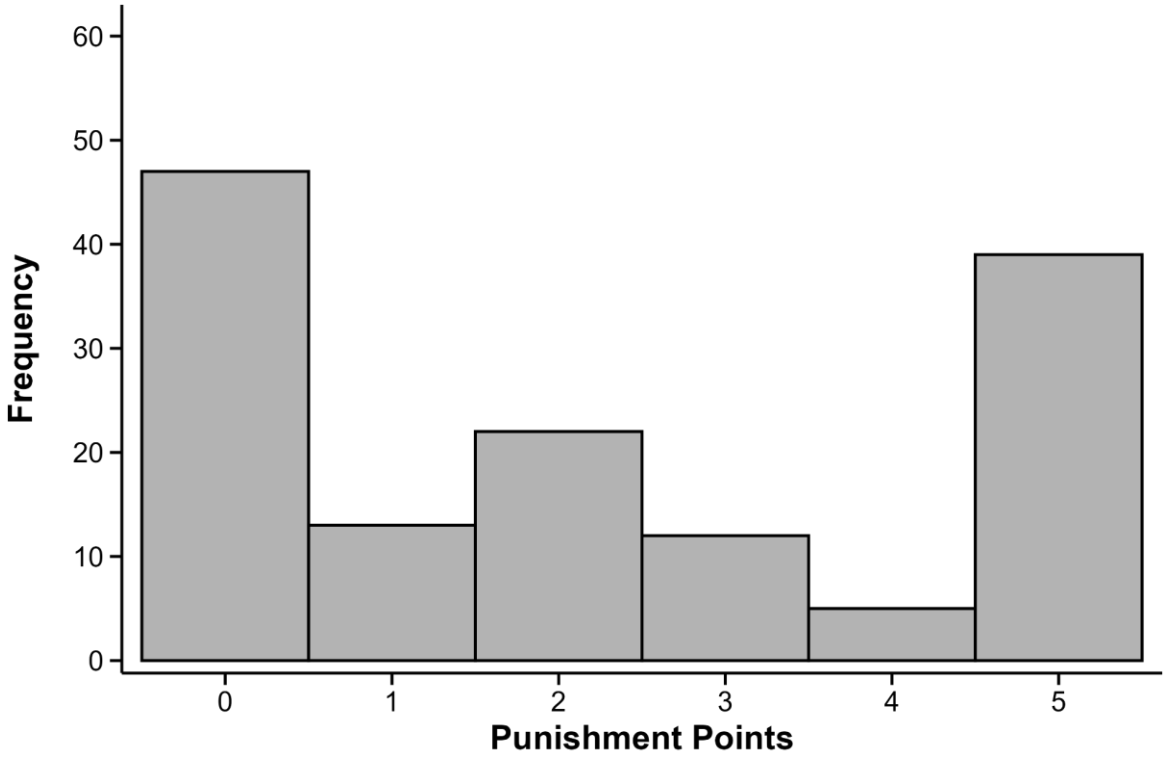
ANOVA Results for Warmth and Competence (Exploratory Analysis)

Effect	F	p	η^2_p	Post hoc tests
Dimension	$F(1, 137) = 106.93$	< .001	.44	
Player type	$F(1, 274) = 240.59$	< .001	.64	Cooperators > Free-riders (Warmth: $M_{DIFF} = 193$, $p < .001$) (Competence: $M_{DIFF} = 1.71$, $p < .001$) Cooperators < Individualists (Warmth: $M_{DIFF} = 1.67$, $p < .001$) (Competence: $M_{DIFF} = 0.36$, $p = .003$)
Dimension * player type	$F(1, 274) = 64.72$	< .001	.32	Individualists (Competence) > Individualists (Warmth) ($M_{DIFF} = 1.26$, $p < .001$)

Note. Post hoc comparisons are Bonferroni-adjusted.

Figure A1

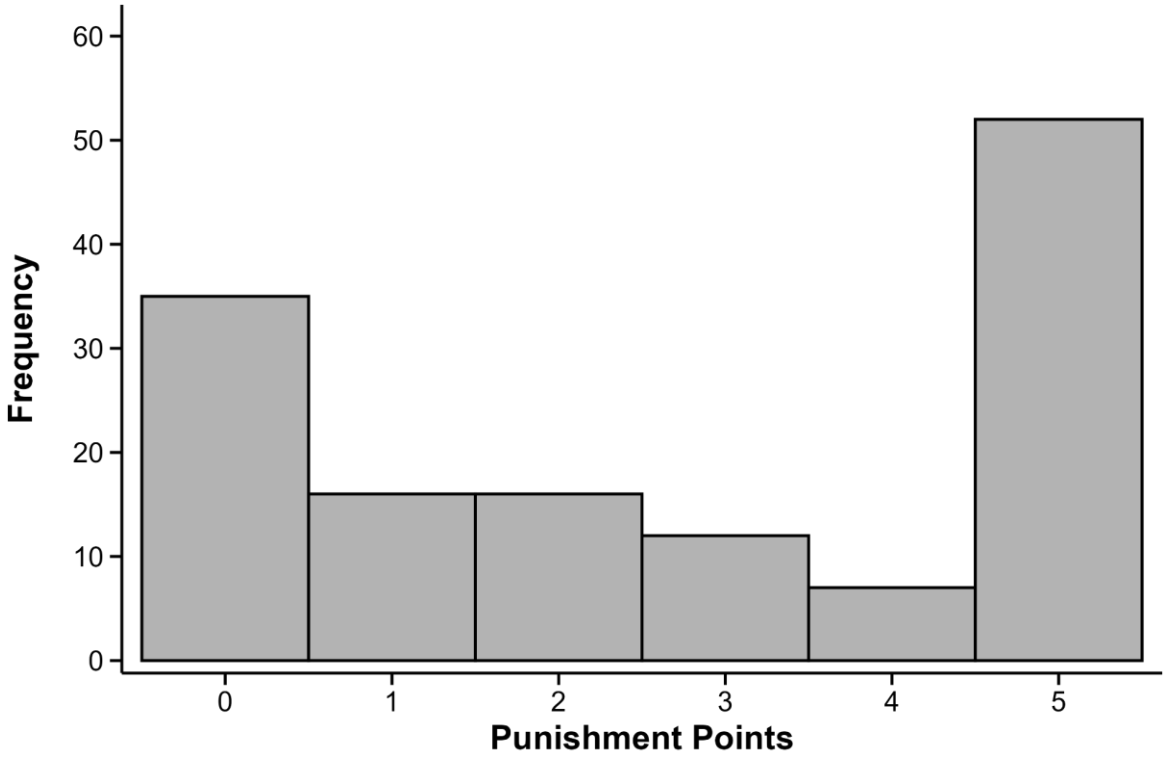
Distribution of Total Punishment in the CSR Condition



Note. Participants could assign up to 5 punishment points. The figure displays the frequency distribution of punishment points in the CSR condition.

Figure A2

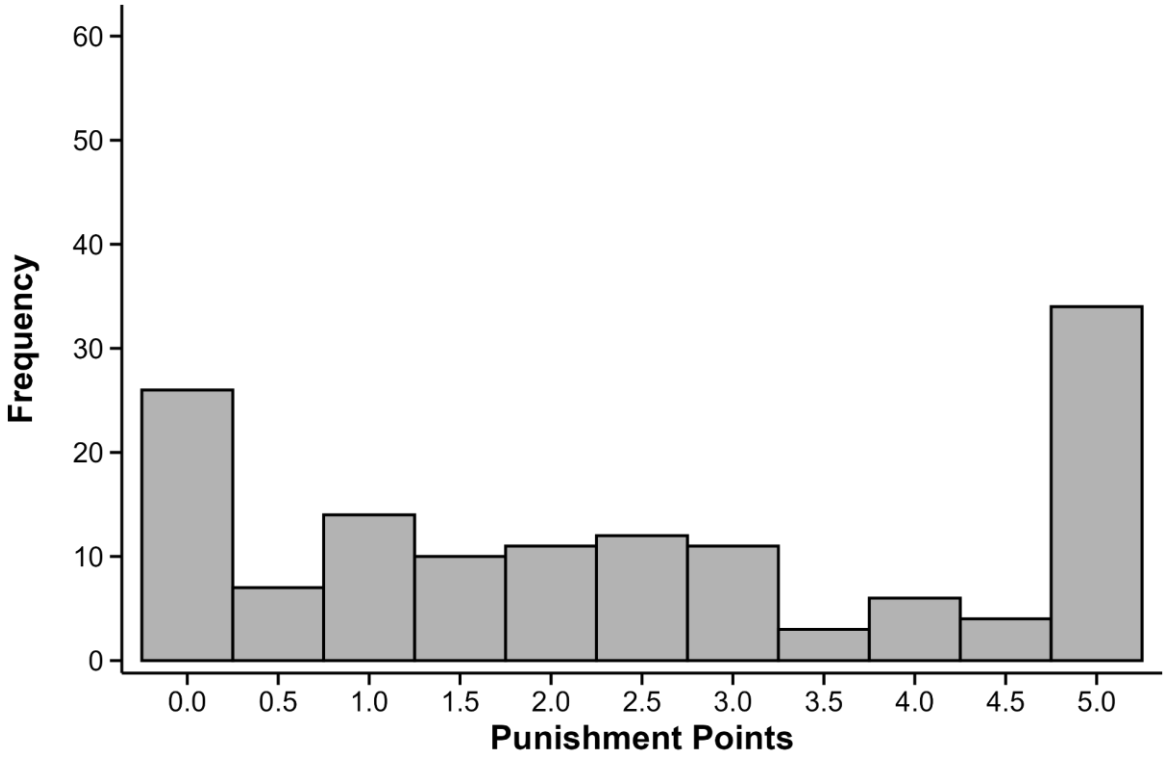
Distribution of Total Punishment in the CSF Condition



Note. Participants could assign up to 5 punishment points. The figure displays the frequency distribution of punishment points in the CSF condition.

Figure A3

Distribution of Total Punishment Across CSR and CSF Conditions



Note. Participants could assign up to 5 punishment points per condition. The figure shows the frequency distribution of aggregated punishment points assigned across CSR and CSF conditions.