Similarity increases altruistic punishment in humans

Thomas Mussweiler[a,1,2] and Axel Ockenfels[b,1]

[a]Department of Psychology, University of Cologne, 50923 Cologne, Germany; and [b]Department of Economics, University of Cologne, 50923 Cologne, Germany

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Humans are attracted to similar others. As a consequence, social networks are homogeneous in sociodemographic, intrapersonal, and other characteristics—a principle called homophily. Despite abundant evidence showing the importance of interpersonal similarity and homophily for human relationships, their behavioral correlates and cognitive foundations are poorly understood. Here, we show that perceived similarity substantially increases altruistic punishment, a key mechanism underlying human cooperation. We induced (dis)similarity perception by manipulating basic cognitive mechanisms in an economic cooperation game that included a punishment phase. We found that similarity-focused participants were more willing to punish others' uncooperative behavior. This influence of similarity is not explained by group identity, which has the opposite effect on altruistic punishment. Our findings demonstrate that pure similarity promotes reciprocity in ways known to encourage cooperation. At the same time, the increased willingness to punish norm violations among similarity-focused participants provides a rationale for why similar people are more likely to build stable social relationships. Finally, our findings show that altruistic punishment is differentially involved in encouraging cooperation under pure similarity vs. in-group conditions.

Not only birds of a feather flock together. Groups and social networks of humans are homogeneous with regard to many sociodemographic, intrapersonal, and other characteristics. Indeed, interpersonal similarity is a powerful descriptive principle in both the formation and the maintenance of social relationships (1, 2). Consequently, the networks that structure much of human social life, including friendship, marriage, work, information transfer, and economic exchange, tend to be homophilous in terms of ethnicity, age, education, etc. (3). Humans are primarily surrounded by similar others.

Here, we show that perceived similarity promotes altruistic punishment—a fundamental constituent of human cooperation (4, 5). Humans entertain elaborate systems of cooperation that transcend genetic relatedness, geographic proximity, and temporal immediacy. Altruistic punishment is essential for the development and maintenance of such cooperative behavior, particularly if cooperation cannot be justified in terms of kinship, reciprocal exchange, or self-interest (4, 6–10). We demonstrate that humans are more willing to altruistically punish uncooperative behavior of others perceived to be similar rather than others perceived to be dissimilar.

In line with our general proposition, it has been demonstrated that specific instances of similarity shape social behavior. For instance, across different species, social behavior is qualitatively different depending on whether it is directed toward genetically similar vs. dissimilar others (11–13). Many nonhuman primates are more likely to groom, form alliances, and share food with genetically similar others. Research on how similarity influences human cooperation has focused on the effects of sociostructural factors, particularly group identity (14, 15). Humans are more likely to allocate resources to, reward the positive behavior of, and coordinate their actions with in-group members than with out-group members (16–20).

Our study goes beyond this previous work and examines the fundamental cognitive underpinnings of human cooperation by asking whether pure similarity—perceived similarity that is not based on group identity—promotes altruistic behavior. In particular, we examine how altruistic punishment is affected by distinct cognitive mechanisms of human information processing that highlight self–other similarity vs. dissimilarity. Our approach is partly derived from social cognition research demonstrating that how people behave toward others critically depends on how they cognitively process information about them (21–23). The influence of cognitive mechanisms on human cooperation and reciprocity has been largely ignored. However, social cognition research suggests that the extent to which people reciprocate others' behaviors depends on how information about these others is processed. More specifically, we hypothesize that cognitively processing information in ways that highlight self–other similarity increases altruistic punishment—whereas group identity does not necessarily do so.

The starting point for our reasoning is research demonstrating that the experience of anger about another's norm violation is an important determinant of altruistic punishment (4). Because anger is particularly evoked by intentional violations of shared norms (24, 25), punishment is more likely the more confident the punisher is that the wrongdoer shares his or her normative expectations and is aware of the norm violation. A potential punisher thus must first infer the wrongdoer's normative expectations. As is typically true for inferences about covert characteristics of others (26), doing so involves social projection: To infer the wrongdoer's normative expectations, perceivers start from their own normative expectations. Such inferences involve different mechanisms and yield diverging results for others who are perceived to be similar to vs. dissimilar from the self (27, 28). People more readily project their own perspectives onto others they perceive to be similar to themselves (29) and are thus more likely to presume shared normative expectations with similar than dissimilar others. Social inferences about similar others are

Significance

Cooperation is a defining characteristic of human social behavior. More than any other species, humans entertain elaborate systems of cooperation that transcend genetic relatedness, geographic proximity, and temporal immediacy. Recent evidence has demonstrated that altruistic punishment is a key behavioral mechanism in the evolution of human cooperation. We show that interpersonal similarity increases reciprocal altruistic punishment. Importantly, this influence of similarity is not explained by group identity, which has the opposite effect on altruistic punishment. These findings illustrate how similarity and altruistic punishment are closely intertwined in encouraging human cooperation. Moreover, because perceived similarity triggers an altruistic response, our result provides a rationale for why similar people are more likely to build stable relationships and groups.

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[1]T.M. and A.O. contributed equally to this work.

[2]To whom correspondence should be addressed. E-mail: thomas.mussweiler@uni-koeln.de.

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also made more easily and with more confidence (30). As a consequence, people are more willing to altruistically punish norm violations of others they perceive to be similar vs. dissimilar to the self.

Differential patterns of social projection are also in place for transactions with in-group vs. out-group members. Shared group membership, however, activates a host of additional motivational and cognitive mechanisms (15–17). In particular, people care more about the outcomes of in-group than out-group members; e.g., they allocate more resources to them (16) and experience stronger emotional reactions to their plight (31). These additional mechanisms create a tendency to be more lenient toward in-group than out-group members. In fact, it has been shown that people often are more forgiving about in-group norm violations (17, 20). This suggests that the tendency to punish norm violations of similar others more strongly than those of dissimilar others may be mitigated or even reversed in analogous transactions with in-group vs. out-group members.

Providing controlled experimental support for these hypotheses has at least three important implications for the study of human cooperation. First, it shows that altruistic punishment in humans is a function of pure perceived similarity, which, in turn, can be cognitively manipulated by inducing distinct information-processing mechanisms. Second, that perceived similarity triggers an increased willingness to punish norm violations provides a rationale for why similar people are more likely to build stable relationships. Third, that group identity and pure similarity promote different patterns of altruistic punishment suggests that altruistic punishment is differentially involved in the development of cooperation under similarity vs. in-group conditions.

In two experiments, we manipulated pure similarity, as perceived by our participants, and group identity in a standard economic cooperation game that includes a phase of punishment (4). To unobtrusively manipulate perceived similarity, before engaging in the game, participants worked on a task (32) in which they compared two pictures (materials are available in *SI Appendix, Material Experiment 1*). In doing so, about one-half of the participants were asked to list all of the similarities between the two pictures they could find. The remaining participants were asked to list all of the differences they could find. Extensively focusing on similarities vs. differences during the picture comparison induces a generalized focus on either similarities or differences that carries over to subsequent tasks. This manipulation has been shown to influence perceived self–other similarity in subsequent interactions: Participants who focused on similarities (differences) in the picture comparison task subsequently judged themselves as more similar to (different from) a given other (33). In our experiments, participants who focused on ways in which the pictures were similar (different) would thus subsequently focus on ways in which they and their partner in the cooperation game are similar (different). This procedure affords a content-free manipulation of self-other similarity—one that (*i*) manipulates perceived similarity independent of group identity, and (*ii*) does not involve differences in incentives stemming from information exchange and reduced social distance.

Group identity was manipulated by matching participants with another participant either from their own town or from a neighboring town. Participants were informed about the matching procedure (materials are available in *SI Appendix, Material Experiment 2*).

The game played by all participants in both experiments had two phases. In phase 1, the cooperation phase, participants each received an initial endowment of €6 and were informed that they could simultaneously transfer any portion of this amount to their coplayer. Any euro sent was doubled. In phase 2, the punishment phase, participants were endowed with an additional €3, which they could either keep for themselves or invest to reduce their opponent's payoff by €0 to €6. Every reduction of €1 in the coplayer's payoff reduced the participant's own payoff by €0.50. We elicited punishment conditionally on each potential cooperation level (€0 to €6). The actual, payoff-relevant punishment was then selected according to the other's actual cooperation level (materials are available in *SI Appendix, Material Experiment 1 and Material Experiment 2*).

To examine whether pure similarity and group identity influence altruistic punishment in different ways, we conducted two experiments. Both experiments realized comparable experimental settings in which each participant engaged in a single-shot interaction with a nonkin, randomly determined, anonymous other. Also, both experiments were run in large introductory business and economics lectures. Anonymity was maintained by leaving participants uninformed about who specifically their coplayer was and by paying participants without requiring any identification.

The interaction involved real monetary stakes and precluded any potential benefits of punishing, such as reputation gains or higher future payoffs. Thus, the amount of money participants invested to reduce the payoff of their coplayer is a valid indicator of altruistic punishment.

Study 1: Pure Similarity

In study 1, participants first completed the similarity manipulation task that, depending on experimental condition, induced a content-free focus on either similarities or differences, and then played the cooperation game. Our reasoning holds that similarity-focused players should show more altruistic punishment than dissimilarity-focused players.

Results: Study 1

Our results (Fig. 1) are in line with this hypothesis. Similarity-focused participants reciprocated smaller amounts received in the cooperation phase with higher punishments in the second phase. The responsiveness to the opponent's level of cooperation, as measured by the difference μ between average reciprocal punishment when the opponent did not cooperate vs. when the

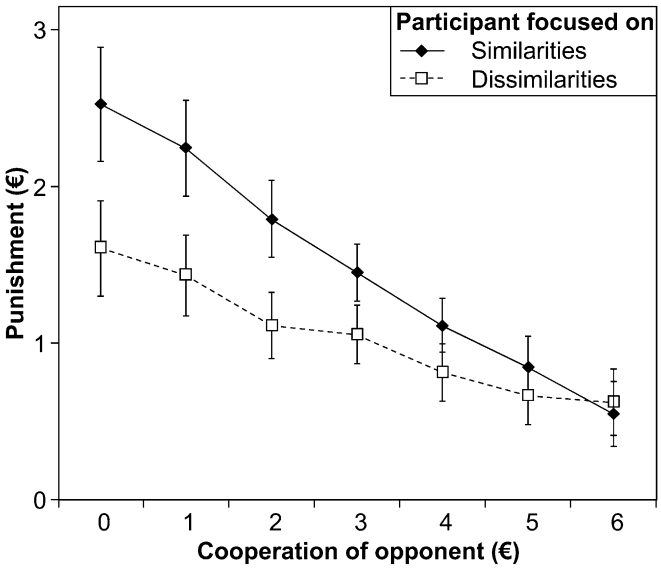

Fig. 1. Average punishment (in euros) in a two-person cooperation game (n = 106) as a function of opponent's level of cooperation (x axis). The solid line depicts average conditional punishment by participants who were experimentally induced to focus on similarities with their opponent. The dotted line depicts average conditional punishment by participants who were experimentally induced to focus on dissimilarities with their opponent. Similarity-focused participants were more reciprocal in their punishing behavior. Error bars represent ±1 SEM.

opponent fully cooperated (μ = €0.98 for dissimilarity focus, μ = €1.98 for similarity focus), approximately doubled with the similarity focus. A random-effects tobit model with punishment in phase 2 as the dependent variable yields $P < 0.001$ ($n = 106$) for the negative coefficient on "other's cooperation level (phase 1)" and $P = 0.017$ ($n = 106$) for its negative interaction effect with similarity focus (see complete model in Table 1).

Much evidence on reciprocity and altruistic punishment suggests that punishment depends not only on the other's cooperation level but also on how this cooperation level compares to the punisher's own level (4, 9, 34–36). This is also the case in study 1. Our tobit analysis shows that punishment depends on how the participants' cooperation levels compare with each other: A given opponent's level of cooperation is more severely punished if the punisher himself or herself cooperated more [the coefficient on "punisher's cooperation level (phase 1)" is significant at $P = 0.002$ ($n = 106$)]. However, the increased reciprocity from a similarity focus is driven by an increased responsiveness to the other's cooperation; in fact, the influence of the punisher's own cooperation level diminishes nonsignificantly with a similarity focus ($P = 0.109$, $n = 106$; see complete model in Table 1). This suggests that similarity-focused participants, when punishing the opponent, tend to shift their focus away from guarding against exploitation toward a norm that values group welfare.

Study 2: Group Identity

In study 2, participants were first informed that the study was administered to two groups, one at the University of Cologne, the other at the University of Düsseldorf. Depending on conditions, participants were paired with a randomly drawn participant from their own group or from the other group. Our reasoning holds that participants' tendency to be more reciprocal in their punishing behavior when interacting with a similar other demonstrated in study 1 is mitigated when interacting with an in-group member.

Results: Study 2

Our results (Fig. 2) indicate that this tendency is even reversed: Participants playing with an in-group member showed less altruistic punishment by reciprocating less cooperation in the cooperation phase with lower punishments in the second phase. The responsiveness to the opponent's level of cooperation is almost cut in half for the in-group treatment (μ = €0.87 for in-group, μ = €1.67 for out-group)—just the opposite effect that we see for the similarity focus. A random-effects tobit model with punishment in phase 2 as the dependent variable yields $P < 0.001$ ($n = 166$) for the negative coefficient on "other's cooperation level (phase 1)" and $P < 0.001$ ($n = 166$) for its positive interaction effect with in-group focus (see complete model in Table 2).

In line with the results of study 1, our tobit analysis for study 2 again shows that punishment also depends on how the other's cooperation level compares to the punisher's level: A given other's level of cooperation is more severely punished if the punisher cooperated more [the coefficient on "punisher's cooperation level (phase 1)" is significant at $P < 0.001$ ($n = 166$)].

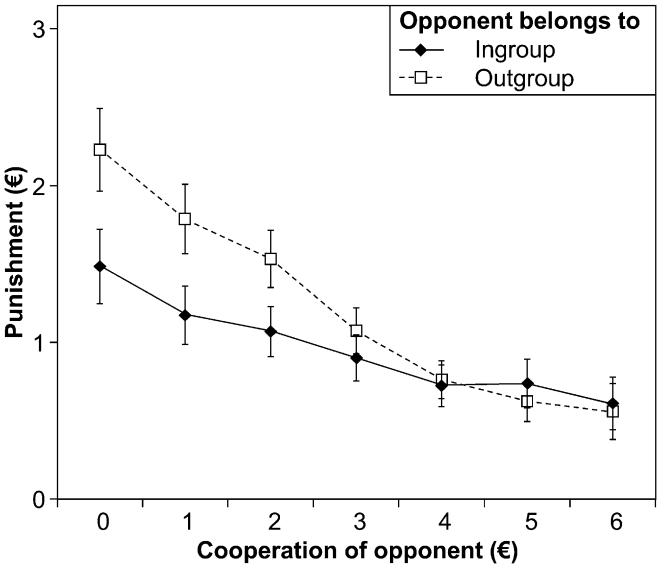

Fig. 2. Average punishment (in euros) in a two-person cooperation game ($n = 166$) as a function of opponent's level of cooperation (x axis). The solid line depicts average conditional punishment by participants who interacted with an opponent from their own group. The dotted line depicts average conditional punishment by participants who interacted with an opponent from the other group. Participants interacting with an in-group opponent were less reciprocal in their punishing behavior. Error bars represent ±1 SEM.

Table 1. Determinants of conditional punishments to be paid by opponent in phase 2 of study 1

Determinants of punishment	Coefficients	SEM
Similarity focus	3.308**	1.464
Other's cooperation level (phase 1)	−0.464***	0.076
Similarity focus × other's cooperation	−0.249**	0.104
Punisher's cooperation level (phase 1)	0.860***	0.281
Similarity focus × punisher's cooperation	−0.593	0.370
Constant	−2.483**	1.043
No. of observations (groups)	742 (106)	
Log likelihood	−927.371	

We report results from a random-effects tobit model, which takes into account the heterogeneity of punishers via random effects and that punishments cannot be below €0 or above €6. The model confirms that participants respond more strongly to the opponent's cooperation level when focused on similarity. *$P < 0.1$, **$P < 0.05$, ***$P < 0.01$.

Table 2. Determinants of conditional punishments to be paid by opponent in phase 2 of study 2

Determinants of punishment	Coefficients	SEM
In-group status	0.666	1.205
Other's cooperation level (phase 1)	−0.724***	0.064
In-group status × other's cooperation	0.288***	0.088
Punisher's cooperation level (phase 1)	0.724***	0.214
In-group status × punisher's cooperation	−0.586**	0.293
Constant	−1.426	0.912
No. of observations (groups)	1,162 (166)	
Log likelihood	−1,350.728	

We report results from a random-effects tobit model, which takes into account the heterogeneity of punishers via random effects and that punishments cannot be below €0 or above €6. The model confirms that participants respond more strongly to the opponent's cooperation level when interacting with an out-group member. *$P < 0.1$, **$P < 0.05$, ***$P < 0.01$.

Also, as with the similarity focus, the increase in the responsiveness of altruistic punishment that we observe as a result of in-group status is driven by a change in the responsiveness to the other's cooperation level; here, the influence of the punisher's own cooperation level diminishes significantly [$P < 0.046$ ($n = 166$); see complete model in Table 2].

It is interesting to note that, although in both studies punishment patterns differ significantly between treatments, average cooperation levels in the first phase of our studies do not [3.74 vs. 3.04 for similarity- vs. dissimilarity-focus, $P = 0.064$ (two-sided Kruskal–Wallis test), $n = 106$, and 3.34 vs. 3.48 for in- vs. out-group status, $P = 0.603$ (two-sided Kruskal–Wallis test), $n = 166$]. We speculate that this may be the case because it takes time and experience for punishment of norm violations to transform into efficient cooperation as previous research has demonstrated (e.g., refs. 4, 37, and 38). However, because the goal of our study is to investigate the determinants of punishment—rather than how punishment translates into more cooperation—we opted for a paradigm in which participants are not given the opportunity to gain experience with the (differential) use of the punishment option.

Discussion

The present research demonstrates that pure similarity, as perceived by the participants, and group identity influence altruistic punishment in opposite ways. Participants who were cognitively induced to focus on similarities showed more altruistic punishment than those induced to focus on dissimilarities. More specifically, similarity-focused participants more strongly reciprocated low cooperation levels with costly punishment than dissimilarity-focused participants. In marked contrast, group identity induced the opposite tendency so that participants interacting with a member of their in-group showed less altruistic punishment than those interacting with a member of an out-group.

These findings demonstrate that altruistic punishment is shaped in opposite ways by pure similarity and group identity. We suggest that these effects are driven by differential patterns of social projection. People are more likely to project their own normative expectations onto others they perceive to be similar rather than dissimilar to the self (28). As a consequence, because low levels of cooperation are more likely to evoke anger if they are seen as violations of shared norms, the mechanism that drives altruistic punishment (4) is more likely to be in place for interactions with similar than dissimilar others. For interactions with in-group vs. out-group members, this pattern of social projection is superimposed by a stronger tendency to be more lenient toward in-group than out-group members (16, 19). As a consequence, participants punish low levels of cooperation less for in-group than for out-group members.

Our findings have several implications for the study of reciprocity and cooperation in humans. For one, they demonstrate how similarity and altruistic punishment are closely intertwined. This suggests that altruistic punishment may be an elementary behavioral glue that not only encourages cooperation among similar people, but also brings and keeps similar people together (3). Second, the fact that in-group identity did not foster altruistic punishment, but rather diminished it, suggests that group identity relies on a different set of mechanisms other than pure similarity to encourage cooperation—including stronger concerns for other group members' outcomes stemming possibly from reduced perceived social distance and increased perceived interdependence.

Furthermore, the present studies highlight the potential benefits similarity may hold for interpersonal relations more generally. Previous research has demonstrated that self–other similarity can foster mental and behavioral activities that are beneficial for interpersonal relations. Specifically, focusing on self–other similarity can induce humans to coordinate more efficiently with others (39), help them more (40, 41), and stereotype them less (29, 42). In line with these findings, the present research demonstrates that perceived similarity also fosters one of the core constituents of human cooperation: Similarity-focused participants are more reciprocal in punishing low cooperation levels. Notably, such increased reciprocity under similarity conditions is not limited to altruistic punishment but also extends to altruistic rewarding. In a separate experiment (results and materials and methods are available in *SI Appendix, Supplementary Study: Similarity Increases Altruistic Rewarding*), we demonstrated that similarity-focused trustees in a two-person sequential trust game (basically a sequential prisoners' dilemma game) sent back lower amounts when receiving small transfers and, in particular, higher amounts when receiving large transfers compared with dissimilarity-focused trustees. This suggests that similarity also increases altruistic rewards. Together, altruistic punishments and rewards constitute a case of strong reciprocity that often provides the foundation for the development and maintenance of human cooperation (7, 43). Similarity can thus hold substantial benefits for human cooperation in particular and for interpersonal relations in general.

We suggest that a complete understanding of these multiple effects of similarity is facilitated by an analysis of its proximate cognitive mechanisms. As we propose for its effects on altruistic punishment, differential patterns of social projection also contribute to other interpersonal benefits of similarity. For example, it has been suggested that similarity reduces stereotyping because it induces humans to see more of themselves in a potentially stereotyped other (29, 42). Importantly, an analysis at this level of human cognition also highlights conditions under which similarity vs. dissimilarity have beneficial effects for interpersonal relations. Specifically, because projecting one's own perspectives, attitudes, and norms onto the other gives more reason to punish deviating and to reward conforming behavior, similarity tends to facilitate the enforcement and coordination of cooperative behavior. Dissimilarity, however, tends to reduce the perception of a common understanding of perspectives, attitudes, and norms, and thus diminishes the scope for mutual coordination and cooperation. We caution, however, that similarity does not per se promote a norm of cooperation. In fact, a perception of similarity may even reduce cooperation if one's own inclination is to defect and this is (wrongly) projected onto others, who are thus (wrongly) expected to not punish selfish behavior. It is also conceivable that perceived similarity may lead one to overimpute one's own perspective onto the other, thereby strengthening an egocentric bias (44). This might eventually lead to disappointed expectations, which can hamper the beneficial effect of similarity. We suspect that, overall, the positive effects of perceived similarity prevail. One reason is that the homophily principle ensures that we surround ourselves with similar others. As a result, the self typically constitutes a good source of information about our interaction partners. This diminishes potentially harming effects of inaccurate beliefs.

This analysis at the level of human cognition also suggests that typically the effects of pure similarity will go hand in hand with those of group identity (e.g., ref. 44). Just as we tend to project our own perspectives onto similar others, we are also more likely to project them onto members of our own group. In addition to these higher levels of social projection, group identity as a particularly strong case of similarity, however, entails a multitude of additional motivational, affective, and cognitive mechanisms (15–17) that may at times superimpose the effects of social projection. We show that altruistic punishment constitutes one example in which this is the case.

The present findings demonstrate that the extent to which humans engage in altruistic punishment is influenced by a purely cognitive mechanism—similarity focus—which can vary independently of economic, social, and biological factors. Behavioral economics research to date has paid little attention to the cognitive

mechanisms that underlie human behavior (for a recent exception, see ref. 45). Social cognition research, however, has repeatedly demonstrated that how humans think, feel, and act critically depends on what cognitive mechanisms they use to process incoming and retrieved social information. The present research provides one example for how varying a pure cognitive mechanism—namely whether participants focus on similarities or differences—influences consequential human behavior in a standard paradigm of behavioral economics. This shows that taking a closer look at cognitive mechanisms can offer a novel and complementary perspective on the determinants of human cooperation. In fact, paying closer attention to the role of cognitive mechanisms of information processing may help to develop a more complete understanding of human economic behavior more generally.

Materials and Methods

Study 1. We recruited 106 participants in an introductory economics lecture at the University of Cologne. Participants received a folder and a sealed envelope and were asked to complete materials in the folder before opening the envelope.

The folder included general instructions and the similarity focus induction task. Participants learned that they would work on two separate tasks with different requirements and were asked to closely follow instructions and not to communicate with other participants. Instructions further explained that the first task was printed on the reverse side of the instruction sheet and that the second task was in the envelope. For the similarity focus induction task (33), participants received one page with two prints, one above the other, of scenes depicting 19th century town squares and were asked to list on the lines provided all of the similarities (differences) between the two scenes they could find.

The envelope contained the instructions for the cooperation game, which is a standard vehicle to study human cooperation (4). Instructions explained that participants would be randomly paired with an anonymous other in the lecture hall. Participants were asked to read instructions carefully and only to proceed with the decisions once they had understood the game. It was further emphasized that all decisions and payoffs were confidential. Instructions presented all rules verbally and also provided the respective equations used to determine participants' payoffs (π). For the cooperation game this was: π = (€6 – amount sent to opponent + 2 × amount received from opponent) + (€3 – punishment from opponent – cost of punishment of opponent).

Participants confidentially and anonymously received the respective payoffs shortly after the study. There was no signature or any other form of identification required for collecting earnings.

Study 2. We recruited 166 participants in introductory business and economics lectures at the University of Cologne and the University of Düsseldorf. As in study 1, participants received a folder and a sealed envelope and were asked to complete materials in the folder before opening the envelope.

The folder included general instructions and the group assignment task. The front page of the instruction sheet provided the same general information as in study 1. The group assignment task was printed on the reverse side of the sheet. Here, participants learned that the study was administered to two separate groups on the same day: one group participating in the context of an economics lecture at the University of Cologne, another group participating in the context of an economics lecture at the University of Düsseldorf. Participants were asked to indicate whether they belonged to the Cologne or the Düsseldorf group and then proceeded with the respective envelope.

The envelope contained the instructions for the cooperation game, which is a standard vehicle to study human cooperation (4). Instructions explained, depending on condition, that participants would be randomly paired with an anonymous other in the same lecture hall (in-group condition) or in a lecture hall at the other university (out-group condition). As in study 1, participants were asked to read instructions carefully and only to proceed with the decisions once they had understood the game. It was further emphasized that all decisions and payoffs were confidential. Instructions presented all rules verbally and also provided the respective equations used to determine participants' payoffs (π), which was identical to the one provided in study 1.

Again, participants confidentially and anonymously received the respective payoffs shortly after the study. There was no signature or any other form of identification required for collecting earnings.

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