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Bringing together "old" and "new" ways of solving social dilemmas? The case of Spanish *Gitanos*

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Abstract

Humans often punish non-cooperators in one-shot interactions among genetically-unrelated individuals. So-called altruistic punishment poses an evolutionary puzzle because it enforces a cooperation norm that benefits the whole group, but is costly for the punisher. Under the "big mistake" (or "mismatch") hypothesis, social behavior such as punishment evolved by individual selection at a time when repeated interactions with kin prevailed. It then misfired in modern humans, who "mistakenly" apply it in sporadic interactions with unrelated individuals. In contrast, cultural group selection theories emphasize cultural differences in normative behavior and the role of intergroup competition and punishment for the emergence of large-scale cooperation in the absence of genetic relatedness. We conducted a series of multilateral-cooperation economic experiments with a sample of Spanish Romani people (*Gitanos*), who represent a unique cultural group to test the predictions of the two accounts: *Gitano* communities rely heavily on close kin-based networks, maintain high consanguinity rates and display a particularly strong sense of ethnic identity. A total of 320 *Gitano* and non-*Gitano* (i.e., the majority Spanish population) participants played a one-shot public goods game with punishment in either ethnically *homogeneous* or ethnically *mixed* (half *Gitano* and half non-*Gitano*) four-person groups. In the homogeneous groups, punishment was commonly used by non-*Gitanos* but virtually inexistent among *Gitanos*. In the mixed groups, however, *Gitanos* who did not cooperate were severely punished by other *Gitanos*, but also by non-*Gitanos* (particularly males in both cases). The results are more consistent with cultural group selection and also qualify some of its predictions.

Keywords: cooperation, punishment, Gypsy/Roma, ethnicity, culture, evolution

Significance statement

Punishment of free-riders plays a key role in sustaining human cooperation. Two leading theoretical accounts yield different predictions about who, and under what circumstances, should punish more. "Big-mistake" models suggest that "old" forms of social organization (based on kinship and closeness) should favor punishment, whereas cultural group selection theories suggest that punishment is favored in "modern" scenarios in response to competition between ethnocultural groups. Cooperation experiments with Spanish *Gitanos*, whose social life relies heavily on kinship and closeness, and non-*Gitanos*, who interact more with non-relatives and on a larger scale, reveal that the presence of outgroups dramatically impacts punishment behavior. *Gitanos* punish less and only punish *Gitano* free-riders when there are non-*Gitanos* in the group. These results challenge "big-mistake" models.

Introduction

Humans possess an extraordinary capacity for large-scale cooperation and this stands as a theoretical puzzle across the biological and behavioral sciences. Mechanisms such as kin selection, and direct and indirect reciprocity have been proposed as explanations for the evolution of cooperation in relatively small populations (1-4). To explain prosocial behavior in large modern societies, however, kinship or reciprocity mechanisms seem to be insufficient because cooperation is observed in ephemeral encounters among unrelated individuals; for instance, in voting, driving, paying taxes, recycling, market interactions and warfare (5, 6). Decentralized (peer) punishment of free-riders has been shown to be a crucial element for understanding the emergence of cooperation beyond kinship and small-scale groups (6-10). So-called altruistic punishment is a kind of costly norm enforcement which cannot be explained by reputation or other traditional forms of reciprocity. Punishment is considered altruistic (in the biological sense) when the absolute benefits triggered by the enforcement of the cooperative norm are received by individuals other than the punisher (11).

Even if groups in which peer punishment is allowed can outcompete those in which it is not due to the discouragement of free-riding (12, 13; but see 14), altruistic punishers are condemned to a lower evolutionary success within their group (15, 16). It turns out that the provision of a sanctioning system to prevent free-riding can be considered as a second-order social dilemma where individual and collective interests are in conflict (11, 17). Nevertheless, altruistic punishment is frequently observed in controlled experiments with unrelated human subjects, even in one-shot anonymous interactions (11, 18-20). In fact, the neurobiological evidence suggests that people suffer disutility from observing uncooperative behaviors (21-23) and derive pleasure from punishing wrongdoers (23-25), which facilitates punishment decisions, even if they are costly. Yet the evolutionary basis of punishment behavior and its psychological underpinnings is subject to debate. Why do people pay irrecoverable costs to punish others?

The “big mistake” (or “mismatch”) hypothesis (26-34) holds that the psychological mechanisms underlying group-beneficial behaviors, such as altruistic punishment, evolved in a period of human history in which nearly all social interactions were repeated and took place among close relatives. Thus, “traditional” reciprocity and/or kin selection mechanisms would lie behind the evolution of punishment, which emerged because under those circumstances punishing others benefits the individual’s (direct or indirect) inclusive fitness, for instance, by reducing future exploitation by others. Such pan-human social psychology, so the argument goes, misfires in the behavior of modern humans, who “mistakenly” use altruistic punishment even in one-shot interactions with unrelated individuals (i.e., where it is no longer adaptive or fitness enhancing). It is argued therefore that human social psychology is not programmed to differentiate between acquaintances and strangers, at least beyond the desire to cultivate and maintain individually profitable, coalitional social-exchange relationships. Different ecologies or environmental cues, however, would lead to different expressions of the common evolved psychology and thus create behavioral variation.

On the other hand, following *cultural group selection* theories (6, 8-10, 35-43), those proximate mechanisms (i.e., the negative emotions associated to the observation of uncooperative acts and the positive emotions associated to their punishment) may be particularly suited for solving the second-order dilemma of punishment—and hence the first-order dilemma of cooperation—in modern large-scale societies where one-shot interactions with non-relatives are common. Altruistic punishment would thus have been shaped following a complex process in which genes and culture co-evolve, with cultural adaptation being much more rapid than genetic adaptation. Under this account, different cultural groups develop the human "norm-psychology" (43) differently in the race for survival against other cultural groups. In particular, specific social behaviors which are advantageous for the group during intergroup competition are transmitted across individuals through social learning mechanisms (i.e., payoff- or frequency-biased imitation) and enforced through sanctions. Behavioral variation would not be the result of current ecology alone, as implied by the "mismatch" hypothesis, but of its interaction with cultural history as well. Therefore, it is likely that some cultural groups use decentralized punishment of free-riding extensively, while others are more lenient or most probably use it to enforce different norms. Intergroup encounters and associated group identity cues, to the extent that they elicit differential behavioral patterns, play a fundamental role in the predictions of cultural group selection models. Not in vain, the selection of prosocial behaviors by cultural evolution hinges upon their ability to benefit the cultural group in the process of intergroup competition. Thus, under this account, human social psychology is essentially programmed to differentiate between acquaintances and strangers and, more specifically, between ingroup and outgroup individuals, as this distinction is key to the success of one's own cultural group.

To test the predictive power of these two accounts of altruistic punishment, we conducted a series of lab-in-the-field economic experiments with a unique sample of Spanish Romani people (*Gitanos*, also referred to as *Calé*). Romani groups represent the largest ethnocultural minority in Europe.[*] *Gitanos* constitute a paradigmatic case study for the purposes of this paper because: (i) kinship is at the core of their social life and organization even if they live a "modern" life, which in many other aspects resembles that of their non-*Gitano* neighbors (i.e., the majority Spanish population). Indeed, consanguinity rates within *Gitano* communities in the geographic area of the study are among the highest ever reported in Europe, at the upper bound of the range observed in traditional small-scale societies of hunter-gatherers and horticulturalists which are considered to resemble the living conditions of ancestral humans (see Text S1 in the Supplementary Information). (ii) *Gitanos* display a strong sense of ethnic identity although in many ways share a bicultural identity (47, 48). While they mostly speak the majorities' languages and have adopted the religion and even a number of their neighbors' mores, they also maintain a strong and vibrant sense of themselves as a separate people. *Gitanos* try to preserve a separate ethnic identity, often reinventing their processes of differentiation, which are mainly based on reproductive strategies where specific factors including marriage, gender and kin systems are crucial (49-52). As a consequence, for

[*]Nonetheless, they have received little attention in experimental research. We are aware of only two studies analyzing the behavior of Romani people: Brañas-Garza et al. (44) using the ultimatum game and Martín et al. (45) using time discounting tasks. Behavior towards Romani people, but not their own behavior, is studied in Bauer et al. (46).

example, even though *Gitanos* and non-*Gitanos* have cohabited the study area for more than 15 generations, mixed marriages have been traditionally rare (less than 5% for over two centuries in the study area). Although this is changing in some areas where the integration of *Gitanos* in education and labor has been notable, according to our data cross-ethnic marriages in the localities studied still remain under the 10% mark. Interestingly, recent advances suggest that societies with more intensive kin-based institutions tend to display a stronger ethnocultural (group) identity, ingroup-outgroup differentiation and ingroup loyalty (53). [†] See Text S1 in the Supplementary Information for more details.

Design and Hypotheses

We conducted our experiments with a total of 320 participants (mean age = 42.80 ± 18.42 SD, 59% females). Participants played a one-shot public goods game with peer punishment (PGP) involving real monetary stakes in anonymous four-person groups. We recruited *Gitano* and non-*Gitano* "ordinary people" from five small semi-rural towns with a large *Gitano* population in southern Spain. The experimental design comprises two conditions (between-subjects): participants played the PGP in either (i) *homogeneous* groups composed of either only *Gitanos* or only non-*Gitanos* or (ii) *mixed* groups with two *Gitano* and two non-*Gitano* members. Importantly, the two conditions were run in different sessions. Thus, ethnic identity was made particularly salient in the mixed sessions because in the homogenous sessions there were only members of one's own cultural group. Ethnicity itself is indeed rather meaningless until the presence of "others" makes it relevant for social interaction and cultural identification processes (58-61). While among minority status groups, such as *Gitanos*, group identity is often carried to every public environment (62), in the mixed condition the behavior of the two cultural groups could be directly compared by the participants, which should enhance the salience of intergroup encounter cues and hence of ethnic identity.

Following standard procedures (18), participants in the PGP first made their cooperation decisions by means of (anonymously) allocating money from their €10 endowment to a group pot. Contributions were doubled and evenly shared among the four group members. Thus, the more one contributes to the group pot (i.e., the public good), the larger the total group benefit, but the lower the decision maker's personal benefit, all else equal. This creates the classical social dilemma between collective and individual interests. After all the participants had made their decisions, they were shown the contributions of each of the other three group members and were allowed to spend part of their earnings in order to reduce others' earnings (punishment stage): €1 spent on punishment reduced the target individual's earnings by €3. It is important to remark that participants contributed knowing beforehand that they could be punished, which introduces strategic incentives to cooperate in order to avoid punishment.

[†] *Gitanos*, as other Romani groups, have developed a series of autonomous law-making processes that are often encoded in open-ended codes of norms, the *Gitano* Law. Although somewhat less elaborated than in Romani groups in Eastern Europe (54-56), these processes are important in the effort to limit the escalation of conflicts between families and descent networks, where the duty of defense and support of family members is a central concern (57).

Finally, by means of a subtle procedure which preserved participants' anonymity, we allowed participants in the mixed groups to match the ethnicity and contributions of each of the other three group members. Hence, our procedure let participants condition their punishment decisions on the target's ethnic identity. Note that this was not relevant in the *homogenous* groups since all four members were of the same cultural group. See Methods for a more detailed description of the experimental procedures.

The two evolutionary accounts we aim to test make clearly different predictions about our participants' punishment behavior (see Table 1 and Figure 1 for schematic and visual representations of the predictions, respectively):

- If the "big mistake" (BM) hypothesis is correct, in the homogenous groups, *Gitanos* should use altruistic punishment of free-riders to a similar extent as non-*Gitanos* because both can be considered as "modern" humans whose current punishment behavior represents the misfiring of a pan-human psychology (that emerged in a common ancestral past where kinship- and closeness-based interactions prevailed). If anything, one should expect misfiring to be more prominent among *Gitanos*. In other words, if punishment evolved because it yields direct or indirect inclusive fitness benefits to the punisher, *Gitanos* might in general punish free-riders more frequently than non-*Gitanos* due to their higher genetic relatedness and closer daily-life relationships. Moreover, the presence of members of the other cultural group in the mixed groups should not dramatically influence behavior except for a possible reduction in aggregate punishment (especially by *Gitanos*) compared to the homogeneous groups along with the associated reduction of cues of genetic relatedness and the diminished likelihood of establishing coalitional social-exchange relationships among the interactants. Intergroup processes are considered to be evolutionarily irrelevant for the emergence of group-beneficial behaviors. Therefore, although the punishment of ingroups might be slightly higher than that of outgroups, the target's ethnic identity should be essentially disregarded by participants when punishing in mixed groups to the extent that potential coalition partners can be both targets and observers of one's own behavior. Consequently, it is the group composition that is relevant to build a reputation of "formidability" (63). The level of punishment of ingroups in the homogeneous and mixed groups should, in any case, be identical.
- On the other hand, following cultural group selection (CGS) theories, one may expect sharp differences between the two cultural groups in the homogenous condition. In the homogeneous groups, altruistic punishment is expected to be used more often by non-*Gitanos*, who interact more frequently with non-relatives and on a larger scale than *Gitanos*. In the mixed groups, however, the salience of ingroup-outgroup identity cues should lead participants to impose harsher punishment onto ingroup vs. outgroup wrongdoers in order to preserve group cohesiveness and, in parallel, to punish outgroup cooperators more spitefully/antisocially (14, 64) as harming the outgroup helps one's own cultural group outcompete other groups. Moreover, altruistic punishment of ingroup free-riders should be stronger in mixed than in homogeneous groups due to the priming of ethnic identity, whereas

antisocial punishment of ingroup cooperators should be avoided in mixed groups and should therefore be stronger in homogeneous than mixed groups. The latter patterns would be expected to be more pronounced among *Gitanos*, who share a much more marked ethnic identity than the majority, and particularly males, as they gain leadership in intergroup encounters (65-67).

Table 1. *Basic predictions of the "big mistake" and cultural group selection hypotheses about altruistic (and antisocial) punishment behavior in the experiment.*

Hypothesis	**Homogeneous**	**Mixed**	**Homogeneous vs. Mixed**
Big mistake - mismatch	$I_G \geq I_{NG}$	$I \geq O$	$I_H = I_M$
Cultural group selection	$I_G < I_{NG}$	$I > O$ --- $I < O$ (*antisocial*)	$I_H < I_M$ --- $I_H > I_M$ (*antisocial*)

Notes: I = punishment targeted at ingroups. O = punishment targeted at outgroups. Subscripts G, NG, H and M refer to *Gitano* punishers, non-*Gitano* punishers, homogeneous groups and mixed groups, respectively. Antisocial punishment is labeled as "(*antisocial*)".

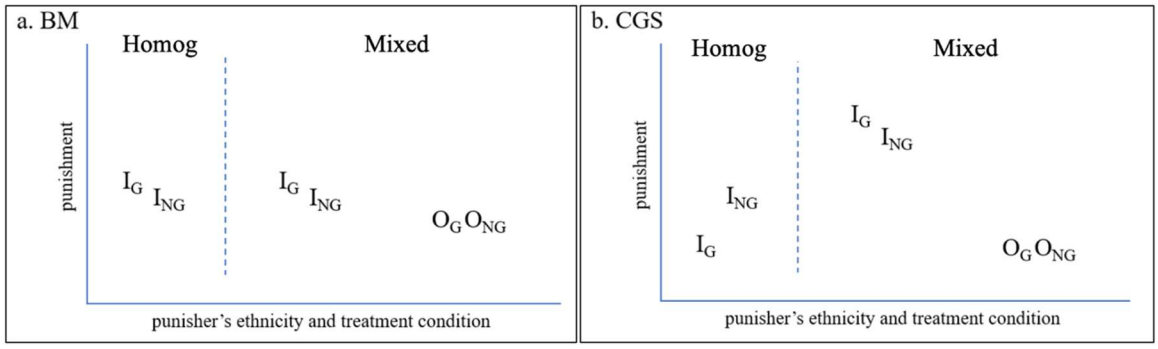

Figure 1. *Visual representation of the predictions of the "big mistake" (BM, panel a) and cultural group selection (CGS, panel b) hypotheses. I = punishment targeted at ingroups. O = punishment targeted at outgroups. Subscripts G and NG refer to Gitano and non-Gitano punishers, respectively. Note that we do not plot the case of antisocial punishment because the BM hypothesis only entails predictions on altruistic punishment.*

We further test the norm-psychology account inherent to cultural group selection models by enumerating some secondary hypotheses linked to the differential cultural norms of *Gitanos* and non-*Gitanos* in the study area. This account states that human social psychology is unique in the animal kingdom because the human brain has differentially evolved to be highly sensitive to social norms, defined as "learned behavioral standards shared and enforced by a community" (43, p. 218). If the norm-psychology hypothesis is correct, *Gitanos*' and non-*Gitanos*' behavior in the experiment should reflect such differences in cultural norms, which work as proximate-level behavioral explanations. In Text S1 in the Supplementary Information we explore some of those cultural differences and set the associated secondary (proximate-level) hypotheses, in particular about norm enforcement institutions and gender roles.

Results

Contributions to the public good. With regard to the participants' cooperation as measured by their contributions to the public good, the results are displayed in Figure 2. No main effect of ethnicity or condition on contributions was found ($ps > 0.22$, OLS regression with robust standard errors and controlling for gender and age; see Figure 2a). The interaction between these two variables was not significant either ($p > 0.27$) and all possible comparisons report $ps > 0.10$ according to joint-significance Wald tests on the model estimates. Contribution levels were relatively high (well above 60% of the endowment on average; see 68). Given that the threat of punishment introduces incentives to cooperate strategically and therefore contributions do not necessarily reflect a "pure" preference for cooperation, the finding of similar average contribution levels across cultural groups and conditions could be due to multiple factors.

However, we observed a significant interaction between gender and condition ($p = 0.02$; see Figure 2b and 2c): across both cultural groups (especially among non-*Gitanos* although the three-way interaction ethnicity X condition X gender was not significant, $p = 0.65$), we found that females contributed less in the homogenous than in the mixed groups ($p = 0.01$, Wald test), while the opposite was observed for males (although not significantly so, $p = 0.33$). As a result, males cooperated significantly less than females in the mixed groups ($p = 0.04$) but similarly in the homogeneous groups ($p = 0.22$).

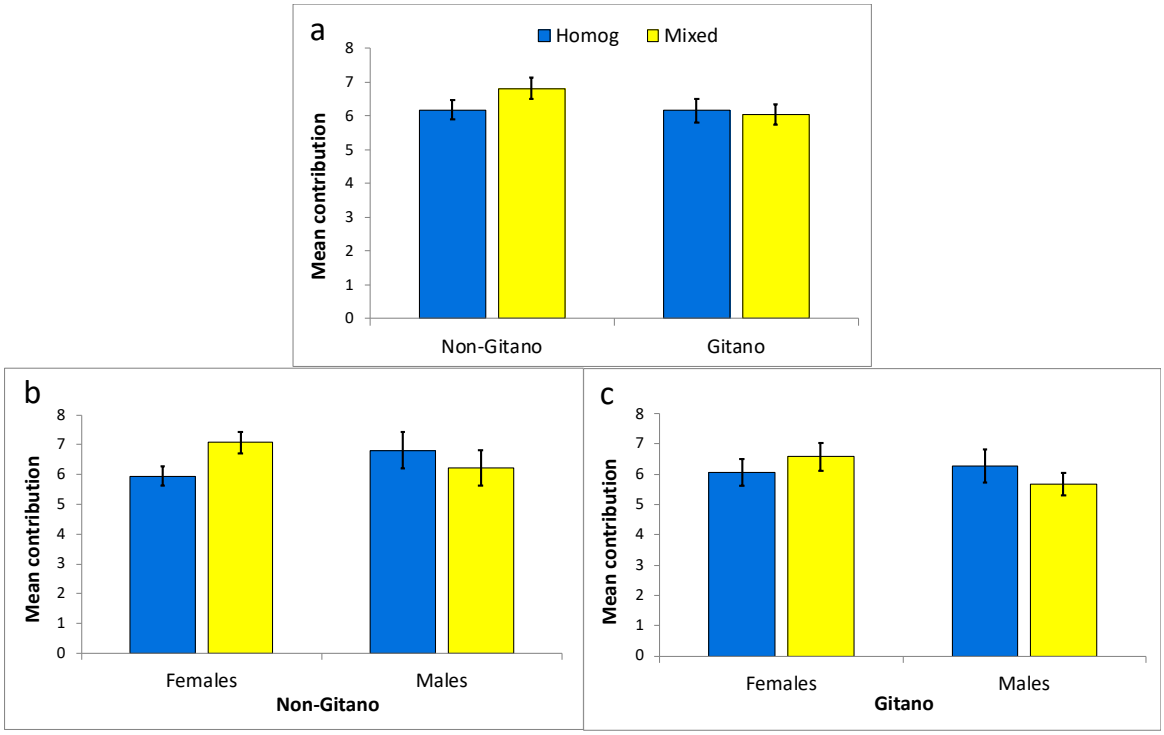

Figure 2. *Mean contributions in homogeneous and mixed conditions. Panel (a) displays the data broken down by ethnicity. Panels (b) and (c) display the data broken down by gender for non-Gitanos and Gitanos, respectively. Error bars represent standard error of the mean.*

Aggregate punishment levels. Figure 3 summarizes the results regarding punishment behavior. We observed a significant main effect of ethnicity indicating that, in general, *Gitanos* punished less than non-*Gitanos* ($p < 0.01$, OLS regression with robust standard errors clustered at both the group and the individual level, and controlling for condition, gender, age, the difference in contributions between the punisher and the target and the mean contribution of the other two group members). The treatment condition did not yield a significant estimate ($p = 0.89$). A significant ethnicity X condition interaction ($p < 0.01$) reveals that *Gitanos* punished much less than their non-*Gitano* counterparts ($p < 0.01$, Wald test) in the homogeneous groups, but there were no ethnic differences in the mixed groups ($p = 0.89$; see Figure 3a). The intergroup encounter triggered by the mixed condition thus exerted substantial and differential effects on both sides: *Gitanos* increased their punishment level ($p = 0.02$) while non-*Gitanos* reduced it ($p = 0.04$), as compared to the homogenous condition.

A significant interaction was also found between gender and condition ($p < 0.01$): we observed a higher level of punishment by males ($p < 0.01$, Wald test) and a lower level of punishment by females ($p < 0.01$) in the mixed than the homogenous groups (see Figure 3b and 3c). This results in males punishing less than females in the homogenous groups ($p = 0.02$) but more than females in the mixed groups ($p < 0.01$). Although the three-way interaction ethnicity X condition X gender was not significant ($p = 0.55$), it can be seen that *Gitano* females almost never used punishment in either condition. In other words, *Gitano* females' punishment was nearly inexistent regardless of the condition whereas the level of

punishment implemented by *Gitano* males, which was negligible in the homogeneous groups, turned out to be rather high in the mixed groups. Among non-*Gitanos*, females punished less while males punished more in the mixed than in homogeneous groups.

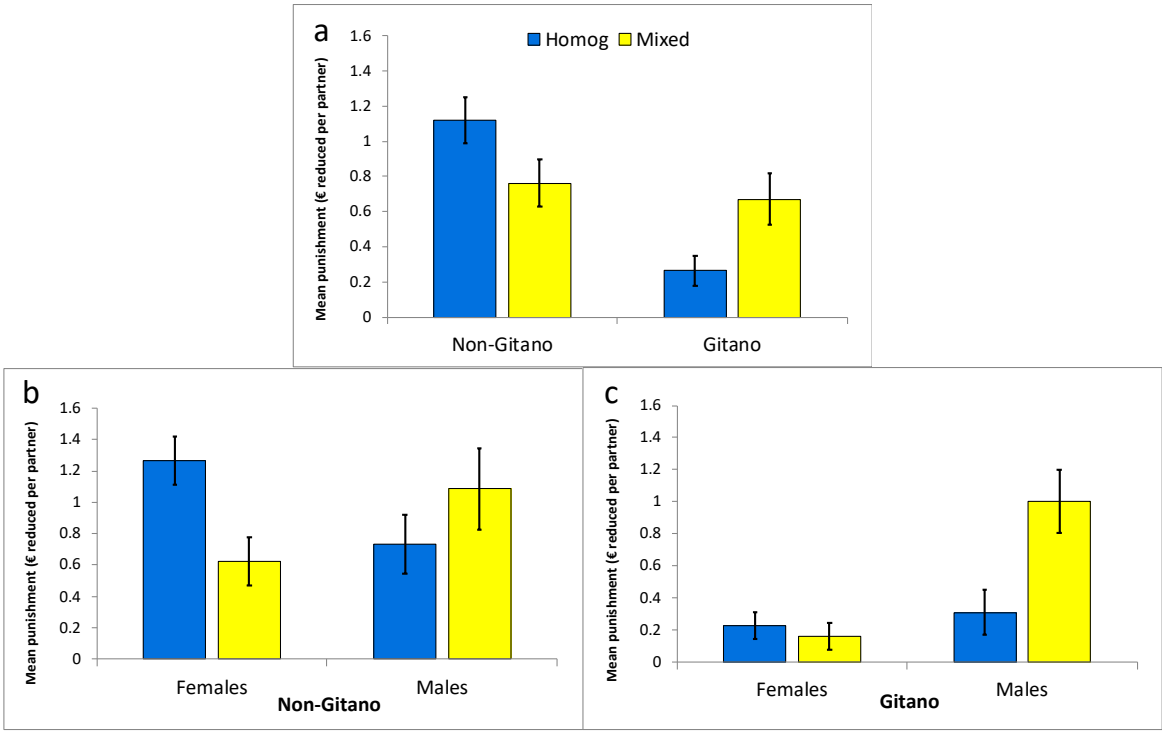

Figure 3. *Mean aggregate punishment in homogeneous and mixed conditions. Panel (a) displays the data broken down by ethnicity. Panels (b) (non-Gitanos) and (c) (Gitanos) display the data broken down by ethnicity and gender. Error bars represent robust standard error of the mean clustered at the group level.*

Altruistic and antisocial punishment. In all regressions, the higher the difference between the punisher's contribution and the target's contribution (punisher's minus target's), the stronger the punishment ($ps < 0.01$), thus indicating that more intense free-riding metes out firmer punishment. However, we also observe some instances of spiteful, antisocial punishment targeted at cooperators. When disentangling between "altruistic" punishment (the target contributed less than the punisher) and "antisocial" punishment (the target contributed more than the punisher) in panels (a) and (b) of Figure 4, we see that the rather strong punishment implemented by *Gitanos*, in particular males (panels c and d break down the data by gender), in the mixed compared to the homogeneous groups is due uniquely to altruistic punishment since their level of antisocial punishment was still very low in the mixed groups. The remaining results mentioned above do not appear to crucially depend, at least qualitatively, on whether punishment is altruistic or antisocial.

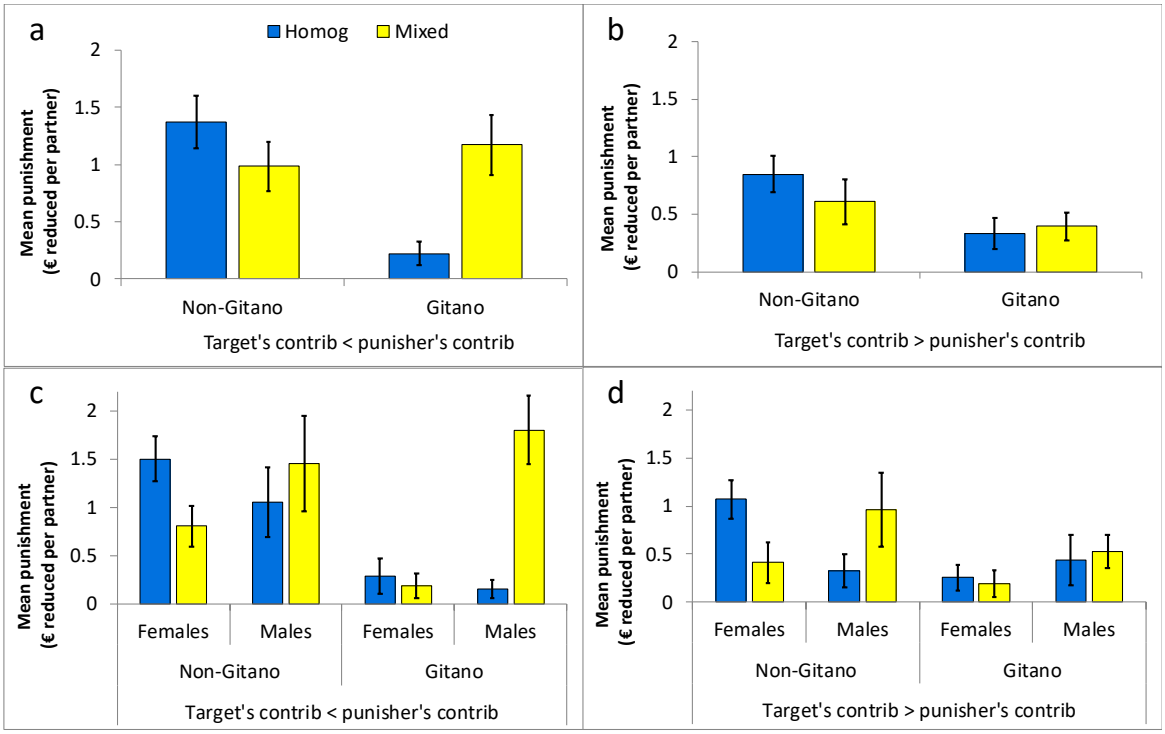

Figure 4. *Mean altruistic and antisocial punishment in homogeneous and mixed conditions. Panels (a) (altruistic punishment) and (b) (antisocial punishment) display the data broken down by punisher's ethnicity. Panels (c) (altruistic punishment) and (d) (antisocial punishment) display the data broken down by punisher's ethnicity and gender. Error bars represent robust standard error of the mean clustered at the group level*

Ethnocultural identities and punishment in mixed groups. It remains to determine whether participants punished differently in the mixed groups depending on the cultural identity of the target (recall that the punisher knew the target's ethnicity but not her personal identity). In Figure 5, we display the mean punishment levels imposed on *Gitano* and non-*Gitano* targets in the mixed groups. We find that, *regardless of the punisher's ethnicity*, *Gitano* targets received less antisocial punishment and more altruistic punishment than non-*Gitano* targets for the same behaviors (significant interaction between contribution difference and target's ethnicity, $p < 0.01$, OLS regression; the triple interaction with punisher's ethnicity is not significant, $p = 0.55$; see Figure 5a and 5b). Put differently, both *Gitano* and non-*Gitano* punishers were more responsive to the distance between their own and the target's contribution (i.e., to the relative level of free-riding) when the target was *Gitano* than when the target was non-*Gitano*. *Gitano* targets got punished significantly less than non-*Gitano* targets when they cooperated more than the punisher ($p < 0.05$ for differences larger than €4; Wald test), whereas *Gitano* targets got punished more than non-*Gitano* ones when they cooperated less than the punisher ($p < 0.05$ for differences larger than €3). As can be seen in Figure 5c and 5d, the difference in altruistic punishment is due solely to male punishers, whereas the difference in antisocial punishment is similar across genders, although it appears to be stronger among non-*Gitano* female punishers.

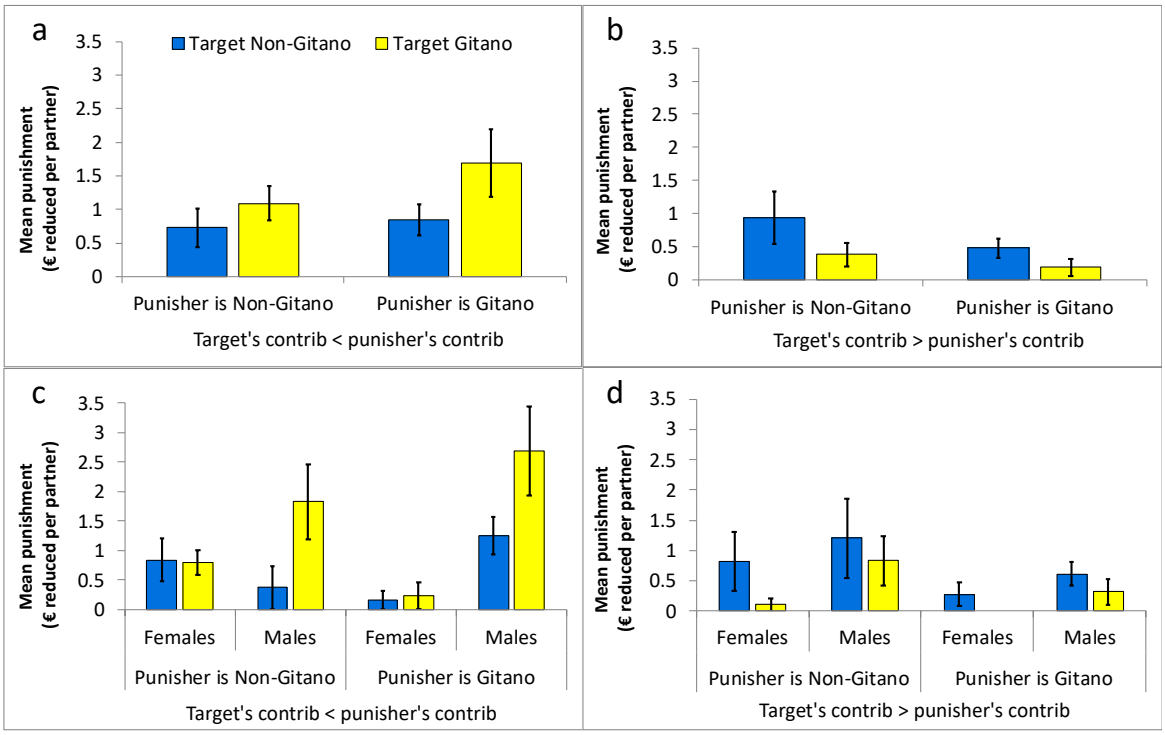

Figure 5. *Mean punishment on Gitano and non-Gitano targets in mixed groups. Panels (a) (altruistic punishment) and (b) (antisocial punishment) display the data broken down by punisher's ethnicity. Panels (c) (altruistic punishment) and (d) (antisocial punishment) display the data broken down by punisher's ethnicity and gender. Error bars represent robust standard error of the mean clustered at the group level.*

To summarize, *Gitanos* practically did not punish the misbehavior of other *Gitanos* in the homogeneous groups but (in particular males) severely punished such behavior in the mixed groups with non-*Gitanos*. Non-*Gitano* males, on the other hand, also retaliated more harshly against *Gitano* free-riders than against non-*Gitano* ones in the mixed groups. Regarding the antisocial punishment of cooperators, the results are somehow weaker: while participants tended to target more punishment at non-*Gitano* than *Gitano* cooperators in the mixed groups, the levels of antisocial punishment were relatively low (especially compared to those of altruistic punishment).

A closer look into the basic competing hypotheses. In Figure 6a we rearrange the above results regarding the altruistic punishment of free-riders in a manner that facilitates comparison with Table 1 and Figure 1, which presented the predictions of the two accounts. Although the BM hypothesis does not yield predictions about antisocial punishment targeted at cooperators, Figure 6b displays the results on antisocial punishment for the sake of completeness.

With regards to **altruistic punishment** (Figure 6a), from the homogeneous condition we observe, following the notation used in Table 1, that $I_G < I_{NG}$ ($p < 0.01$). Thus, the punishment

targeted at ingroup free-riders in the homogeneous groups is higher among non-*Gitanos* than among *Gitanos*, as predicted by the CGS account. In the mixed groups, we can see that $I > O$ holds for *Gitanos*, indicating that ingroup free-riders get punished more harshly than outgroup ones, whereas the opposite is true for non-*Gitanos* ($p < 0.05$ for differences between the punisher's and the target's contributions larger than €3 in both cases; see above). Here, the results for non-*Gitano* punishers do not fit into the basic predictions of any of the two accounts, but the results for *Gitano* punishers match the predictions of both accounts. Finally, we also observe that $I_H < I_M$ holds among *Gitanos* ($p < 0.01$ for all possible differences between the punisher's and the target's contributions), meaning that ingroup free-riders get punished more in the mixed than in the homogeneous groups, while the opposite is observed among non-*Gitanos*, albeit marginally ($p < 0.10$ for differences between the punisher's and the target's contributions larger than €1). Again, both accounts fail to predict the behavior of non-*Gitano* punishers. The CGS hypothesis, however, gives a good approximation to the behavior of *Gitano* punishers.

Figure 6c displays the results on altruistic punishment for male and female punishers separately. As mentioned above, *Gitano* females practically did not punish in any condition. In addition, the $I_G < I_{NG}$ finding from the homogeneous groups and the $I_H > I_M$ finding for non-*Gitanos* hold qualitatively regardless of the punisher's gender, whereas the $I > O$ ($I < O$) observed among *Gitanos* (non-*Gitanos*) in the mixed groups as well as the $I_H < I_M$ among *Gitanos* are only driven by male punishers.

As for the **antisocial punishment** of cooperators (Figure 6b), the prediction of the CGS hypothesis that outgroup cooperators should mete out more punishment than ingroup ones ($I < O$ (*antisocial*) in Table 1) accurately describes the data when focusing on *Gitano* punishers. However, the opposite pattern ($I > O$ (*antisocial*)) is observed among non-*Gitano* punishers, also contrary to the predictions of the CGS account ($p < 0.05$ for differences between the target's and the punisher's contributions larger than €4 in both cases; see above). On the other hand, to the extent that the presence of ingroup-outgroup identity cues should make individuals direct any competitive desires (and efforts) toward the outgroup, a CGS approach also predicts that $I_H > I_M$ (*antisocial*). That is, the existence of any instances of ingroup antisocial punishment in homogeneous groups must be suppressed in mixed groups. This prediction is met among the *Gitano* punishers ($p < 0.10$ for differences larger than €7, $p \leq 0.05$ for differences larger than €8) but not for non-*Gitano* ones ($p > 0.31$ for all possible differences).

Breaking down the results on antisocial punishment by gender in Figure 6d, we see that both the $I < O$ (*antisocial*) and $I_H > I_M$ (*antisocial*) findings for *Gitano* punishers hold qualitatively for both males and females (with the disclaimer that females punish very little), whereas the $I > O$ (*antisocial*) observed for non-*Gitanos* is only driven by male punishers. Also, when comparing the ingroup antisocial punishment between the homogeneous and mixed conditions among non-*Gitano* punishers, we observe $I_H < I_M$ (*antisocial*) for males, that is, the opposite of what is predicted by the CGS account and is met for *Gitano* punishers.

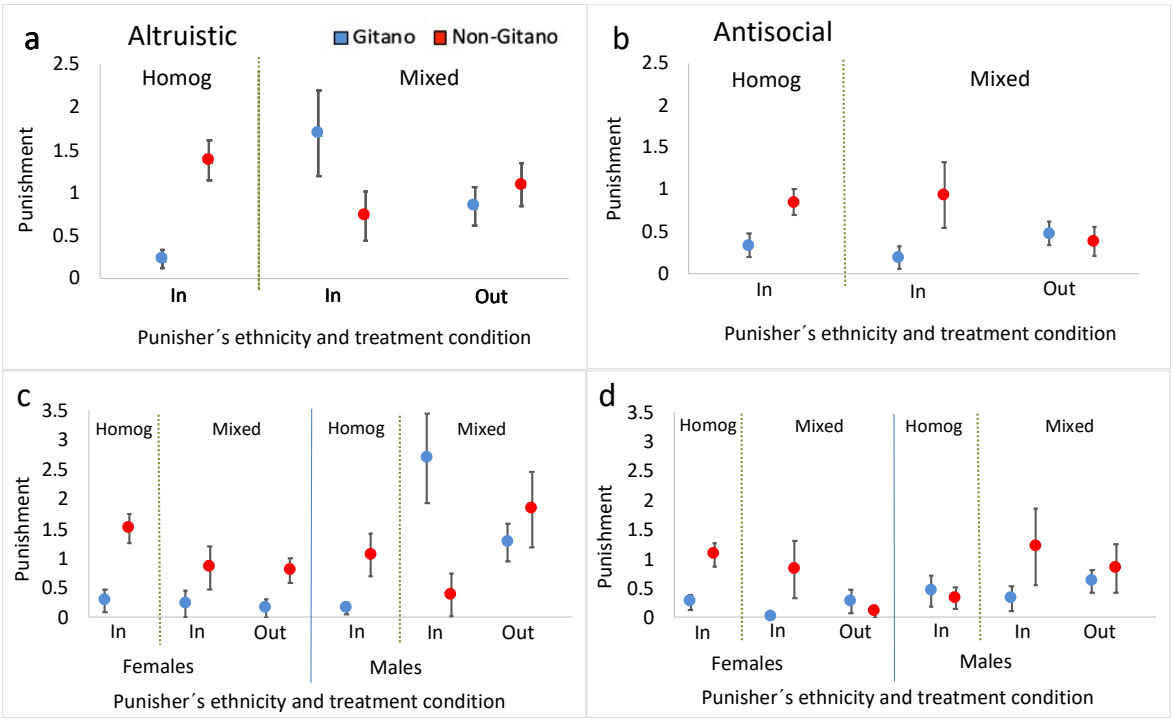

Figure 6. *Mean altruistic and antisocial punishment targeted at ingroups and outgroups. Panels (a) (altruistic punishment) and (b) (antisocial punishment) display the data broken down by punisher's ethnicity and treatment condition (ingroup-homogeneous, ingroup-mixed and outgroup-mixed). Panels (c) (altruistic punishment) and (d) (antisocial punishment) display the data broken down by punisher's ethnicity, treatment condition and punisher's gender. Error bars represent robust standard error of the mean clustered at the group level.*

Discussion

Our experiments yield new insights into the evolutionary roots of human prosocial behavior and altruistic punishment in particular. Given that *Gitanos*' use of punishment in the homogeneous groups was nearly inexistent, especially compared to that of non-*Gitanos*, our data seem to be inconsistent with the "big mistake" or "mismatch" hypothesis. Under this hypothesis, *Gitanos* should punish similarly or slightly more than non-*Gitanos* on average because, while also being "modern" humans (i.e., citizens of modern states), their social organization is more heavily based on kinship, family networks and closeness. The explanation would be that group-beneficial behaviors such as altruistic punishment evolved at a time when nearly all social interactions were among relatives and reputation was always at stake. Thus, altruistic punishment would have been selected through kin selection and/or "traditional" reciprocity mechanisms given that its use tended to confer inclusive fitness benefits to the punisher in ancestral, small-scale human groups. Such an evolved psychology should be equally or more clearly displayed by *Gitanos* who are still heavily organized around kinship and close relationships in contrast to non-*Gitanos*, who have more frequent sporadic encounters with non-relatives. Our results do not support this prediction.

On the other hand, if altruistic punishment is particularly important for the enforcement of cooperation among non-kin in large-scale societies, as argued by theorists of cultural group selection, non-*Gitanos* should punish more than *Gitanos* in homogeneous groups. This is what we observe. The results from Henrich and Henrich (69) suggest that relatedness might reduce the willingness to punish others, since they found that individuals more genetically related to the average member of the "yavusa" in a Yasawan sample (Fiji Islands) tended to punish less as third-party observers. Moreover, in such a highly genetically-related population, punishment was comparatively infrequent, and zero offers were very often accepted in both ultimatum and third-party punishment games, whereas actual offers were on average quite high (i.e., "fair"). This matches the ultimatum game results of Brañas-Garza et al. (44) with a sample of Spanish *Gitanos* in Madrid, where high levels of cooperation were observed in the form of high offers even though much lower offers would have gone unpunished. In cultural groups organized around kinship-based networks, peer punishment may not be favored to enforce daily-life group cooperation if other mechanisms such as gossiping or centralized punishment institutions represent lower-cost solutions (given the short-run negative impact of punishment on the fitness of individuals who share genes with the punisher). Indeed, previous theoretical evidence suggests that punishment is typically selected against in environments of high genetic relatedness (70). Recent advances also indicate that public, multilateral cooperation can evolve by kin selection in sizeable groups in the absence of punishment if genetic relatedness is strong enough (values observed today in small-scale populations may suffice, e.g., 71) so that indirect inclusive fitness benefits act as a sufficiently powerful cooperation-enhancing force (72). In a related manner, experimental research suggests that cooperation, but *not* punishment, increases with cues of kin density in PGP groups (73). The exact role of genetic relatedness for punishment behavior is yet to be systematically assessed, however.

In addition, as opposed to the arguments of the mismatch hypothesis, the existence of cultural selection processes predicts different manifestations of the same behavior (i.e., punishment toward members of one's own cultural group) in intergroup encounters compared to situations where group identity cues are absent, and this is again what we observe. *Gitanos* (but only males), who have a strong sense of ethnic identity, targeted punishment at *Gitano* wrongdoers when they interacted with non-*Gitanos* in the mixed groups but not in the only-*Gitano* homogeneous groups. This observation is consistent with the hypothesis that punishment plays an important role in the evolution of cooperation through its impact on intergroup processes. At the proximate level, we interpret this result as reflecting that *Gitano* males use punishment only in response to a clear threat to group identity (74, 75): that of being seen as less cooperative than non-*Gitanos*. The negative emotions triggering punishment (11, 21, 23) among *Gitanos* would thus emanate from the possibility of comparison between the two ethnic groups. Previous research indicates that, during intergroup contact, feelings of identity threat are particularly likely to be aroused among individuals with a stronger group identification (61, 76). It can thus be inferred that the key norm for *Gitanos* (that which is to be enforced) is not cooperation *per se*, but preserving an ethnic identity of which they are

proud.[‡] This result is to a large extent coherent with previous results from ultimatum game experiments (77-79) and multilateral gift-giving (non-standard) third-party punishment games (80) using identity manipulations.

However, the latter finding seems at odds with most results from standard third-party punishment experiments in which harsher punishment has been observed when the victim is an ingroup of the third-party (i.e., the punisher) and the norm violator is an outgroup, compared to other combinations (81-87; but see Shinada et al. (80) for a non-standard design with different results). In contrast to results with adults, a recent third-party punishment experiment found that three to four-year-olds, but not older children (see also 84), inflict harsher punishment onto ingroup than outgroup norm-violators (88). Yet there are important differences between the multilateral cooperation environment of our PGP and the framework posed by the third-party punishment game in those experiments. For instance, the punisher is directly affected by the norm violation in the former but not in the latter. Also, both ingroups and outgroups can be victims (and observers) of the norm violation *at the same time* in the PGP but not in the third-party punishment game. Likewise, punishers might have been more cooperative than the target, or less, in the third-party punishment game, but this fundamental detail—which informs about the true nature of punishment (14, 64, 89)—is by design unknown (but see 80), in contrast to the PGP. Exploring the possible reasons for the inconsistencies between experimental frameworks (and between young children and adult behavior) is an interesting endeavor for future research.

Non-*Gitano* males' sanctioning behavior, on the other hand, is closer to what previous experiments using (standard) third-party punishment games with adults have shown: they punish outgroup wrongdoers harshly but not ingroup ones in mixed groups. Indeed, the lowest level of altruistic punishment by non-*Gitano* males is observed when the wrongdoer is an ingroup and there are outgroup "third-party" victims, whereas the maximum level of punishment is targeted at outgroup wrongdoers when there are ingroup third-party victims. When both the wrongdoer and the third-party victims are ingroups (i.e., in homogenous groups), their punishment remains at intermediate levels. Seen in this way, these behavioral patterns resemble previous observations from third-party punishment games with adults (see, for instance, 81). Non-*Gitanos*' punishment behavior in mixed groups, therefore, seems inconsistent with the basic predictions of cultural group selection theories—but also with those of the mismatch hypothesis. It might be that the lower strength of group identity or the majority status of non-*Gitanos* (see below) contribute to explaining this finding and the

[‡] In fact, in the homogeneous condition, a common comment by *Gitano* participants during the post-experimental interview when informally asked about their perception of punishment opportunities (i.e., "the possibility of reducing others' earnings") was that punishing others makes no sense at all. "Destroying others' money and paying for it!" (subject #25) was seen as something weird, irrational and very negative by *Gitanos* in the homogeneous condition. Comments of this type were inexistent in the mixed condition (as well as in the only-non-*Gitano* homogeneous condition), as if the reasons for punishing others were evident for everyone. In fact, even though the beliefs elicitation was not incentivized and should therefore be taken with caution, participants' expectations seem to match their behavior to a large extent: *Gitanos* expected much less punishment than non-*Gitanos* in the homogeneous groups ($p < 0.01$; same regression specification as for punishment decisions) and expected more punishment in the mixed than in the homogeneous groups ($p = 0.05$; Wald test).

discrepancy with *Gitanos*' punishment behavior, which aligns well with the predictions of cultural group selection in both the homogeneous and mixed groups.

In addition, we find some indication that *Gitanos* spitefully punished non-*Gitano* cooperators more than *Gitano* ones (i.e., more antisocial punishment targeted at outgroups than ingroups). This result is in line with the prediction of cultural group selection theories as well, but the level of antisocial punishment in the mixed groups was perhaps too low to draw any firm conclusion.

Taken together, these results highlight the complexity of inter-ethnic relationships for both the provision of public goods and the enforcement of cooperation. The role of majority versus minority status of groups, which has been largely overlooked in previous research on punishment behavior in intergroup encounters, might be crucial. As mentioned, *Gitano* non-cooperators were firmly punished by other (male) *Gitanos* in mixed groups, but also by (male) non-*Gitanos*. The fact that ethnic minorities, and Romani groups in particular, are often perceived as if not following the collective action norms of the majority (46, 50, 54, 55) and as potentially violent in their reactions to the majority's enforcement institutions (51, 52, 57) may explain the strong punishment of *Gitano* wrongdoers by non-*Gitano* males. This result could be reflecting the opportunity provided by the anonymous experimental setting for the majority to sanction the minority without fearing retaliation, probably symptomatic of a sense of moral superiority (60) or pretended assimilation (61). Further research should explore these possibilities in greater depth. Note that non-*Gitanos* typically do not share such a strong group identity as *Gitanos* due, in part, to their majority status. Indeed, groups' majority/minority status is a predictable, although imperfect, correlate of group identity strength that shapes intergroup encounters in many ways (61). Previous evidence indicates that members of majority status groups are typically more concerned with not being perceived as prejudiced by the minority, whereas members of minority groups are concerned with becoming the target of the majority's prejudice (90, 91). Since an extended stereotype is that Romani people do not contribute to the commons and display low compliance with the majority collective action norms (46), following those arguments, it might be natural that both non-*Gitanos* and *Gitanos*, although for different reasons, punish acts that confirm the stereotype (i.e., *Gitanos* not cooperating) more firmly than acts that contradict it (i.e., non-*Gitanos* free-riding or *Gitanos* cooperating). This would be consistent with our findings.

An important aspect uncovered by our experiments relates to the impact of gender roles within as well as across cultural groups. While females contribute more in mixed than homogeneous groups, the opposite is observed for males. Also, in contrast to what we see among females, males punish generally more in mixed than homogeneous groups (consistent with a "male-warrior" account; 65-67). These two results hold similarly for both *Gitano* and non-*Gitano* participants, thus suggesting the existence of gender differences common to both cultural groups. One candidate proximate force underlying such gender differences is risk aversion. If mixed groups are perceived as risky environments due to the presence of outgroups, probably the safest strategy is to avoid conflict by cooperating and not punishing others (to the extent that the punished individual cannot learn the ethnic identity of the punisher, punishment not only of outgroups but also of ingroups may trigger conflict). Since

there is abundant evidence suggesting that, at least in patriarchal societies, males are less risk averse than females (92, 93; for studies suggesting a biologically-informed explanation see, for instance, Brañas-Garza et al. (94) and Brañas-Garza & Rustichini (95)), this might explain why they tend to use such a strategy to a lesser extent than females.

However, while non-*Gitano* females' punishment was strongly modulated by group type—high in the homogeneous and low in the mixed groups—*Gitano* females practically did not punish in either condition. This result may be reflecting a culture-specific differential role of females and males on norm enforcement. Indeed, the finding is consistent with the evidence reviewed in Text S1 suggesting that the *Gitano* cultural norms prescribe women to reduce their assertiveness in the presence of (*Gitano*) males, who should ostensibly lead social interactions in such situations. These marked gender roles are far less prevalent in the majority population.

In sum, while our results are more consistent with cultural group selection theories and their associated norm-psychology account than with misfiring-based theories, several findings challenge a strict view of how cultural group selection processes should translate into behavioral outcomes. These findings in fact raise a number of new questions that deserve further exploration.

Methods

Five semi-rural towns in southern Spain (Granada, Andalusia) with comparable demographic characteristics hosted our experiments: Benalúa de Guadix, Darro, Deifontes, Iznalloz and Pedro Martínez (see Figure 7a). Recruitment of non-*Gitano* participants was made through the town halls (the activity was publicly announced as a study for the University of Granada, and individuals informed the staff about their interest in participating). Town halls however did not provide a good means to contact *Gitanos* since they are typically less involved in towns' official collective activities. To recruit *Gitano* participants, two of the main researchers visited several households in the weeks preceding the experiment and asked the (previously-known) family heads to "bring some of their folks". As a call for participation, there was a €5 show-up fee and a drink and tapa at the end of the experiment.

In each location, we ran two experimental sessions in a between-subjects design: one ethnically homogeneous session (either all *Gitanos*, in two locations, or all non-*Gitanos*, in three locations) and one ethnically mixed session (same number of *Gitanos* and non-*Gitanos*; one session in each of the five locations) where ethnic identity was made salient. We ensured that subjects in one session did not learn the ethnic composition of the other session prior to participating. In each of the 10 sessions, 32 participants played the PGP in eight independent groups of four people. The participants were initially evenly assigned one out of four colors using visible colored scarves. Colors were assigned randomly in the homogenous sessions but were dependent on ethnicity in the mixed sessions, so that two colors were associated to

Gitanos and the other two colors to non-*Gitanos*. This procedure was unknown to participants and was done by giving scarves of identical color to participants who showed up together. Since *Gitanos* and non-*Gitanos* always arrived separately, the resulting assignment of colors to ethnic groups was nearly perfect (see below).

In the mixed sessions, we subtly induced participants to realize the link between colors and ethnicities prior to playing the game—in the homogenous sessions we made the composition of colors public as well in order to allow for comparability between conditions—: the eight participants of each color were placed together wearing their scarves and were photographed by an assistant in front of the other participants. This feature of the design allowed participants to associate cooperation decisions to ethnicities (i.e., colors) and condition their punishment decisions upon the ethnicity of the target in mixed groups. Data from post-experimental interviews indicate that most participants were able to associate ethnicities to scarf colors in the mixed sessions (even if socially-desirable responding might have reduced their willingness to acknowledge this). See Figure 7b for a representation of the structure of the experiment.

For the statistical analyses we excluded seven participants; two *Gitanos* because they participated in a homogeneous non-*Gitano* session by coincidence (we learned their ethnicity ex-post) and five individuals from four different mixed sessions because their ethnicity did not match their color (including them does not qualitatively affect the results). The final sample consisted of 143 *Gitanos* and 170 non-*Gitanos*.

The basic elements of the PGP design have been reported elsewhere (19). Each four-person PGP group was composed of one randomly selected person from each color. Beyond colors, group membership was unknown. After deciding how much from an endowment of €10 to contribute to a public good (marginal per capita return = 0.5; thus each euro contributed cost the individual 50 cents but increased the earnings of each of the other three group members' by 50 cents), participants received feedback on their group partners' contributions and earnings in a color-based fashion and could then anonymously reduce other group members' payoffs at a personal cost (cost-to-impact ratio of punishment = 1:3). Finally, participants were also asked to state the level of punishment they expected from each group partner (no monetary incentives were used for this task). Figures S1 and S2 in the Supplementary Information display the contribution and punishment decision cards, respectively. Several examples of all stages of the PGP were displayed on a whiteboard to facilitate understanding of the game rules. After the PGP, participants completed an unrelated task. At the end of the experiment, participants were privately asked to answer a set of socio-demographic questions and received their payment. Mean earnings from the PGP were €13.34 ± €4.08 (SD).

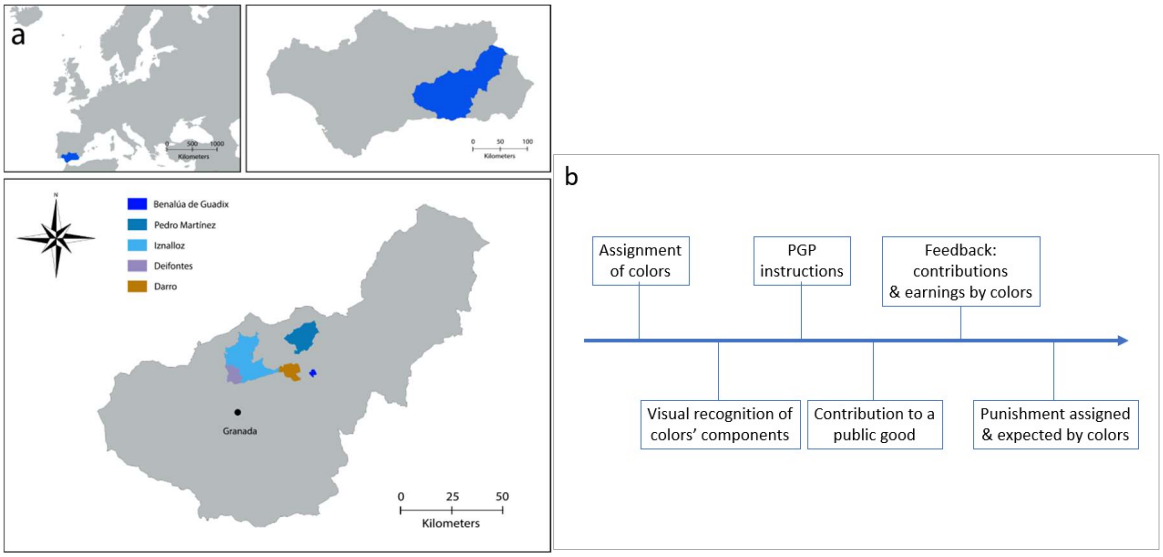

***Figure** 7. Panel (a) Five semi-rural towns in southern Spain (Granada, Andalusia): Benalúa de Guadix, Darro, Deifontes, Iznalloz and Pedro Martínez. Panel (b) Structure of the experiment.*

Ethics statement

All participants provided consent prior to participation. Oral informed consent was obtained because literacy was not a requirement to participate due to the (expected) low educational level of many participants; only being able to read and write numbers was required to participate. This study was conducted in accordance with the Declaration of Helsinki for human research. All participants were treated anonymously by assigning them a numerical code in accordance with Spanish Law 15/1999 on Personal Data Protection.

Authors' contributions

AME designed and conducted the experiment, performed the statistical analyses and wrote the paper; PBG designed and conducted the experiment and wrote the paper; BH designed the experiment and wrote the paper; JFG designed and conducted the experiment and wrote the paper; JM performed the statistical analyses and wrote the paper.

Competing interests

The authors declare no conflict of interest.

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Supplementary Information

for

Bringing together "old" and "new" ways of solving social dilemmas? The case of Spanish *Gitanos*

Text S1. A short overview on Spanish *Gitanos* and further hypotheses

The *Gitanos* or *Calé*[§] are an ethnocultural minority who lives today in all Spanish regions. They are related to other Romani groups in Europe and America with whom they seem to share a remote origin from an "initial founder population" that moved westwards from the Indian subcontinent over one thousand years ago (Mendizabal et al. 2012). All these groups, however, have adapted to the surrounding groups with whom they have lived and today show some traits of familial resemblance and considerable cultural heterogeneity (Matras 2015, Piasere 2004, Fraser 1992). Even those who preserve articulated dialects of Romani language (Matras 2002) are bilingual, and thus bicultural. The *Gitanos* come from the first Romani migrations into Western Europe, which ended in the second half of the 15th century (Pym 2007, Leblon 1985). Their lifeways are product of a long coexistence and exchange with local Spanish populations. Life in common has been marked by persecution, segregation and discrimination, but also by cooperation and hybridization (Pym 2007, Gómez Alfaro 1998, 1999, Leblon 1985, Gamella 2011, Gamella et al. 2014b).

In this sense, *Gitanos* of Spain are often portrayed as an example of successful integration. Arguably, their treatment and living conditions are relatively favorable compared to large Romani populations living in other European societies, particularly those of Central and Eastern Europe. (For instance, George Soros, the business magnate and Roma advocate and philanthropist "called upon Spain to lead Europe in bettering the conditions of the Roma" [Peiró 2012: ix]. Similar claims have been expressed often in the international mass media.) But the rosy view of the lot of the Spanish Romani is often exaggerated and downplays the discrimination and exclusion many of them still suffer in labor, income, education and even daily life encounters (Álvarez-Roldán et al. 2018). It is true, however, that since 1977, when the new political context brought about democracy and decentralization of the Spanish state, there have been clear improvements in their access to health care, education and housing, but not without conflicts and rejection by local majorities.

[§] Most Spanish Romani people call themselves *Gitanos* both in private and public settings. Minority leaders also use the term to name public institutions, such as the *Instituto de Cultura Gitana*. The first Romani groups reaching Spain in the fifteenth century were called "*Egyptanos*", as they were considered to originate in Egypt. *Gitano* is thus synonymous with the English term "gypsy". Many Romani leaders and intellectuals reject this exonym as derogatory and prefer to be identified by their own denominations, such as Roma, Sinti, Kalé, etc. In Spain, *Gitanos* also refer to themselves as *Calé* (plural of *Caló*, black in Romani), but less frequently.

Today, most *Gitanos* are proud of their ethnic identity, although they consider themselves autochthonous Spaniards especially in face of the large number of foreign economic immigrants who moved into Spain in the last two decades and increased the country's ethnic and cultural diversity. *Gitanos* speak the languages and dialects of the regions where they live and have lost most of their old trades and occupations. They have, however, developed other differences to construct and vindicate their shared identity (Gay Blasco 1999, Cantón 2010, Gamella et al. 2013, 2014a, 2014b). *Gitanos*' identity often shows elements of an "oppositional identity" built in opposition or in contrast to the dominant majority culture and associated with the status of involuntary minority (Ogbu & Simons 1998). But *Gitanos* have contributed much to Spanish culture and folklore. Perhaps in no other part of Europe has such a cultural fusion occurred as in Spain, especially in Andalusia, where many of the symbols and practices that identify the region to the world (such as Flamenco singing and dancing) have a crucial *Gitano* component (Leblon 2003, Pasqualino 1998).

Almost all Spanish *Gitanos* are sedentary; they have been living in the same towns and counties for generations and often have a strong attachment to their places of birth or residence, defining themselves as Andalusians, Catalans, or even *Sevillanos* and *Granadinos*. Informed estimates of the size of the *Gitano* population put it in the range of 500,000 to 600,000, around 1.5% of the total Spanish population (FSG 2008). Although in some locations, mainly in the southern region of Andalusia, where about 40% of the Spanish *Gitanos* live (even though Andalusia has less than 20% of the total Spanish population), *Gitanos* represent a particularly high fraction of the population. We conducted our study in an area of eastern Andalusia. This geographical area was chosen due to its high concentration of *Gitanos*, thus allowing the recruitment of a sufficient number of members of this ethnicity for our study. In the five towns hosting the experiments, *Gitanos* account for about 25.6% of the population on average (range: 20.0%–41.4%), that is, about 3,970 over a total of 15,490 inhabitants, according to our estimates for 2007.

Some *Gitano* cultural traits are essential for the understanding of their social behavior, and of punishment in particular. Such traits are mainly associated with social organization and gender roles. We summarize their differential characteristics in the following lines and develop further hypotheses about how some of these cultural traits might translate, as proximate-level explanations, into observed behavior in the experiment.

Social organization and "the family"

Even considering the growing heterogeneity of *Gitanos*, their social universe is largely based on kinship and marriage relations. Their main social networks are family networks, and these tend to be larger, denser, more complex and multifunctional than those of their non-*Gitano* neighbors (or *Payos*, as *Gitanos* often refer to them).

For *Gitanos* today, their most important institution is "the family". The particular notion of family among the *Gitano* population encompasses many different meanings, which can be summarized across two levels. First, compared to non-*Gitanos*, *Gitanos* display relative smaller stress in the household or co-resident domestic unit and a more general understanding

of the "closest family" as including a network of households formed by close kinship links. Considering the different moments in the developmental cycle of domestic units, it is possible to find, for instance, that a specific couple and their children gravitate heavily and almost daily towards the husband's parents. Thus, a patri-virilocal bias strengthens the patrilineal ideology sustained primarily by males (Gay Blasco 1999, Martín & Gamella 2005, Gamella & Martín 2007, Gamella 2011). Second, kin networks include a larger number of people due to several processes that differ from the majority at large: in particular, (i) higher fertility leading to a larger number of siblings and, in turn, aunts-uncles, cousins, second cousins, etc.; and (ii) higher consanguinity in marriage that generates a multiplicity of links between members of any network, as well as higher network homogeneity (Gamella 2019).

Inbreeding has indeed been strikingly common among *Gitanos*, who show a marked preference to marry "known", compatible and "good" people from reliable interrelated kin networks. This does not stem only from geographic isolation or inheritance rules and patrimonial strategies. Rather, it is more the result of social isolation or segregation, as well as a marked cultural preference for endogamy (Gamella 2019).

It has long been argued that in premodern or "traditional" societies kinship "provides […] an organising medium of trust relations." As such, "kinspeople can usually be relied upon to meet a range of obligations more or less regardless of whether they feel personally sympathetic towards the specific individuals involved" (Giddens 1990, p. 101), while in modern societies relationships of trust have been replaced by "friendship or sexual intimacy as a means of stabilising social ties" (p. 102). The dominant idea is that modernity implies isolation from kin networks and individuals confront each other as separate entities "divorced from their kinship and family units" (Finkler et al. 2001, p. 236). This varies across countries, however (Schulz et al. 2018). Precisely, Spain as well as other southern European countries are usually portrayed as "familial" societies, where family bonds and support are relatively prominent, and individualism is somehow limited by family obligations (Reher 1998). Therefore, the distinction between *Gitanos* and Spaniards at large in this regard might be considered as a question of degree rather than as an absolute one. But the density and intensity of kin bonds often generate a differential institutional setup and affect the interpretative lens shared by local *Gitanos*.

Inbreeding is much more common among *Gitanos* than among Spaniards at large and has shown both a distinctive character and evolution. Although Spain once had some of the highest levels in Europe, inbreeding began to fall in the 1950s and, in following decades, the fall was so rapid that consanguineous marriages have become as rare as in other Western countries (Fuster & Colantonio 2002, 2004, Calderon et al. 2009). Within *Gitano* communities, however, inbreeding has been and remains widespread. According to recent estimates based on genealogical reconstruction for the period 1925–2006 (Gamella 2019), in 22 contiguous localities in the area where this study was conducted more than half (54.8%) of all *Gitano* marriages are among relatives, with close-kin consanguineous marriages (up to second cousins) averaging 28.7%. An estimation that can be compared to the measures reported in studies using interviews or other synchronic research methods yields average inbreeding coefficients (Wright's F) of about 11.3 ($x10^{-3}$), levels never found in Spain and

much less so recently. This value is rather conservative, however, and may underestimate the actual F by more than 30% in this population. These are among the highest rates of inbreeding found in any European population, including the most inbred of Spanish isolates (Gamella 2019). In the same area, aggregate consanguinity rates for the overall population (including *Gitanos* and non-*Gitanos*) reached a maximum of around 7.4% between 1920 and 1936, with corresponding F coefficients ranging from 2.4 to 2.7 ($x10^{-3}$). Since the 1960s the rates of consanguinity and inbreeding have decreased rapidly (Gamella & Núñez-Negrillo 2019). Note that recent comparable estimates for small-scale societies of hunter-gatherer and horticulturalists report average F values well below 2 ($x10^{-3}$) and 10 ($x10^{-3}$), respectively (Walker 2014, Walker & Bailey 2014). Given the strong correlation between coefficients of inbreeding and mean relatedness (Hamilton's r) of groups (Walker 2014), these data demonstrate that Romani people of this area are highly genetically related on average, even compared with people from small-scale societies. Multiple consanguinity is the norm among *Gitanos*: couples are linked by several bonds and share many ancestors, a product of a pattern of inbreeding sustained over many generations. Although these patterns are starting to change and the rate of marriages between *Gitanos* and non-*Gitanos* is slowly increasing, they have remained quite constant in the last decades.

In sum, even in a region where consanguineous marriages had been important, inbreeding among *Gitanos* shows a particularly high intensity and permanence, as it is the product of a strong cultural preference and not only of geographical isolation and poverty. Hence, it is somehow reasonable that *Gitanos* spread that sense of kin to the whole community: "here we all are family"; "all *Gitanos* are related, they share some blood, at least a drop of blood for sure"; "distant but relatives". Neighbors, friends and partners are often family as well.

The enforcement of norms—a norm-psychology hypothesis

Regarding norm-enforcement institutions, some Romani groups have formal conflict resolution processes and tribunals. *Gitano* people, however, use more informal systems of justice and adjudication of rights to avoid the escalation of violence and blood feuds (San Román 1986, 2010). Respected elders, typically men (*hombres de razón* or *hombres de respeto*: "men of reason" or "men of respect"), are often asked to mediate. Affinal kin relationships may also limit the extent and seriousness of conflicts, which have been recurrent and feared. Still today a serious conflict (a death) may imply the abandonment of their residences by several hundreds of the closest kin of the accused.

Notwithstanding, *Gitanos*, both males and females but in different socio-political spheres, display a comparatively strong sense of individual autonomy (Gamella 2000, 2011) which, added to the possibility of escalation of conflict between families, may restrict the role of decentralized overt sanctioning unless key norms are transgressed (Piasere 2012, Matras 2015, San Román 2010, Gay Blasco 1999, Álvarez-Roldán et al. 2018). This culture of liberty or resistance, possibly related to the avoidance of conflict between *Gitano* families, should be associated with a low willingness to punish in homogeneous groups if cultural differences are translated into game play as predicted by a norm-psychology account. This proximate-level prediction is indeed in line with the basic prediction of the cultural group selection hypothesis,

which was stated above using an evolutionary perspective. An earlier study with a sample of Spanish *Gitanos* provides preliminary support for this prediction. Brañas-Garza et al. (2006) used ultimatum game experiments to examine sharing and punishment behavior in anonymous one-shot bilateral interactions between *Gitanos* in Vallecas, Madrid. Most of them did not express any willingness to punish stingy co-ethnics (but see Espín et al. 2012, 2015, for combined evidence suggesting that the psychology underlying the rejection of low offers in the ultimatum game may differ from that underlying altruistic punishment in the PGP). Furthermore, a common rationale of *Gitanos* who were unwilling to reject unfair, even zero, offers was, "What if (s)he needs the money?". This suggests that sporadic acts of uncooperativeness carried out by *Gitanos* may not per se be considered by other *Gitanos* as deserving peer punishment.

Gender roles—a norm-psychology hypothesis

In general, *Gitanos* are portrayed as a group that sustains relatively conservative or patriarchal gender relationships, where women are subordinated to fathers and brothers when they are single, and to their husbands and husband's family when married (San Román 2010, Gay Blasco 1999). Care of children, family members and the sick are generally seen as women's primordial tasks, but in this regard there is only a degree of difference with non-*Gitanos* of this area.

However, the considerable agency developed by *Gitano* women in their daily lives, both in the domestic and public realms, is rarely considered. It is often *Gitano* women who confront authorities in administrative matters, and in the defense of their rights to housing, education or public benefits. But they do that somehow as in delegation by their husbands and partners; it is part of their accepted gender roles. In confrontational encounters judged as impersonal, *Gitano* women can be very assertive, and their attitudes are often seen as inadequate by majority standards, as if they were not following the same patterns of modesty and good manners of middle-class Spaniards (Gamella 2000, 2011). This supposed lack of accommodation to their subordinate status is part of the generalized anti-*Gitano* bias that reflects important majority norms; a process also found with respect to anti-Roma bias in Eastern Europe (Kende et al. 2017).

But in personal interactions, or in front of *Gitano* people, the presence of males in public encounters somehow transforms the ways most *Gitano* women will voice their concerns and pursue their interests. There exists a number of principles that *Gitano* women must typically follow in these cases: e.g., "never let him lose face in public" or "never contradict him or the elders publicly". If women decide or influence family decisions, as they often do, their role has to be more private than public, more by applying reason than violence (Gamella 2000, Gamella & Martín 2007). In this sense, while gossiping is a fundamental weapon in the hands of women, violence is seen as the prerogative of males in extreme circumstances (Gay Blasco 1999, San Román 2010). There is obviously a lot of variation among individuals and couples in these gender arrangements and age may also play an important moderating role, but this norm clearly differs with respect to the majority population. Following the norm-psychology account, this cultural difference is hypothesized to be reflected in game behavior in that

Gitano females should be more reluctant (than non-*Gitano* ones and males in general) to punish others in either condition of the experiment, given that *Gitano* males are always present.

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Supplementary Figures

Figure S1. *Contribution decision card (Yellow #1 participant example; translated from Spanish)*

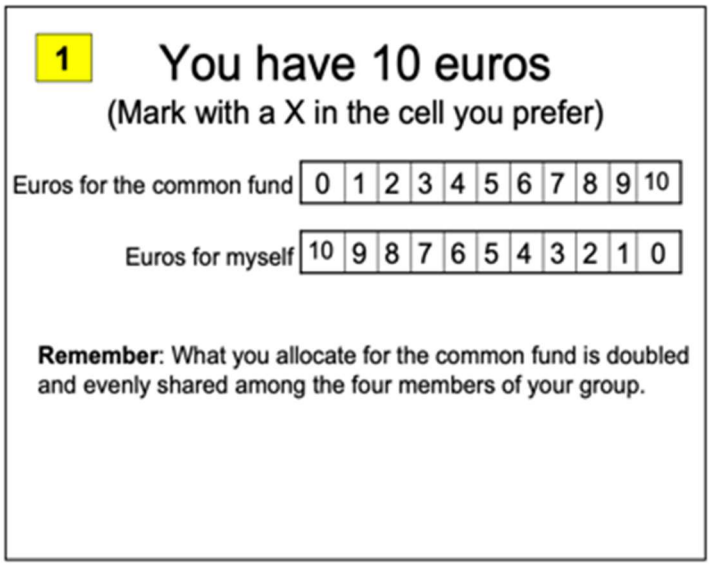

Figure S2. *Punishment decision card (Yellow #1 participant example; translated from Spanish)*