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# Does ethnic diversity always undermine pro-social behavior? Evidence from a laboratory experiment☆

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ABSTRACT

A large body of literature concludes a negative association between ethnic diversity and pro-social behavior. Inspired by the works suggesting that the costly punishment would sustain the contribution level in public goods experiment, we compare the economic behavior of Mongolian- and Han-Chinese and investigate how ethnic diversity would affect contribution, punishment, and the marginal effect of punishment on contribution. We find that the association between ethnic diversity and pro-social behavior is not a simple negative relationship but rather depends on both cultural traits and ethnic fusion when we take punishment opportunity into consideration. Ethnic diversity may help promote contribution, alleviate the punishment level, and increase the efficiency of introducing a punishment mechanism in some circumstances.

## 1. Introduction

Enhancing ethnic cooperation is vital to all countries with ethnic diversity. There has been extensive political economics literature that links high levels of ethnic diversity to low levels of public goods provision, altruistic cooperation, and pro-social behavior (Habyarimana et al., 2007) since the groundbreaking work of Alesina et al. (1999). For example, Miguel and Gugerty (2005) find that ethnic diversity is associated with lower primary school funding and poor maintenance of water well in Kenya. The experimental result from Ferraro and Cummings (2007) reports a higher minimum acceptable offer and hence lower cooperation preference in the Ultimatum Bargaining game session with ethnic composition.

To our knowledge, there has not been literature taking punishment level into consideration. However, punishment is found to be a vehicle for sustaining contribution in the laboratory experiment of Fehr and Gächter (2002). The field experiment by Falk et al. (2019) finds that while poor cooperation of farmers threatens the sustainability of public investment in the rural water infrastructure, a sanctioning mechanism with communication and coordination could support cooperation. Meanwhile, factors such as the potential

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ethnic fusion developed from Han and Mongolian lived together for long, and the ethnic traits whereby different ethnicities may react differently to the punishment mechanism would both potentially reverse the negative association.

In this paper, we compare Mongolian- and Han-Chinese economic behavior in the public good game experimentally and investigate how ethnic diversity would affect contribution, punishment, and the marginal effect of punishment on contribution between the two ethnicities. Punishment opportunity in the public goods game has long been used to capture the tension between personal and social interest since Fehr and Gächter (2000, 2002) first highlights its importance. More importantly, though voluntary contribution reflects cooperation well, the welfare loss from punishment might offset the welfare gain from higher contribution, where the welfare is calculated using cumulative earnings (Nikiforakis and Normann, 2008). To manipulate the ethnic diversity, Han Chinese and Mongolian Chinese are randomly assigned into three treatments. There are thus all-Han Chinese group, all-Mongolian Chinese group, and Mixed ethnicity group that contains half of the subjects from each ethnic group in our implementation of the game.

We find that the association between ethnic diversity and pro-social behavior is not a simple negative relationship. Rather, it depends on the ethnic traits, despite that the negative association does exist in the all-Han treatment, consistent with the prediction from ingroup bias in the existing literature. In our experiment, Mongolian Chinese contribute more and punish less when there is ethnic diversity in the group. An ethnic diversity also boosts punishment efficiency for both ethnic groups. All the above evidence shows that the negative association between ethnic diversity and pro-social behavior does not always hold and highlights the importance of cultural idiosyncrasy when dealing with ethnic diversity-related issues.

Several mechanisms may explain our results.

First, ethnic diversity reduces punishment level in the Mongolian group. In our experiment, Mongolian Chinese have higher expectation on others' contribution and punish harsher at and only at their same-ethnic fellow. This behavioral pattern seems very close to the spirit of the "Anda" tradition. In turn, the introduction of the punishment mechanism to the all-Mongolian group is the least efficient in our experiment.

Second, some ethnic fusion has developed between the two ethnic groups. Cultural fusion refers to the bilateral process where the minority group adopts behaviors of the dominant culture. The dominant culture is also transformed by the minority elements of culture (Croucher and Kramer, 2017). Mongolian Chinese's understanding of Han's culture boosts their contribution in the mixed-ethnic session. We could not validate the bilateral effect of cultural fusion due to the lack of Han Chinese with Mongolian culture in the population and hence the sample.

Both discrepancies point out that ethnic diversity and pro-social behavior are never a simple negative association in a public goods game. Rather, it depends on multiple factors such as cultural traits (e.g., "Anda" tradition) and the extent of interactions between different ethnic groups. Our evidence suggests that instead of treating ethnic diversity and pro-social behavior as a simple negative relationship when dealing with multi-ethnic related issues, the policymakers should have a deep understanding of different ethnicities and implement the measures to create an opportunity for ethnicities to build fusion.

Our study contributes to the existing literature in two ways. We are the first to experimentally investigate the association between ethnic diversity and prosocial behavior by taking the punishment opportunity into consideration. Our result shows that the association between pro-social behavior and ethnic diversity is culturally dependent and can be affected by the long-term interactions between the two ethnicities. Meanwhile, this paper answers Schlee's (2008) questions of whether ethnic affiliation is the factor that causes conflict or political fragmentation. Succeeded on but not limited to Algan et al. (2016), which suggests that ethnic diversity prevents the creation of strong social norms to punish and revenge. Our experimental result suggests that ethnic diversity would boosts contribution and alleviate the punishment level in some community with an established sanctioning mechanism.

## 2. Literature review

This paper is related to three bodies of literature, namely public goods experiment (Isaac et al., 1984), identity effect on economic behavior (Chen and Li, 2009; Li et al., 2011), and culture effect on economic outcomes (Putnam et al., 1994).

Our study is most related to the body of research that explores ethnic diversity and contribution using macroeconomic data. Putnam (2007) suggests that trust, altruism, and community cooperation are rarer in an ethnically diverse neighborhood in the US. Using a general equilibrium growth model, Zak and Knack, 2001 shows that the investment decreases as social heterogeneity increases. Knack and Keefer (1997) highlight the role of trust and point out that trust and civic cooperation are associated with stronger economic performance. The replication work of Putnam (2007) in a West-European country confirms the negative association while did not find the negative effects of neighbor's ethnic diversity on inter-ethnic trust. There is literature that applies the association between ethnic diversity and public good provision on the water resource allocation. Using the empirical data from 667 community water wells in rural western Kenya, Miguel and Gugerty (2005) find a negative association between ethnic diversity and water well maintenance. Compared to an area with homogeneous ethnicity composition, the area with an average ethnic diversity is with 6% lower probability of having a functioning water well. Akramov and Asante (2009) find a negative impact from ethnic diversity on the access to the local public services such as drinking water, using the district and household-level data on the decentralized districts in Ghana. There is also research looks at how cooperation level can be explained by rice versus wheat agriculture in China. Their finding suggests that since paddy rice requires a significant amount of water, the rice-growing southern China has learned to cooperate intensely. They are hence more interdependent than the wheat-growing north who does not have to depend on each other (Talhelm et al., 2014). In contrast with the simple negative association between ethnic diversity and pro-social behavior in macroeconomic literature, our result shows that the association between pro-social behavior and ethnic diversity is culturally dependent and can be affected by the long-term interactions between the two ethnicities. Besides ethnic diversity, language constraints our behavior because, like ethnic diversity, it is part of society's culture that nurtures informal rules (North, 1900). Pendakur and Pendakur (2002) find that language knowledge is

correlated with earning differentials because it is economically functional as a dimension of ethnic identity and commitment.

A related strand of economic literature considers the identity effect on individual behavior. The role of identity on the economic outcomes was first incorporated by Akerlof and Kranton (2000). The prominent examples by Akerlof and Kranton (2002, 2010) later confirmed the role of a "sense of self" by demonstrating how identity would affect individual behavior and alter the economic outcomes made by his belonging group. However, their analysis only investigates the exogenous factor such as ethnicity and age yet exclude the identity choices being a critical confounding factor. Sen (2006) includes identity choice in the consideration and argues that a rational awareness of multiple identities could mitigate ethnic hatred and violence, which would, in turn, affect both individual and group behavior. Our experimental result is consistent with the identity effect. The cooperation level is largely depending on whether subjects being placed in same-ethnic or mixed-ethnic group in our experiment. The effect of "Anda" tradition in Mongolian culture is also prominent on the behavior of Mongolian Chinese.

Our study also contributes to the literature in the public goods game experiment. The public goods game has long been studied since Isaac et al. (1984) and the subsequent evidence from Isaac et al. (1994) on the positive association between group size and voluntary provision of public goods. Although rational choice theory predicts the free-riding behavior as the outcome, early literature has shown that it is still possible where almost all the subjects contribute towards the group interest (see the survey by Ledyard et al. (2001)). By extending the rational choice theory to include notions of social preference, Fehr and Fischbacher (2002) capture the altruistic behavior to explain the voluntary contribution. Charness and Rabin (2002) show that subjects are concerned with increasing social welfare and motivated by reciprocity, where these two social preferences are beneficial to the cooperation level. The role of social preference is then confirmed by Fischbacher and Gächter (2005). There are also researches studying the role of voluntary punishment in maintaining the private provision of the public good. Fehr and Fischbacher (2002) point out that subjects care positively or negatively for the material payoffs of relevant reference agents, where the combination of reward and punishment could preserve the contribution of the public good. Yang et al. (2018) embeds a peer reward system in which it reverses the downward contribution trend of standard public goods game and achieves a high level of contribution without the support of external funding. Xiao and Houser (2005) suggest that costly punishment might itself be used to express negative emotions. The existing study also suggests the negative role of ambiguity (Dai et al., 2015) and positive role of overconfidence (Yin et al., 2019) in the contribution.

Finally, our research adds to the literature regarding the economic behavior across Chinese ethnic groups. Chen and Tang (2009) report a comparison of the ultimatum game (UG) bargaining behavior between Tibetans and ethnic Han Chinese. They find that Tibetans are more likely to accept offers in the ultimatum game, but their decisions are unrelated to actual offer size. There are also studies compare how gender differences affect economic behavior between the Matrilineal Mosuo and the Patriarchal Yi (Gong and Yang, 2012; Gong et al., 2015). This paper compares contribution and punishment behavior in the public goods game between Han Chinese and Mongolian Chinese, focusing on identifying how cultural traits affect the contribution level.

## 3. Experimental design and testable hypotheses

Our experimental design focuses on studying how ethnic diversity affect the contribution and punishment in the public good game, following the setup of Fehr and Gächter (2002). Ethnic diversity is manipulated by constructing single-ethnicity and mixed-ethnicity session with Han[1]- and Mongolian- Chinese subjects. We then measure how the marginal effect of punishment on contribution varies with regards to ethnic diversity. A post-experiment questionnaire controls the baseline demographic characteristics of subjects.[2] Table 1 summarizes the treatments manipulating ethnicity diversity within a group. Table 2 summarized subjects played with *and* without punishment in public goods games, each for ten periods.

We first describe the stage without punishment opportunity. In each period $t$ ($t = 1, \ldots, T$), each of the $n = 4$ subjects in a group receives an endowment of $y = 20$ tokens. A subject must choose how to allocate the investment between the private good and the public good. The marginal return of private goods is 1, while the marginal return of public goods is $a$. Hence, the profit of subject $i$ ($i = 1, \ldots, n$) in the period $t$ during the without-punishment condition is hence:

$$\pi_i^{t_1} = y - g_i^t + a\sum_{j=1}^{n} g_j^t,\ 0 < a < 1 < na \tag{1}$$

The major difference between with-punishment and the without-punishment condition is the addition of a second decision part, right after the simultaneous contribution decision being revealed to every member in each period. Group member $j$ can choose to punish group member $i$ voluntarily by purchasing punishment point $p_{ji}$, at the cost of 1 token to $j$. For each punishment point assigned to $i$, the first-part payoff of subject $i$, $\pi_i^{t_1}$, will be reduced by three units. However, the first-part payoff of subject $i$ can never be reduced below zero. Note that in each period, every member must own a non-negative number of tokens. They are not allowed to make any decisions that would lead to bankruptcy.

Hence, the payoff of subject $i$ period $t$ during stage 2 is written as:

[1] We conducted an additional clear-cut all-Han treatment as robustness check as suggested by one of our referees. The details can be found in Appendix E.

[2] The questionnaire asks subjects about their age, gender, year of study, place of birth, Hukou, nomadic experience, and information on the living culture since childhood. See Appendix D for details.

**Table 1**
Treatment conditions on ethnicity structure.

| No. | Treatment | Number of Participants | Total Number of Groups (Observations) |
|---|---|---|---|
| 1 | all-Han | 24*3 | 18 |
| 2 | all-Mongolian | 24*3 | 18 |
| 3 | Mixed | 24*3 | 18 |

**Note:** Mixed denotes that there are half of the subjects whose is Han-Chinese and other half of the Mongolian-Chinese in one group.

**Table 2**
Treatment conditions on punishment opportunity.

| Stage | Experiment | Endowment | Investment return rate | Show-up Fee | Punishment |
|---|---|---|---|---|---|
| 1 | Without Punishment | 20 | 0.4 | 10 | N.A. |
| 2 | With Punishment | 20 | 0.4 | 10 | Voluntary |

$$\pi_i^{t_2} = \max\left\{\pi_i^{t_1} - \sum_{j\neq i} 3p_{ji}^t - \sum_{j\neq i} p_{ij}^t, 0\right\} \tag{2}$$

The standard null hypothesis is that contribution, punishment, and punishment on contribution are not affected by ethnic diversity. We formulate this as follows:

**Hypothesis 1**. Ethnic diversity does not affect the level of contribution in a public goods game.

**Hypothesis 2**. Ethnic diversity does not affect the level of punishment.

**Hypothesis 3**. Impact of punishment opportunities on the public goods contribution remains the same among each ethnic group with different ethnic diversity.

## 4. Experimental results

The experiment was conducted at the Lab for Behavioral & Experimental Economics (BEE) at Inner Mongolia University (IMU). A total of 216 undergraduate subjects[3] (108 Mongolian Chinese, 108 Han Chinese) were recruited by BEE (using the WeChat recruitment system, posters, etc.). Each session lasted 40 min on average. The average earnings (including a show-up fee of 10 RMB) were 40 RMB. The experiment was conducted in a computerized laboratory where subjects anonymously[4] interacted with each other.

We follow Fehr and Gächter (2002) to test the social preference of our subjects. The experiments were conducted with experimental software "z-Tree" developed by Urs Fischbacher (2007). A total of 216 subjects were randomly allocated into nine sessions, where 24 of them will participate in the experiment, with the remaining two served as a reserve. Candidates who do not participate in the experiment will leave the lab with a payment of 20 RMB.

Each subject played two 10-period public goods games, firstly a public good game without-punishment, and then a public good game with-costly punishment.[5] The instruction showed in Appendix A explains the payoff structure, random re-composition of groups across periods, anonymity of identities, history, and payment. We test subjects' understanding of payoff structure in each treatment by asking them to compute the payoff of a hypothetical player and his group members in several examples, as shown in Appendix C, before the beginning of each treatment stage. Subjects could not proceed to the game until they answered all the control questions correctly. In each period, subject needs to indicate both his/her contribution to the public good, and the expectation on the mean contribution by the other three group members ("expectation on the group member").

Subjects made their investment decisions simultaneously. Double anonymity in this experiment ensures that both members and experimenters were not informed by any subjects' identity. They were then required to complete a respondent questionnaire. At the end of the experiment, subjects were privately paid according to their total amount of tokens endowed and earned using an exchange rate of 0.05 RMB per token (i.e., 20 tokens = 1 RMB). Each subject collects their earnings alone with their unique trial number in a separate room. As shown in Table 3, there are nine sessions in total, where each subject is only allowed to take part in one of the sessions.

[3] Students share diversified discipline of studies in our experiment (the subjects pool cover students studying engineering, science, social science, literature, etc.).

[4] Roles and seats were randomly assigned to the subjects.

[5] Instructions for both stage 1 and stage 2 highlight the ethnicity composition, as showed in Appendix A. The two instructions were both read aloud by the experimenter. The instructions for the without punishment and with punishment conditions are provided *separately*. Subjects receive only the without-punishment instruction after completing the informed consent form, where they did not know about the upcoming with-punishment stage. The instruction for the with-punishment stage is handed out to subjects after all the subjects have completed stage 1 before moving to stage 2.

**Table 3**
Experiment sessions.

| Sessions | Time (Year of 2017) | Place | Number of Participants | Session No. |
|---|---|---|---|---|
| 1 | 27 November, 19:00–20:00 | IMU-BEE | 24 | 1 |
| 2 | 28 November, 19:00–20:00 | IMU-BEE | 24 | 2 |
| 3 | 29 November, 19:00–20:00 | IMU-BEE | 24 | 1 |
| 4 | 30 November, 15:00–16:00 | IMU-BEE | 24 | 1 |
| 5 | 30 November, 19:00–20:00 | IMU-BEE | 24 | 3 |
| 6 | 01 December, 15:00–16:00 | IMU-BEE | 24 | 2 |
| 7 | 01 December, 19:00–20:00 | IMU-BEE | 24 | 2 |
| 8 | 05 December, 19:00–20:00 | IMU-BEE | 24 | 3 |
| 9 | 08 December, 19:00–20:00 | IMU-BEE | 24 | 3 |

Table 4 provides descriptive statistics of different ethnic groups. Han-Chinese and Mongolian-Chinese subjects' average age is roughly the same (at about 21 years old). Mongolian Chinese subjects have higher Mongolian proficiency level on average.[6] Most of the Mongolian Chinese subjects grow up in Mongolian culture.

### 4.1. Contribution

**Result 1:** We reject Hypothesis l and conclude both ethnicity and ethnic diversity affect contribution on the public goods contribution. Ingroup bias plays an important role in Han Chinese contribution. Ethnic fusion is observed to dominate ingroup bias on Mongolian Chinese's with-punishment contribution behavior, where those with Han culture contribute more when placed in a group with ethnic diversity.

#### 4.1.1. Without-punishment condition

**Result 1(a):** Only Han Chinese contributes less when in a group with ethnic diversity in the without-punishment condition. The two ethnicities react about the same towards a group with ethnic diversity, compared with when they are playing with same-ethnic fellow.

As a baseline check, we compare the mean contributions in the without-punishment condition across different treatments. The overall contribution level of Mongolian treatment (treatment with only Mongolian Chinese, "all-Mongolian") and Han treatment (treatment with only Han Chinese, "all-Han") is about the same in the absence of punishment opportunity. all-Han contributes 4.82, and all-Mongolian contributes 4.79. The difference is not statistically significant at 10% level ($p = 0.9126$).

We move on to the support for result 1(a), which is presented in Fig. 1 and Table 5. The contribution level in the mixed treatment (treatment with half Han Chinese and half Mongolian Chinese in one market, "Mixed") is lower than all-Han ($p < 0.0001$)[7] and all-Mongolian ($p < 0.0001$). Both Han Chinese and Mongolian Chinese in the Mixed contribute less than their counterpart in the single-ethnic group ($p < 0.01$).

Table 6 presents the OLS regression result. Column (1) and (2) analyze Mongolian and Han Chinese subsample, and the result is consistent with the summary statistics. *Mixed* is a dummy variable indicating whether a treatment is of Mixed ethnic groups or composed of a single ethnic group only (i.e., Mixed = 0 for all-Mongolian and all-Han = 0). Males and females are found to react differently in cooperation and other behaviors (Charness and Rustichini, 2011; Galasso and Nannicini, 2016), and hence we control gender variable in all our regressions. Only Han-Chinese reveal a 5% statistically significant association between contribution and ethnic diversity, after controlling for gender and age. Han-Chinese contributes more when playing with the same-ethnic fellow, while the contribution of Mongolian Chinese is unaffected by ethnic diversity.

Column (3)–(6) presents the pooled OLS analysis with all the variables and data in our sample. Mixed ethnic session always has lower-level contribution in all our models. In sum, we can conclude that both ethnicity and ethnic component within the group affect the contribution in the without-punishment treatment.

#### 4.1.2. With-punishment condition

**Result 1(b)**: Han Chinese contribute less in the mixed-ethnic group. Mongolian Chinese contribute more when in a group with ethnic diversity in the with-punishment condition. Mongolian Chinese makes significantly more contribution in a group with ethnic-diversity than playing with same-ethnic fellow, compared to Han Chinese.

In this part, we evaluate the contribution level by different ethnicities when punishment opportunity is available. Support for result 1(b) is presented in Fig. 2 and Table 7. The contribution level in the Mixed is lower than in the all-Han ($p<0.0001$) but higher in the all-Mongolian treatment ($p<0.0001$). Han Chinese contributes less in the Mixed ($p<0.0001$) while Mongolian Chinese contributes more when there is ethnic diversity in the group ($p<0.0001$).

Table 8 presents the OLS regression result. Column (1) and (2) analyze Mongolian and Han Chinese subsample, and the result is consistent with the summary statistics. The association between contribution and ethnic diversity is 5% significant positive for

[6] Since Han Chinese has no proficiency on Mongolian language, we exclude this factor from all our analysis.
[7] We use two tail *t*-test to examine the difference in this paper.

**Table 4**
Summary statistics.

| | Full sample | | | Han Chinese | | | Mongolian Chinese | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | SD | N | Mean | SD | N | Mean | SD | N |
| Age | 20.82 | 2.19 | 216 | 21.02 | 2.40 | 108 | 20.63 | 1.94 | 108 |
| Gender (female = 1)[a] | 0.77 | 0.42 | 216 | 0.73 | 0.44 | 108 | 0.81 | 0.40 | 108 |
| Native Language (Mongolian = 1) | 0.33 | 0.47 | 216 | 0.00 | 0.00 | 108 | 0.66 | 0.47 | 108 |
| Mongolian Proficiency (0–5) | 3.64 | 1.87 | 216 | 0.00 | 0.00 | 108 | 2.29 | 1.83 | 108 |
| Culture (Mongolian = 1) | 0.33 | .47 | 216 | 0.02 | 0.13 | 108 | 0.65 | 0.48 | 108 |

[a] We are aware that there is a dominant female percentage of subjects. Previous research has found that females are more likely to contribute initially and have a higher tendency to behave more like each other throughout the game (Cadsby and Maynes, 1998). However, there is no significant difference in the gender composition between the two treatments (female subjects composed of 73% of Han Chinese and 81% of Mongolian Chinese), implying successful randomization in our experiment. Therefore, the effect from dominant female subjects should cancel out, given that we have a balanced gender component *across* Han Chinese and Mongolian Chinese treatments. To further address the concern in the dominant female percentage of subjects, we control gender in all our analyses.

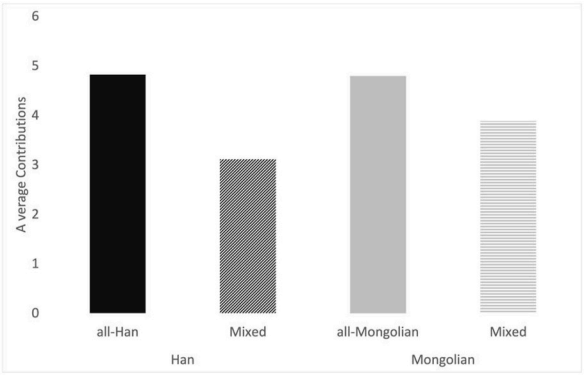



**Fig. 1.** Mean contributions in the without-punishment condition.

**Table 5**
Mean Contributions in the without-punishment Condition.

| Treatment | All samples | Han Chinese | Mongolian Chinese |
|---|---|---|---|
| all-Han | 4.82 [72] | 4.82 [72] | 0.00 [0] |
| all-Mongolian | 4.79 [72] | 0.00 [0] | 4.79 [72] |
| Mixed | 3.50 [72] | 3.11 [36] | 3.88 [36] |

**Note**: Sample size in bracket.

Mongolian Chinese, while turns into marginally significant for Han Chinese (Model 1 and 2).

Column (3)–(6) presents the pooled OLS analysis with all the variables and data in our sample. According to model (6), a significant gap between Han and Mongolian Chinese of 2.556 on the response to ethnic diversity is observed from the interaction term. More specifically, Han Chinese is parsimonious in the Mixed by contributing 1.328 lower unit than their counterpart in the same-ethnic group. In contrast, Mongolian Chinese are generous when playing in the Mixed, where they contribute 1.228 unit more than their counterpart in the same-ethnic group We will explore the mechanism in Section 4.1.4 by looking more closely at the cultural background of the subjects. Other than that, we can conclude that both ethnicity and ethnic component within the group affect the contribution in the with-punishment treatment.

#### *4.1.3. Dynamic result as a robustness check*

The evolution of contributions over time for different treatments (Fig. 3) is consistent with our findings in the static state. In the without-punishment condition, all-Han and all-Mongolia's dynamic average contribution is roughly the same, where both are higher than that of Mixed treatment. When punishment is possible, contribution by Mixed is in between all-Mongolian (lowest) and all-Han (highest).

Figs. 4 and 5 distinguish the dynamic average contribution by different ethnic groups. Under the without-punishment condition, single ethnic group treatment always contributes more than Mixed (except for the last period). Under the with-punishment condition, Han Chinese consistently contribute more in the all-Han than in the Mixed, while Mongolian Chinese contribute a lower level of dynamic average in all-Mongolian except the first two periods of the game.

**Table 6**
Determinants of contribution in the without-punishment condition — regression results.

| Contribution | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Mongolian Chinese | Han Chinese | Full Sample Pooled Regression | | | |
| **Mixed** | **−0.919 (0.650)** | **−1.627** (0.707)** | −1.306*** (0.489) | −1.306*** (0.488) | −1.263** (0.491) | −1.678** (0.717) |
| Mongolian | | | | 0.236 (0.433) | 0.271 (0.619) | −0.0339 (0.674) |
| Mixed × Mongolian | | | | | | 0.839 (0.950) |
| Control (gender, age, cultural background) | YES | YES | NO | NO | YES | YES |
| $N$ | 1080 | 1080 | 2160 | 2160 | 2160 | 2160 |
| $R^2$ | 0.025 | 0.046 | 0.016 | 0.016 | 0.026 | 0.028 |
| Adjusted $R^2$ | 0.0213 | 0.0428 | 0.0153 | 0.0155 | 0.0241 | 0.0253 |
| F | 1.345 | 3.380 | 7.131 | 3.813 | 2.569 | 2.223 |
| Number of Clusters | 108 | 108 | 216 | 216 | 216 | 216 |

**Note**: robust standard error in parenthesis. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Standard errors are corrected for clustering at the subject level (of 216 or 108). Model 1, 2, 5, and 6 additionally controls for gender, age, and cultural background.

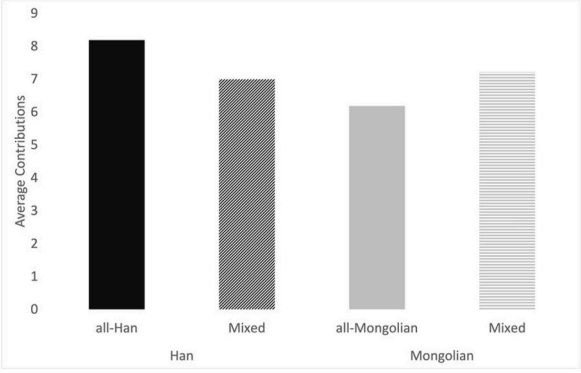



**Fig. 2.** Mean contributions in the with-punishment condition.

**Table 7**
Mean contributions in the with-punishment condition.

| Treatment | All Samples | Han Chinese | Mongolian Chinese |
|---|---|---|---|
| all-Han | 8.18 [72] | 8.18 [72] | 0.00 [0] |
| all-Mongolian | 6.18 [72] | 0 [0] | 6.18 [72] |
| Mixed | 7.10 [72] | 6.99 [36] | 7.21 [36] |

Note: Sample size in bracket.

#### *4.1.4. Potential mechanism of contribution discrepancy*

We have showed that ethnic diversity does play a role in the contribution of the public good game, and the effect also differentiates with regards to different ethnicities. We move on to provide some mechanisms behind the finding.

To our knowledge, there are mainly two competing mechanisms that could affect the economic behavior in our experiment, namely cultural fusion and ingroup bias. Cultural fusion refers to the bilateral process where the minority group adopts behaviors of the dominant culture. The dominant culture is also transformed by the minority elements of culture (Croucher and Kramer, 2017). On the other hand, ingroup bias refers to the tendency of evaluating one's group more favorably than groups to which one does not belong. This effect has been commonly investigated since Ruffle and Sosis (2006) first investigate how it could affect cooperation in the economic discipline. In a mixed-ethnic group, we would expect to see a higher-level contribution if cultural fusion dominates but a lower level if ingroup bias dominates.

As presented in Table 9, Han Chinese always contributes more in the same-ethnic group ($p < 0.0001$) in both without- and with-punishment group. This implying a strong ingroup bias in the Han Chinese contribution behavior.

The effect of culture is with 5% significance in half of analysis. Among all, cultural fusion plays a significant role in the mixed-ethnic treatment's contribution level, where Mongolian Chinese contribute more under both with and without punishment conditions when

**Table 8**
Determinants of with-punishment Contribution — Regression Results.

| Contribution | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Mongolian Chinese | Han Chinese | Full Sample Pooled Regression | | | |
| **Mixed** | **1.225** (0.600)** | **−1.265*** (0.652)** | −0.0919 (0.453) | −0.0896 (0.455) | −0.0606 (0.462) | −1.328** (0.653) |
| Mongolian | | | | −1.275*** (0.370) | −1.211** (0.524) | −2.145*** (0.524) |
| Mixed × Mongolian | | | | | | 2.566*** (0.877) |
| Control (gender, age, cultural background) | YES | YES | NO | NO | YES | YES |
| *N* | 972 | 972 | 1944 | 1944 | 1944 | 1944 |
| Number of Clusters | 108 | 108 | 216 | 216 | 216 | 216 |

**Note**: Robust standard error in parenthesis. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Standard errors are corrected for clustering at the subject level (of 216 or 108). Model 1, 2, 5, and 6 additionally controls for gender, age, and cultural background. All models control for punishment received from last period.

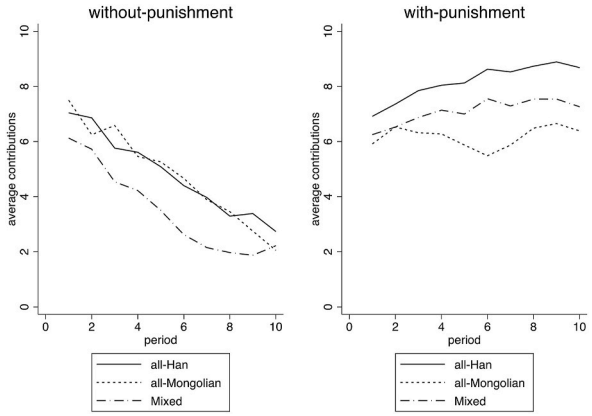



**Fig. 3.** Average contributions over time.

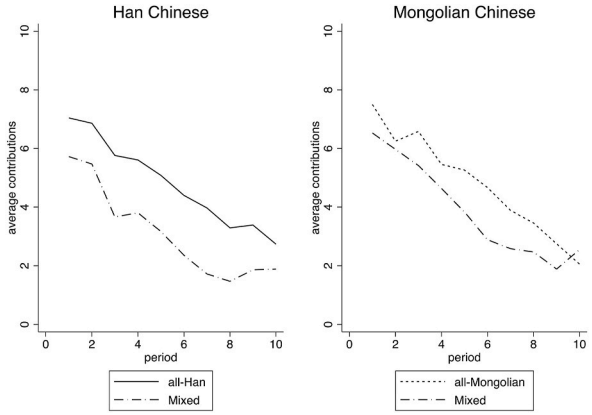



**Fig. 4.** Average contributions over time in the without-punishment condition.

they have some understanding of the Han Culture (row 4 and row 9).

Note that only those Mongolian Chinese with Han culture contribute 1.95 unit significantly more in the Mixed session ($p < 0.001$) when punishment is possible. In the rest cases where Mongolian with Mongolian culture or when they are placed under without-punishment condition, we do not observe a significant positive association between ethnic diversity and contribution. Hence, we can safely conclude that it is the understanding of Han culture makes Mongolian Chinese being generous in the mixed-ethnic group.

We are aware that ethnic fusion should be a bilateral effect from two ethnic groups. The zero-sample-size of Han Chinese with Mongolian culture is due to the lack of this type in the population. First, Han dominates about 91.5% of the population despite that

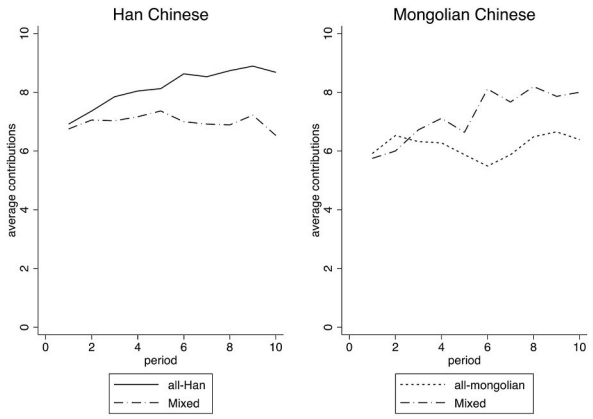



**Fig. 5.** Average contributions over time in the with-punishment condition.

**Table 9**
The role of Mongolian Culture on the Contribution Behavior.

| Condition | Treatment | | Mongolian Culture | Han Culture | p-value |
|---|---|---|---|---|---|
| Mean contribution without punishment | all-Han | | 8.65 [2] | 4.71 [70] | 0.0004*** |
| | all-Mongolian | | 4.82 [50] | 4.72 [22] | 0.7912 |
| | Mixed | Overall | 3.41 [20] | 3.53 [52] | 0.7744 |
| | | **Mongolian** | **3.41 [20]** | **4.46 [16]** | **0.0431**** |
| | | Han | [0] | 3.11 [36] | |
| Mean contribution with punishment | all-Han | | 10.80 [2] | 8.10 [70] | 0.0003*** |
| | all-Mongolian | | 6.25 [50] | 6.02 [22] | 0.4340 |
| | Mixed | Overall | 6.60 [20] | 7.29 [52] | 0.0618* |
| | | **Mongolian** | **6.60 [20]** | **7.97 [16]** | **0.0031***** |
| | | Han | [0] | 6.99 [36] | |

**Note**: Sample size in bracket. *** $p<0.01$, ** $p<0.05$, * $p<0.1$, using two-tail $t$-test.

China is a multiethnic society with 56 officially recognized ethnicities. Second and more important, Jia and Persson (2020) find that the material benefit (i.e., ethnic policies in which government gives policy favors to minorities) dominates the identity costs and social regulation of breaking the norm of following father's Han ethnicity. This material benefit increases the propensity for the half-Han-half-minority family to choose minority as the child's ethnicity. Those Mongolian Chinese with minority background and culture will hence more likely to be registered as the Mongolian Chinese (instead of Han Chinese) for the material benefit. The above mechanisms lead to the result that Han Chinese with minority background is a scarcity in nature.

Understanding Mongolian culture also encourage Han Chinese to contribute (row 1 and 6) when play with same-ethnic fellows, although this result suffers from the problem of imbalance sample problem.

The result from formal regression in Table 10 is in line with mean comparison. More specifically in a mixed-ethnic group, Mongolian Chinese with Han culture contribute more especially in the with-punishment condition. Note that Mongolian Chinese does not always contribute more in the Mixed, as only those Mongolian Chinese with Han culture in the with-punishment condition contribute more when playing in the mixed-ethnic group. We see either a lower level or no difference contribution in other cases, similar as our finding in the mean comparison. We hence safely to conclude a one-way ethnic fusion: understanding Han culture teaches Mongolian Chinese to contribute more in the mixed-ethnic group. We did not conduct regression on Han Chinese contribution because of zero-

**Table 10**
The role of Mongolian Culture on the Contribution Behavior — Regression Result.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Without-punishment | | With-Punishment | |
| Mongolian Chinese Contribution | Mongolian Culture | Han Culture | Mongolian Culture | Han Culture |
| **Mixed** | **−1.494*** | **0.0882** | **0.649** | **2.303***** |
| | **(0.770)** | **(1.089)** | **(0.789)** | **(0.870)** |
| Control | YES | YES | YES | YES |
| *N* | 700 | 380 | 630 | 342 |
| Number of Clusters | 70 | 38 | 70 | 38 |

**Note**: Robust standard error in parenthesis. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Standard errors are corrected for clustering at the subject level. All models control for gender, age, and punishment received from last period.

sample-size problem.

### 4.2. Punishment

**Result 2**: We reject Hypothesis 2 and conclude that ethnic diversity has significant effects on the punishment behavior. The "Anda" tradition in Mongolian culture makes Mongolian Chinese expect more and punish harsher, but only at their same-ethnic fellow.

#### 4.2.1. Effect of ethnic diversity on punishment behavior

Fig. 6 and Table 11 presents the overall punishment level across treatments. Compared with their counterpart in the Mixed, Mongolian Chinese punish harsher but contribute less (Result 1b) when playing with their same ethnic fellow ($p < 0.001$). Han Chinese also punishes more harshly in the same-ethnic session, yet the difference is not significant ($p = 0.1396$).

We hypothesize that the punishment discrimination from Mongolian Chinese is due "Anda" relationship[8] (i.e., a blood brotherhood relationship formed by unrelated men), which is an important complement to the patriarchal kin-based Mongol society (Atwood, 2004; Birtalan, 2007). In this context, Mongolian Chinese set a default expectation on within-ethnic consolidation by expecting their Mongolian to contribute at a higher level. Anyone who breaks the commitment by contributing less will in turn be punished severely. However, they only expect their Mongolian fellow to keep "Anda" but not non-Mongolian. Given the significant role of "Anda" relationship in the Mongolian society, the harsher punishment may also be the corresponding mechanism formed by the Mongol society to maintain longer-term cooperation.

We test the above hypothesis by comparing subjects' actual contribution ("actual contribution") with their expectation on the average contribution by the other three group members ("expectation on the group member"). According to Figs. 7 and 8, there is a substantial gap between actual and expected contribution in Mongolian treatment, and this gap is at its largest under the with-punishment treatment. This result supports our hypothesis that Mongolian Chinese tend to expect a higher contribution from their Mongolian fellow.

#### 4.2.2. Potential mechanism of punishment discrimination

The result from last section shows that both Han- and Mongolian- Chinese tend to impose more punishment on the single-ethnic fellows. The punishment discrimination is most severe on Mongolian Chinese, which is the result of "Anda" relationship.

To have a closer analysis on the role of Mongolian culture, we reanalyze the effect of ethnic diversity on punishment by taking whether subjects have Mongolian culture background into the consideration.

As presented in Table 12 and consistent with our finding from the last section, the Mongolian culture (i.e., "Anda") encourages Mongolian Chinese to punish harsher at their same-ethnic fellow (row 2). However, Mongolian Chinese's Anda culture does not impose this high expectation when they know that the group mates may be Han Chinese (row 4).

#### 4.2.3. Regression analysis: potential mechanism of punishment discrimination

Table 13 presents the OLS result of how ethnic diversity affects the punishment behavior for Han Chinese and Mongolian Chinese.

The expectation discrepancy in the all-Mongolian session is 1.350 higher than that of mixed-ethnic group, implying that Mongolian Chinese place a higher expectation on their same-ethnic fellow (model 1). This result is also in line with Figs. 7 and 8.

Among all, Mongolian Chinese punish harshest on their same-ethnic fellow for every unit of mean group contribution's deviation from their own. This is because the coefficient for *diff* is at the largest in the sample of Mongolian Chinese in all-Mongolian, indicating that Mongolian Chinese punish his same-ethnic fellow 0.185 unit of each deviation.

Consistent with our mean comparison in 4.2.1, both Mongolian Chinese and Han Chinese punish less harshly on each unit of deviation when there is ethnic diversity in the group (row 1). The difference of the coefficient of *diff* (same-ethnic group - Mixed) in is larger in Mongolian Chinese (0.1097) compared with that of Han Chinese (0.0078), implying that the punishment discrimination for each unit of deviation on the same-ethnic group is 0.1019 larger of Mongolian Chinese, compared to Han Chinese.

According to row 4, Mongolian culture makes Mongolian Chinese punish more severely controlling for the level of deviation of other group members from his own contribution (i.e., *diff*), when playing with their Mongolian fellow. Yet this culture does not seem to have effect when Mongolian Chinese playing against Han Chinese. This result is in line with the "Anda" tradition where Mongolian Chinese do not place the high expectation on Han Chinese, while expect more and punish harsher on same-ethnic fellow.

Finally, only Han Chinese in Mixed impose punishment on subjective belief (i.e., *discrepancy*) of their group mates ($p < 0.1$), and we do not find Han Chinese in all sessions impose punishment based on *diff*. On the other hands, Mongolian Chinese always impose punishment based on the deviation of other group members from his own contribution (i.e., *diff*) instead of subjective belief.

### 4.3. The impact of punishment opportunities on the public good contribution

**Result 3**: We reject Hypothesis 3 and conclude that ethnic diversity boosts punishment efficiency in both ethnic groups. Punishment is inefficient only in the all-Mongolian session, which is in line with the findings that Mongolian Chinese respond to "Anda

[8] The Turko-Mongolic term "Anda" designates one of the key phenomena of the formation of tribal confederations among the early thirteenth-century Mongols. In the contemporary indigenous and foreign historical sources, entering into an "Anda" relationship signifies a two-sided coalition of two males, usually clan or tribal chieftains, who after a ritual sealing of the alliance align to each other in military and political affairs.

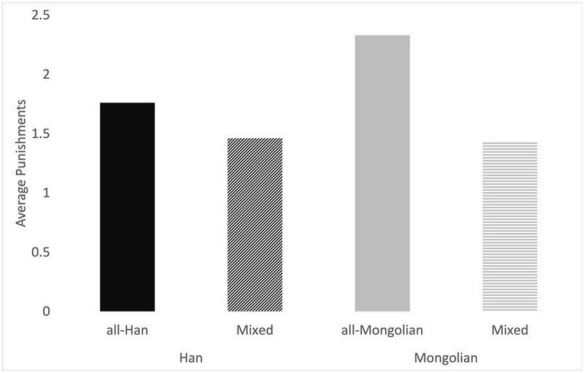



**Fig. 6.** Mean punishment.

**Table 11**
Mean punishment across treatments.

| Treatment | All samples | Han Chinese | Mongolian Chinese |
|---|---|---|---|
| all-Han | 1.76 [72] | 1.76 [72] | 0 [0] |
| All Mongolian | 2.33 (72] | 0 [0] | 2.33 [72] |
| Mixed | 1.44 [72] | 1.46 [36] | 1.43 [36] |

**Note:** Sample size in the bracket.

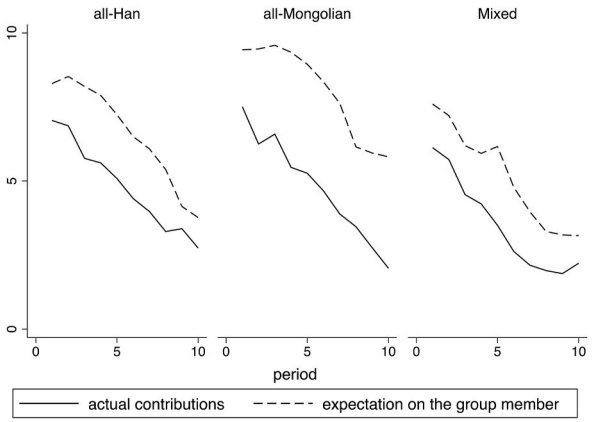



**Fig. 7.** Actual and Expected contribution under the without-punishment condition.

tradition" and punish harshly on their same-ethnic fellow.

Due to punishment being costly for both punishers and the punished individuals, punishment may not always be desirable. A higher punishment level may not necessarily lead to a higher contribution to public goods. Even if there is a higher level of contribution, the welfare loss from punishment might offset the welfare gain from higher contribution, makes the punishment opportunity inefficient from the social welfare perspective. In this section, we look at the marginal effect of punishment on social welfare and examine how this marginal effect varies with regards to the ethnic composition within a group.

We examine how one unit of punishment changes the contribution level on average. More specifically, we divide the difference on the average contribution in the with- and- without-punishment condition by the average punishment received by all groups during all periods in one treatment. Mathematically, the marginal effect (ME) is done using the following formula:

$$ME = \frac{Average\ Contribution\ with\ Punishment - Contribution\ without\ Punishment}{Average\ punishment\ received}$$

We declare that punishment is undesirable if marginal effect is less than 0, and inefficient if the marginal effect is less than 1 (i.e., one unit of punishment leads to less than 1 unit of contribution).

Table 14 shows the result. First, the punishment is desirable, where punishment behavior always leads to a higher contribution, as the marginal effect in all the cases is always positive. Our result follows the result from the existing literature that if the with-

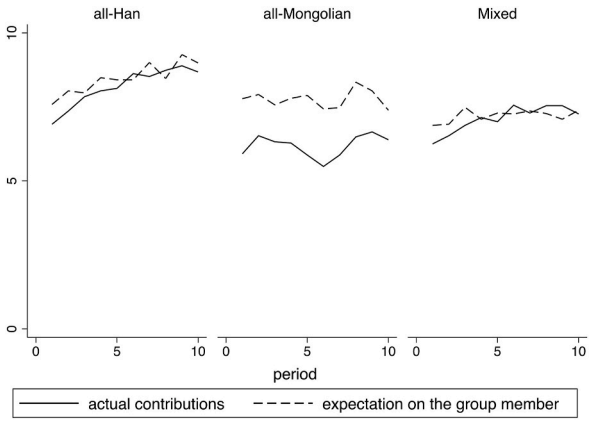



**Fig. 8.** Actual and Expected contribution under the with-punishment condition.

**Table 12**
The role of Mongolian Culture on the Punishment Behavior.

| Condition | Treatment | | Mongolian Culture | Han Culture | p-value |
|---|---|---|---|---|---|
| Punishment | all-Han | | 4.85 [2] | 1.67 [70] | 0.0000*** |
| | all-Mongolian | | 2.79 [50] | 1.28 [22] | 0.0000*** |
| | **Mixed** | Overall | 1.36 [20] | 1.48 [52] | 0.5521 |
| | | **Mongolian** | **1.36 [20]** | **1.51 [16]** | **0.4982** |
| | | Han | [0] | 1.46 [36] | |

**Note**: Sample size in bracket. *** $p<0.01$, ** $p<0.05$, * $p<0.1$, using two-tail $t$-test.

**Table 13**
Determinants of punishment behavior — regression results.

| Punishment | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | discrepancy | Mongolian Chinese in all-Mongolian | Mongolian Chinese in Mixed | Han Chinese in all-Han | Han Chinese in Mixed |
| diff | | **0.185*** (0.0532)** | 0.0753** (0.0336) | 0.0749 (0.0452) | 0.0671 (0.0534) |
| all-Mongolian | **1.350** | | | | |
| | **(0.608)** | | | | |
| all-Han | 0.322 (0.686) | | | | |
| Mongolian Culture | 0.264 (0.710) | **1.183** (0.545)** | −0.0494 (0.376) | 1.901 (2.367) | omit |
| discrepancy | | 0.0819 (0.0924) | −0.00786 (0.0451) | −0.0426 (0.0802) | 0.0899* (0.0485) |
| Control | YES | YES | YES | YES | YES |
| *N* | 6480 | 2160 | 1080 | 2160 | 1080 |
| $R^2$ | 0.035 | 0.077 | 0.050 | 0.076 | 0.033 |
| Adjusted $R^2$ | 0.0346 | 0.0750 | 0.0459 | 0.0739 | 0.0294 |
| F | 1.592 | 4.103 | 3.056 | 1.478 | 1.130 |
| Number of Clusters | 216 | 72 | 36 | 72 | 36 |

**Note:** Robust standard error statistics in parenthesis. ***$p < 0.01$, **$p < 0.01$, *$p < 0.1$. Standard errors are corrected for clustering at the subject level. diff denotes punished subjects' deviation from the group members' mean contribution (i.e., *diff* = own contribution − mean contribution from group members); *discrepancy* denotes the gap between his/her expectation on the average contribution by the other three group members and his/her own contribution (i.e. *discrepancy* = belief – contribute). All models control for gender, age, and ethnicity.

**Table 14**
Social welfare of punishment across treatments.

| Treatment | All Samples | Han Chinese | Mongolian Chinese |
|---|---|---|---|
| all-Han | 1.91 [72] | 1.91 [72] | 0.00 [0] |
| all-Mongolian | 0.597 [72] | 0 [0] | 0.597 [72] |
| Mixed | 2.50 [72] | 2.66 [36] | 2.33 [36] |

Note: Sample size in bracket.

punishment stage is introduced after the without-punishment stage, the punishment will encourage the contribution behavior (Fehr and Gächter, 2002).

Second, the punishment is efficient in the all-Han (ME = 1.91) and Mixed treatment (ME = 2.50) but being inefficient in all-Mongolian treatment (ME = 0.597). The result on the inefficiency of the latter group is in line with our finding that Mongolian Chinese responds to "Anda tradition" and punish harshly on their same-ethnic fellow.

On the other hand, an introduction of ethnic diversity boosts the punishment efficiency on social welfare for both Han Chinese and Mongolian Chinese, according to row 3 of the table. The marginal effect of punishment is a bit stronger on Han Chinese than Mongolian Chinese in the Mixed group.

## 5. Conclusion

We compare Mongolian- and Han-Chinese economic behavior in the public good game experimentally and investigate how ethnic diversity would affect contribution, punishment, and the marginal effect of punishment on contribution between the two ethnicities. There have been extensive literature links high levels of ethnic diversity to low levels of public goods provision. To our knowledge, there has not been literature taking punishment level into consideration. However, punishment is found to be a vehicle for sustaining contribution in the laboratory experiment of Fehr and Gächter (2002). Meanwhile, factors such as the potential ethnic fusion developed from the facts that Han and Mongolian lived together for long, and the ethnic traits whereby different ethnicities may react differently to the punishment mechanism could both potentially reverse the negative association.

We find that the association between ethnic diversity and pro-social behavior is not a simple negative relationship. Rather, it depends on the ethnic traits, despite that the negative association does exist in the all-Han treatment, consistent with the prediction from ingroup bias in the existing literature. In our experiment, Mongolian Chinese contribute more and punish less when there is ethnic diversity in the group. An ethnic diversity also boosts punishment efficiency for both ethnic groups. All the above evidence shows that the negative association between ethnic diversity and pro-social behavior does not always hold and highlights the importance of cultural idiosyncrasy when dealing with ethnic diversity-related issues.

Several mechanisms may explain our results.

First, ethnic diversity reduces punishment level in the Mongolian group. In our experiment, Mongolian Chinese have higher expectation on others' contribution and punish harsher at and only at their same-ethnic fellow. This behavioral pattern seems very close to the spirit of the "Anda" tradition. In turn, the introduction of the punishment mechanism to the all-Mongolian group is the least efficient in our experiment.

Second, some ethnic fusion has developed between the two ethnic groups. Cultural fusion refers to the bilateral process where the minority group adopts behaviors of the dominant culture. The dominant culture is also transformed by the minority elements of culture (Croucher and Kramer, 2017). Mongolian Chinese's understanding of Han's culture boosts their contribution in the mixed-ethnic session. We could not validate the bilateral effect of cultural fusion due to the lack of Han Chinese with Mongolian culture in the population and hence the sample.

Both discrepancies point out that ethnic diversity and pro-social behavior are never a simple negative association in a public goods game. Rather, it depends on multiple factors such as cultural traits (e.g., "Anda" tradition) and the extent of interactions between different ethnic groups. Our evidence suggests that instead of treating ethnic diversity and pro-social behavior as a simple negative relationship when dealing with multi-ethnic related issues, the policymakers should have a deep understanding of different ethnicities and implement the measures to create an opportunity for ethnicities to build fusion.

Our study contributes to the existing literature in two ways. We are the first to experimentally investigate the association between ethnic diversity and prosocial behavior by taking the punishment opportunity into consideration. Our result shows that the association between pro-social behavior and ethnic diversity is culturally dependent and can be affected by the long-term interactions between the two ethnicities. Meanwhile, this paper answers Schlee's (2008) questions of whether ethnic affiliation is the factor that causes conflict or political fragmentation. Succeeded on but not limited to Algan et al. (2016), which suggests that ethnic diversity prevents the creation of strong social norms to punish and revenge. Our experimental result suggests that ethnic diversity would boosts contribution and alleviate the punishment level in some community with an established sanctioning mechanism.

## Declaration of competing interest

None.

## Data availability

Data will be made available on request.

## Appendix A. Experimental Instructions

*The following instructions were originally written in Chinese. We show the translation of the instructions we used in the {all-Mongolian} and [Mixed treatment] below. The instructions in the Han treatment were adapted accordingly.*

*Instruction for Stage 1 (Public goods game without Punishment)*

Welcome to BEE! Please read these instructions carefully.

Your payoff will depend on the decision you made in this experiment. During the experiment, we shall not speak RMB but rather of tokens. At the end of the experiment, the total amount of token you have earned will be converted to RMB at the following rate: **20 Tokens = 1 RMB**.

You will be randomly paired into a group of 4. The group composition is paired randomly, but there will always be **{4 Mongolian Chinese} [2 Mongolian Chinese and 2 Han Chinese]** in a group. Random re-composition of group members will take place across periods. The experiment is divided into ten periods.

**Note that the ethnicity composition will not be changed by the randomized paring**. In other words, though your group will consist of different participants each period, the group will always be composed of {**4 Mongolian Chinese**} [**2 Mongolian Chinese and 2 Han Chinese**].

All the interactions in the experiment will be taken place **anonymously**. **You will not be informed about the other participants' identity in your group, and other participants will never be informed about your identity.** The **number assigned to your opponents** (i.e., Member 1, Member2, Member 3) **are randomly allocated**.

You will be endowed with 20 tokens at the beginning of each period. Your task is to decide how to allocate your endowment between two accounts, one **private account** and one **group public-good account**. You will **only be asked to decide** how many tokens you would like to invest to the public-good account. Once you have decided, the experimental software will transfer the remaining tokens into your private account. All group members are required to **make decisions**.

**Private account:** The tokens you keep in your private account increase your monetary payoff at the rate of **1:1**. Others cannot benefit from your private account. Suppose you invest 6 tokens to the public project account. The remaining 14 tokens will automatically be transferred to your private account.

**Group public-good account**: Investment to the public project account will generate returns to your group. The rate of return is **1:1.6**. In other words, each unit invested on this joint account will generate a 1.6 unit of returns and be **equally divided** among all 4 group members.

Therefore, each token invested to the group-account project will generate every member in your group return of 0.4 tokens. In other words, your income from the public project is 0.4 times the total contributions to the project from all four group members (including your contribution).

$$\textbf{Your income in token} = 20 - \textbf{tokens contributed to the project by you} + 0.4 \times \textbf{sum of all tokens contributed by all members of your group}$$

Suppose in some period of the game, you contribute 10 tokens to the public project, and all other members each contribute 10 tokens. [9]Therefore,

$$\text{Your income in token} = 20 - \text{tokens contributed to the project by you} + 0.4 \times \text{sum of all tokens contributed by all members of your group} = 20 - 10 + 0.4 \times (10 + 10 + 10 + 10) = 26$$

Hence your income from this period is 26 tokens.

Should you have any questions, please raise your hand, and your question will be answered in private. It is prohibited to communicate with the other participants during the experiment. If you violate this rule, we shall have to exclude you from the experiment and all the payment.

*Instruction for Stage 2: **Public goods game with Punishment***

You will proceed to play 10 periods of simple game. The game rule is the same as in Stage 1, except that there will be additional punishment mechanism at this stage.

In each period, you will be **randomly paired** in a group with 3 other participants. The experiment is divided into **10 periods**. **Random re-composition** of group members will take place across periods.

**Note that the ethnicity composition will not be changed by the randomized paring**. In other words, though your group will consist of different participants each period, the group will always be composed of {**4 Mongolian Chinese**} [**2 Mongolian Chinese and 2 Han Chinese**].

[9] We are aware that there are numerical examples in our instructions that may act as suggested contributions. However, we think the numerical example does affect our result much. First, the numerical example is not highlighted in our instruction, as opposed to the formula calculating the income without numerical example which is highlighted. Second, the numerical example (of contributing 10 units) does not seem to form a focal point in our experiment. In the first few periods, the average contribution is below 8 units in both with and without punishment condition. There is no numerical example in the 2nd stage of the experiment, but the average initial contribution of the 2nd stage (with-punishment) contribution is also below 8 units as in the 1st stage. Third, even if the example leads to some priming on the subjects, the priming effect from our numerical examples should be able to cancel out as we compare the contribution and punishment discrepancy between the treatments, as the same numerical example appear on all treatment. Moreover, instructions with numerical example are also quite common or standard in the public good game setup because it help subjects better understand the game (e.g., Fehr and Gächter, 2000).

All the interactions in the experiment will be taken place anonymously. You will not be informed about the other participants' identity in your group, and other participants will never be informed about your identity. The number assigned to your opponents (i.e., Member 1, Member 2, Member 3) are randomly allocated.

In this stage, you will be endowed with 20 tokens at the beginning of each period.

There will be **two parts** of the games **in each period**.

The first part is the same as in stage 1, where you need to decide how much to invest into the group project. Members of your group will make the investment decision simultaneously. Contribution to the public project account will generate returns to your group. Each 1 unit invested in this joint account will generate a 1.6 unit of returns and be equally divided among all 4 group members.

In the second part, you will be informed about the amount of token each member of your group contributed to the project and their income. After that, you can punish other group members by assigning negative point. Each negative point will **cost you 1 token**, but it will also **reduce the individual you would like to punish by 3 tokens**. The other group members can also reduce your income by assigning negative points to you if they wish to do so.

That is to say, in each period,

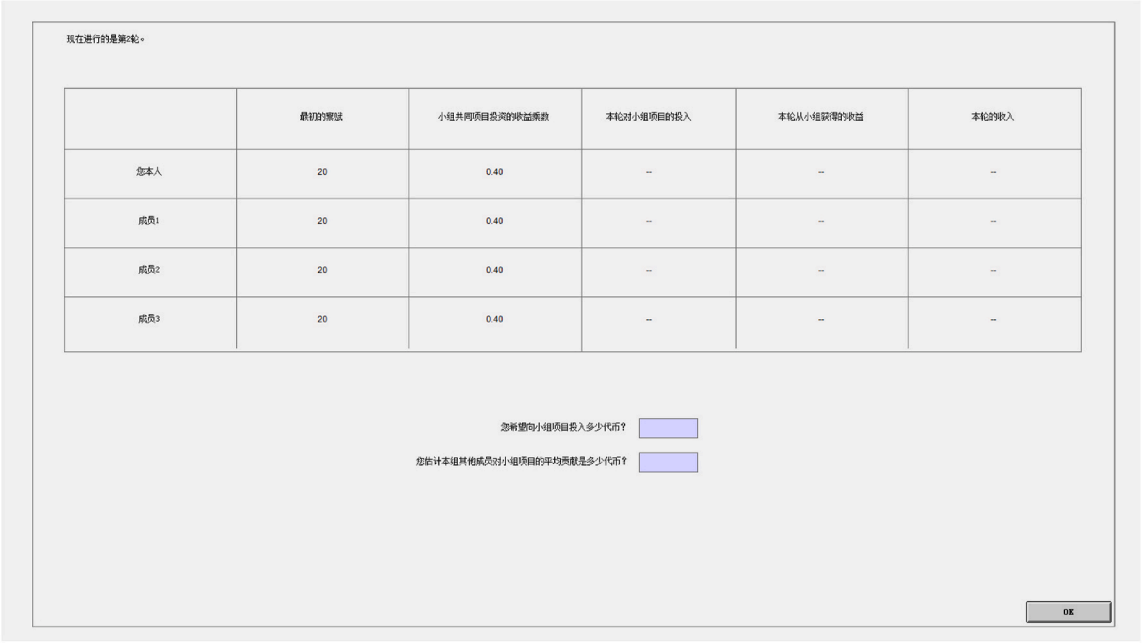
$$\begin{aligned}\textbf{Your total income in token} = 20 - \textbf{tokens contributed to the project by you} + 0.4 \\ \times \textbf{sum of all tokens contributed by all members of your group} \\ - \textbf{costs of negative points assigned by you} - 3 \times \textbf{sum of negative points assigned to you}\end{aligned}$$

Once every group member has made decisions on assigning negative points, you will be informed whether you have been assigned negative points, the amount of token being deducted, and your final earning.

You will then proceed into the next period (there are ten periods in total).

## Appendix B. User Interface of the Contribution Stage

The picture below shows the screenshot of the interface where subjects need to make decisions on their contribution to the public good. In each period, subjects need to indicate how much they would like to contribute to the public good, and their expectation on the average contribution by the other three group members ("expectation on the group member").




The translation of the above screenshot is as follows:

This is the 2nd period.

| | Endowment | Investment return rate from the public good | Contribution to the public good in this period | Total return from public good in this period | Total income from this period |
|---|---|---|---|---|---|
| You | 20 | 0.40 | – | – | – |
| Member 1 | 20 | 0.40 | – | – | – |
| Member 2 | 20 | 0.40 | – | – | – |
| Member 3 | 20 | 0.40 | – | – | – |

How many tokens are you willing to contribute to the public good? _____

How many tokens do you think will be the average contribution by the other group members? _____

## Appendix C. Control Questionnaire

*The following instructions were originally written in Chinese.*

*Questionnaire for Stage 1: Public goods game with Punishment*

**Question 1**: Please read and answer the following question:

Suppose John attends today's game. In some period, nobody (including John) in his group contributes any point to the project.

John's income from this period? Correct answer: John earns 20 tokens.

**Question 2**: Please read and answer the following question:

Suppose John attends today's game. In some period, everybody (including John) in his group contributes 20 tokens to the project.

John's income from this period? Correct answer: John earns 80*0.4 = 32 tokens.

**Question 3**: Please read and answer the following question:

Suppose Johns attend today's game. In some periods, John contributes one token to the project while none of the other group members contributes any token to the project.

John's income from this period? Correct answer: John earns 19 + 1*0.4 = 19.4 tokens.

The income of the other group members from this period? Correct answer: Other group members each earn 20 + 1*0.4 = 20.4 tokens.

**Question 4**: Please read and answer the following question:

Suppose John attends today's game. In some periods, John contributes five tokens to the project while all other members contribute 15 tokens.

John's income from this period? Correct answer: John earns 15 + 50*0.4 = 35 tokens.

The income of the other group members from this period? Correct answer: Other group members each earn 5 + 50*0.4 = 25 tokens.

*Questionnaire for Stage 2: Public goods game without Punishment*

**Question 1**: Please read and answer the following question:

Suppose John attends today's game. In some period of this stage, John contributes one token to the project while none of the other group members contributes any token to the project in part 1. In part 2, John distributes three negative points to the other members (i.e., John distributes one negative point for each of the other members in his group), while none of the other members distributes any negative points.

John's income from this period? Correct answer: John earns 19 + 1*0.4–3 = 16.4 tokens.

The income of the other group members from this period? Correct answer: Other group members each earn 20 + 1*0.4–3 = 17.4 tokens.

**Question 2**: Please read and answer the following question:

Suppose John attends today's game. In some period of this stage, John contributes 0 tokens to the project while all of the other group members contribute ten tokens in part 1. In part 2, only Lily distributes one negative point to John while none of the other members (including John) distributes negative points.

John's income from this period? Correct answer: John earns 20 + 30*0.4–3 = 29 tokens.

The income of Lily from this period? Correct answer: Other group members each earn 10 + 3*0.4–1 = 21 tokens.

## Appendix D. Respondent Questionnaire

1. Academic major: _____
2. Matriculation number: _____
3. Year of study: _____
4. Age: _____
5. Place of birth (Province): _____
6. Hukou: _____
7. Native place (Father's place of birth): _____
8. Gender: _____
9. Ethnicity: _____
10. First language (choose from English, Chinese, Mongolian, Others): _____
11. Proficiency of Mongolian: 1) no proficiency; 2) listening; 3) listening and speaking; 4) listening, speaking, and 5) listening, speaking, reading, and writing; reading.
12. Living culture since childhood (choose from Han culture, Mongolian culture, others): _____
13. Years of nomadic experiences (fill in 0 if N.A.; 1 if less than 1): _____

## Appendix E. Robustness Check with clear-cut Han Chinese

Result: The contribution in the without-punishment condition and punishment behavior from clear-cut all-Han is similar as the all-Han treatment. However, clear-cut all-Han contributes more in the with-punishment condition, implying a stronger level of ingroup bias compared to all-Han session in the single-ethnic group.

Ethnic diversity is manipulated by constructing single-ethnicity and mixed-ethnicity session with Han- and Mongolian- Chinese subjects in our experiment. However, Han Chinese in the all-Han session may still be affected by some Mongolian culture as they are recruited from Inner Mongolian University, which locates in Inner Mongolia. We hence conduct an additional clear-cut Han Chinese session ("clear-cut all-Han") that restricts to only students with non-Mongolian "Hukou" from Inner Mongolian University[10]. High school students in China are required to take The National College Entrance Examination (Gaokao) at their "Hukou" locality. Hence, the non-Mongolian locality controls that the subjects are neither Mongolian Chinese nor grow up in the Mongolian districts. We check their background using questionnaire after the experiment. All the subjects who participate in the clear-cut Han Chinese session are Han Chinese. None of them have living experience in the Inner Mongolia districts before attending college or have any Mongolian language proficiency.

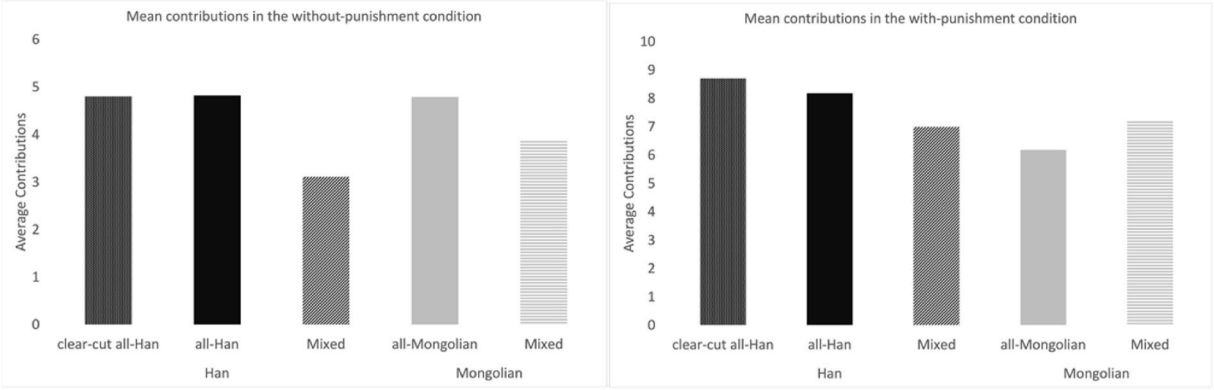



**Fig. E1.** Mean contributions include clear-cut all-Han

In the without-punishment condition, Han Chinese from clear-cut all-Han session contributes about 4.80, which is about the same compared with all-Han session's contribution of 4.82 ($p = 0.9419$). In the with-punishment condition, Han Chinese from clear-cut all-Han session contributes about 8.70, about 0.5 unit more compared with all-Han session ($p = 0.0042$). This result suggest that clear-cut all-Han reveals a stronger ingroup bias than all-Han in the single-ethnic group, when punishment opportunity is possible.

[10] We are aware that students from Inner Mongolian University may also have been exposed to Mongolian culture. However, we believe that it would introduce further heterogeneity problems using subjects from other universities in China. For example, those universities may have different Gaokao scores cutoff compared to Inner Mongolian University and hence would introduce additional noise to our analysis.

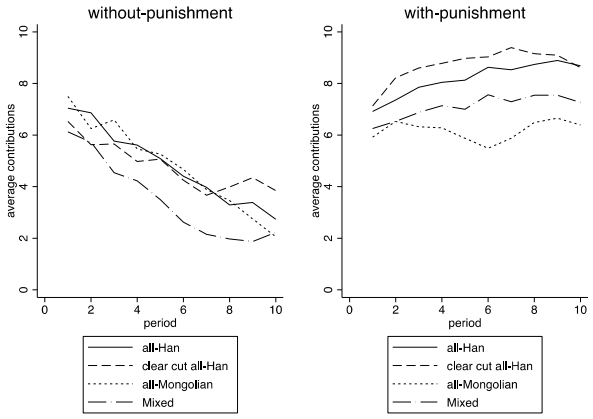



**Fig. E2.** Average contributions include clear-cut all-Han

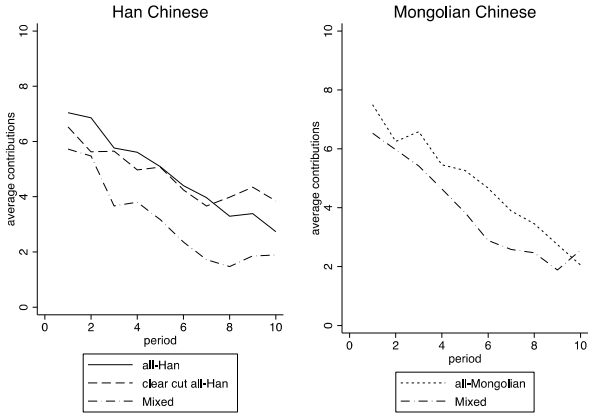



**Fig. E3.** Average contributions in the without-punishment condition include clear-cut all-Han

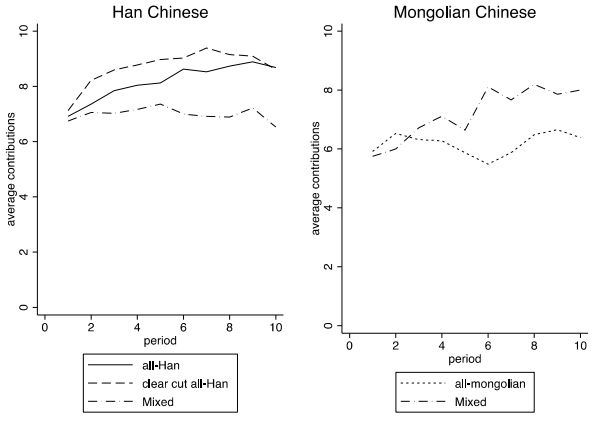



**Fig. E4.** Average contributions in the with-punishment condition include clear-cut all-Han

The contribution from clear-cut all-Han is always closest to the all-Han session, implying that there is no significant difference between the two sessions. Consistent with Figure E1, clear-cut all-Han has a dynamic contribution higher than all-Han in the with-punishment condition, though there is no significant difference observed from without-punishment condition.

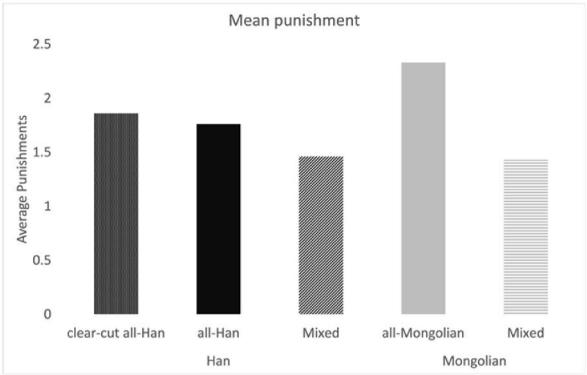



**Fig. E5.** Mean punishment include clear-cut all-Han

Moving on to the punishment behavior, Han Chinese from clear-cut all-Han session punishes 1.86 unit on average, which is about the same compared with all-Han session's punishment of 1.76 unit ($p = 0.4968$). Meanwhile, the dynamic pattern of subjects' actual contribution and their expectation on the group member is about the same between clear-cut all-Han and all-Han sessions, in both without- and with-punishment condition.

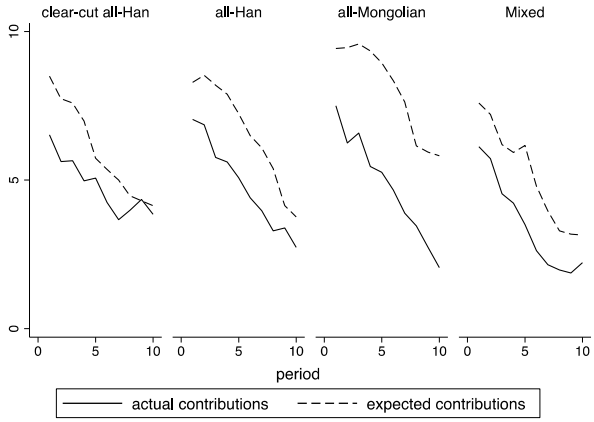



**Fig. E6.** Actual and Expected contribution in the without-punishment condition include clear-cut all-Han

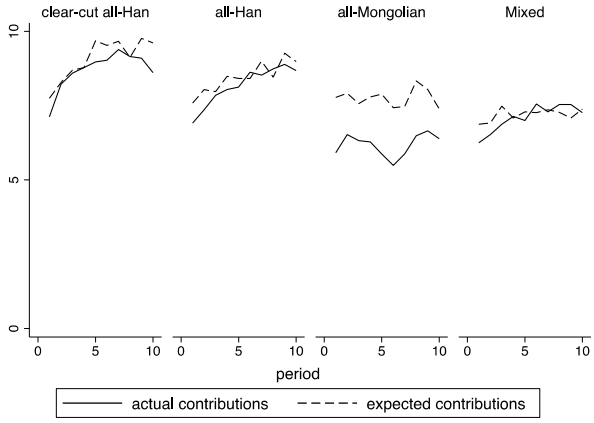



**Fig. E7.** Actual and Expected contribution in the with-punishment condition include clear-cut all-Han

Finally, we look at the impact of punishment opportunities on the public good contribution. The result from clear-cut all-Han session is closest to all-Han session. The fact that it is even higher than all-Han is in line with our finding that except for a higher with-punishment contribution, without-punishment contribution and punishment level is the same as all-Han. This result emphasizes that there is a stronger ingroup bias of contribution in the Han culture when punishment opportunity is possible.

**Table E1**
Social Welfare of Punishment include clear-cut all-Han

| Treatment | All Samples | Han Chinese | Mongolian Chinese |
|---|---|---|---|
| all-Han | 1.91 [72] | 1.91 [72] | 0.00 [0] |
| Clear-cut all-Han | 2.10 [72] | 2.10 [72] | 0.00 [0] |
| all-Mongolian | 0.597 [72] | 0 [0] | 0.597 [72] |
| Mixed | 2.50 [72] | 2.66 [36] | 2.33 [36] |

**Note**: Sample size in bracket.

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