Economic Potential, Leader Power, and Culture Predict Corruption

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Humans cooperate in large societies of anonymous strangers. Recent research using the Public Goods Game reveals that large scale cooperation can be sustained by institutional punishment, whereby costly punishment is meted out by a designated leader using pooled resources[1,2]. Such institutional punishment is analogous to governments, police forces, and other institutions that sanction free-riders on behalf of individuals in large societies. However, in the real world, corruption undermines the effectiveness of these institutions, with correlated economic and social costs[3-5]. Levels of corruption correlate with institutional, economic, and cultural factors, but the causal direction of these relationships are difficult to determine[5,6]. Here we show that lower economic potential increases corruption, but that stronger leaders are more corrupt if economic potential is high and less corrupt if economic potential is low. We find that exposure to corruption norms increases corrupt behavior, beyond these ecological factors, but that having ancestors from more corrupt nations controlling for direct exposure to corruption norms, reduces corrupt behavior. We also show that efforts to reduce corruption, such as transparency or forced leader investment, are only effective when economic potential is high and can be detrimental when economic potential is low. Our results reveal that economic potential and the power of leaders causally predict corruption, and that cultural background affects corrupt behavior controlling for ecology. Moreover, our results suggest that strategies that successfully reduce corruption in high economic potential contexts, can backfire if economic potential is low.

Human cooperation, particularly large-scale human cooperation, remains a puzzle of importance to both biologists and social scientists, with real world social and economic implications. One method for sustaining cooperation that has received considerable attention is costly punishment[7-9], whereby individuals pay a cost to punish free-riders who fail to contribute to the public good. Cross-cultural evidence shows the ubiquity of costly punishment, but also variance in its magnitude[10]. Research on Public Goods Games (PGGs) reveal that peer punishment – individuals directly paying a cost to sanction free-riders – suffers from the problem of second-order free-riding – individuals unwilling to pay the cost of punishment[11]. Institutional punishment (also called pooled punishment) resolves these problems by designating one individual as a "leader", who can extract taxes and punish free-riders on behalf of all individuals. Institutional punishment avoids the problem of second-order free-riding and can sustain large-scale cooperation[1]. Moreover, recent empirical research shows that participants (at least WEIRD participants[12]) prefer institutional punishment to peer punishment; such institutions can emerge endogenously via assortment[2,13].

Institutional punishment PGGs constrain player choices to contributing to the public pool or keeping money for themselves and constrain leader choices to punishing players or doing nothing. However in the real world, channels such as bribery, nepotism, and lobbying, allow individuals to avoid contributing to the public pool (e.g. evading taxes) and avoid being punished (e.g. by paying a bribe) – real leaders and institutions are corruptible.

Results

Cost of corruption. To capture this corruption, we modify the institutional punishment PGG, giving players one additional choice – contribute to the leader (i.e. offer a bribe). In turn leaders have one additional choice for each player – accept the contribution (i.e. accept the bribe). To

measure the effect of this Bribery Game (BG) on the efficiency of the public good, we compare the BG to the institutional punishment PGG without the option to bribe, regressing these conditions on contributions using a multilevel model. Overall, we find 0.54 standard deviation reduction in contributions when bribery is an option (see Table 1).

	Coefficient	**95% CI**	**p-value**
Bribery Game	−0.54	−0.61, −0.47	< .001
High Economic Potential	0.60	0.34, 0.85	< .001
Strong Leader	0.08	−0.17, 0.33	.521
(Intercept)	−1.22	−1.86, −0.57	< .001
Obs.		1694	
N		160	

Table 1 | Size of Contribution Multilevel model of condition (institutional punishment PGG vs BG), economic potential (low vs high), and leadership strength (weak vs strong) regressed on z-score of contribution, controlling for period, order of conditions, order of background questions, age, and gender. We control for common variance created by multiple observations from the same person with random effects for each individual.

Causes of corruption. To test possible ecological causes of corruption, we randomly assigned each group of participants a marginal per capita rate of return (0.3 vs 0.6) as a measure of economic potential and a punishment multiplier (1 vs 3) as a measure of the strength of the leader or institution. The marginal per capita rate of return is the expected return for every point invested in the public pool and the punishment multiplier is the number of points subtracted from a sanctioned player for every tax point spent on punishing that player. To test for individual and cultural differences, we gave participants a heritage corruption score (the mean of the corruption perception index values of their heritage countries) and a country corruption score (the mean of

the corruption perception index values of the countries in which they had lived) as well as several individual demographic and personality measures. We regressed each leader choice (compared to the two other choices) on these ecological and cultural values using a multilevel binary logistic regression, with random intercept to control for common variance created by multiple observations. We find a significant interaction for acceptance of bribes. In high economic potential contexts, strong leaders are more likely to accept bribes, but in weak economic potential contexts, weak leaders are more likely to accept bribes (see Table 2 and Figure 1). Controlling for these ecological differences, participants who had lived in more corrupt places were 1.5 times as likely to accept a bribe for every standard deviation increase in country corruption score and 1.7 times less likely to accept a bribe for every standard deviation increase in ethnic corruption score (see Table 2).

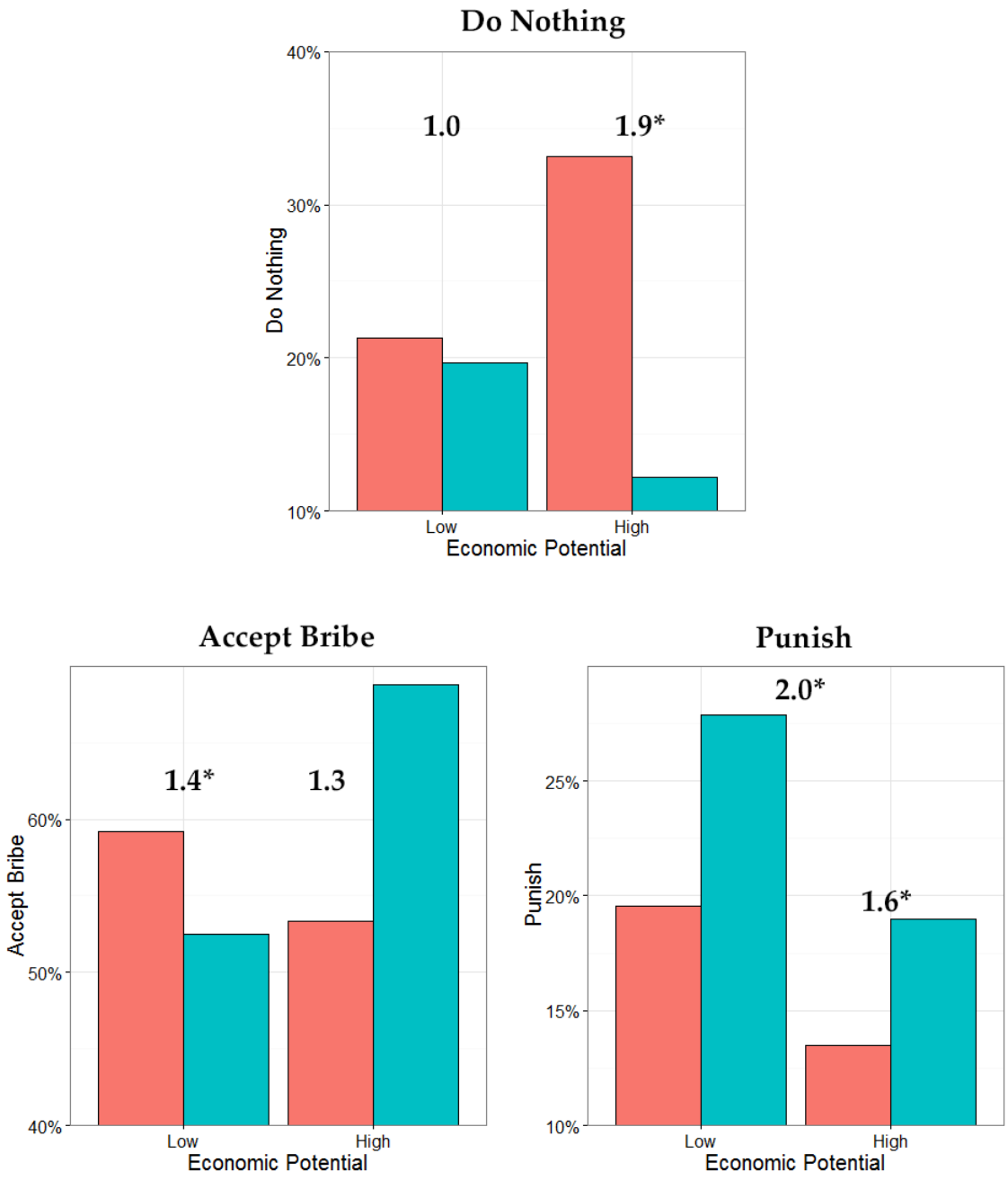

Figure 1 | Leader Decisions. Percentage of each decisions where leader made each of their 3 choices (do nothing, accept bribe, or punish). Leaders are most likely to do nothing when weak in a high economic potential context. Accept bribes is higher among weak leaders in low economic potential contexts. Punishment is higher when leaders are stronger and when economic potential is low (no interaction).

	Accept Bribe	Punish	Do Nothing
High Economic Potential	0.96 [0.333,1.33]	0.49 [0.27,0.65]	1.84 [1.06,3.24]
Strong Leader	0.72 [0.35,0.97]	1.59 [1.06,2.31]	1.01 [0.27,1.42]
Country Corruption Score	1.47 [1.16, 1.70]	0.89 [0.68,1.06]	0.68 [0.53,0.82]
Heritage Corruption Score	0.59 [0.48,0.70]	1.13 [0.89,1.34]	1.85 [1.34,2.21]
Economic Potential × Leadership	1.80 [0.17,2.64]		0.52 [0.23, 1.13]
(Intercept)	0.50 [0.07,0.74]	0.34 [0.05,0.51]	0.75 [0.35,1.58]
Obs.	894	894	894
N	112	112	112
AIC	1164	895	854

Table 2 | Leader Decision Multilevel logistic regression of economic potential (low vs high), and leadership strength (weak vs strong), country corruption score (z-score), and heritage corruption score (z-score) regressed on each decision compared to all others, controlling for period, order of conditions, and order of background questions. Confidence intervals (95%) were bootstrapped using 10,000 replications, reporting the smallest interval. We control for common variance created by multiple observations from the same person with random effects for each individual.

Cures for corruption. We attempted to reduce corruption using three different methods: two transparency measures and forced leader investment. The first transparency measure (Partial Transparency) allowed all players to see the leader's contribution, thereby offering leaders an opportunity to establish a norm. The second transparency measure (Full Transparency) allowed players to see all Leader actions: leader contributions and anonymized contributions and bribes from each player and the leader's decision in each case. Leader Investment forced leaders to maximally contribute their endowment to the public good, thereby tying their success to the efficiency of the public good and incentivizing them to increase contributions rather than accept bribes. At national level, leader investment has been explicitly used as an anti-corruption measure in places such as Singapore, which has one of the lowest levels of corruption as per the

corruption perception index with the highest paid leader in the world[14]. Singaporean minister salaries are pegged at the salaries of top professionals and Singapore's gross domestic product. To determine the effectiveness of each measure, we compare contributions in each condition to the institutional punishment PGG control and to the Bribery Game by regressing condition, economic potential, and leader strength on the z-score of contributions. Table 3 reports the results of this regression, reporting separate coefficients within each condition. Note that these values come from a single regression and are calculated by changing reference groups (see Supplementary Information). These results are graphed in Figure 2.

	Weak Leadership		**Strong Leadership**		
	Control	BG	Control	BG	**Low Economic Potential**
Control	-	0.23**	-	0.61***	
BG	-0.23**	-	-0.61***	-	
BG+PT	-0.48***	-0.25***	-0.53***	0.08	
BG+FT	-0.29***	-0.07	-0.03	0.59***	
BG+LI	-0.45***	-0.23***	-0.16**	0.45***	
	Control	BG	Control	BG	**High Economic Potential**
Control	-	0.22**	-	0.69***	
BG	-0.22**	-	-0.69***	-	
BG+PT	<0.01	0.22**	-0.60***	0.10	
BG+FT	<0.01	0.23**	-0.33***	0.36***	
BG+LI	0.12	0.34***	-0.32***	0.37***	

Table 3 | Cures for corruption Multilevel model of economic potential (low vs high), leadership strength (weak vs strong), and conditions – Control, Bribery Game (BG), Partial Transparency (BG+PT), Full Transparency (BG+FT), Leader Investment (BG+LI) regressed on contributions (z-score) controlling for country corruption score (z-score), heritage corruption score (z-score), period, order of conditions, and order of background questions. We control for common variance created by multiple observations from the same person with random effects for each individual. The graph shows comparisons of each condition to the Control and Bribery Game. Significant reductions in contributions are highlighted in red, significant improvements in contributions are highlighted in green.

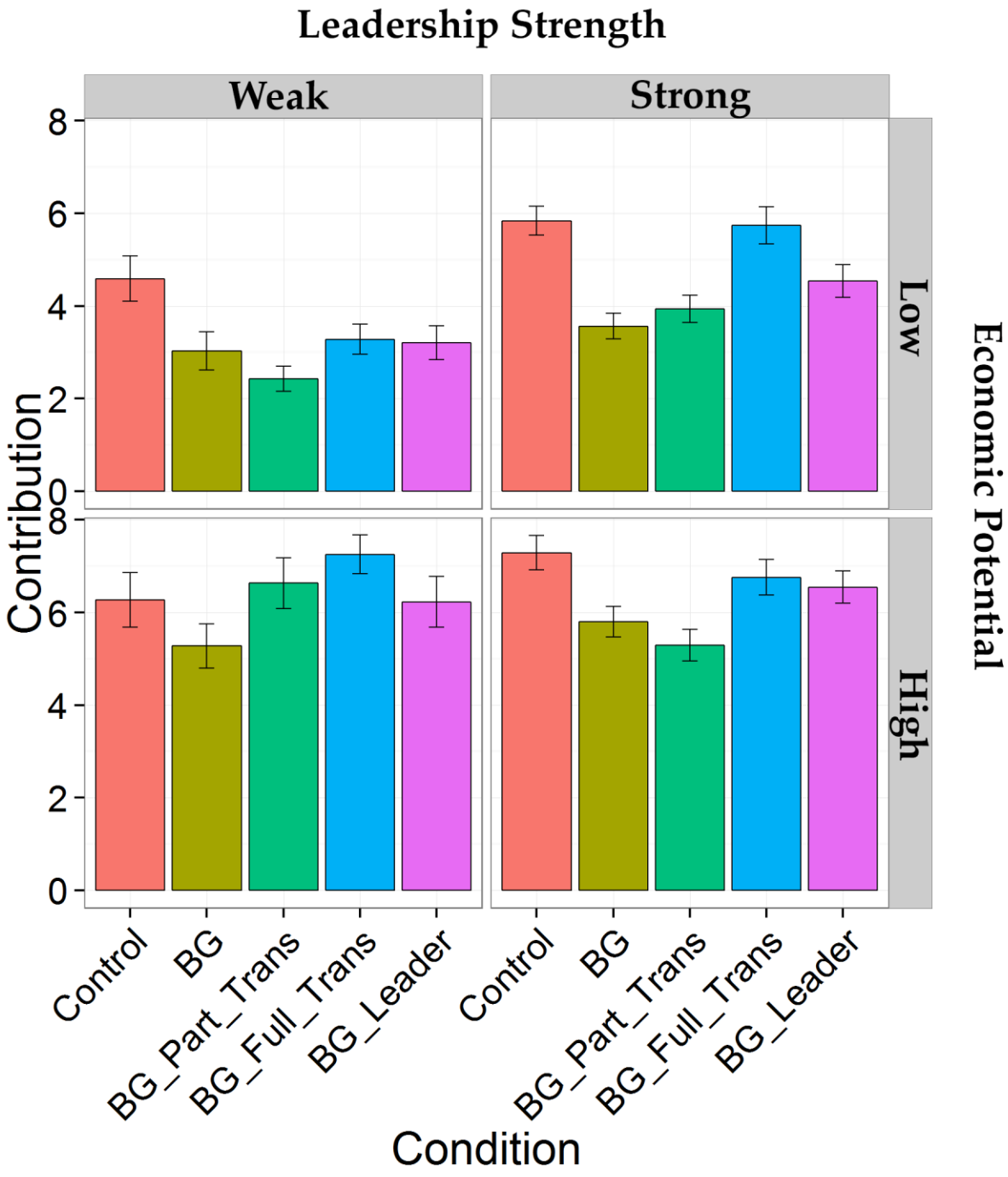

Figure 2 | Contributions by condition Raw contributions for each within-subjects condition within between-subjects ecologies with 95% confidence intervals. These are raw values, i.e. not drawn from the regression controlling for extraneous factors, so values don't perfectly match the regression shown in Table 3.

Partial transparency, full transparency, and leader investment all increased contributions, except when leaders were weak in low economic potential situations. Here, all three attempts to mitigate corruption actually worsened corruption, decreasing contributions to levels lower than the Bribery Game.

Discussion

Overall, these results confirm that the potential for bribery decreases the efficiency of the public good. Strong leaders and leaders in weak economic potential contexts are both more likely to punish. The acceptance of bribes is higher among weak leaders in low economic potential contexts and strong leaders in high economic potential contexts, suggesting a causal role for ecological conditions. Controlling for these ecological effects, exposure to corruption norms, as measured by the corruption perceptions index, increases the probability of accepting bribes, but having an ethnic heritage from more corrupt nations without direct exposure to these norms, decreases the probability of accepting bribes. The role of exposure to corruption norms is consistent with a cultural evolutionary perspective and norm psychology, specifically the internalization of norms[15,16]. The decreased probability of accepting bribes among those with a higher corruption norm heritage culture with may be an indication of selection; uncorrupt individuals selectively migrating corrupt countries, but this explanation should equally apply to those who have lived in corrupt countries. A second possibility is that non-European Canadians in our sample are behaving even less corrupt than their European Canadian peers, as a reaction to perceptions based on their ethnic appearance. This explanation is consistent with some psychological research on "identity denial"[17], but our study in isolation cannot fully explain this finding. Together these results suggest that corruption may be rooted in ecology, but is internalized as corruption norms carried to new contexts.

Together, these results suggest that: (1) More Punishment is required when economic potential is low and the incentive to free-ride is higher. (2) If Leaders are powerful when the economy is strong and punishment is not needed to sustain cooperation, they may use their excess power to extract bribes rather than sustain the public good. (3) If economic potential is low, powerful leaders benefit by using their power to sustain the public good, but weak leaders, unable to sustain the public good, use their power to extract bribes and make themselves wealthy.

These results suggest that as economic potential grows, less government intervention is required to enforce cooperation and power is likely to be misused. However, if economic potential is low, more government intervention is required to enforce cooperation (and ideally, in the real world, increase economic potential). This paradox helps explain why our intuitions about "cures for corruption" based on experiences in rich nations do not work as well in poorer nations. In fact, our results suggest that transparency and leader investment can be effective in reducing corruption when leaders are strong or economic potential is high, but that when economic potential is low and leaders are weak, transparency can actually decrease contributions. In these conditions, transparency just reveals the price of the bribe and that no one is contributing, because it's not worth contributing. These results help us understand why these corruption mitigation attempts fail and suggest routes to avoiding negative economic cycles as individuals in low economic potential situations realize their plight. These results suggest that one route to breaking out of corruption is to increase economic potential and the ability for leaders to punish free-riders and only in these conditions, apply transparency and encourage leader investment.

Methods

Recruitment of Subjects. We had a total of 180 participants (106 female, mean age=20.71) drawn from an Economic Subject Pool open to the general public. Participant ethnic

backgrounds were as follows: 41 Euro Canadians, 110 East Asians, 11 South Asians, 18 Other Ethnicities. Participants played in groups of between 4 and 7 players.

Experimental Design. We used a 2 (high vs low economic potential) x 2 (weak vs strong leader power) between subjects design with 5 within subjects conditions (institutional punishment public goods game, bribery game, bribery game with partial transparency, bribery game with full transparency, bribery game with leader investment. Participants were randomly assigned to one of the 4 between-subjects conditions and 4 of the 5 within subjects conditions. Within subjects conditions were played in a random order with instructions prior to each period and a quiz to ensure participants knew how each condition worked. We used a block randomization design, where participants played a minimum of 10 rounds, but the game may have ended at any point prior to the completion of 10 rounds. At 10 rounds, participants were informed which round the period ended or played further rounds until the game ended. In this way, we had 10 rounds to analyze, but there were no end game effects – participants did not know when the game would end. Participants were paid for 10 random rounds from across all conditions they played at 15c per point and a showup fee of $10.

Measures. We measured Age, Gender, Degree & Major, Prestige/Dominance, Right Wing Authoritarianism, Whether they spent their entire life in Canada, Where Else They've Lived, What Suburb they grew up in, Ethnic Group, Religion & Importance of religion, How well they speak their native language (Cultural Competence), Fused Identity Task - Identification with their Ethnic Group & Identification with Canadians, Vancouver Index of Acculturation – Mainstream vs Heritage Acculturation (Integration into Culture). Two corruption scores were calculated for each person using the mean perception of corruption index from Transparency International for all of the countries they've lived in and the countries of their ethnic heritage.

The corruption index goes from 0 (most corrupt) to 100 (least corrupt), so for each country, we subtracted this value from 100 (so higher scores indicated higher corruption). Perceptions of corruption was chosen as the measure of corruption since it indicates the descriptive norm for national corruption. We asked the last 100 participants their preferences for the game. We report these preferences in Supplementary Information. These participants were asked these questions after taking all other measures so that they were no different to the preceding 80 participants.

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Supplementary Information is available in the online version of the paper.

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