Impartial Institutions, Pathogen Stress and the Expanding Social Network

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Abstract Anthropologists have documented substantial cross-society variation in people's willingness to treat strangers with impartial, universal norms versus favoring members of their local community. Researchers have proposed several adaptive accounts for these differences. One variant of the pathogen stress hypothesis predicts that people will be more likely to favor local in-group members when they are under greater infectious disease threat. The material security hypothesis instead proposes that

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institutions that permit people to meet their basic needs through impartial interactions with strangers reinforce a tendency toward impartiality, whereas people lacking such institutions must rely on local community members to meet their basic needs. Some studies have examined these hypotheses using self-reported preferences, but not with behavioral measures. We conducted behavioral experiments in eight diverse societies that measure individuals' willingness to favor in-group members by ignoring an impartial rule. Consistent with the material security hypothesis, members of societies enjoying better-quality government services and food security show a stronger preference for following an impartial rule over investing in their local in-group. Our data show no support for the pathogen stress hypothesis as applied to favoring in-groups and instead suggest that favoring in-group members more closely reflects a general adaptive fit with social institutions that have arisen in each society.

For most of their evolutionary history, humans have relied primarily on kin, friends, and a relatively small circle of community members to fulfill basic needs and to protect against physical and social threats. However, in the past 10,000 years, large-scale institutions, such as markets, have expanded access to nonlocal resources and created novel opportunities for productive interactions with people well outside one's immediate social network (Bowles 2011; Bowles and Gintis 2004; Newson and Richerson 2009; Richerson and Boyd 2001). Given the limited scope for reputation and reciprocity in these situations, generalized norms of exchange and impartial allocation play an important role in making these interactions run smoothly. The emergence of these norms, and their subsequent codification and enforcement through formal institutions, can fundamentally alter the trade-offs between investing preferentially in one's in-group and following impartial rules of exchange as one expands one's sphere of social interaction to relative strangers. Existing evidence suggests that human populations differ dramatically in how they trade off these two concerns, and both researchers and policy makers have shown great interest in understanding how this variation affects the functioning of such institutions as markets, courts, and meritocracies (Banfield 1958; Buchan et al. 2009; Gelfand 2011; Parsons and Shils 1951; Treisman 2000; Triandis 1995).

Two evolutionary approaches have sought to explain cross-population variation in how people trade off (1) investing in their in-group versus (2) extending impartial rules of allocation to relative strangers. The first approach proposes that population-level variation in in-group favoritism arises from an evolved response to environmental threats (Fincher and Thornhill 2012; Van de Vliert 2011). One version of this approach argues that the threat of infection from outsiders evokes a behavioral immune response which leads people to consolidate their social group and to ignore, neglect, or fear outsiders (Fincher et al. 2008). Although some versions of the hypothesis have focused on efforts to exclude and segregate immunologically different outsiders, recent high-profile descriptions of the hypothesis have also extended it to other forms of in-group altruism and favoritism (Fincher and Thornhill 2012). Moreover, several mechanisms have been proposed to underlie this behavioral immune system, ranging from

facultative responses at the individual level to adaptive cultural evolution at the group level (Schaller 2011). Nonetheless, all propose that differential treatment of in-group members arise from cognitive mechanisms targeted specifically at the exogenous threat of infectious disease (Fincher and Thornhill 2012; Schaller 2011).

Alternatively, the material security hypothesis assumes the people respond to a variety of threats—including pathogens (Fincher et al. 2008; Schaller 2011), but also environmental extremes (Van de Vliert 2011), food insecurity (Kaplan, Gurven, and Hill 2005), and inter-group conflict (Mathew and Boyd 2011)—as well as the social institutions available to mitigate those threats. Impartial institutions which encourage beneficial interactions with strangers create novel opportunities for preventing and managing threats through such mechanisms as trade, insurance, social welfare, and investment in education and human capital (Fershtman, Gneezy, and Verboven 2005; Fukuyama 1995; Inglehart and Welzel 2005). Without these compelling, impartial institutions, people must rely on friends, family and local community members to mitigate these threats and to meet their basic needs (Hruschka 2010; Kranton 1996). In this way, impartial institutions permit individuals to rely less on friends, family, and local community members to meet their basic needs and thus modify the trade-offs between investing in an expansive network of kith and kin versus pursuing other forms of social insurance.

Methods and Results

To assess these two hypotheses—pathogen stress and material security—we selected eight societies which maximize variation in the degree to which their members can securely meet basic needs, including the quality of public services aimed at health, education, and public safety, as well as access to adequate food and monetary resources. Although material security and pathogen stress often strongly covary across societies, in our sample of eight societies they are only moderately related ($r = -0.46$). With only moderate covariation between the independent variables, our sample of eight societies is thus well-suited to discriminate between these two hypotheses.

If in-group investment is an adaptive response to the availability of impartial institutions which can buffer material insecurity, we would expect that citizens of countries with lower-quality public services and less material security will favor themselves and their immediate in-group over following impartial allocation rules. However, if in-group investment is a specific response to pathogen stress, then we should expect in-group investment to increase with increasing pathogen prevalence. The pathogen stress hypothesis also predicts that investment in self will increase in situations of extremely high pathogen stress (Fincher and Thornhill 2012).

In each fieldsite, we identified a salient in-group satisfying the following criteria: (1) members expect each other to cooperate and to help each other on a regular basis and (2) the group should comprise 40 to 900 adults, spanning the interpersonal network and supernetwork social scales identified by Dunbar and colleagues as a characteristic of human groups in both past and contemporary societies (Dunbar 2008). Depending on the locale, in-groups consisted of villages, clans, neighborhoods, sororities, congregations, or college classes. Out-groups were defined as individuals in a generically defined location (e.g., another village, community, university, or island) within the

same country and ethnic group, but at a substantial distance from the participants' own in-group. We defined the out-group generically to avoid any group-specific feelings of animosity or affinity (e.g., students from one university may have had specific responses to students of a rival university).

To assess the salience of these in-groups, we asked each participant to rate how emotionally close they felt to (1) a member of the out-group who they imagined meeting for the first time and (2) a member of their in-group (Aron, Aron, and Smollan 1992). In all sites, the average rating of emotional closeness was higher for the in-group than for the out-group members, and the difference was significant for all but two of the sites (Chinese and Fijian villages). Although sites varied in average subjective closeness to in-group members relative to out-group members, this variation was not significantly correlated with the study outcomes, at either the individual or site-level ($p > 0.10$).

We ran two experimental tasks to capture the trade-off between following an impartial rule of allocation between individuals and preferentially allocating to oneself or one's in-group. We implemented the Resource Allocation Game (RAG), a simplified variant of the Mind Game in which participants can follow or violate a rule of impartial allocation only in their minds (Greene and Paxton 2009; Jiang 2013). This makes it more than evident to the participant that whether one violates or follows the rule is invisible to others. To illustrate, each participant was allotted 30 monetary units (coins or bills equal in total to 50% of a day's wage) to divide between two cups. The participant was told that after the experiment, one cup (clearly marked for an unspecified in-group member) would be given to an anonymous in-group member and the other cup (clearly marked for an unspecified out-group member) would be given to an anonymous out-group member. The participant was given a die with three black and three white sides to help allocate the money. For each of the 30 monetary units, the participant had to allocate the monetary unit to one of the two cups by rolling the die and then following a prescribed impartial rule. First, before allocating each unit, the participant had to choose a cup purely in her mind: the in-group cup or the out-group cup. Then, the participant rolled the die. In the last step, if the die turned up black, she was supposed to allocate that single monetary unit to the cup she initially chose in her mind. If the die turned up white, she allocated it to the other group which she hadn't mentally targeted. She repeated these steps for each of the 30 units. Thus, she was confronted with a trade-off between benefiting an in-group member and following an impartial rule of allocation. After the task, we gave the money allocated to in-group and out-group members to randomly chosen individuals from the respective groups.

Task 2 closely paralleled task 1 except it captures the trade-off between following an impartial rule and allocating to oneself versus an anonymous out-group individual. The order of tasks 1 and 2 were counterbalanced across individuals.

If a participant followed the rule for allocating based on the die roll, then we expect her allocation to represent a random draw from a binomial distribution (with an expected value of 50% of the total stakes). At a population level, the mean amount of money allocated either to the in-group or to the self provides measures of in-group and self investment, respectively, relative to out-group members. At the population level, the measure of bias is quite sensitive. Given thirty individuals and thirty rolls per individual in a population, even an average allocation of 53% could be detected as a significant deviation from 50% (at alpha=0.05 level). Individual allocations to in-group

or self are reported as percentages of the total stake (a half day's wage). At the individual level, there was a moderate correlation between self and in-group allocations ($n=223$, $r=0.40$, 95% CI=[0.21,0.55], $p<0.001$).

We took a number of steps to ensure a high degree of anonymity of individual allocations. Only the participant knew the cup she chose in her mind. Participants made their choices in complete privacy. Cups had lids which prevented anyone, including researchers, from linking a given allocation with a given participant. Finally, the researcher who counted the coins and made the final payments did so behind a screen, which prevented him or her from seeing any of the participants (see ESM).

We performed these experiments with 223 individuals in eight diverse populations. All groups were sedentary and engaged in wage work, farming, fishing, or herding. Table 1 provides the location, environment, economic base, size of in-group, and sampling information for each population, as well as averages for key variables. We knew in advance that many of the subjects would be illiterate and would not be able to read descriptions of the research and sign consent forms. So in place of this, at the start of each session, the participants were read a simple description of what would happen, and told that if at any point they became uncomfortable with any aspect of the games they were being asked to play they were free to leave at any time. The study protocol was approved by the Arizona State University Institutional Review Board.

We compare the two hypotheses using multiple measures of both material security and pathogen stress. Material security is measured at both the local and national levels. At the national level, we used the World Bank's indicator of government effectiveness, which assesses the quality of public services, including schools, roads, and healthcare (government effectiveness). At the local or community level, we used the average of individual responses to a four-question scale about participant anxiety over obtaining sufficient food for their household at various time scales (1 month to 5 years, food security). The community- and national-level variables encompass two important elements of material security, and are highly correlated ($r=0.87$). The results we discuss are robust to different measures of material security (Table S8–9).

For pathogen stress, we use country-level estimates of non-zoonotic pathogen prevalence (Fincher and Thornhill 2012) since the pathogen stress argument focuses on responses to human-to-human diseases. The ESM analyzes all other published pathogen stress measures (Table S8–9). The two theories outlined above—material security and pathogen stress—make different predictions about in-group allocations in the experiments. The material security hypothesis proposes that people who have access to impartial institutions that help meet basic needs through interactions with strangers will be more inclined to follow the impartial rule. Meanwhile, without such institutions, people will meet their basic needs by investing preferentially in in-group members. Thus, the material security hypothesis predicts that as access to quality public services increases and when people have the resources to meet their basic needs they will tend to follow impartial rules over favoring in-group members or self. The pathogen stress hypothesis proposes that people exhibit increased in-group favoritism specifically in response to the threat of infectious disease. Limited exposure to infectious disease, by contrast, leads to decreased in-group favoritism. Thus, the pathogen stress hypothesis predicts a positive relationship between pathogen prevalence in an area and in-group allocations.

Table 1 Summary information for study populations

Population	Location	N	Environment	In-group		Size	Allocation		GDP per capita	Pathogen Stress	Food security	World Bank GE
				Economic base	Type		In-group	Self				
village	Bangladesh	32	alluvial plain	farming/wage	neighborhood	332	55.7	60.3	1,485	0.07	1.97	−0.84
community	Bolivia	32	montane valley	farming/wage	community	41–126	52.6	59.8	4,353	1.85	0.43	−0.45
village	Fiji	32	tropical coastal	fishing/ farming	clan	142	59.6	62.6	4,060	−1.13	1.19	−0.74
village	China	30	temperate plain	wage	neighborhood	900	50.2	54.8	6,810	1.85	3.07	0.12
university	China	32	urban	wage	class	40	50.1	50.2	6,810	1.85	2.88	0.12
rural village	Iceland	24	temperate coastal	wage	village	175	49.9	47.9	32,962	−1.87	3.96	1.58
urban church	U.S.	23	urban	wage	congregation	100	50.1	44.9	42,642	−0.69	3.83	1.44
university	U.S.	18	urban	wage	sorority/ fraternity	150	47.6	52.4	42,642	−0.69	3.75	1.44

N=number of participants. Size is number of adults in specific in-group. Allocation is % of stake allocated to in-group and self, respectively. GDP per capita and Pathogen stress from World Bank 2011. Food security from participants' assessments (see text). *GE* government effectiveness (for 2010, from World Bank 2011)

Figure 1 plots community means for in-group and self-allocations versus the material security measures of government effectiveness and food security. Consistent with the material security hypothesis, government effectiveness accounts for 62% ($p=$ 0.01) of the variance and food security for 53% of the variance ($p=0.02$) in population means of in-group allocations; government effectiveness accounts for 78% (p=0.002) and food security for 75% of the variance ($p=0.003$) in population means of self-allocations. By contrast, for both self and in-group allocations, non-zoonotic pathogen stress accounts for less than 5% of the variance (r=−0.09 & 0.21, $p=0.30$ & 0.42; Figure S3 shows bivariate scatterplot for pathogen stress).

To analyze these data further, we estimated six regression models predicting individual level responses. In the first three, we regress in-group allocations on government effectiveness, food security, and pathogen stress, as well as four control variables. Control variables included one study design variable (task order: self or in-group allocation first) and three individual-level variables (age, sex, and years of schooling normalized by site). The second set of three regressions was identical to the first three, except allocation to self was the outcome variable.

Table 2 shows these regression results. Consistent with the relationship shown in Fig. 1, and now controlling for individual-level sociodemographics and study design variables, the coefficients for government effectiveness, country-level gross domestic product per capita, and community-level food security are large, negative, and significant at conventional levels. A standard deviation increase in government effectiveness is associated with decreases of 0.9 monetary units in allocations to in-group and 1.6 monetary units in allocations to self. A standard deviation increase in GDP per capita is associated with a decrease of 0.8 monetary units to in-group and a 1.5 decrease to self. A standard deviation
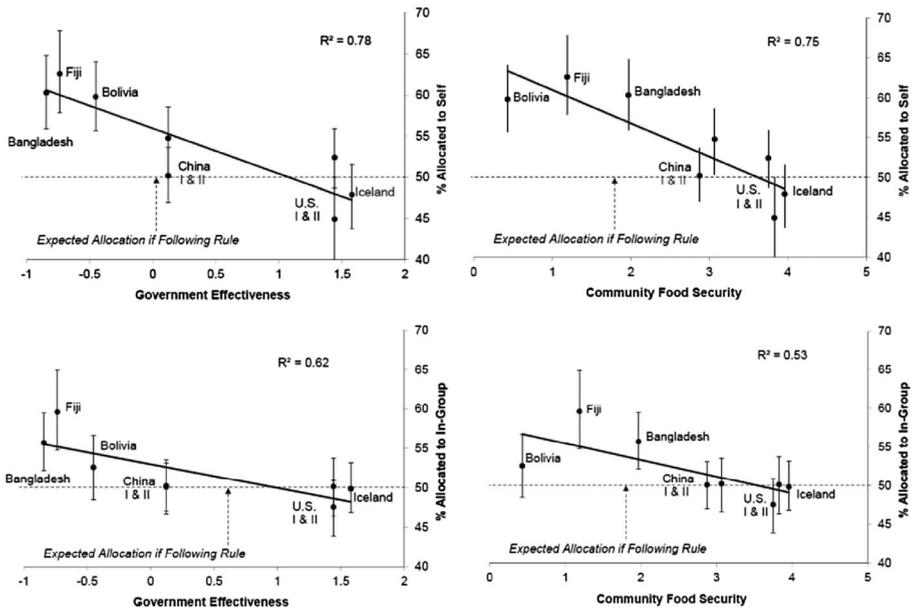

Fig. 1 Increasing Government Effectiveness and Food Security Associated with Decreasing Allocation to Self and In-group. Error bars are bootstrapped 95% CIs. Dotted line indicates expected allocation when following blind, impartial rule for allocation

Table 2 Linear regression models for in-group and self-allocations. Ordinary least-squares models include four additional control variables (sex, age, education, and order). Standardized coefficients reported ($n=223$)

Variables	Models predicting in-group allocations		Models predicting self allocations	
	Coefficient	Adj. R^2	Coefficient	Adj. R^2
Government Effectiveness (GE)	−0.25* (−0.33**)	0.05	−0.41*** (−0.45**)	0.16
GDP per Capita (GDP)	−0.22* (−0.30*)	0.04	−0.37** (−0.42*)	0.14
Community Food Security (FS)	−0.23* (−0.28)	0.04	−0.39*** (−0.42)	0.16
Pathogen Stress (PS)	−0.09 (−0.21)	0.00	0.04 (−0.12)	0.00

Adjusted for years of schooling (normalized by site), gender, age, and task order. Numbers in parentheses are adjusted for competing hypothesis—GE, GDP, and FS adjusted for PS, and PS adjusted for GE

*We calculated bootstrapped standard errors clustered on field sites (10,000 iterations) to adjust inferences for non-independence of cases within sites (21)

P-values are one-sided given model predictions. *<0.05, **<0.05, ***<0.001

increase in food security was associated with a decrease of 0.8 monetary units to in-group and a 1.5 decrease to self. Notably, there is no significant effect of within-group variation in food insecurity on either in-group or self allocations (Table S5).

Contrary to the prediction of the pathogen stress hypothesis, increasing pathogen stress was not associated with in-group allocations, and the estimated coefficient for in-group investment was in the opposite of the predicted direction. Using the other measures of pathogen stress yields similar results (Table S8-9).

When controlling for the competing hypothesis, the findings are largely the same, except for community food security (Table 2). When adding pathogen stress to the government effectiveness model, the effect of government effectiveness remains significant and even increases slightly. The same holds for gross domestic product per capita. The effect of community food insecurity increases slightly, but the effect is no longer significant. When adding government effectiveness to the pathogen stress model, pathogen stress remains insignificant and small.

Discussion

Based on data from eight societies from an experimental protocol that pits following an impartial rule of allocation against giving to one's community, we find that cross-society variation in following an impartial rule of giving is more consistent with a general response to institutional quality and material security than a dedicated response to specific environmental threats, such as the risk of exposure to pathogens.

These results show that individuals in societies with greater institutional effectiveness and more material resources are more likely to follow an impartial rule instead of favoring themselves and in-group members. The fact that most participants in most places allocated a substantial portion of funds to an anonymous out-group member suggests that people in these diverse societies value following rules for impartial allocations, or at least they give some value to out-group members. However, the strength of these motivations appears to vary in relation to the local environment. The

relevant material concerns appear to be quite general—including food insecurity, monetary resources, and lack of quality social services—which is consistent with experimental findings in industrialized societies (Heine, Proulx, and Vohs 2006; Mikulincer and Shaver 2001; Navarrete et al. 2004) and with observational cross-national studies (Cashdan and Steele 2013; Hruschka and Henrich 2013). These findings are more consistent with the hypothesis proposing a general adaptive response to institutional quality and material security over that suggesting a dedicated response to pathogens. They also provide novel behavioral confirmation of cross-population findings based on self-report (Hruschka and Henrich 2013) and ethnographic reports (Cashdan and Steele 2013) of in-group preferences.

These results also potentially clarify a puzzle raised by prior studies of sharing in diverse small-scale societies. Ethnographies worldwide have recorded that people in societies with little market integration place great importance on generosity, equality, and sharing. However, recent experimental studies have shown the opposite—members of more market-integrated communities are also the most likely to share equally or be generous with an anonymous individual (Henrich et al. 2010). Our results provide a potential resolution to this puzzle that relies on the scope of sharing and opportunities for exchange. If high-level institutions, such as state governments, create new opportunities for beneficial interactions with strangers (such as markets), we expect that individuals will no longer need to rely exclusively on their local family, friends, and community to meet their basic needs for security and advancement. Thus, in such situations, we will observe individuals being less generous within their local relationships and communities but more likely to follow norms of equality and impartiality with relative strangers. Conversely, in situations lacking such higher-level institutions, we will observe both a higher value placed on equal sharing and generosity locally in face-to-face situations as well as less generosity and equal sharing with less-familiar individuals.

A number of limitations to the study should be considered in interpreting the results. The study strove to ensure anonymity, but it is still possible that people in different sites had different perceptions of being watched either by others or by divine entities (Bateson, Nettle, and Roberts 2006). Measures of parasite stress were at the national level and so may not have been suitably fine-grained to identify an association. Future studies with site-specific and individual-level measures of actual and perceived parasite stress would provide an important check on these findings. We considered five other plausible explanations for the associations observed in this study. First, they could be caused by confounding owing to shared cultural or religious history. However, this seems unlikely as the three societies with less material security (Bolivia, Bangladesh, and Fiji) have three very different cultural backgrounds and the three societies with greatest material security (China, Iceland, and U.S.) have two very different cultural backgrounds. This suggests that shared cultural heritage is unlikely to account for the observed association. Second, pathogen stress might be a proximate mediator of the relationship between material insecurity and government effectiveness. However, when we include pathogen stress in models containing government effectiveness and material security, the effect sizes for these variables actually increase. If pathogen stress were a mediator, we would expect these effect sizes to decrease when adding it to the model. Third, within-country fractionalization, such as ethnolinguistic diversity and social inequality, may lead to greater in-group favoritism and lower government effectiveness.

However, neither World Bank measures of inequality (World Bank 2011, Consumption Gini) nor three country-level measures of ethnic, linguistic, or religious diversity (Alesina et al. 2003) were significantly ($p>0.05$) or even moderately ($R^2<0.01$) associated with in-group allocations. Another possibility is that greater in-group allocations are due to smaller in-group sizes if people thought that their allocations would more directly return to them in smaller groups. However, in-group size accounted for less than 1% of the variance in either individual allocations or community mean allocations (Table S10). This suggests that in-group size is not a plausible account for individual- or community-level variation in allocations in this data. Finally, although we tried to place some limit on the size of these groups across societies, it is possible that people attribute very different meanings to each of these different groups. If this is the case, it will be important to identify additional hypotheses as to how these different meanings might have led to the results observed in this study.

The fifth possible account for the observed fit between institutional quality, material security, and in-group allocations involves impartiality at the government level. Societies with substantial government-level corruption may have poor government effectiveness. We might also see citizens in these societies learning that this is appropriate behavior, and thus engaging in greater in-group favoritism. This process of learning from government officials slightly differs from individuals favoring in-groups to meet needs that the government cannot. When we examine the relationship between a direct measure of corruption—the World Bank's Control of Corruption index 2010—there is indeed a strong association between this and in-group allocation ($R^2=0.41$). However, it is not as strong as the association of in-group allocations with government effectiveness ($R^2=0.62$). Given the small number of sites, it is hard to determine if these are indeed different effects, or whether one process of adaptation—social learning from government officials or favoring in-groups because larger institutions don't meet basic needs—dominates the other. Further work will hopefully discriminate between these processes and determine how they possibly interact.

Our study also leaves open a number of questions about the mechanisms that give rise to the observed relationship. Potential mechanisms include individual cost-benefit responses to immediate threats, internalization of rules of thumb over the lifespan, and culturally acquired beliefs, values, habits and motivations (Bowles 1998; Navarrete and Fessler 2005; Sugiyama 2004; Van de Vliert 2011). For example, recent immigrant studies show that in-group favoritism can remain stable across generations exposed to new environments, suggesting that cultural learning plays a role (Giuliano and Alesina 2010) in addition to facultative behavioral responses to novel threats (Kranton 1996). The causal feedback that gives rise to the relationship between material security and expanding one's in-group also deserves further scrutiny. Existing models propose co-evolutionary feedbacks by which (a) an expanding in-group permits the creation of novel, large-scale institutions while (b) new institutions make expanding one's in-group a viable strategy (Greif 1994). It is also possible that lower levels of in-group favoritism foster economic growth (Fukuyama 1995; Gelfand 2011; Kranton 1996) and the development of institutions that mitigate material threats. Altogether, these hypotheses suggest the important possibility that in-group favoritism and material insecurity can be mutually reinforcing.

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