Do Women Supply more Public Goods than Men?
Preliminary Experimental Evidence from Matrilineal and Patriarchal Societies

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Some 35 years ago the Club of Rome published a book that sold more than 30 million copies across 30 different translations (Donella Meadows et al. 1972). The book predicted the collapse of modern society if population growth, resource depletion, and pollution proceeded unabated. More recently, the Millennium Ecosystem Assessment echoed similar sentiments, documenting the loss of vital ecosystem services and predicting a dismal future unless drastic measures were taken. The underlying causes of our rapacious attitude towards the Earth has been conjectured to be linked to several factors, including Homo Sapiens' selfishness and lack of empathy for other humans and other species.

The selfishness hypothesis has been studied extensively in experiments. One popular approach is to use variants of the simple prisoners' dilemma game. For example, public goods experiments, which are *n*-person simultaneous move games, are designed to make individual contributions to the public good yield positive externalities, but non-contribution is a dominant strategy. A typical result in this setting is that subjects are sensitive to free-riding incentives, but nonetheless cooperate at a level that cannot be fully explained by the selfishness assumption.

Results from this class of games point to an interesting asymmetry between play across women and men—women appear more socially minded than men (see Catherine Eckel and Philip Grossman, forthcoming, and Rachel Croson and Gneezy, 2008, for a review). Relatedly, non-experimental evidence provides support for the hypothesis that gender-specific preferences matter for resource allocation. Ted Goertzler (1983), John Lott and Lawrence Kenny (1999), and Lena Edlund and Rohini Pande (2001) argue that men and women may have different policy

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preferences. Raghabendra Chattopadhyay and Esther Duflo (2004) exploit the Indian system of random political reservations for women to show that gender has an impact on policy decisions – notwithstanding theoretical predictions of the 'Downsian' voting model (where voter preferences determine policies). The evidence suggests that female politicians favor policies that reflect the preferences of women. Relatedly, David Dollar et al. (2001) argue that increased female participation in politics is negatively correlated with corruption measures.

In this research agenda, our overarching theme is to explore the source of the observed gender differences. This paper represents our first step, which is a simple economic experiment conducted in three different Indian societies that are situated closely geographically—yet, a major difference is that one is matrilineal and two are patriarchal societies. Our main objective in this first step is to examine whether agents in female-dominated societies provide public goods at a different level than agents in non-matrilineal societies in a simple experiment.

We report some suggestive results. First, fewer agents are strong free-riders in the matrilineal society compared to the non-matrilineal societies. Second, public good provision is highest in the matrilineal society. Third, this higher level of provision is primarily due to *male, rather than female,* differences in contributing to the public good. We view these results as only providing preliminary insights into the underpinnings of the factors hypothesized to be important determinants of resource depletion. We conclude by outlining the necessary work that must be done to proceed in an informative manner.

I. Experimental Design

The experiment was conducted in similar environments within three different societies in North East India: a Khasi village, and two Assamese villages. The Khasi of Meghalaya, India, are a matrilineal society and inheritance and clan membership is organized around the mother's house headed by the grandmother who lives with her unmarried daughters, her youngest daughter (even if she is married), and her youngest daughter's children. Though Khasi women

do not generally assume the roles held by men in patriarchal societies (they do not become warriors or hunters, for example) they always live in households in which they or their mother have authority over most household decisions. For a more patient description of the Khasi society see Gneezy et al. (2008).

The experiment with the Assamese was conducted in two geographically separated villages in the Guhuwarti region in Assam of North East India. The two patriarchal Assamese societies are situated closely to the Khasi in India. The Assamese of Assam, India, is a myriad of ethnic practices and assimilated beliefs. The region is predominately a patriarchal Hindi society though the patriarchal Islam was introduced to the region in the thirteen century. Both Hindi and Muslim tribes and villages are spread across the plains of Assam in smaller and larger clusters. Our two patriarchal societies are mainly populated by Hindi and Muslims and, in contrast to the Khasi, in these societies lineage is traced through males. To attenuate confounds between nurtured culture and religion, we chose two distinct societies in Assam. In this spirit, we have two distinct patriarchal societies in which to compare behavior in the matrilineal society

While we attempted to consider the balance of observables and unobservables beyond the power of women across the societies, there might remain a critical vector of other variables that varies between the societies other than the role of women. Clearly, this issue is central to inference made from data gathered across any distinct groups, and highlights that care should be taken when making inference from the data patterns observed. Ultimately, what is necessary to shed light on these issues is to build on our work by studying other societies. In particular, the villages we examined also differed in religion. While the people in the Khasi village we study were mostly Christian, one of the patriarchal villages was Hindi while the other was Muslim. We return to this issue below.

Similar experimental procedures were used across the societies. We recruited the participants in advance and asked each potential subject to show up at the village school at a

given time. This attenuated selection problems since everyone was interested in participating in the experiment after they were made aware of the pecuniary incentives involved. The structure was such that subjects had a private area where they were instructed in the task. One by one we called participants to the experimental area. After subjects had completed the tasks, they waited outside the experimental area. Once enough subjects had completed the experiment to ensure anonymity, subjects were randomly assigned to groups and their payments were executed. Subjects who awaited payment were kept aside from subjects waiting to participate.

The task participants were given was to choose the amount of money to place in the individual exchange and the group exchange.[1] We employ the traditional public good game exactly from James Andreoni (1995), which includes two distinct frames: a *positive* and a *negative* framing. The difference in treatments is merely the wording of the two investment types. In the *positive* framing, subjects are instructed, "Every Rupee you invest in the Individual Exchange will yield you a return of one. Every Rupee invested in the Group Exchange will yield a return of one half for every member of the group, not just the person who invested it." In the *negative* framing, subjects are instructed "Every Rupee you invest in the Individual Exchange will yield you a return of one. However, each Rupee you invest in the Individual Exchange will reduce the earnings of the other players by one half Rupee each." Thus, under both frames allocating the entire endowment to the individual investment is the dominant strategy for those with purely selfish preferences, whereas the group investment maximizes the total group surplus.

We used a between-subject design whereby participants were informed to allocate 60 Rupees under one of the two frames (Glenn Harrison and List, 2004, denote such an exercise an "artefactual" field experiment). This stakes level is relatively high compared to the literature given that the average daily income of our subjects is roughly 60 Rupees. After choosing the

[1] Instructions are available upon request. The instructions were translated from English to the local language (either Khasi or Assamese) and were checked by having a different person translate them back into English. The instructions were read aloud to the individual participant by the experimenter. In each session we had one male and one female experimenter to control for possible gender effects of the experimenter.

allocation, participants completed an exit survey. As promised, they were never given the opportunity to learn with whom they were paired and were paid their earnings in private.

In total, we had 191 participants (79 Khasi, 61 Muslim Assamese, and 51 Hindi Assamese participated in the experiment). Concerning specific participant observables, we find that our average subject was in the 25-30 age range, but the Khasi sample had slightly older subjects (30.1 versus 25.3 and 26.8 in the Assamese societies). The male/female compositions are roughly similar across the three groups, but slightly more men were in the Assamese Hindu sessions. There are also some slight marital status differences, with marriage rates slightly higher among the Khasi. Due to these differences, besides analyzing the raw data we also examine empirical models that control for these observables.

II. Experimental Results

Table 1 contains the aggregate data across gender for each society as well as the finer data in the positive and negative frames. In Table 1, we define "strong free-riding" as not contributing anything to the public good. Table 2 presents the results from conditional analyses. From these data we report a first result concerning the tendency for strong free-riding:

> *Result 1: Fewer agents are strong free-riders in the matrilineal society compared to the non-matrilineal societies.*

Evidence to support this result is contained in Tables 1 and 2. In Table 1, we report that in aggregate, and across both the positive and negative frames, the Khasi were considerably more likely to contribute a portion of their endowment to the public good. Indeed, using a test of proportions, we find that the percentages of strong free-riders are significantly different across the Khasi and non-Khasi groups at the $p < .05$ level for each comparison.

While the raw data provide initial evidence that strong free-riding and society is linked, there has been no attempt in these unconditional tests to control for observables. In columns 1-5 in Table 2 we present estimates from a Probit regression model in which we regressed whether the individual was a strong free-rider on a dummy variable for society and individual specific

observables collected from our survey (using the Assamese Muslim group as the baseline). Empirical results from the various specifications suggest that regardless of which specification is preferred, empirical results are consonant and suggest that the Khasi are less likely to be strong free-riders than agents from the other societies. For example, results in column 1 suggest that the Khasi are roughly 73 percent less likely to be strong free-riders than the Assamese Muslim. Further, the Khasi are significantly less likely to be strong free-riders than the Assamese Hindi, but in the positively framed treatment this difference is only significant at the $p < 0.16$ level.

Concerning total provision of the public good, we find:

Result 2: Agents in the matrilineal society tend to contribute more to the public good than agents in the other societies.

Table 1 presents preliminary empirical support for this result, revealing that aggregate investment in the public good amongst the Khasi was more than 27 units, whereas investment among the Assamese Muslim and Assamese Hindi is roughly 5 and 23, respectively.

We provide regression evidence in support of *Result 2* in columns 6-10 in Table 2, where we use a Tobit specification to model the individual contributions. Empirical results suggest that the Khasi contribute roughly 36-69 more units to the public good than the Assamese Muslim. Such differences are large, as they represent deviations of several hundred percent in the negative framed treatment. The regression results also reveal the differences that exist between the Khasi and the Assamese Hindi in the negative framed treatment. In addition, much like the probit results in columns 1-5, the parameter estimates are robust to inclusion of individual specific covariates.

Upon digging a level deeper into the data, we find that these results are not driven primarily by Khasi women contributing more than their cross-society female counterparts; rather, the evidence on women giving is mixed whereas men in the Khasi society tend to contribute more than their male counterparts in other societies. This represents the basis of our next result:

Result 3: The higher public good provision observed in the matrilineal society is due more to male differences in giving across societies rather than to female differences.

Evidence for this result can be found in Table 1. In both framing conditions, Khasi males, on average, contribute more than Assamese Hindi and Assamese Muslim males. The evidence for females is consistent with this finding across the Khasi and Assamese Muslim, yet the result reverses for the Khasi/Assamese Hindi, where Khasi females contribute less than their female counterparts.

We interpret *Result 3* as suggestive of the underpinnings of the factors hypothesized to be important determinants of the observed gender differences. Some commentators have argued that the underlying factors responsible for the observed differences in cooperation rates across gender are innate. For example, Scott Baron-Cohen (2003) argues that males, on average, are biologically predisposed to be "forgetful of others," whereas females are, on average, innately designed to care more for others. Our data patterns lend some support for the notion that innate differences are not the sole driver.

Our final result corroborates an earlier methodological insight due to Andreoni (1995):

Result 4: In the non-matrilineal societies framing matters.

Evidence for this result can be found in Tables 1 and 2. For example, both tables reveal that strong free-riding is greater in the negatively framed treatment among the Assamese groups. Yet, among the Khasi the frame does not influence the tendency for strong free-ridership. These insights are supported via a series of proportion tests, which show that the frame does not matter for the Khasi group, but is an important determinant of strong free-riding among the Assamese. There exist stark differences in contribution patterns across the Assamese in these treatments.

We view these results as evidence in support of Andreoni's (1995) findings, and highlight the power that the frame can have in these games.

III. Concluding Remarks

Ecosystem services are integral to the sustainability of the human race. A result in the literature that has recently surfaced suggests that resources would be used friendlier if women held the major responsibilities for environmental stewardship. Yet, such conjecture clearly relies on speculative data, and to our knowledge little formal evidence exists that supports this hypothesis. Our goal in this study is to provide some preliminary, and merely *suggestive*, insights into this issue. We stress that our simple environment is one where the results should be used with caution.

Our data are consistent with the notion that societal structure is critically linked to public good provision. We find that matrilineal societies not only have fewer strong free riders (agents who contribute nothing to the public good), but that the level of public good provision is highest in the matrilineal society. This result is not driven primarily by females in the matrilineal society contributing extraordinary amounts, rather this insight is also due to Khasi men contributing more to the public good than their Assamese male counterparts. We believe that these results provide some initial insights into the underpinnings of the factors hypothesized to be important determinants of resource depletion.

An important caveat to our findings concerns the potential confound between religion and matrilinearity across villages. The two patriarchal villages we studied differed significantly in the amount contributed *and* in the religion of the people. Designing the experiments we did not predict such a strong influence of the religion of the participants. In this sense, religion appears to be strongly correlated with individual contributions in simple public goods games.[2] Further research is needed to disentangle this potential confound in our data.

[2] The literature does not report income differences between the groups. For example, cross-section empirical work by Marcus Noland (2005) suggests no systematic differences between Muslims, Hindus, and Christians in terms of income growth or total factor productivity, this could be explored further in future research (see also Rachel McCleary and Robert Barro 2006)

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Table 1 Experimental Outcomes

	Khasi Mean (Std. dev.)	**Assamese Hindi** Mean (Std. dev.)	**Assamese Muslim** Mean (Std. dev.)
Aggregate:			
Investment	27.3	23.3	4.6
	(14.6)	(24.7)	(13.4)
Male	25.9	18.2	3.2
	(16.4)	(23.8)	(11.9)
Female	28.8	32.8	6.0
	(12.5)	(24.2)	(14.8)
Strong Free Riders	10.0%	47.1%	86.9%
Male	15.0%	57.7%	90.3%
Female	5.0%	27.8%	83.3%
N	79	51	61
Positive treatment:			
Investment	27.2	32.3	8.3
	(14.7)	(23.4)	(17.6)
Male	29.0	22.7	6.25
	(15.5)	(24.3)	(16.3)
Female	25.3	45.5	10.7
	(13.9)	(14.4)	(19.4)
Strong Free Riders	12.8%	26.9%	76.6%
Male	15.0%	46.6%	81.3%
Female	10.5%	0.0%	71.4%
Negative treatment:			
Investment	27.5	14.0	1.0
	(14.7)	(22.9)	(5.4)
Male	22.8	14.4	0
	(17.1)	(23.3)	(0)
Female	32.1	12.9	1.86
	(10.4)	(23.6)	(7.5)
Strong Free riders	7.5%	68.0%	96.8%
Male	15.0%	66.6%	100%
Female	0.0%	71.1%	93.7%

Notes:
Investment denotes money invested in the public good
Strong Free riders denotes the share of subjects investing zero in the public good

Table 2 Regression Results

	Model I - Probit					Model II - Tobit				
	All	**Positive**		**Negative**		**All**	**Positive**		**Negative**	
Constant	1.12	0.73	-1.67	1.84	0.53	-24.3	-11.1	24.6	-42.9	-22.3
	(.20)	(0.25)	(1.96)	(0.44)	(1.07)	(5.6)	(6.4)	(28.4)	(11.4)	(16.0)
Khasi	-.73	- 0.57	-0.61	-0.90	-0.93	50.2	36.5	37.7	69.4	68.1
	(.05)	(0.09)	(-0.09)	(0.06)	(0.05)	(6.4)	(7.6)	(7.6)	(12.3)	(11.2)
Hindi	-.40	-0.40	-0.42	-0.50	-0.56	39.7	39.9	40.8	43.4	42.5
	(.07)	(0.09)	(0.09)	(0.15)	(0.16)	(6.7)	(8.1)	(7.8)	(12.1)	(11.6)
Male			.29		0.25			-11.5		-10.8
			(.12)		(0.17)			(5.7)		(6.0)
Age			.05		0.03			-1.8		-0.8
			(0.05)		(0.03)			(1.9)		(0.8)
Age^2			0.00		0.00			(0.0)		(0.0)
			(0.00)		(0.00)			(0.0)		(0.0)
Married			0.26		-0.07			-7.0		8.9
			(0.19)		(0.19)			(7.5)		(6.6)
N	191	95	94	96	93	191	95	94	96	93

Notes:

1. Dependent variable for probit model is "Strong Free Rider" and takes on a value of 1 if the participant opted not to contribute, and 0 otherwise. Explanatory variables are reported as marginal effects on dummies. Standard errors are in parentheses.
2. Dependent variable for tobit model is "Investment" and takes on the amount of money invested in the public good. Standard errors are in parentheses.
3. Due to missing age information on 1 participant for the positive framing and 3 for the negative, these observations are omitted in the conditioned regressions
4. Probit estimates are partial derivatives computed at sample means or the discrete change of dummy variables from 0 to 1.