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Economic Games Among the Amazonian Tsimane: Exploring the Roles of Market Access, Costs of Giving, and Cooperation on Pro-Social Game Behavior

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Abstract

This paper reports the results of the Ultimatum Game (UG), Dictator Game (DG) and Public Goods Game (PGG) played among the Tsimane, a group of forager-horticulturalists living in the Bolivian Amazon. Game results differ significantly from those commonly reported among modern, westernized populations. Without a long history of anonymous interactions, it is highly suspect whether the Tsimane or other traditional populations play economic games under assumptions of anonymity and one-shot exposure. Employing a behavioral ecology framework, I test predictions that differential market exposure, costs of giving, and experience with cooperation can help explain much of the variance in game outcomes. While these factors sometimes act as important predictors of game behavior, the most significant predictor is village membership. Implications for understanding the role of markets, frequent interaction with strangers, and payoffs to cooperation in daily life can help us better understand cross-cultural variation in pro-social behavior.

Keywords: experimental economics, fairness, Tsimane, cooperation

JEL Classification: C70, B40, C93, D30

Introduction

Few scholars who view individuals as free decision-making agents, sensitive to the costs and benefits of various behavioral options, still adhere to the notion that humans (and other social animals) act according to strict rational self-interest. Much theoretical and empirical work in sociobiology and behavioral ecology, and many experimental studies in economics and psychology over the past thirty years have forced researchers to conclude that costly acts conferring benefits on others are not simply anomalies to be explained away as exceptions to the self-motivated *Homo economicus*; models of individual altruism consistent with genetic selfishness have long been a part of behavioral biology (Hamilton, 1964; Trivers, 1971). Other models in the social sciences go a step further by explicitly incorporating others' welfare as important components of individual utility functions (Bolton, 1991; Bergstrom, 1996; Rabin, 1993; Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000). One productive avenue of research that has made great dents in the *Homo economicus* framework is that of experimental economics. Several of the simplest and most common economic games which

produce results at odds with self-interest predictions are the Ultimatum Game (UG), the Dictator Game (DG), and the Public Goods Game (PGG). While the results of these games have been shown to vary under different experimental conditions (see reviews in Roth, 1995; Ledyard, 1995), they show robust results across many treatments. They repeatedly show that the rational, self-interested money-maximizer rarely rears its selfish head.

The accumulation of evidence from these experiments among industrialized western populations indicates that people value fairness, fear punishment, and that direct punishment is an effective means of increasing, or at least maintaining, high levels of cooperation among interacting individuals. Whether these results reflect universal aspects of fairness, or an evolved psychology modulating decisions about giving is the subject of much recent debate (e.g., Camerer and Thaler, 1994; Fehr and Schmidt, 2000; Hoffman et al., 1994). This paper evaluates assessments of fairness and generosity from a behavioral ecology perspective using data collected among the Tsimane, a horticultural and foraging population in Amazonian Bolivia. I first describe the three games, introduce the Tsimane, test key predictions about their behavior in the games, then discuss implications of these results with respect to our understanding of giving, generosity, fairness, and equality.

The UG, DG, and PGG

In the two-player UG and DGs, a sum of money (called the endowment) is given to one individual of a pair (the *proposer*). The proposer anonymously makes an offer, ranging from 0 to 100% of the endowment, to the other member of the pair (the *responder*). In the UG, the responder can accept and thereby receive the offer, or if the responder rejects the offer, then both members of the pair receive nothing. The DG is an UG where the responder has no power of rejection; the responder simply receives whatever was offered. Whereas the UG confounds strategic play, based on expected rejection behavior of the anonymous responder, with generosity, the DG presumably examines pure 'baseline' generosity. Because the identities of proposers and responders are not known in these two games, any incentive to display, show-off, or seek a desirable reputation, is removed. The game-theoretic optimal behavior, assuming money-maximizing self-interest, is for the responder in the UG to accept any positive offer, because any money is better than none, while the proposer should therefore offer the minimal amount possible in the UG and offer nothing in the DG. Modal proposals among most players from western populations consistently hover around 50%, while mean offers are only slightly less (40–50%) (Camerer and Thaler, 1995; Roth, 1995). Most importantly, offers below 20% (deemed inequitable) are usually rejected.

The PGG is a multi-player game where each of four individuals anonymously grouped together must allocate a portion of an endowment to a common pot, keeping the remainder for themselves. Total money contributions to the common pot are doubled and then redistributed equally among all group members, regardless of their contribution. As in the UG, the rational money-maximizer should contribute nothing to the common pot, since on average, individual returns on investments in the common pot will be less than the corresponding returns from keeping the money. This is true even though the entire group could benefit by contributing their entire endowment to the common pot (i.e., the Pareto-efficient outcome). Empirical tests of the PGG in western populations reveal that mean contributions to the

common pot range from 40–60% (Camerer and Thaler, 1995) in one-shot games, whereas repeated trials with the same group members witness a steady decline in contributions over time (Ledyard, 1995).

What about other cultures?

In one of the first cross-cultural comparisons in UG behavior, Roth et al. (1991) discovered only minor differences in the distributions of offers and acceptances between student populations in Pittsburgh, Tokyo, Ljubljana, and Jerusalem. Although the four countries differ in cultural history, each of these samples were university populations living in industrialized nations with a long history of market economies. Henrich's (2000) finding of low offers and few rejections in the UG, and low contributions in the PGG among the Machiguenga, a group of Peruvian forager-farmers, suggested that the cultural trajectory associated with a traditional, non-market oriented subsistence economy may lead to very different outcomes. Subsequent tests by anthropologists and economists working in similar traditional communities in Africa, Indonesia, New Guinea, and South America have revealed a much broader spectrum of offers and rejections in the UG and of contributions in the PGG (Henrich et al., in press). Most notably, among the Tsimane, Ache, and Achuar, three South American forager-horticulturalist groups, no offers in the UG were rejected, even though many offers in these societies were significantly lower than 50%. Due to the relatively scarce levels of integration to the market in many of these traditional societies, it has been argued that living in large populations characterized by a market environment somehow favors 'divide equally' and 'punish selfishness' motivations in the UG, whereas the extent to which cooperation is essential for daily subsistence or welfare determines cross-cultural variation in contributions to the common pot in the PGG (Henrich et al., in press; Gurven, in press).

In this paper I present data collected among the Tsimane. The Tsimane are a subsistence-based forager-horticulturalist group similar in many respects to the Machiguenga (see below). We might therefore expect to find UG and PGG behavior similar to that reported among the Machiguenga, which would then add more weight to the Machiguenga results. Additionally, the Tsimane' are a valuable test case for exploring the extent to which market involvement affects expectations of fairness and giving because Tsimane' villages vary significantly in the degree to which they are exposed to markets, wage labor, and Bolivian national society (Godoy et al., 1998). Indeed, players in the two sample villages located nearby the town of San Borja were about twice as literate in Spanish, visited San Borja seven times as frequently, had five times the number of years of formal education, and worked eight times as much outside the village in wage labor than players living in the three more distant upstream sample villages (see Table 3 in Gurven, in press).

The Tsimane

Ethnographic information about the Tsimane is given in Chicchón (1992), Ellis (1996), Reyes-Garcia (2001), and Gurven (in press). Only relevant features are summarized here. The Tsimane are an Amazonian forager-horticulturalist group inhabiting a vast area of lowland forests and savannas east of the Andes in the Beni department of Bolivia. Roughly

6,000 Tsimane live in about sixty villages settled along the banks of the Maniqui River, while an additional 1,000 live in the Pilon Lajas region and in interior villages between San Borja and San Ignacio de Mojos. The Tsimane economy is based on small-scale cultivation of plantains, rice, corn, and sweet manioc, as well as fishing, hunting, and gathering wild forest products. Each adult, or husband-wife pair maintains their own horticultural fields, although farm labor is often shared among members of households, which generally consist of one to four nuclear families. Households are also the units of food distribution, although it is not uncommon for portions of fish and game to be distributed to other nearby unrelated households. While the distribution of raw foods is limited relative to that encountered among many foragers, requests of cooked foodstuffs are not uncommon, and are rarely denied. The Tsimane employ both solitary and group fishing activities, especially during the dry season months from May to October. They use hooks (purchased in San Borja or from upstream merchants), bow and arrow, poisonous vines, and occasionally nets, if available. The Tsimane hunt mainly with the use of rifles or shotguns, sometimes with the use of tracking dogs, and with machetes. However, the use of bow and arrow is not uncommon, especially when ammunition is not available.

The average number of individuals living in a Tsimane village along the Maniqui River is 93, with about half of all villages containing fewer than 50 people (PRODESIB, 1997). Villages vary in the extent to which family clusters are dispersed or clustered, although in general, direct interactions with most group members on a daily basis are fairly common. High levels of visiting and sharing among members of different households are usually associated with beer consumption. Huge vats of fermented manioc, corn, or plantains always attract visitors from other household clusters and even other villages.

Although the Tsimane were exposed to Jesuit missionaries in the late 17th century, they were never successfully settled in missions. New mission posts in several different villages only began in the 1950s, with an increasing influence of missionaries and other outsiders on the Tsimane lifeway (Chicchón, 1992). The greatest influence of the twenty year-old New Tribes Mission was to create a system of bilingual schools with trained Tsimane' teachers and an elected village chief in each of the villages downstream from the Catholic mission, Fátima. Indeed, three of the four villages with over 200 individuals contain either a Catholic Redemptorist or Evangelical New Tribes mission.

The UG and PGG were played in five villages of similar size (40 to 70 people) that vary in their proximity to the town of San Borja (pop'n ∼13,000). Puerto Mendez and La Pampita are located within a half-day's walk or several hours bus ride from San Borja. Ocuña, Catumare and Cachuela are located much farther away from San Borja, requiring several day's journey upstream (up to about 6 days) in a dugout canoe. The DG was played only in one village, Cosincho. Cosincho is larger than the other villages (population in 2000–179), and is located several days upstream from San Borja.

Ecology of giving

If propensities to give, and sentiments about fairness were shaped in the long selective historical context of a hunting and gathering lifestyle, then understanding the conditions that favor increased giving and cooperation in traditional societies may guide us towards

making qualitative predictions about game behavior among the Tsimane and other groups. Human behavioral ecologists have studied aspects of food production and distribution in small-scale societies to investigate conditions that favor or disfavor increased giving (e.g., Kaplan and Hill, 1985; Winterhalder, 1997; Sosis et al., 1998; Gurven et al., 2000, 2001; Bliege-Bird and Bird, 1997; Hawkes et al., 2001). The two most robust patterns regarding the kinds of resources widely shared are that larger items tend to be shared more than small items, and that items characterized by high levels of acquisition variance across individuals are shared more widely than predictable foods. The former suggests diminishing returns to consumption of food with resource package size, such that increased sharing of large packages reflects a decreased marginal cost of giving (and the potential to receive increased return benefits). The latter result is consistent with the notion that sharing provides risk- or variance-reduction benefits to those who pool uncertain resources.

There are also several robust characteristics of individuals and households that tend to correlate with more giving. Those living in large families tend to give less and receive more than those in small families (Gurven et al., 2000a; Kaplan and Gurven, in press). Thus, those with greater relative need for food are less likely to give and more likely to receive. Males tend to share more food than females, although this relationship stems from the fact that men are more likely to acquire large, asynchronously acquired foods (wild game). Researchers disagree about the relative importance of signaling or status-display, versus family provisioning in structuring men's and women's actual foraging and sharing decisions; nonetheless, there is much evidence to suggest that status display is a salient motivation for several kinds of widespread giving in many societies (Smith and Bliege Bird, 2000; Hawkes et al., 2001; Gurven et al., 2000b). Finally, no consistent age differences in sharing exist independent of the kinds of foods individuals of different ages acquire.

Gurven (in press) showed that the Tsimane ($n = 70$) gave an average of 37% in the UG, and no offer was ever rejected, while they contributed an average of 54% to the common good in the PGG. The mean offer given in the DG was 32% (Table 1). These economic games played among the Tsimane were one-shot decisions performed under anonymous conditions, which should therefore eliminate any motivation to give based on status or reputation. However, the extent to which anonymity is experienced as a common occurrence, and understood in close-knit, small-scale populations is debatable. A consensual realization among the anthropologists who played these games in numerous cultures was that even when players report understanding that their responses will be kept confidential, it seemed likely that individuals nonetheless played the games as if others may be aware of their choices. Only repeated games, and more focused post-game interviews will indicate whether or not individuals learn the anonymity rules built into the structure of the games. With the possibility that individuals at least partially ignore the anonymity component of the games, we can organize a set of predictions invoking aspects of market access, costs of giving, and experience with cooperation.

The first set of predictions stems from the notion that access to markets, a monetary-based economy, and association in larger communities with more anonymous interactions, leads to fairer (i.e. 50%) offers in economic games (Henrich, 2000). The other sets of predictions derive from an underlying psychology motivating resource transfers in traditional societies. If individuals treat the decisions modeled in economic games as analogies for real-life

Table 1. Summary statistics on three economic games.

	n	Mean	Std	Median	Mode
			UG		
All	70	0.37	0.14	0.37	0.50
Distant villages	37	0.39	0.11	0.40	0.50
Cachuela	11	0.41	0.11	0.50	0.50
Catumare	10	0.37	0.12	0.35	0.50
Ocuna	16	0.39	0.10	0.40	0.40
Nearby villages	33	0.36	0.16	0.30	0.30
Puerto Mendez	17	0.42	0.18	0.35	0.30
La Pampita	16	0.29	0.11	0.30	0.30
			DG		
Cosincho	24	0.32	0.08	0.30	0.25
			PGG		
All	134	0.54	0.22	0.60	0.67
Distant villages	69	0.52	0.25	0.53	0.80
Cachuela	20	0.27	0.23	0.30	0, 0.33
Catumare	18	0.60	0.15	0.57	0.47, 0.80
Ocuna	31	0.61	0.21	0.67	0.80
Nearby villages	65	0.57	0.20	0.60	0.60, 0.67
Puerto Mendez	31	0.63	0.17	0.67	0.60
La Pampita	34	0.51	0.21	0.53	0.67

Note: *n* in the UG refers to the number of proposers.

decisions, we should expect similar associations between the giving of traditional resources (e.g. food) and that of money.

Hypotheses

Market access:

1. Villages located in closer proximity to the market town of San Borja should make larger offers in the UG and DG, and make larger contributions to the common pot in the PGG.
2. Within villages, individuals with more formal education, greater access to wage labor, and greater literacy in Spanish should make larger offers in the UG and DG, and make larger contributions to the common pot in the PGG.

These predictions test the notion that increased acculturation and association with markets and wage labor lead to more 'fair' offers and contributions hovering around 50%. No prediction is made about rejections in the UG, although a majority of offers hovering at 50% implies that low offers should be rejected, as is commonly found in the West.

Costs of giving:

3. Individuals with greater stores of accessible food are more likely to give in the UG and DG and to contribute in the PGG.
4. Individuals possessing a greater quantity of market-derived foods should give more in the UG and DG and contribute more in the PGG.
5. Individuals possessing a greater quantity of domesticated animals should give more in the UG and DG and contribute more in the PGG.
6. Individuals in families with low dependency should give more in the UG, DG, and PGG than those in families with high dependency.

These predictions presume that an increased need for money, as measured by the quantities of all food, market foods (which are purchased with money or obtained from trade with merchants), domesticated animals (which can be used as food or as a currency for trade with merchants), and a greater number of dependents in the household relative to the number of net food producers, may produce a desire to give or contribute less in the games. Note that the prediction about market foods (#4) is also consistent with the notion that more market association leads to greater giving, as described in the previous section.

Cooperativeness:

7. In villages with greater variation in accessible household food stores (where presumably sharing among households is less widespread), individuals should give or contribute less in the three games than those living in villages with lower inter-household variation in food stores.
8. Because many resources are significantly pooled within the household, those living in households containing more individuals should give more in the UG, DG, and PGG.
9. Members of households whose in-house food holdings derive more from members of other households should give less in the UG, DG, and PGG.

These predictions test the notion that a greater intensity of sharing, with a wider pool of closely interacting individuals, may correlate with increased giving in the games. The last prediction implies that those receiving relatively more from other families may be receiving more than they are giving, and are therefore less likely to be generous in the context of the games. However, if members of these households receive more because they are less self-sufficient, they may potentially give more of the endowment away as a manifest desire to pay back others.

These nine predictions are listed in the first two columns of Table 2.

Experimental methods

Economic games

Instructions for the UG and PGG were adapted from those used by Henrich (2000) for the Machiguenga, and are reproduced in Gurven (in press). These games were played

Table 2. Bivariate correlations of game outcomes with ecological variables.

Predicted	direction	UG [1] std. est.	UG [2] std. est.	UG int?	DG [1] std. est.	DG [1] std. est.	PGG [2] std. est	PGG int?
Market/urban								
Spanish ability	+	0.42^	1.26*	no	0.36*	0.29	0.54	no
Visits to San Borja	+	−0.03	0.22^	no	0.35*	0.11	0.1	no
No. of years education	+	−0.05	0.04	no	0.07	0.01	0.14	yes
No. of days wage labor	+	−0.09	−0.14	no	n/d	0.12	0.25	no
Costs of giving								
In-house food	+	0.00	0.04	no	n/d	−0.10	0.38^	no
Market foods	+	0.18	0.70**	yes	n/d	−0.40***	−0.15	no
Domestic animals	+	−0.08	−0.14	no	n/d	0.06	−0.09	no
Low dependency	−	0.01	−0.37*	yes	−0.11	−0.17**	0.06	no
Cooperativeness								
Inter-house variance	−	0.18	–		n/d	−0.34***		
Household size	+	0.05	−0.19	no	−0.08	0.10	0.04	no
% Received from others	−	−0.11	−0.32	no	n/d	−0.08	−0.25^	no
Other								
Sex		0.25*	0.41**	no	0.39*	−0.04	0.16	yes
Age		0.12	−0.15	no	0.07	0.03	0.05	no
Village		0.36*			–	0.51***		

Note: [1] refers to bivariate regressions, [2] controls for village and village-interactions ("int?" in table).
$^{\wedge} p < 0.10$, $^{*} p < 0.05$, $^{**} p < 0.01$, $^{***} p < 0.001$.
n/d refers to no data collected to perform statistical test.

between May–August 1999. The DG used a similar protocol, and was played in only one village (Cosincho) in June 2000. The standard procedure used in all 6 villages was first to gather as many individuals over age 15 as possible in one location. This location was the school in the four villages that had schools (Puerto Mendez, La Pampita, Cachuela, Cosincho), in a temporary shelter along the beach at Ocuña, and in an empty house in Catumare. After everyone had arrived, the instructions for the UG were read first in Spanish, then translated into Tsimane with the help of a translator. The instructions were read again in both languages, and the details summarized in both Spanish and Tsimane. Several hypothetical questions were asked of numerous individuals in an attempt to test understanding of the rules of the games. The answers were explained to all in the group, and more questions were asked until it seemed apparent that all individuals understood the rules of the game. Special attention was given to younger and older individuals, who appeared to have greater difficulty in understanding the rules. Before beginning play, I re-emphasized the anonymity of their decisions. The UG was then played, and a similar procedure was then employed for the PGG. The rules of the

DG were the easiest to understand and the procedure for explaining the game was similar to that used for the UG. The stakes for the UG and DG were set at 20 Bolivianos (Bs), and for the PGG at 15 Bs ($1 = 5.8 Bs in 1999; $1 = 6.1 Bs in 2000). These were based on current average daily wages obtained from Tsimane during household interviews (mean = 16.5 Bs, s.d. = 4.4, $n = 41$). Before play, I reiterated the fact that players could behave any way they desired in the games, and that their responses would be kept strictly confidential.

In each game, individuals entered a separate area (i.e., the school, an abandoned house on the beach, or an empty house) one by one until all available individuals had played each game. During the game, I was the only other individual aware of the players' choices. For the UG and DG, each individual was told whether they were the "first person" (proposer) or the "second person" (responder). After the "first person" gave an offer, they were told the consequences of their choice (e.g., 'you offered 4 Bs, so if the second player accepts, you receive 16 and the other person receives 4; if the second player does not accept, neither of you receive anything') to insure further that their choice was based on a proper understanding of the game. The "second person" was also told the consequence of their decision to accept or reject the offer in a similar manner. Although the PGG was played after the UG, villagers were not aware that another game would follow the first one. Confusion due to individual variation in mathematical ability was avoided by using either single boliviano coins, wood chips or pieces of paper meant to represent individual coins (see below).

The rules of the PGG were easy to understand, but the consequences of specific game behavior were not. To clarify the implications of specific game behavior in the PGG, I demonstrated through example the consequences of three group scenarios: (a) all contribute everything to the common pot, (b) all contribute nothing to the common pot, and (c) three players contribute everything while the fourth player contributes nothing. During actual play of the game, little interaction between myself and the players was required. Each player entered the separate area, and was given an envelope containing fifteen pieces of paper. During the instructions, the players were told that each piece of paper represented 1 Bs. Paper was used in the envelopes instead of actual boliviano coins because it would have been impossible to obtain sufficient quantities of 1 Bs coins for play. Finding change for even 10 Bs bills (<$2) was often difficult in the town of San Borja. Players then decided how many pieces of paper to take with them, and how many to leave in the envelope, which represented the "common pot".

Total time for explaining the instructions and for play in each game totaled about 2 hours. After the games were played, I calculated the returns for each player, and paid each individual (or each nuclear family the combined total for its members since change was a rare commodity) the appropriate amounts they earned. Each player was also given a participation fee of 5 Bs. The maximum possible earnings from the UG and PGG, respectively, are 20 Bs (offer nothing and this offer is accepted) and 37.5 Bs (self contributes nothing to public good while others contribute everything). Minimum earnings are 0 in the UG and DG (be offered nothing, or having an offer rejected) and 7.5 in the PGG (self contributes everything to public good whereas others contribute nothing).

Village-level and individual-level information

Censuses were conducted in each of the villages where the games were played. Interviews were also conducted with the assistance of translators several days prior to playing the games. These were done to obtain demographic and socioeconomic information on all potential players. For all adult household members, I recorded their name, sex, age, place of birth, number of children (and their sexes and ages), the number of times they visited San Borja in the past month (and the purposes of their visits), the number of times they went hunting or fishing in the past month, and the number of days they worked for wages outside the village in the past year (and their average daily wage). I also ranked their Spanish ability on a four point scale (4 = fluent speaking and can read and write, 3 = fluent speaking only, 2 = speaks little, 1 = speaks none). Although this method was subjective, Reyes-Garcia (2001) found a strong correlation between subjective measures of linguistic competence and those obtained with a more rigorous and time-consuming standard protocol.

Food availability was assessed by an inventory of all foods present in the household at the time of the interviews. All foods were weighed using Homs spring scales, and weights were converted to calories through the use of standard tables for Latin American foods and from tables published in Hill and Hawkes (1983). The identities of all acquirers, processors, and donors of all food items were recorded. These data allow for an estimation of the percentage of in-house food received by others, and for the village-level estimation of the standard deviation in in-house food stores. Inventories of all domesticated animals, if any, were also recorded in the household interviews. Since market-derived foods have explicit monetary value, I estimate the total monetary value of all in-house market foods by multiplying the measured weights of foods by the per kilogram price of those foods in the markets of San Borja.

Analyses

I explore the nine predictions in this paper through the use of Pearson correlations between offers or contributions and relevant predictors. I also use multiple linear regression, which allows me to examine the partial effects of single variables while controlling for other, often co-dependent, variables. Correlations in bivariate analyses are equivalent to standardized regression coefficients. Offers and contributions were transformed using an arcsine square-root function to deal effectively with the constraint that all responses are between 0 and 100 (and most responses are restricted to a narrower range). All parameter estimates from the regression analyses are standardized so that the means = 0 and the standard deviations = 1. The use of standardized estimates allows for a simple way of comparing the relative effects of different predictors on offers and contributions.

Results

Figure 1 shows the distribution of offers in the UG and DG, and of contributions in the PGG among all Tsimane players. Table 1 gives the means and standard deviations for offers made in the UG and DG and for contributions to the public good made in the PGG. The UG

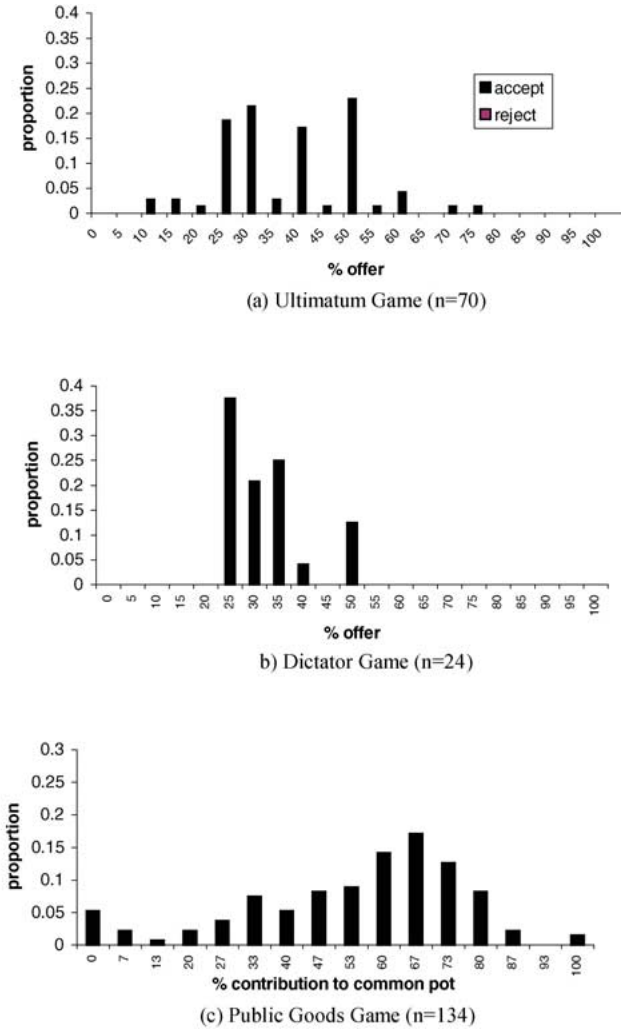

Figure 1. Ultimatum, Dictator, and Public Goods Game. Entire Tsimane sample (No. of players given).

and PGG offers are given for the pooled sample of five villages, and separated as "distant villages" (Cachuela, Catumare, and Ocuna) and "nearby villages" (Puerto Mendez and La Pampita). Overall, the Tsimane results show smaller offers in the UG, larger offers in the DG, and similar average PGG contributions when compared to game behavior from urban, westernized populations. However, using an Epps-Singleton (E-S) test, the distribution of PGG contributions is significantly different from those reported among western populations (Gurven, in press). The Tsimane PGG distribution shows much variation, with contributions spanning the entire range from 0–100% of the endowment. No offers in the UG were rejected.

Market access

The overall shapes of the "distant" and "nearby" distributions for the UG are significantly different at the 6% level (E-S, CF = 9.07, $p < 0.06$), and the median in the "distant" sample is 10% greater (and the mode 20% greater) than that in the "nearby" sample (Table 1). This result is in the opposite direction predicted if more intensive affiliation with money-oriented markets correlates with western notions of fairness. There were no offers less than 25% or greater than 55% in the distant sample, compared with 15% offering both less than 25% and more than 55% in the nearby sample. In the PGG, there was no statistically significant difference in means or in the distributions of contributions between the distant and nearby samples (E-S, CF = 3.73, $p = 0.44$).

In the pooled sample across villages, the only significant individual-level market-related variable correlated with game behavior in the UG was literacy in Spanish, while no market variable was correlated with game behavior in the PGG (Table 2, column UG-[1]). The most literate Tsimane tend to offer more money in the UG. Further analysis reveals a more complicated picture. By adding the category of "village" and interaction terms that allow for the effects of market variables to vary across villages, we find that the effect of Spanish literacy becomes stronger, and that those who were more frequent visitors of the market town, San Borja, made larger offers (Table 2, column UG-[2]). Similarly, greater proficiency in Spanish, and more visits to San Borja were also associated with significantly larger offers in the DG played in the single village of Cosincho. Bivariate analyses revealed no significant effects of market variables on PGG contributions, although controlling for village residence and interaction effects makes involvement in wage labor a significant predictor of greater PGG contributions (Table 2).

A multiple regression of UG offers on village residence and these market variables (analysis not shown) makes formal education emerge as a significant negative effect on offers, while Spanish literacy remains significant (standardized estimate (std. est). of education = -0.22, $p < 0.05$; std. est. of Spanish literacy = 0.87, $p < 0.05$; full model $F(12, 65) = 2.41$, $p < 0.01$, $R^2 = 0.35$). In the multiple regression of PGG contributions on the market variables, the number of days spent working in wage labor loses statistical significance ($F(10,129) = 5.04$, $p < 0.0001$, $R^2 = 0.30$).

Costs of giving

Bivariate analyses revealed no significant correlations between total in-house food stores, the total monetary value of market foods, the total weight of domesticated animals owned by household members, and the ratio of consumers to producers on UG offers. However, controlling for village residence and village interaction effects (as described above) makes the amount of market foods and dependency ratio significant predictors of UG offers. Those possessing more market-derived foods and those with relatively fewer dependents in the household tend to give more in the UG (Table 2, column UG-[1]). For the DG, I only have census data and so the only variable I can test is dependency ratio, which is uncorrelated with DG offers. In bivariate analyses, market foods and dependency ratio were also correlated with PGG contributions. Controlling for village residence and potential interactions, the

effects of market foods and dependency disappear, while total amount of in-house food emerges as a positive predictor of higher contributions (Table 2, column PGG-[2]).

Multiple regression of UG offers on village residence and these four predictor variables (analysis not shown) eliminated the effect of dependency, while the effect of market foods remained significant (standardized partial estimate = 0.67, $p < 0.001$; $F(16, 68) = 2.22$, $R^2 = 0.41$, $p = 0.02$). None of these variables remained significant in the multiple regression of PGG contributions ($F(17, 126) = 3.85$, $R^2 = 0.38$, $p = 0.0001$).

Cooperativeness

Neither inter-household variance in in-house food stores, household size, nor the percentage of food received by members of other families (sharing) correlated with UG offers. Controlling for village and potential village-effect interactions does not change these results for the UG. Village and inter-household variance in food possessions cannot be included in the same model because these variables are perfectly correlated. The only variable of the three listed above that were measured among the DG players of Cosincho was household size, which is shown to be uncorrelated with DG offers (Table 2, column DG-[1]). Finally, greater variation in in-house availability of accessible food across households within a village was associated with significantly smaller PGG contributions (Table 2, column PGG-[1]). Controlling for village residence and associated interactions makes sharing emerge as a significant negative predictor of PGG contributions (Table 2, column PGG-[2]). Multiple regression of UG offers ($F(13, 68) = 1.18$, $R^2 = 0.22$, $p = 0.32$) and PGG contributions ($F(6, 130) = 9.45$, $R^2 = 0.31$, $p = 0.0001$) on village residence, household size, and sharing does not change these results.

Village, age, and sex

The fact that including the village of each game player as a variable in the UG and PGG often changed the direction and significance of several bivariate results suggests that village membership matters because villages differ in their overall market access, as well as in the other measured variables. Even in the multiple regressions, however, village identity proved to be the strongest independent predictor of UG and PGG behavior, even after controlling for socioeconomic variables. Village identity accounts for 13% and 26% of the variation in UG and PGG behavior, respectively. The robust effect of "village" derives from the fact that members of La Pampita, on average, gave less in the UG than members of other villages, while members of Cachuela, on average, gave less in the PGG than members of the other villages. This remained true even after controlling for each of the twelve variables listed in Table 2.

It is also important to realize that several predictor variables showed different effects across villages, which is evidence of an interaction. One example of a significant interaction involved the effect of dependency on UG offers. The standardized effect of dependency on UG offers across the five villages is shown in figure 2. Dependency had little effect on the residents of La Pampita, who generally gave small amounts across the entire range of dependencies. It had a negative effect on giving among residents of Puerto Mendez, while

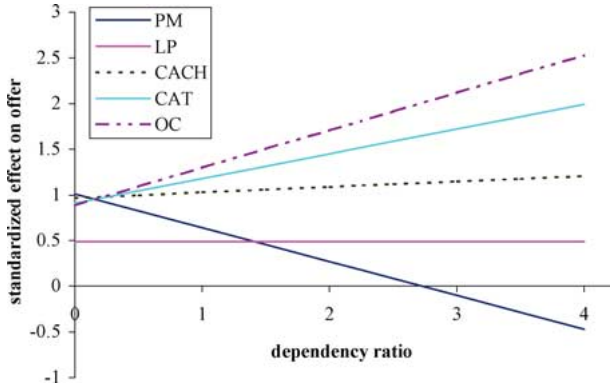

Figure 2. Interaction effect of dependency ratio and village of player. PM = Puerto Mendez, LP = La Pampita, CACH = Cachuela, CAT = Catumare, OC = Ocuña.

dependency had a positive effect on giving in the three upstream villages, with the positive effect increasing the further upstream the village.

Men offered more money than did women in the UG and DG, whereas there was no difference in PGG contributions by sex (Table 2). These effects of sex remain significant after controlling for village and village by sex interaction. Finally, a player's age showed no relationship to game behavior in any of the games.

Discussion

Lower offers in the UG coupled with no responder rejections, the large mean and variance in PGG contributions, and the significantly positive offers in the DG are novel results that require explanation by any theory that addresses species-typical sociality and economic decision-making based on data collected among less traditional populations (assuming these results are not artifacts of unseen nuances in the field-applied methodology). This study attempted to explain these results by exploring the effects of market access, variable costs associated with giving, and experiential cooperation on economic game behavior among the Tsimane. In small-scale societies with little access to markets (and little experience with economic games), people may base their game decisions as if their behavior were public, ignoring the anonymous structure of the game. There was little reason to believe that the Tsimane, or players in other traditional societies, were suspicious of the researchers or suspected them of lying about the privacy of game decisions (Henrich et al., 2002). Therefore, this study examined whether predictors of generous behavior in other common social and ecological contexts also affected giving behavior in the economic games.

While geographical proximity to San Borja did not explain variation in UG or PGG behavior, Tsimane with greater literacy in Spanish, and who frequently visited San Borja offered more money in the UG and DG, while those with more experience in wage labor contributed more in the PGG, after controlling for village membership. This result lends

some support to the notion that interaction with nationals, and more direct experience with money and the market economy may lead to more giving. A cross-cultural comparison of UG offers among 15 traditional populations varying in their overall market exposure showed, on a gross level, that greater market access correlated with greater offers (Henrich et al., in press). It may be premature, however, to conclude that increased giving is due only to distinct social norms learned through greater exposure to modern economies and urban environments. Among the Tsimane, those possessing more market foods and those living in households comprising relatively more dependent consumers also gave more in the UG, and each of these variables is associated with a greater proficiency in Spanish (Spearman rank correlation controlling for village, $r = -0.26$, $p < 0.05$; $r = -0.24$, $p < 0.05$). Controlling for village and dependency, the effect of Spanish ability loses statistical significance ($p = 0.23$) while possession of market foods remains marginally significant ($p = 0.06$). However, wage labor work experience was uncorrelated with total in-house food stores ($r = -0.01$, $p > 0.90$) and the percentage of food received by members of other households ($r = 0.05$, $p = 0.55$), which suggests an independent effect of wage labor on PGG contributions.

The indirect measures of cooperativeness employed in this paper related to game behavior only in the PGG. Both the variance in available household food storage, and percentage of foods received by others were associated with fewer contributions, after controlling for village affiliation.

Market access, costs of giving, and to some extent, cooperativeness, seem to influence economic game behavior, which suggests that Tsimane are at least partially ignoring the anonymous, one-shot conditions of the games. From the perspective of a *Homo economicus* operating according to the structure of the games, the variables listed in Table 2 should display no effect on game behavior. The results of the analyses showed some support for the notions that market association matters, and that the Tsimane give away their endowments in a similar fashion as they might give away other resources.

Greater affiliation with markets, in association with a greater degree of anonymity in daily social interactions, may make cooperative "first-moves" a salient social norm, although it could be argued that the increased anonymity of larger, market-based societies could just as easily make opportunistic defection a common salient social norm. The inconsistent effects of the market variables on the different games may be due to the fact that these variables examine different components of market exposure and acculturation, and the fact that while the outcome variable in each game reflects 'giving', the structure of each of the three games is very different. Additionally, each of the market variables is strongly correlated with the other market variables, but the history producing each individual's attributes for these variables may reveal important insights about self-selection. Adults proficient in Spanish tend to either live (or have lived) in downstream villages, and have engaged in more wage labor working for Bolivian nationals. Younger adults proficient in Spanish are more likely to have learned their Spanish from formal schooling in addition to visits to San Borja. Men are more likely to visit San Borja than women, and are more proficient in Spanish than are women. The fact that Spanish proficiency requires long-term exposure to nationals in non-Tsimane environments (more than exposure to schooling), may explain why Spanish proficiency is the most revealing market variable.

More theoretical and empirical research is needed that explores how acculturation, market affiliation, and social context influence game behavior. We saw that distance to San Borja did not predict game behavior, perhaps as a result of migration of individuals from downstream to upstream villages, a self-selection bias where those most heavily influenced by markets were most likely to be absent from the downstream villages when the games were played, and the possibility that market exposure has a non-linear effect on the kinds of decisions and norms that may influence game behavior (Gurven, in press). The Tsimane trade items with each other, and with local merchants, and trade is hardly a recent invention in human history specific only to modern markets. More insight may be gained by exploring the greater familiarity of interacting with strangers, strictly dyadic interactions, and with direct confrontation, rather than the 'economic transaction' aspect of market-oriented environments. Tsimane and members of other traditional populations may largely interact with known individuals, often in a public domain, and may be less likely to "reject offers" or punish through direct means (Gurven, in press; Hill and Gurven, n.d.).

It is clear that decisions made in the three games discussed in this paper are not equivalent. Offers made in the UG showed no relationship with contributions made in the PGG by the same individuals (Gurven, in press). A similar result has been shown among the Ache (Hill and Gurven, in press). It is possible that the PGG is viewed as a gamble, with the potential doubling of the endowment perceived as an incentive for high contribution levels. Given that males have been described as more risk-prone than females cross-culturally across a wide spectrum of behaviors (Daly and Wilson, 1988), it is surprising that Tsimane males offered more in the UG than did females, but there were no sex differences in PGG contributions. It is interesting to note that although the anonymous, one-shot nature of the games may not have been internalized, and although UG offers were never rejected, DG offers are smaller on average than UG offers. However, DG offers are not as low as those among the Hadza (Marlowe, n.d.), or among westerners, where rejections of low offers are very common. In fact, the difference in mean UG and DG offers among the Tsimane, Orma, Hadza, and Iowans was 0.05, 0.13, 0.13, and 0.24, corresponding with overall UG rejection rates of 0, 0.04, 0.24, and 0.25, respectively ($r = 0.76$, $p = 0.24$). These data therefore suggest that UG proposers do not ignore anticipated responder behavior.

While market effects, costs of giving, and cooperativeness were introduced as separate sets of influencing factors on game behavior, these three categories are related in meaningful ways. As mentioned above, increased market affiliation can generally decrease the costs of giving when the currency used in the game is money, even though money can be stored and used on other days. Godoy et al. (n.d.) found that Tsimane (from other villages) showed evidence of lower discount rates when the currency used in time preference elicitation was money rather than food. Nonetheless, money is still a relatively rare commodity that can be transformed into food, medicine, clothes, and accessories, and so demand is high. With an increasing reliance on market goods to reduce temporal variation in food- and health-related risks, households become more self-sufficient, and may be less likely to share. Thus overall cooperativeness may decrease with increasing market involvement. However, individuals are still able to reap the gains of cooperation with sufficient opportunity, as when groups of Tsimane, regardless of market access, collaborate in barbasco fishing, field clearance, and village maintenance activities.

The most important predictor explaining game behavior is village affiliation. Why do villages differ in their game behavior, and why do several variables listed in Table 2 exhibit different effects in different villages? First, small sample sizes for each village, or unexpected differences in protocol, may have produced spurious differences where none exist. While it is also possible that pre-game communication may have caused different focal responses, there were no clear ordering effects of UG offers or PGG contributions in any village. If observed differences in game behavior are real, it may be possible that different villages arrive at different equilibria regarding norms influencing game behavior. Why different groups arrive at different norms, and the extent to which these norms are maintained over time is an important area for future research. Additionally, the same games may cue different responses by different people even within the same culture (Henrich et al., in press). Without focal rules or norms of behavior regarding the games, due, in part, to the unfamiliarity with anonymous interactions with strangers, it may not be surprising that Tsimane UG, PGG and DG responses are more variable than those found in western populations.

Any theory that attempts to explain cross-cultural variability in norms influencing cooperative (and hence game) behavior, should therefore also apply here for explaining variability among villages. The presence of inter-village variability also cautions us when attempting to explain game results by post-hoc anecdotes that seem to capture key cultural traits or behaviors. For example, low PGG contributions were common in Cachuela, a small village where most of the houses are visible to each other, and where food sharing, production and household visitations were more coordinated among group members than in the other villages. Similarly, the Ache and Hadza are two groups which engage in widespread active sharing, yet the Ache UG offers resembled those of the west (albeit no rejections) (Hill and Gurven, n.d.) while the Hadza offered little (and with high rejection rates) (Marlowe, n.d.).

Conclusion

The UG and PGG results from traditional populations, where daily cooperation is often viewed as a crucial component of subsistence strategies, are closer to the self-interest predictions than the results from games played among industrialized, western populations. Thus, this and other similar studies raise more questions than answers. How do aspects of modern economies and the social context of large, more urban environments shape prosocial behavior? How does exposure to out-group norms interact with established norms shaped under a traditional context in a traditional economy? What affects rates of social learning of norms of fairness, equity, generosity, politeness, obligation, and punishment? How frequently do individuals violate these norms when favorable opportunities requiring norm violation appear (e.g., the economic games)? Are the Tsimane, and other groups who were never observed punishing others in the UG, more likely to punish via other means or in other contexts (e.g., through gossip)? Even though no Tsimane ever rejected an offer in the UG, offers in the DG (essentially the UG without punishment) were lower than those observed in the UG.

It is important to realize that these same questions were relevant before these games were played in traditional societies. Although there is generally less variance in responses in both the UG and PGG played in western populations, and usually relatively smaller

endowments, there is still some variation that could potentially be explained by some of the factors influencing costs of giving, and proclivity towards cooperation. Even in modern societies where interaction with strangers is a common occurrence, individuals often do not behave as if the economic games they are playing are truly anonymous and individuals will respond accordingly when greater emphasis is placed to insure anonymity (Hoffman et al., 1996).

There is little doubt that humans everywhere have worked out cultural ways of attaining gains from cooperative ventures, and that these cultural methods might require some universals of human cognitive machinery, including abilities to detect and punish cheaters (Cosmides and Tooby, 1989; Bolton and Zwick, 1995; Bowles and Gintis, 2000). Because cooperation is usually costly in terms of time, energy, or other resources, there are strong incentives to control free-riding in cooperative ventures. However, most economic experiments that examine costly decisions about giving, are only "costly" in the sense that a portion of the potential gains go to other individuals. The endowments represent 'windfalls'—large sums obtained without any cost (other than the time spent playing the games). It is unclear whether rules of thumb or cultural norms designed to direct costly acts of cooperation apply for cooperative acts that are relatively costless. Deciding how much of a windfall should go to others might more accurately require an economics of etiquette or manners (Camerer and Thaler, 1995).

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