Collective action in action:

Pro-social behavior in and out of the laboratory

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ABSTRACT

Experimental approaches have become an increasingly popular method to study altruism and cooperation in laboratory and, more recently, in field settings. However, few studies have examined the extent to which behavior in experimental settings tells us about behavior in the real world. To investigate the ecological validity of several common experimental economics games we compare game behavior with pro-social behavior among Tsimane forager-horticulturalists of lowland Bolivia. We find that patterns of food sharing, social visitation, beer production and consumption, labor participation in well construction and contributions to a village-wide feast are not robustly correlated with levels of giving in the Dictator Game and Ultimatum Game. Payoff structure and socioecological context may be more important in predicting pro-social behavior in a wide variety of domains than stable personality traits**.** We argue that future use of experimental methods should employ novel game design that will help illuminate observations derived from ethnographic fieldwork.

Keywords: altruism, cooperation, experimental economics, Tsimane

1. Introduction

Economics experiments are increasingly used to measure pro-social sentiment or behavior by social scientists in a growing number of fields, including anthropology (see Henrich, et al. 2004 volume), psychology (e.g. Caporael, et al. 1989), political science (e.g. Eckel, et al. 2002; McDermott 2002), neural science (e.g. King-Casas, et al. 2005; McCabe, et al. 2001) and even primatology (e.g. Brosnan and de Waal 2003; Silk, et al. 2005). The relative ease of recruiting subjects and setting up laboratory-based experiments in almost any location makes

them an attractive option. However, it is unclear whether economics games are useful for drawing inferences about altruism and pro-sociality outside the artificial conditions of the experiments. This paper therefore explores the ecological validity of experimental economics games by comparison with observed pro-social behavior among a group of Bolivian forager-horticulturalists.

Researchers are using the results of economics games to make broad inferences about social preferences and human behavior. Indeed, the unfamiliar character of experimental games is sometimes viewed as their advantage; novel games may be more likely to elicit intuitive propensities instead of patterned responses to familiar conditions. To date, experimental games have been successful in debunking simple notions of a self-interest-driven *Homo economicus*, despite long-standing tradition placing short-term self-interest as the starting point for any analysis in neoclassical economics. *Pro-social*, or *other-regarding*, preferences include concerns over profit or resource distribution, equity and equality. These preferences are often contrasted with the standard self-interest calculus of *Homo economicus*, whose egoism mandates a sole focus on short-term personal benefit or utility. Hundreds of studies, employing popular experiments such as the Ultimatum Game and Dictator Game, show that, contrary to expectations based on profit maximization, people everywhere willingly offer money to anonymous others in one-shot scenarios even though they could easily profit by hoarding the monetary endowments provided by researchers (Camerer and Thaler 1995; Oosterbeek, et al. 2004). Repetitions of these games have revealed valuable information about fairness, division rules and punitive sentiment, with inferences made concerning species-typical cognitive design (Hill 2002; Hoffman, et al. 1998) and cross-cultural norm variation (Henrich et al. 2004). They are also used as the empirical basis for revising theoretical models of cooperation. For example,

game results have been used to argue that standard evolutionary models of cooperation, such as nepotism based on kin selection, costly signaling and both direct and indirect reciprocity, cannot explain the widespread occurrence of altruistic behavior observed among many participants. Instead, results have been used to support some form of cultural group selection (Fehr, et al. 2002; Henrich 2004).

The most popular experimental games require pairs of individuals to make decisions about the division of resources. Notwithstanding the unique payoff structure, or set of rules that assigns costs and rewards benefits based on the joint decisions of players, there is an underlying assumption in these games that pro-social individuals should behave more altruistically than self-interested individuals. Games are typically played anonymously among players to reduce incentives based on an implicit desire to enhance reputation, engage in reciprocity, signal an intent to cooperate, or favor kin and friends—motivations that under many conditions have been linked to more pro-social behavior (Gurven 2004c; Winterhalder 1997). After these motivations are structurally removed, the residual altruistic giving is interpreted as a core aspect of pro-social tendency or agreeableness. Individuals that exhibit high levels of such pro-sociality in these games under context-free conditions of anonymity are believed to gain utility from increasing others' welfare at personal cost. Indeed, people who are unconditionally pro-social tend to score higher on conscientiousness and agreeableness scales as part of the "Big Five" personality dimensions that show remarkable robusticity and stability over time. These two dimensions contain other-regarding sub-components that have shown a weak but positive relationship with pro-social experimental behavior (Ben-Ner, et al. 2004; Boone, et al. 1999; Burghart, et al. 2005). Other experiments show that (western) subjects after repeated play in a variety of games

can be categorized consistently as obligate cooperators, defectors or conditional cooperators who pay very close attention to changes in costs and benefits (Kurzban and Houser 2005).

Despite the success and appeal of experimental games, not all social scientists are proponents of experimental approaches. The reluctance of skeptical social scientists to accept experiments as a useful tool to learn about human behavior seems to be due to a belief that the experiments lack ecological validity: they are too contrived to accurately reflect everyday patterns of behavior (e.g. Chibnik 2005)..

Laboratory experiments have been criticized because they mostly use restricted, eager, paid student volunteers, sometimes employ artificial assumptions with little ecological validity, and wealth-maximizing optima are often at odds with socially desirable or moral ways of behaving (List and Levitt 2005). Quasi-experiments done in non-western "field" settings are touted as one solution, although these mainly address the problem of biased "convenience" populations of students in western settings (Cardenas and Carpenter 2005). The anonymity of many (especially double blind) games, and the laboratory setting, often precludes the collection of information about pro-social behavior outside the laboratory, except through problematic self-reports.

There have been few systematic attempts to examine the external validity of these games. To our knowledge, only two studies have examined the relationship between pro-social behavior in and outside of the laboratory. One of these shows a weak but significant correlation between behavior in donation experiments and charitable donations (Benz and Meier 2005). Among Ache forager-horticulturalists of Paraguay, no relationship was found between food sharing behavior and Ultimatum Game offers or public goods game contributions, both in the standard anonymous

and a public version, where individual behaviors could be linked to specific individuals (Hill and Gurven 2004).

Key questions remain unanswered. Does economic game behavior reflect underlying altruistic propensities, concern for others, and actual willingness to incur personal costs to increase the welfare of others? Or does the controlled setup of experimentation bear too little resemblance to the context-rich environment in which people make choices and decisions? Are game rules and payoff structures not analogous to conditions of daily life? Even if revealed social preferences in games are "real", what is the empirical relevance of such preferences in specific pro-social domains, such as charitable donations, volunteerism, wealth transfers, conservation, food and labor sharing and gift giving? Apart from the contrived content of the games, is it valid to assume that significant treatment effects will hold in non-game contexts? Treatment effects include changes in the scripts of games, framing effects, knowledge available to players, and other alterations to the game that are expected to have a predicted effect on the pro-social outcome (see Kagel and Roth 1995). It is likely that treatment conditions may interact unexpectedly with contextual factors in non-game settings and thereby affect pro-social decision-making differently than in the games.

1.1. Goals and predictions

This paper begins to assess the ecological validity of these games by examining several economics games played among Tsimane Amerindians in lowland Bolivia. Extensive ethnographic fieldwork carried out with the Tsimane allows us a unique opportunity to use recorded information about players rather than using more typical self-reporting. Much of

Tsimane social life is public and observable during the course of ethnographic fieldwork. We examine the relationship between pro-social behavior, as measured by several economics games, and instances of pro-social behavior in everyday life based on observation. We show that game behavior bears little relationship with non-game behavior at the individual level. While such a lack of validity may be troublesome, the results indicate that much of cooperation in experimental and field settings is affected by context, and context may be more important than individual propensities.

Our experimental measures of pro-social behavior are based on three games--Ultimatum Game (UG), Dictator Game (DG) and Third Party Punishment Game (TPPG). In one village where both UG and DG were played, our non-game measures include participation in the construction of a community well, food sharing behavior, the size of an individual's typical social group, participation in local beer provisioning and consumption, and time spent in social visitation. In a separate village where TPPG was played, we examine labor and food contributions to a community feast. Beer production and consumption, social visiting and observed group sizes do not represent acts of altruism, but nonetheless are pro-social activities that might be expected to reflect other-regarding social preferences. If proposer behavior in the games measures some intrinsic aspect of altruistic, pro-social or other-regarding preferences, then (1) we should expect the offers made to others in the games to be positively correlated with participation in the pro-social activities listed above.. If, however, beer is more likely to be consumed by roaming slackers, then we may find a negative relationship between beer consumption and size of offers.

A growing body of theoretical and empirical data suggests that the maintenance of cooperation, especially in large groups, requires a system of punishing norm violators or

rewarding of norm adherents (Boyd, et al. 2003; Fehr and Gächter 2002). Without these measures, defectors may outcompete altruists by receiving benefits without cooperating with others or paying sufficient costs. In large groups, monitoring the actions of potential defectors may become particularly costly. If altruism is maintained within populations by some system of punishment we might expect that (2) those acting in a more pro-social manner in the behavioral domains above should show less tolerance for low offers in the experimental games. In the UG and TPPG, this means that norm-enforcing responders should be less likely to tolerate low offers, and should therefore display higher minimum acceptable offers (MAOs). These predictions are summarized in Table 1.

The next section presents a brief ethnographic description of the Tsimane, followed by a description of the experimental games and their protocols used in the study villages. The results section describes the relationships between experimental game behavior and several domains of observed non-game behavior. Finally, we discuss the merits of using experimental games for gaining insight into pro-social behavior and offer caveats and guidelines for the consideration of practitioners.

2. Materials and Methods

2.1. The Tsimane

The Tsimane are Amazonian forager-horticulturalists living in the Beni Department of Bolivia on the eastern foothills of the Andes. Tsimane typically live in villages of extended family clusters of 50-150 people. Villages are usually located along major rivers, although villages also exist in terra firme areas of the Isiboro-Secure region. The majority of Tsimane live

along the banks of the Maniqui River in over 40 villages. Most of the food in the Tsimane diet comes from horticulture, fishing, hunting and gathering. They cultivate plantains, rice, corn, and sweet manioc in small swiddens and regularly fish and hunt for meat. Fish, game, and gathered foods comprise about a quarter of the diet, although this quantity varies by season and local abundance.

Despite the perception of widespread sharing and cooperation among relatively egalitarian peoples, most daily coordination, cooperation and sharing among Tsimane is confined to the nuclear and extended family which retains strong economic independence. . Each family maintains its own set of fields, and sometimes individuals within families claim ownership of specific fields. Over 70% of the diet comes from fields and house gardens. Men within a household slash and burn unused primary or secondary forest to create new fields during the dry season, while both men and women harvest and weed fields throughout the year. Occasionally male relatives or affines collaborate in some of these activities. Single-day hunting and fishing activities are mostly solitary or with up to two male partners, usually siblings, sons, in-laws, or age-mates. The exceptions are group fishing events, where groups of families, and sometimes entire villages, use plant poisons to fish in closed-off sections of rivers, streams, and lagoons. In these events, several men perform all the work (acquiring plant poisons, closing off the body of water, pounding poison), and many more individuals, including women and children, harvest the fish with bow and arrow, machete, or knife. Finally, entire families often go on extended fishing trips in riverine villages, and on extended hunting trips in the interior forest villages, that can last from two days to several months.

An estimated 10% of household consumption derives from gifts or transfers from relatives and friends, while 88% comes from labor of household members (Godoy, et al. 2004).

Some foods are shared more than others. The most widely shared food is manioc in the form of home-brewed beer (*shocdye*). Strong beer always draws visitors, and beer drinking often continues until none remains. Any Tsimane can visit another household and expect to be served. As in other small-scale populations, large game may be shared with wide depth, but a restricted breadth of only several households (Gurven 2004c). Small game tends to be shared only within the household. Food preparation and cooking is usually done in the open (kitchens typically do not have walls), but consumption can occur inside houses. Cooked meals are usually consumed by household members. Though people eat communally in smaller villages, they rarely invite others to partake in their meals. Tsimane often turn their backs to others when they eat, and people in more modern villages often complain that neighbors do not share meat. Some evidence suggests that the lack of extensive sharing in daily life is mirrored during difficult times as well. In a study of risk management, we found that roughly half of 570 Tsimane adults said that kin or neighbors helped them cope with a misfortune such as illness or crop loss.

In villages with schools and chiefs, men usually engage in communal labor, such as clearing soccer fields and building schools. Both men and women organize festivities. In a panel study done during 2001-2002 in 37 villages, Godoy et al. (2004) found that 92% of households had made some gift of food and 61% of households had engaged in communal labor in the week prior to the interview. Nonetheless, gifts tend to be small, and made to close kin, while communal labor is of brief duration.

Experimental Games

2.1. Dictator Game (DG) and Ultimatum Game (UG)

In the DG, a proposer (Player 1) decides how much of a monetary endowment to give to another individual whose identity is unknown (Player 2). Player 2 receives the offered amount, and Player 1 keeps the remainder. The UG is similar, except that Player 2 may reject Player 1's offer, and by doing so, neither player receives any money. A rejection is viewed as a form of second-party punishment. In the UG, Player 1 knows that Player 2 can potentially reject the offer. In order to elicit punishment decisions for each possible offer by Players 2 in the UG, a "strategy method" was used (Brosig, et al. 2003).

2.1.1. Study Community: Cosincho

The DG and UG were played in the village of Cosincho (Gurven 2004b). Cosincho is located about 60 km, or up to several days journey upstream, on the Maniqui River (Figure 1a). Much of the village is located along the Cosincho River, about a fifteen minute walk from the main navigable river. At the time, 215 people lived in Cosincho.. In the center of the village is a soccer field, a new school building and a scattered cluster of eleven families. Two clusters about five minutes walk away consist of six and two families, respectively. A cluster of four families lives another ten minutes walk across the Cosincho River. The other two clusters are more distant. One of these distant clusters of four families lives near the Maniqui River about half an hour away, and the other lives across the Maniqui River, about 45 minutes away. This latter cluster moved across the river after political conflicts within the village several years prior.

2.1.2. Procedure

The DG and UG protocols were based on standardized scripts used by fifteen members of the Cross-Cultural Experimental Economic Games Project[1].

Protocols were translated into Tsimane with the help of a bilingual Tsimane assistant, Alfredo Zelada Supa. Zelada, a resident of a community outside this sample, also acted as a personal assistant during all games. All Tsimane protocols were back-translated into Spanish to assess the accuracy and clarity of the Tsimane translation. Revisions were then made in the Tsimane language version.

Games were played Nov. 30 and Dec. 1, 2002. All Tsimane eighteen years of age and older were invited to appear at the school in the morning. Roughly 90% of eligible people came to the meeting. People were told they would be playing two games, they would receive 5 Bolivianos (Bs) as a show-up payment for each game, and they should only play the first game if they could play the second game. The DG was played first, and the UG second. The sample for the DG was 71 individuals (38 proposers), and 67 (36 proposers) for the UG. Four individuals did not return to play the UG after the DG. The endowment for each game was 20 Bs ($2.75; 7.3 Bs=$1 US), which represents about one day's wage labor with food, or about 0.8 day's wage labor without food.

The DG was explained with scripted examples in both Spanish and Tsimane by Zelada and MG. Special emphasis was given to capture the attention of younger and older individuals, who experience has shown, have difficulty listening to spoken rules in group settings. We emphasized the confidentiality of responses, and the facts that Player 1 (the proposer) can choose the amount of the gift, and that the money was derived from a U.S.-based foundation for this purpose. Players then entered the school one-by-one in a random order. Only the player, MG and Zelada were inside the school. However, Zelada's presence was minimized as his back was turned during actual play. Zelada has no relationship with any of the study communities, and community members said they did not mind his presence in the room. Nonetheless, his assistance

was requested only if test questions were answered incorrectly and therefore the game rules needed to be explained again. After entering the room, players received additional instruction, a series of test questions, and additional help if necessary, until the test questions were answered correctly.

Outside the school, discussion of the games was forbidden. Movies were playing on the patio and refreshment was prepared to encourage people to stay. After playing the game, individuals were urged to stay and watch the films. Those who had already played sat on the opposite side of the patio to avoid potential for contagion.

The UG was explained in a similar fashion. Thirteen people played the UG in two hours, after which the sun had set, players were bored and hungry, and the truck battery powering the movie-displaying laptop computer had died. The UG was then continued the next morning for 7.5 additional hours until 54 others played the game. About half of the players were paid for the games in the late evening on Day 2, and the remainder of the players were paid the following morning. People were paid individually in a private house.

2.2. Third-party punishment Game (TPPG)

The TPPG is similar to a DG but adds a third player, who receives a smaller endowment of 10 Bs (Fehr and Fischbacher 2004). Player 3 may pay a portion of this to punish Player 1, such that for each 1 Bs paid, 3 Bs are reduced from Player 1's earnings. A rejection in the TPPG is considered a third-party punishment of the proposer.

2.2.1. Study village: Fátima

The TPPG was played in Fátima, located about 70 km upstream on the Maniqui River, or up to a four-day river journey (Figure 1b).[2] This village was used for the TPPG because of the large sample of subjects required to play the game. At the time of the TPPG, there were 444 residents, making it one of the largest Tsimane villages.[3] Like Cosincho, much of the village is located in the interior, along the smaller Chimanes River. Fátima is home to a well-organized Catholic Mission, which flourished under the stewardship of the Alsacian Father Martín from the 1950s-1990s. He attracted Tsimane to the Mission from other parts of the Maniqui region. Presently, much of the village is highly dispersed, with at least a half-day's journey from the mouth of the Chimanes River where settlement begins to the last household upstream . Over half of the village congregates at Sunday masses. After Martín's death in 1997, the only Tsimane "priest" was given charge of the Mission. Father Martín struggled against river merchants and loggers, and strongly discouraged village residents from interacting with them. The majority of agricultural production traded or sold was, and still is, purchased by the Mission, rather than by merchants. In recent years, river merchants and loggers have started to revisit the region.

2.2.2. Procedure

The TPPG protocol also followed the adapted standard version used as part of the Cross-Cultural Experimental Games Project. Village members were first told about the game at the conclusion of Mass one week before the games, and then reminded during household visits and by word-of-mouth. The TPPG was played after a Sunday service in June 2003. Over 90 individuals congregated to listen to the rules of the game. Explanation of the game followed the procedure outlined in section 2.1.2. Players then entered singly into a private area inside the Mission courtyard. Game rules were explained and test questions given repeatedly until the test

questions were answered correctly. Total sample size for the TPPG is 73 (27 proposers, 23 receivers, 23 punishers). All players were paid at the end of the second day of game play[4].

Behavioral observation

2.3. Digging a well in Cosincho

During the wet season, the Cosincho River is muddy and dirty. People often complain that river water tastes bad, and believe that drinking it is a major cause of sickness. Over the past ten years, a local government initiative was organized to install an underground well in several Tsimane villages. Funds ran out as the project collapsed, leaving Cosincho residents with only an 8 m hole. The well was left unfinished until 2000 when a pig fell into the hole and died. After that, villagers refilled the hole with dirt. As a goodwill gesture, our research team bought concrete in November 2002, and a group of residents were quickly motivated to re-construct the well. The well was to be built in the same location as originally planned. It took about nine work days (over 2.5 weeks) to dig a hole 8 m deep and 2 m wide, transport stones from the river, and apply liquid concrete for interior walls. Well construction is a classic public good because once built, everyone has access to the water. To recruit workers, the village chief visited each household and discussed the project, asking all men to contribute labor. There were 41 eligible males in the community who could potentially work on the well. The identity and type of work done by each worker was recorded for each day of labor.

2.4. Time spent in social visitation and social group size

Estimates of time spent in social visitation and social group size are based on spot observations from three-hour observation blocks in Cosincho from July 2002 to June 2003. During these blocks, all activities of members from several groups of families were recorded every half hour. Individuals present at or near the residential cluster were observed directly while the activities of absent individuals were obtained by informant interviews, many of which were later verified. Sampling was done without replacement until all group clusters were equally sampled throughout the day. Percentage of time in social visitation was calculated as the percentage of all person-scans spent visiting others outside an individual's immediate residential cluster.

For each observational scan, individuals within a social group were assigned a unique group-code. A group was defined as a gathering of individuals engaged in a similar activity with a similar focus of attention, or within two meters of one another. Children, siblings, spouses and parents were removed from the group to determine the number of non-nuclear kin within an individual's group. These counts were averaged over all observational scans for each individual to determine the average number of non-nuclear related individuals with whom that person interacted.

2.5. Food sharing

Individuals observed eating during observation blocks were interviewed about the acquirer of any food item eaten. For stews or foods with mixed ingredients, we recorded up to three main components (e.g. rice, meat, fish, etc.) and up to three acquirers for each component when more than one person contributed to acquisition. Credit was equally divided among all acquirers for any particular component. For agricultural foods, credit was divided among the

harvester(s) and the husband and wife owners of the field[5]. This credit was multiplied by the caloric concentration of the food item (kcal/kg) in order to weigh more nutritional foodstuffs accordingly, and then divided by the number of ingredients in the food being consumed, resulting in a value termed "food credit". Our measure of food sharing was then computed as the percentage of an individual's total food credit consumed by individuals outside his or her nuclear family.

2.6. *Beer provisioning and consumption*

To measure beer provisioning we summed the number of extra-household individuals observed drinking beer at focal hosting households during each spot observation, then divided this number by the total number of observation scans for each household. An individual was considered to be consuming beer if he or she was actively drinking or waiting to drink beer.

Beer consumption at others' households was estimated as the total number of observations where the focal individual was observed drinking beer at another household. There is no discernible denominator in this case because all community individuals could potentially be observed drinking at others' houses for every observational scan, regardless of the specific focal cluster of houses being observed.

2.7. Village Feast

During a Saturday service one week after the TPPG was played in Fátima, a visiting priest from San Borja announced plans for a village-wide feast following the Sunday service. He said the Mission would provide some rice, but the responsibility for a satisfying feast depended upon the generosity of all community members. He urged village members to bring fish, meat,

rice, manioc or other foods to prepare, cook, and eat communally near the Mission. Type and quantity of individuals' food contributions were recorded by MG and Zelada, as were the identities of those who helped process or cook the food, and those who ate from the (literal) common pot. No one was excluded from eating, and consumption continued until the pot was empty.

3. Results

3.1. General game results

Mean, median and modal offers and offer distributions for DG, UG and TPPG are shown in Figure 2. Overall offers are low compared to standard western and non-western samples. Rejection rates are also extremely low. In the UG and TPPG, no responder said they would reject any offer over 20%. One person said they would punish an offer of 20% in the TPPG. For offers of 10%, only one and two players said they would reject these offers, in UG and TPPG, respectively. Only 64% and 26% of players said they would punish (reject) instances of complete hoarding (offers of 0) in the UG and TPPG, respectively. Thus, experimentally-induced altruism is low with minimal propensity to punish.

3.2. Well construction

On average, only eight men contributed labor per work-day, even though 19 (46%) of the men worked at least once. Overall, only 18% of the total possible labor-force (if all men worked all days) was spent on the well project.

We find no relationship between the number of days an individual worked and his or her offer in the DG ($r=-0.21$, $p=0.40$, $n=18$) or in the UG ($r=0.14$, $p=0.59$, $n=18$). No relationship is

found if we group helping behavior as either 'worked' or 'did not work' ($p=0.18$ for DG, $p=0.79$ for UG).

Even though water is freely available for anyone in the community, travel costs are lower for those who live near the well. Those living closer to the Maniqui River than to the well are unlikely to use the well because they would have to travel at least twenty minutes each way. Indeed, none of the fourteen men who live near the Maniqui worked on the well, and 64% of the non-workers live near the Maniqui. However, even after controlling for location (defined as near Maniqui, central near well, central interior, near Cosincho River), neither number of days worked nor presence or absence of help was significantly associated with either DG or UG offers.

If participants in collective action are 'suckers' who pay the costs so that others (and themselves) may receive benefits, then participants might display low minimum acceptable offers (MAOs) in the UG. If these participants are more likely to rally and enforce coordination for collective action purposes, then these individuals should display higher MAOs. However, we find no relationship between MAO and the number of days worked on the well ($r=0.15$, $p=0.70$, $n=9$). After controlling for residence location, however, we find a significant *negative* relationship, such that each additional day of work was associated with 2.3% lower MAO. Contrary to the expectation that cooperation is maintained by some degree of punishment, we find that cooperators in well construction are less likely to punish low UG offers.

3.3. Food sharing

Fourteen individuals were recorded as producers in an average of 16 consumption observations per person. They gave an average of 64.6% of their produced food to non-nuclear

kin. Because members of larger families may have less food to share with non-family members, we performed weighted least squares (WLS) regression (weighted by number of eating observations) with family size as a control variable. With this model, the percentage of food going to non-nuclear kin is a marginally significant positive predictor of DG offers (WLS regression, B=3.92, p=0.06, n=14) but not of UG offers (WLS regression, B=2.15, p=0.28, n=14). Regressing MAO using the same model revealed no significant effect of this measure either (WLS regression, B=5.30, p=0.30, n=14).

3.4. Time spent in social visitation

An average of 68 spot scans were recorded on 35 individuals who spent a weighted average (based on number of observations) of 6.1% of their time visiting families socially outside of their immediate cluster of houses. We found no effect of the percentage of time spent visiting on either DG or UG offers (WLS regression, B=-0.03, p=0.69, n=35 for DG; WLS regression, B=0.03, p=0.64, n=34 for UG), or on MAO (WLS regression, B=-0.02, p=0.91, n=27).

3.5. Social group size

Individuals were observed interacting with a weighted average of 1.1 non-nuclear kin and non-related individuals at any given moment. Variation in this average, however, does not significantly predict DG or UG offers. The parameter estimates are actually in the opposite direction than predicted (WLS regression: B=-0.34, p=0.62, n=35 for DG; B=-0.62, p=0.24, n=34 for UG). Social group size is also not significantly associated with MAO (WLS regression, B=-0.30, p=0.83, n=27).

3.6. Beer provisioning and consumption

The extent of beer provisioning fails to predict DG and UG offers (WLS regression, B=10.98, p=0.20, n=35 for DG; WLS regression, B=2.21, p=0.74, n=34 for UG), nor does it predict MAO (B=-0.68, p=0.97, n=27).

Beer consumption was marginally and negatively correlated with DG offers (r=-0.33, p=0.06, n=35). Individuals who were more frequently observed drinking others' beer offering less in the DG. However, there was no relationship between this measure and UG offers (r=-0.19, p=0.29, n=34), or MAO (r=0.15, p=0.47, n=27).

3.7. Village feast contributions

Out of 85 total households, members of only ten households provided food or some type of assistance, but adults from 34 households were observed eating. Thus, only 11% of households helped contribute to the total pot, whereas 40% of households benefited from consumption. The percentage of consumers that benefited is probably higher than reported here because identities of children (who were only consumers and not producers) were not recorded. Out of a total of 187 adults in the community, only 5% helped provide food, but 27% received shares. From the perspective of the average consumer, three-fourths of those who ate at the feast did not contribute food or services to the common goal. All who contributed food or labor ate during the feast.

We find no significant relationship between feast labor participation and TPPG offers (r=0.09, p=0.67, n=23). We also find no relationship with feast labor participation and MAO (r=0.02, p=0.92, n=23).

4. Discussion

4.1. *What do the games tell us about prosocial behavior?*

Table 1 summarizes the results of all relationships between game and non-game behavior. Overall we find that game behavior among Tsimane is not correlated with pro-social behavior in several important domains of everyday life. Two of the three significant results were found with the DG, the only game presented here that does not have the potential for strategic punishment by a second- or third-party. (For this reason, DG offers have traditionally been considered a purer measure of altruistic behavior than UG or TPPG offers.) Given the large number of analyses performed here (20), however, it might be premature to lend too much credence to few significant results.

Given that one goal of experiments is to manipulate a controlled environment in order to reveal underlying social preferences and to explore how they are impacted under different conditions, the overall lack of correspondence of behavior in these games to observed natural behaviors compels us to reconsider the importance and use of experimental games. For example, at the population level, game behavior among the Tsimane and other small-scale subsistence populations such as the Machiguenga, Hadza, Shuar and Ache, is more consistent with *Homo economicus* than behavior from industrialized societies, despite the casual impression that members of more subsistence-oriented non-market societies engage in more daily face-to-face cooperation with kin and non-kin alike.

We acknowledge that our set of pro-social domains was based on data generally not collected for the issues discussed in this paper. Other domains could have been chosen, or the ones we chose could have been measured differently. Alternatively, it might be necessary for players to play the games repeatedly or to play a variety of games in order to gain a representative picture of individual-level tendencies. It may be of limited use to expend valuable field time to measure behavior or covariates like wealth, income and education, only to correlate these elaborate data with a single one-shot experimental outcome. One's "taste" for cooperation may vary over time and capturing representative behavior will require greater sampling of experimental behavior to say anything confidently at the individual level.

More importantly, endowments in the games are like windfalls and so may be unrepresentative of most "endowments" that are typically created through labor participation. The sharing of windfall-like monetary endowments is therefore unlikely to be related to the sharing of earned income. Indeed, when players must compete and work for the right to be a proposer and produce the endowment, DG offers are very low (Cherry, et al. 2002). However, critical elements of the production process and the extent to which these relate to subsequent distribution can and should be directly incorporated into the structure of the games (Königstein 2000). This is a vital but relatively unexplored area of investigation.

Our purpose here is not to dismiss the use of experimental economics in anthropological research because of a potential lack of ecological validity at the individual level. At the group level, results of economics games have been shown in several cases to reflect underlying cultural values. For example, Ensminger (2004) shows that Orma villagers approached a public goods game as they would their local *harambee* institution that is designed to support community projects. The Au and Gnau of Papua New Guinea surprisingly reject hyper-fair offers (those over

50%) presumably because of the culture of obligation associated with gift-giving (Tracer 2003). Tsimane rarely punish others in the UG and also tend to be non-confrontational and strongly individualistic in their daily sharing decisions (Gurven 2004a). While these post-hoc insights are revealing at the group level, and a good starting point for understanding how people approach novel forms of cooperation, the link between ethnographic impressions and game results can be tenuous. An anecdote demonstrates the fallibility of post-hoc ethnographic interpretations of game behavior. Villagers in the Tsimane community of Cachuela made the lowest contributions in a public goods game in 1999 (Gurven 2004a). This was a surprising result at the time because the community was small and tight-knit. Social visiting, group production and sharing were more commonly observed than in other villages. Although there was conflict among several group members who were prone to drunken brawls, the villagers shared a common history as migrants from the larger village of Fátima about fifteen years before. However, in 2001, the village fissioned after a series of conflicts erupted in a violent altercation. In this case, the contributions in the public goods game may have been affected more by the antagonistic mood of the community which belied the observed levels of sharing, household visitations, and communal work enterprises.

The next step is to extend macro-level inferences to help explain within cultural variation and to use the game results to better explain variation in cooperative sentiment and behavior in ecological context. The incentive-based experimental framework allows each player to react to the same stimulus and can therefore be a powerful means of eliciting behavior and beliefs. In light of observations and elicited beliefs and norms, experimental games can add a level of control not typical of anthropological settings. Such control may be very important in testing

theories about cooperation and altruism across populations (Henrich, et al. 2006; Henrich, et al. 2004).

Experimental games should be enlisted as another methodological tool that augments and does not replace ethnographic study. The rich span of cultural and behavioral diversity found among anthropological field settings allows for broader tests of ecological, psychological and social theories of social preferences, cultural norms and behavior. Diverse cultural settings can provide the empirical grist for models of how learning processes, cultural history and ecology impact the formation, maintenance and evolution of local norms or "equilibria" (Boyd and Richerson 1985).

To date, the most noteworthy application of economics games in anthropology has been to examine cross-cultural differences in altruistic donations and in the willingness to punish others. Most attention has highlighted the supporting roles of market integration and payoffs of cooperation to explain macro-level differences (Henrich, et al. 2004). A separate area of investigation, particularly in development economics, environmental science and political science, has focused on the determinants of trust and social capital accumulation that promote greater contributions to public goods (Cardenas 2000; Ostrom 2006). Further and repeated use of these and other experimental games in a variety of populations, combined with ethnography and observational or survey-based methods can help us gain insight into how social norms, individual preferences and ecological context shape behavioral decisions, perceptions of trust and social capital.

4.2. *Can we increase ecological validity and should it be our goal?*

The abstract, content-free and anonymous structure of many economics games allows participants to engage their own set of rules, beliefs, knowledge, heuristics, values and experiences during game play. The greater unfamiliarity with such structures in non-western, non-student populations is probably responsible for the larger amount of variation observed in these study populations. Much effort has been spent to try and explain "anomalous" behavior in the games. Rather than try to explain variation in the games, our perspective is that the games should be further used to provide insight into non-game behavior. For example, experimenters have altered the typical game structure by using local currencies instead of money (e.g. Alvard 2004) or by describing game rules using culturally appropriate analogies that invoke particular sharing rules (e.g. Hill and Gurven 2004). Such uses of alternative currencies for the endowment, and manipulation of other framing effects can provide insights into the nature of resource-specific and situational division rules. Additional insight may be gained by relaxing anonymity assumptions and examining, for example, whether experimental cooperation is more likely with known individuals of certain categories like family members, friends or foes (Rucas, et al. 2006). Indeed, comparing levels of cooperation in anonymous versus non-anonymous versions of games, and comparing choice of cooperative partners in non-anonymous games and non-game behavior, may help to bridge the gap between natural field-based and experimental cooperative behavior.

These and similar changes in game design should be combined with more traditional ethnographic and observational approaches. A likely explanation for diverse outcomes across game and non-game contexts is the considerable discrepancy between costs and benefits of cooperation across domains and games. Any comparison of pro-social behaviors with game results may not be very revealing when non-experimental results involve public display to an

audience, immediate personal benefit, or different magnitude and currency of benefits, all of which can change the perceived incentive structure of cooperation. Thus, it may not be surprising that game results differ from non-game results, and that pro-social behavior in one domain can be uncorrelated across other non-game domains (Table 2). For example, well construction is a public event, and people stand to differentially gain private benefits from use of the well depending on where they live.

The frequent lack of correspondence suggests instead that context is extremely important and can overwhelm the effect of stable personality traits[6]. This conclusion is consistent with the observation that social institutions can make it costly for cooperators to cooperate or conversely for defectors to not cooperate (Fehr and Gächter 2002). It remains to be seen whether there is as much discrepancy by the same individuals over time and across domains as among individuals in the extent and intensity of their pro-social behavior. Behavior involves significant trade-offs where decisions can be situation-specific and can vary over time as conditions change over the life course. For example, food sharing behavior in small-scale non-market societies depends on context—whether done publicly or privately, meant to display to many others or to target specific others without drawing attention. It depends on aspects of production—the size, divisibility and relative demand that others have for access to the caloric "profit", costs of production and extent of coordination required to produce food. It depends on characteristics of potential recipients with respect to the resource in question—number of hungry bellies of family and others, debts to repay, favors to curry. These factors, and others such as wealth and social networking, may be as important, if not more, in explaining food sharing behavior as any context-independent propensity towards altruism. Thus, two hunter-gatherer groups, the Ache and Hadza, both abundantly share food resources yet play the UG very differently (Hill and

Gurven 2004; Marlowe 2004). We repeat our earlier suggestions that 1) modified games will be necessary to explain behavioral diversity, 2) investigation of a wider range of pro-social activities may be necessary to arrive at a robust average measure of cooperation at the individual level, and 3) a larger sample of game behavior from either repeated rounds or from other types of games may be necessary to achieve robust experimental estimates.

Experiments allow us to assess the content and magnitude of the features believed to shape observed behavior by examining the effects of each contributing factor as separate treatment conditions. Their utility is in providing a rigorous, systematic and standardized method to better understand the determinants of cooperative behavior in a variety of within-cultural settings and conditions. It is difficult to isolate separate effects of intervening factors that affect cooperative behavior in the field. Statistical methods such as multiple regression analysis are useful to glean the separate effects of donor and receiver characteristics, such as age, sex, kinship and social status, as well as characteristics of the resource (e.g. fish, meat, vegetable, etc.) when explaining variation in sharing or cooperative foraging behavior. The practice of examining separate effects of specific variables while keeping everything else the same, however, means that some experiments are essentially designed to lack external validity! Their goal is to examine treatment effects, and in this way, they add internal validity to the research enterprise (Ostrom 2006). We believe both field and experimental methods are necessary for confidently demonstrating causal relationships in a coherent, scientific framework.

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FIGURE LEGENDS

FIGURE 1. Map of study communities: a) Cosincho and b) Fatima.

FIGURE 2. Distribution of offers made in the Dictator Game (DG), Ultimatum Game (UG) and Third-Party Punishment Game (TPPG). Stakes were 20 Bolivianos (U.S. $2.74).

FIGURE 1.

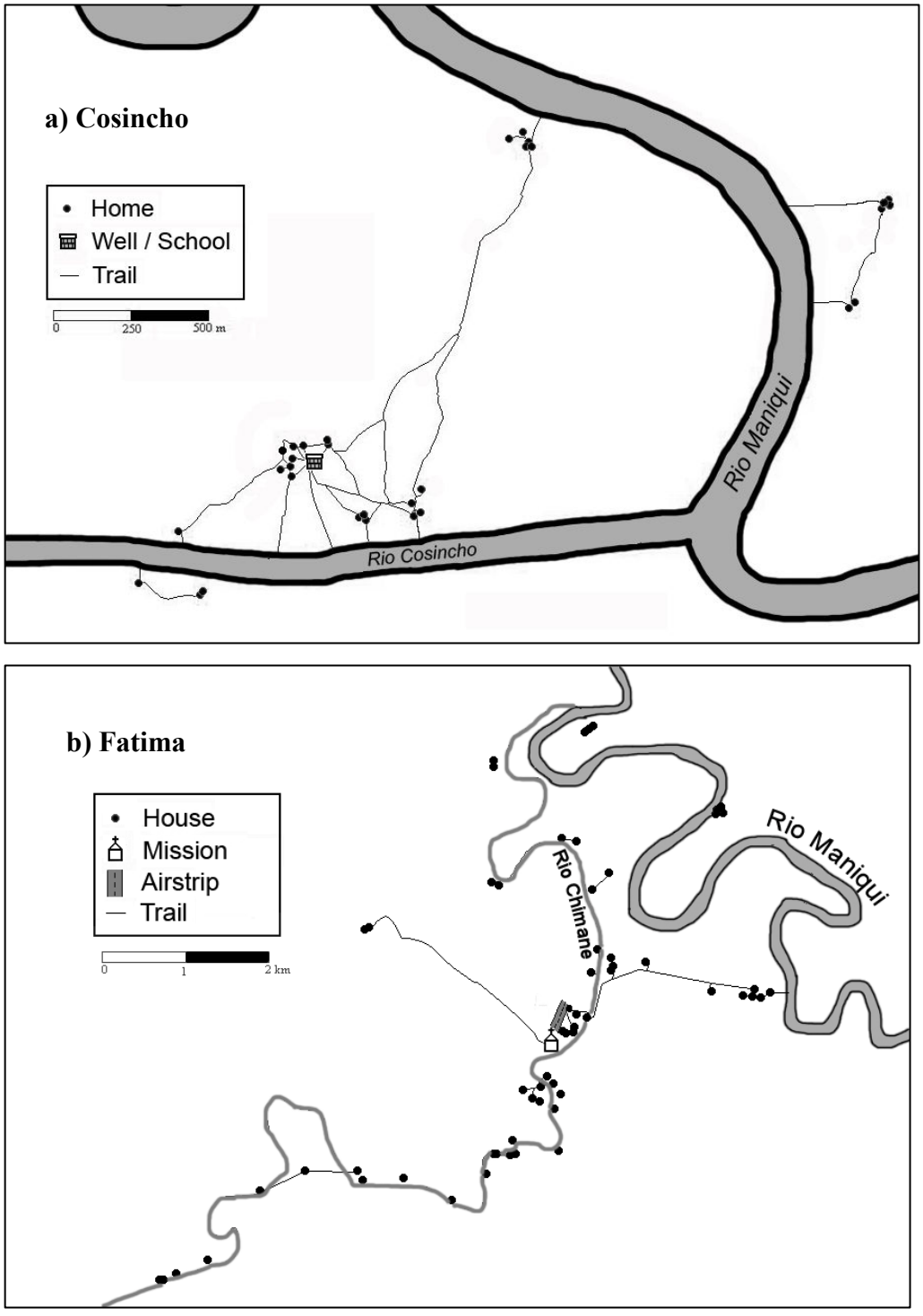
a) Cosincho
Home
Well / School
Trail
0
250
500 m
Rio Maniqui
Rio Cosincho
b) Fatima
House
Mission
Airstrip
Trail
0
1
2 km
Rio Maniqui
Rio Chimane

FIGURE 2.

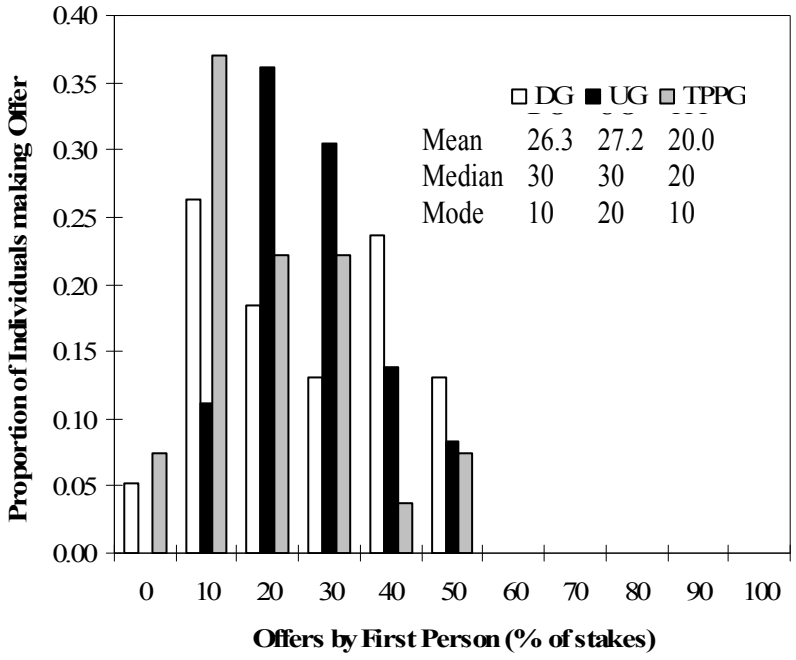
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Proportion of Individuals making Offer
DG
UG
TPPG
Mean 26.3 27.2 20.0
Median 30 30 20
Mode 10 20 10
0 10 20 30 40 50 60 70 80 90 100
Offers by First Person (% of stakes)

TABLE 1. Summary of results discussed in paper

Measure of Pro-Sociality	**Predicted Direction for offers**	**DG offer**	**UG offer**	**TPPG offer**	**Predicted Direction for MAO**	**MAO (UG)**	**MAO (TPPG)**
1. Well labor contribution	+	NO	NO	n.a.	+	YES (-)	n.a.
2. Food sharing							
a. % of production given to others	+	YES (+)	NO	n.a.	+	NO	n.a.
3. Social partners							
a. Avg # social partners per scan	+	NO	NO	n.a.	+	NO	n.a.
4. Time spent in social visitation	+	NO	NO	n.a.	+	NO	n.a.
5. Communal drinking							
a. Beer provisioning	+	NO	NO	n.a.	+	NO	n.a.
b. Beer party participation	+/-	YES (-)	NO	n.a.	+/-	NO	n.a.
6. Village feast contribution	+	n.a.	n.a.	NO	+	n.a.	NO

Yes= statistically significant effect at $p<0.10$ in predicted direction, No=statistically insignificant, (+/-) indicates the direction of observed effects; n.a.= not applicable; DG=Dictator Game, UG=Ultimatum Game, MAO=minimum accepted offer

TABLE 2. Correlation among observational measures of pro-social behavior

	Well Construction[a]	Food Sharing[b]	Time in Social Visitation[c]	Social Group Size[c]	Beer Provision[c]
Food Sharing[b]	0.415	—			
(p-value)	0.180				
(Sample size, n)	12				
Time in Social	0.055	-0.146			
Visitation[c]	0.785	0.620	—		
	27	14			
Social Group Size[c]	-0.218	0.291	0.206		
	0.275	0.313	0.122	—	
	27	14	58		
Beer Provision[c]	**0.446***	-0.237	-0.153	-0.144	
	0.020	0.415	0.252	0.280	—
	27	14	58	58	
Beer Drinking[c]	-0.020	0.069	-0.024	0.064	-0.043
	0.921	0.813	0.859	0.634	0.748
	27	14	58	58	58

[a] Residual of regressing number of days worked on distance from house to well.
[b] Weighted by number of consumptions hits (multiplied by number of time observations for all [c])
[c] Weighted by number of time observations
* $p<0.05$

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[1] All protocols are available upon request in English, Spanish and Tsimane.

[2] Cosincho and Fátima are connected by means of a poorly maintained trail. By river, Fátima is up to a day's journey upstream from Cosincho.

[3] The village of Ijnanarej is part of Fátima, although its 25 members live on the opposite side of the Maniqui some distance from the rest of Fátima. Residents from Ijnanarej only sporadically visit the Mission for mass or social visitation.

[4] There was no significant effect of day of play on offers made (19.6% (n=23) on the first day, 22.5% (n=4) on the second day, p=0.76, M-W) or on minimum accepted offer (4.2% (n=19) vs. 2.5% (n=4), p=0.60, M-W). There was also no effect of order of play and offer (r=0.03, p=0.88).

[5] All harvesters received 55% of the credit, as this was the percentage of all time in garden labor spent in harvesting. Husband owners received 32% and wife owners received 13% of the credit, as these were their respective proportions of non-harvesting labor based on time allocation.

[6] Alternatively, personality traits indicative of altruism may reflect one's history of association in particular contexts where more pro-social behavior is favored.