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Personal and group incentives to invest in pro-social behavior:

A study in the Bolivian Amazon

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Abstract

Ethnographic evidence, empirical research, and results of experimental studies suggest that people across cultures invest in pro-social behavior, but little research addresses the relative importance of personal versus group incentives to invest in pro-social behavior. We estimate the relative weight of personal and group incentives for households to invest in pro-social behavior using two waves of panel data (2001 and 2002) from ~350 Tsimane' Amerindians, a foraging-farming society in the Bolivian Amazon. We found that some personal incentives bore a significant association with household decisions to display pro-social behavior. Consistent with previous research, we found that investments in pro-social behavior first rise and then decline with age, and that cash income bore a positive association with investments in pro-social behavior. We found no evidence that group incentives were associated with personal investments in pro-social behavior once we controlled for fixed attributes of villages, but village fixed attributes did explain a significant share of the variation in the data.

Keywords: pro-social behavior, Tsimane' Amerindians, Bolivia, gift giving, reciprocity.

Introduction

Ethnographic evidence, empirical research, and results of experimental studies suggest that people across cultures display pro-social behavior (Inkeles 2000; Henrich et al. 2001; Henrich et al. 2005). Pro-social behavior refers to personal actions that benefit other people with a cost to the person but without an immediate personal benefit (Gintis et al. 2003). Pro-social behavior takes many forms. For example, anthropologists have noted that people in pre-industrial societies practice gift-giving and cooperation (Gurven et al. 2000; Gintis et al. 2003; Hill 2002) and sociologists have noted that people in industrial societies share goods (Benkler 2004) and participate in formal civic institutions (Putnam et al. 1993; Portes 1998).

Despite the ubiquity of pro-social behavior, we still do not understand well the reasons why people do good deeds. Are individuals more inclined to display pro-social behavior because of their own characteristics (e.g., age, sex, income) or because of the characteristics of the group of which they form a part? In exploring the reasons for pro-social behavior, researchers have adopted two approaches. Some have said that people invest in pro-social behavior because they have personal incentives to do so. For example, hunters and gatherers might share food because they expect food in return (Kaplan and Hill 1985). Others have focused on social pressures to display pro-social behavior. People might invest in pro-social behavior owing to group norms, role models, or pressure from the relevant peer group (Inkeles 2000). Group pressure can be enforced by punishing antisocial behavior (Boyd et al. 2003; Boyd and Richerson 1992).

Of course personal and group incentives can both operate at the same time. At the theoretical level researchers have successfully combined approaches that mix personal

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and group incentives to explain pro-social among humans (Gintis 2003). But at the empirical level we still do not understand well the interaction of the two types of incentives as they might shape pro-social behavior; so the empirical task centers on untangling the relative weight of personal and group incentives and the interaction of the two in shaping a person's pro-social behavior. In this article we estimate the relative weight of personal and group incentives to invest in pro-social behavior using longitudinal data from Tsimane' Amerindians, a foraging and farming society in the Bolivian Amazon. We focus on household differences in pro-social behavior in different villages *within* the same ethnic group.

Our study advances research on the covariates of pro-social behavior in two ways. First, unlike previous studies, we use data from everyday interactions. Many studies on pro-social behavior in industrial societies, and recently in small-scale societies, draw on information from experimental games. Experimental games provide insights into people's behavior under artificial laboratory conditions, but might reflect social learning (Henrich 2001) and might not mirror what people do under ordinary conditions (Chibnik 2005; Karlan 2005). Second, we use a comprehensive proxy which includes two dimensions of pro-social behavior: material resources (i.e., gifts) and labor investments (i.e., help). Most studies on pro-social behavior in pre-industrial societies have focused on the sharing of wildlife. Those studies show that attributes of the item, such as the size of the catch, help predict the type and the amount of items people share (Hawkes et al. 2001; Bleige-Bird and Bird 1997; Gurven et al. 2000; Kaplan and Hill 1985; Sosis 2001). By including other expressions of pro-social behavior besides gifts of wildlife, such as

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other material gifts and everyday cooperation, we obtain a more comprehensive view of pro-social behavior.

The question of what might drive pro-social behavior matters for reasons related to scholarship and public policy. On the academic side, the research can advance our understanding in two important areas. First, it is empirically unclear whether personal or group incentives drive pro-social behavior, or whether a mixture of both can better explain it. We know of only one study explicitly designed to test for personal versus group incentives to invest in pro-social behavior (Glaeser et al. 2002) – and it was done only in the USA – and we know of only one cross-cultural experimental study whose results allow us to compare the two types of incentives (Henrich et al. 2001, 2005).

Drawing on information from the General Social Survey of the United States, Glaeser and his colleagues found that personal incentives, not group affiliation, drove personal decisions to invest in pro-social behavior. Based on results from experimental studies in 15 small-scale societies, Henrich and his colleagues found that group-level differences, and not individual variation within the group, explain a substantial portion of the variation in pro-social behavior across societies (Henrich et al. 2001).

Second, cultural evolutionists have studied the relative role of genes and culture in shaping behavior. More so than other species, humans rely on social learning – or imitation of other's behavior - to acquire behavior (Henrich and Boyd 1998; Boyd and Richerson 1985; Cavalli-Sforza and Feldman 1981). By untangling the relative weight of personal and group incentives and the interaction of the two in shaping pro-social behavior this study can contribute to a better understanding of the importance of the group in shaping individual behavior among humans.

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The question of what drives pro-social behavior also matters for reasons related to public policy. Researchers doing work in industrial, and to a lesser extent in pre-industrial, societies have found a positive association between pro-social behavior and indicators of well-being. Putnam's seminal work (Putnam et al. 1993) pointed at the positive association between social capital – a form of pro-social behavior - and democracy. Others have since found that pro-social behavior is associated with economic growth (Grootaert and van Bastelaer 2002; Woolcock and Narayan 2000), schooling (Coleman 1988; Gibbons et al. 1994), and health (Kawachi 2002; Kawachi and Kennedy 1999). Thus, a study of the determinants of pro-social behavior could shed light on how to achieve these desirable social outcomes.

The personal and group correlates of pro-social behavior

Researchers have argued that feelings of fairness and equity are human (and perhaps pre-human) universals that explain pro-social behavior (Bolton and Ockenfels 2000; Brosnan and de Wall 2003). For example, a recent experimental study showed that inequities produced by the arbitrary manipulation of rewards increased sullenness, grievance, and angry behavior among non-human primates (Brosnan and de Wall 2003). However, empirical research suggests that there is large variation in pro-social behavior between individuals within and across societies (Henrich et al. 2005).

Some scholars argue that individuals display pro-social behavior because they have personal incentives to do so; that is, individuals can reap personal benefits in the future by investing in generosity or in pro-social behavior in the present. For example, economists and behavioral ecologists have explained personal investments in pro-social

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behavior as a form of private insurance. Economists argue that pro-social behavior serves as insurance to poor households in developing countries. Using household panel data on economic shocks in South Africa, Carter and Maluccio (2003) found that households in villages with more pro-social behavior, proxied with social capital in their study, weathered shocks better than households in villages with less social capital. Thus, personal investments in pro-social behavior might reflect a person's desire to have a safety net for the future.

Behavioral ecologists studying food-sharing in pre-industrial societies have made the same point. They have said that people might invest in pro-social behavior as an insurance against poor luck hunting (Kaplan and Hill 1985; Cashdan 1985; Gurven et al. 2000). Foragers who subsist only from their own effort are more likely to experience greater daily fluctuations in food consumption. By pooling resources foragers reduce the variability in their personal food consumption. Therefore, a forager might share food with others because sharing helps to smooth or protect the forager's own food consumption against idiosyncratic income shocks (Gurven et al. 2000; Kaplan and Hill 1985; Kaplan et al. 1984).

Behavioral ecologists have also noted that successful hunters might be motivated to share food – still another form of pro-social behavior – to avoid harassment from the unsuccessful hunters and thus reduce the costs of conflict (Smith 1982; Sugden 1986; Blurton-Jones 1987; Bleige-Bird and Bird 1997). For a hunter, additional units of a big game exhibit diminishing returns, i.e. each additional unit consumed is less valuable than the preceding unit. Because the marginal value of additional units is low, the hunter prefers to share food than to incur conflicts over the food (Blurton-Jones 1987;

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Winterhalder 1997). The two hypotheses of behavioral ecologists present different explanations of why foragers might share food, but they share the assumption that people have personal incentives to display pro-social behavior.

Economists working in industrial societies have also stressed the importance of incentives that individuals might have to invest in pro-social behavior. Using data on membership in organizations from the General Social Survey of the United States, Glaeser, Laibson, and Sacerdote (2002) found that individual characteristics (e.g., age, geographical mobility, income) were most strongly associated with personal decisions to display pro-social behavior and that group characteristics (e.g., ethnic membership) explained only six percent of the variation in their data.

Data to support the importance of group incentives to explain the universality of pro-social behavior also comes from a large range of studies, including experimental research and observational studies in industrial and pre-industrial societies. Henrich and colleagues (2001, 2004, 2005) used experiments to study pro-social behavior in 15 small-scale societies exhibiting a wide variety of cultural conditions. Their results suggest large variability in pro-social behavior across the 15 societies. They find that group-level differences in economic organization and in the structure of social interactions explained about 12 % of the variation across societies: the higher the degree of market exposure and the higher the payoffs to cooperation in everyday life, the greater the level of pro-social behavior as expressed in experimental games. None of the studies discussed so far, nor our own presented below, purges the estimated associations of pro-social behavior of endogeneity biases, so one must be extremely cautious about drawing inferences about causality from the studies.

The model

We proceed in three steps to test the relative weight of personal and group incentives as they might be associated with pro-social behavior. Since some of the expectations and hypotheses discussed below have been tested in industrial societies and others have been tested in pre-industrial societies, we do the necessary modifications to adapt the hypotheses to the ethnographic setting in which we worked. For example, we use data aggregated to the household level because among the Tsimane' the household (rather than the person) is the unit that shares and cooperates.

Table 1 contains a summary of our hypotheses based on previous research. First, economists (Glaeser et al. 2002) and behavioral ecologists (Gurven et al. 2000) have observed an inverted U-shape relation between age and personal investment in pro-social behavior. Based on this previous work, we hypothesize that household pro-social behavior will first rise and then fall with the age of the household head (H1). Second, following findings from research in industrial societies (Glaeser et al. 2002; Knack and Keefer 1997), we expect to find a positive association between income and expressions of pro-social behavior (H2). Third, if personal investments in pro-social behavior stem from a desire to self-insure against adverse shocks (Kaplan and Hill 1985; Carter and Maluccio 2003), then we would expect that higher investments in pro-social behavior would be associated with lower adverse effects of misfortunes in the rest of the group (H3). This is not to say that shocks would not occur, but that the group, as such, would be better insured against the effects of shocks. Last, if pro-social behavior helps reduce conflicts, then we should see a negative association between expressions of pro-social behavior and conflicts with other households in the village (H4).

INSERT TABLE 1 ABOUT HERE

To estimate the association of personal incentives and a household decision to invest in pro-social behavior, we express pro-social behavior using the following linear approximation:

$$[1]. SB_{jvt} = \alpha + \beta A_{jvt} + \zeta I_{vt} + \gamma S_{vt} + \theta O_{ihvt} + \varepsilon_{jvt}$$

where SB_{jvt} is the investment in pro-social behavior of household j in village v at time t . A_{jvt} is the age of the household head (H1). I_{jvt} captures the total cash income obtained by adults in the household (H2). S_{jvt} captures the average outstanding debt with outsiders in other households of the village. Debts proxy for village poor insurance against shocks (H3). O_{ihvt} is a set of dummy variables that captures the opinion of the household head about other Tsimane' visiting the village. Negative opinions of other Tsimane' proxies for more conflicts in the village (H4). ε_{jvt} is a random error term.

As a second step, we test the association of group incentives in the household's decision to invest in pro-social behavior. First, researchers have argued that people might decide (or be pushed) to share and cooperate when others in the group do so (Boyd et al. 2003). If true, we should find a positive association between household and group expressions of pro-social behavior (H5). Second, researchers have found that income inequality erodes pro-social behavior (Kawachi 2002). Therefore, we expect that household pro-social behavior should be negatively associated with village income inequality (H6). Last, we test the amount of variation explained by village-level variables. Since we worked in a small-scale society in which most villagers know each other and in which there are extensive kinship links, we expect that village-level variables

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alone should explain a considerable part of the variability in pro-social behavior (H7).

For the second step, we use the following linear approximation:

$$[2]. SB_{jvt} = \alpha + \beta A_{vt} + \zeta S_{vt} + \gamma C_{vt} + \varepsilon_{jvt}$$

where SB_{jvt} is the investment in pro-social behavior of the household (the subscripts are the same as before). A_{vt} captures the level of pro-social behavior of each village excluding household j (H5). S_{vt} captures village income inequality (H6). C_{vt} is a vector of dummy variables, one for each village, that captures unobserved fixed village attributes (H7), and ε_{jvt} is a random error term.

In our third model we put together all the variables discussed so far to assess the relative weight of personal and group covariates and their association with pro-social behavior. For the empirical estimation, we use the following linear approximation:

$$[3]. SB_{jvt} = \alpha + \beta I_{jvt} + \zeta S_{vt} + \gamma C_{vt} + \varepsilon_{ijvt}$$

where SB_{jvt} is the investment in pro-social behavior of the household. I_{jvt} is a vector of variables that captures the personal incentives to invest in pro-social behavior (H1-H4). S_{vt} captures village-level variables that might influence a household's decisions to invest in pro-social behavior (H5-H6). C_{vt} is a vector of village dummy variables that captures unobserved fixed village attributes (H7), and ε_{ijvt} is the error term.

We use ordinary least square regressions with robust standard errors and clustering by village. We did not have convincing instrumental variables to control for the endogeneity of pro-social behavior (Durlauf and Fafchamps 2005) so we cannot infer causality from the parameters we estimate.

The people, methods, and data

The people: In recent publications we provide ethnographic and historical background information on the Tsimane' (Figure 1), including description of sharing and cooperation (Godoy et al. 2004; Godoy et al. 2002; Vadez et al. 2003), so here we just summarize some of the main findings related to pro-social behavior.

INSERT FIGURE 1 ABOUT HERE

In previous research we found that among the Tsimane' gift giving and cooperation permeate everyday life. For example, about seven percent of the value of goods consumed in Tsimane' households come from gifts (Godoy et al. 2002). We observed that Tsimane' routinely share food and home-brewed drinks. We also found cooperation in many activities, such as fishing, maintenance of schools, or the clearing of public places. In villages far from market towns we also observed cooperation in hard agricultural tasks, such as clearing of forests in preparation for planting of subsistence crops.

In contrast to findings from observational studies among the Tsimane', results from experimental studies suggest that Tsimane' display low levels of pro-social behavior relative to people in industrial societies or to people in other small-scale pre-industrial societies (Henrich et al. 2001, 2005). Experimental work also suggests that the distance from a village to the closest market town, a proxy for market exposure, is unrelated to personal pro-social behavior in experimental games. Gurven (2004) found that village of residency –independent of the village's distance to the closest market town – was more strongly associated with pro-social behavior during experiments than attributes of the individual.

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Sample: Fieldwork lasted 19 months (October 2000-April 2002) and took place in 37 Tsimane' villages along the Maniqui river, department of Beni, in the Bolivian Amazon. We interviewed the same participants twice. To avoid seasonal bias, we did both surveys during the same season (February-April) during two consecutive years (2001 and 2002). During the first year, we selected at random either the female or the male head of the household to answer survey questions. In each village we selected a random sample of about eight households. The sample for the first year included 378 households or 28% of the entire population of Tsimane' households. We interviewed the same household heads the second year. During the second year we re-interviewed 325 of the 378 households from the first (2001) survey. The final number of observations over the two years was 703 households. In other publications (Godoy et al. 2005) we have assessed whether adults who left the sample differed in socioeconomic or demographic attributes from adults who stayed in the sample, and found no significant statistical difference, so it is likely that attrition will not produce biases in the parameters we estimate.

Dependent variable: Pro-social behavior: We proxied pro-social behavior by measuring the number of gifts and the frequency of labor help and communal labor given by the household to other households. We asked about the total number of times adults in a household gave or helped people outside their household during the week before the day of interview. We asked about gifts of staples (plantain, rice, manioc, and maize), wildlife (game and fish meat), and other goods (seeds and medicines). We found that only 7.5% of households did not make any gifts during the week before the interview. We also asked about help given in hunting, fishing, and farming and help in other

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activities, such as healing and running errands. We found that 39.0% of households did not offer any help during the week before the day of the interview.

We found a positive, moderate, and statistically significant correlation between the different proxies for aggregate measures of pro-social behavior (Table 2). Gifts of staples and animal foods had the highest correlation coefficients (0.65). Gifts of other goods had slightly lower correlation coefficients with food gifts: 0.49 (staple – other) and 0.45 (wildlife – other). Correlation coefficients between gifts and help were lower than correlation coefficients between gifts of different types of foods: 0.31 (staple – help food production), 0.34 (wildlife – help food production), 0.23 (non-food items – help food production), 0.39 (staple – other help), 0.39 (wildlife – other help), and 0.28 (non-food items – other help). The correlation coefficient between help related to food production and help unrelated to food production (e.g., errands) was 0.27. The Chronbach alpha for the different proxies of pro-social behavior was 0.70, suggesting that the different expressions of pro-social behavior might reflect an underlying dimension of generosity.

INSERT TABLE 2 ABOUT HERE

Because the Chronbach alpha was reasonably high, we added the value of all the expressions of pro-social behavior to create one summary measure. We found that the average household engaged in 14.5 episodes of pro-social behavior each week (sd=14.35). Only 4.5% of households did not make either any gift nor offer any help during the week before the day of the interview (Table 3). To facilitate the interpretation of results, for the regression analysis we took logarithms of aggregate measure of pro-social behavior. In this way, we can interpret the parameter estimates as a percent change in pro-social behavior for a change in one unit in the explanatory variable.

INSERT TABLE 3 ABOUT HERE

Explanatory variables. Personal incentives: To test whether pro-social behavior first increases and then declines with age (H1), we collected information on the age of the household head who answered the survey questions (mean=33.1, sd=12.24). The age variable contained measurement errors because at least 25% of people said they did not know their exact age. Surveyors estimated the age of the people who did not know their age. We calculated age squared to control for non-linear effects. To test whether pro-social behavior increases with cash income (H2), we included a variable that captures the total amount of cash earned by adults in the household through wage labor and the sale of products during the 14 days before the day of the interview (mean = 156 bolivianos/household, sd=328.4; US \$ 1 = 6.31 bolivianos). To test whether pro-social behavior acts as an insurance to reduce the effects of adverse shocks in the village (H3), we asked about the amount of credit incurred by adults in the household from people outside the village during the month before the interview (mean=39.9 bolivianos/household, sd=116.06). For the regression, we constructed a variable that captures the average amount of debt outstanding reported by adults in other households in the village (excluding the household of the participant supplying the information). To test whether pro-social behavior is associated with conflicts (H4), we included a variable that captures the opinion of the household head about other Tsimane' visiting the village. Negative opinions of Tsimane' visitors likely capture more conflicts within the village. We found that, on a range from one ('positive') to three ('negative'), most Tsimane' perceive other Tsimane' visitors in a positive light (mean=1.1; sd=0.50).

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Explanatory variables. Group incentives: To test whether household investments in pro-social behavior are associated with the behavior of other households in the same village (H5), we calculated the average number of times other households in the village (without the subject's household) offered gifts or help, or cooperated in communal work during the week before the day of the interview (mean = 14.4 times/week, sd = 8.43). The variable captures group pressure to engage in pro-social behavior. To estimate the relation between village inequalities and household investments in pro-social behavior (H6), we calculated the village Gini coefficients of cash earnings per male-adult equivalent during the two weeks before the day of the interview (mean = 0.60, sd = 0.14).

Explanatory variables. Village dummies. In some of the models we also included a full set of dummy variables for villages ($n = 37 - 1 = 36$) to control for the possible confounding role of village fixed attributes. Notice that village dummies do not necessarily capture group incentives, but rather village characteristics that could be linked with both some of our covariates and with pro-social behavior. For example, people in villages with better lands might have higher yields and income and be more inclined to display pro-social behavior owing to higher farm productivity than people in villages with less productive lands. Other possible village fixed effects include role models of pro-social behavior or proximity to markets. For instance, suppose that some villages have well-respected, generous elders who other villagers emulate in their generosity. If we did not control for this fixed attribute of the village we would overstate the significance of group incentives on the pro-social behavior of the household because the role model provided by elders would presumably bear a positive association with the pro-social behavior both the rest of the village and the individual household.

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Control variables: In all the regressions we include the year of the survey, the number of adults in each household, and the total number of households in each village.

Results

Table 4 shows the regression results for model [1] including only the personal incentives to invest in pro-social behavior (column [1]), for model [2] including group incentives to invest in pro-social behavior (column [2]), and village fixed characteristics (column [3]), and for model [3] combining personal and group incentives to invest in pro-social behavior, with and without village dummies (columns [4] and [5]).

INSERT TABLE 4 ABOUT HERE

Model [1]: Personal incentives to invest in pro-social behavior (H1- H4): We hypothesized that investments in pro-social behavior would first rise and then fall with the age of the household head (H1). We found the hypothesized inverted U-shape relation between pro-social behavior and age (Table 4, column [1]). The age of the household head was associated in a positive way with household investments in pro-social behavior ($p=0.002$); the quadratic term for age bore a negative association with household investments in pro-social behavior ($p=0.009$). Investments in pro-social behavior increase with the age of the household head until about 45 years of age, after which investments in pro-social behavior decline. We did other analysis (not shown) to explore the relation between age and gifts and labor. When using the disaggregated expressions of pro-social behavior, we found that gifts giving peaked at about 50 years of age, whereas helping others through labor peaked at about 37 years of age.

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Our data also suggest a positive relation between personal investments in pro-social behavior and cash income (H2). Results hold whether we use the raw data (not show) or the logarithm of household cash income, so we use the logarithm of income. Since both the outcome and the explanatory variables are in logarithms, we can read the coefficient of cash income as an income elasticity of investment of pro-social behavior. The income elasticity of household investment in pro-social behavior is 0.037 ($p < 0.01$); that is, doubling household cash income would be associated with an increase in household investment in pro-social behavior of 3.7%.

Hypothesis 3 states that personal investments in pro-social behavior will be associated with lower effects of shocks in other households in the village, and therefore with lower average outstanding debts. We found no statistically significant relation between the household pro-social behavior and the average outstanding debts in other households. To rule out the possibility that the lack of a significant association reflects a poor choice of a proxy variable for an adverse shock, we re-estimated the model of column [1] using a different proxy for household shocks. We used the average number of days the household head had been sick during the week before the day of the interview. We found similar results (not show). The number of days adults in other households in the village (excluding the participant's household) reported being sick was negatively associated with a household's investments in pro-social behavior, but the coefficient was low (-0.001) and statistically insignificant ($p = 0.98$).

As hypothesized, we found that having a negative opinion of Tsimane' visitors was associated with lower household investments in pro-social behavior (H4). Household investments in pro-social behavior were not related to the household head's

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positive opinion of other Tsimane' visiting the village, but they were negatively related to the negative opinion of visitors held by the household head. Household heads who had a negative opinion of Tsimane' visitors gave and helped 66% less than household heads who had a good or neutral opinion of other Tsimane' visiting the village ($p=0.06$).

Model [2]: Group incentives to invest in pro-social behavior (H5-H6): We hypothesized that household investments in pro-social behavior would bear a positive relation with group investments in pro-social behavior (H5) and that household investment in pro-social behavior would be negatively related with village income inequality (H6). Results from column [2] of Table 4 suggest that investments in pro-social behavior by other households in the village bore a positive relation with own investments in pro-social behavior: doubling investments in pro-social behavior by the rest of the village was associated with an increase of about 62.3% in own household investment in pro-social behavior ($p=0.001$). Results from the same regression suggest that village income inequality bore a negative relation with a household's investment in pro-social behavior. Doubling the Gini coefficient of village income inequality was associated with a decrease of 45.5% in the amount of pro-social behavior of the household ($p=0.02$). Since Gini coefficients drawn from a small sample might produce imprecise estimates, we used two other measures of village income inequality to test the robustness of our results: a) the standard deviation of the logarithm of income in the village and b) the coefficient of variation (standard deviation/mean) of income in the village. The results (not shown) confirmed the analysis using the Gini coefficient. Both the standard deviation of the logarithm of income in the village and the coefficient of variation of income in the village bore a negative relation with household investments in

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pro-social behavior. The coefficient of the standard deviation of the logarithm of income was -0.025 ($p=0.08$) and the coefficient of the coefficient of variation was -0.14 ($p=0.01$).

Village fixed characteristics (H7): The two previous models do not control for the role of fixed attributes of the village (e.g. better lands, role models, or proximity to markets). We ran a regression of household investments in pro-social behavior against a full set of dummy variables for villages and found that village fixed effects alone explained 21% of the variation in household expressions of pro-social behavior (H7). If we re-estimate the model with only personal variables on the right side, we find that personal incentives alone explained 8 % of the variation in household pro-social behavior, considerably lower than the 21% with village fixed effects.

Model [3]: Personal and group incentives to invest in pro-social behavior (H1 to H7). In our next model, we combine personal and group incentives to invest in pro-social behavior, first without controlling for village fixed effects (Table 4, column [4]) and then including a full set of village dummy variables (Table 4, column [5]). Results from column [4] resemble results from columns [1] and [2] except for one variable. Once we control for group incentives to invest in pro-social behavior, the variable that captures village income inequality loses significance. The variables that capture the age of household head, household cash income, debts, opinion of Tsimane' visitors, and investments in pro-social behavior by other households in the village remain largely unchanged.

Last, results from column [5] suggest that, after controlling for village fixed effects, many of the relations found in columns [1] – [4] disappear. In column [5], only the age of the household head and household cash income continued to bear a significant

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relation with household investments in pro-social behavior. The three variables that were significantly related to household investments in pro-social behavior in previous models – having a negative opinion of other Tsimane', investment in pro-social behavior by the rest of the village, and village income inequality – lost their statistical significance.

Robustness and extension: We ran two additional models to test the robustness of the positive relation between household cash income and household investments in pro-social behavior, and one model to test the possible direction of causality between pro-social behavior and household cash income. In our first test for robustness, we regressed *changes* in household investments in pro-social behavior between the first and the second year of the survey against *changes* during the same time period in the explanatory variables that proxy for personal incentives to invest in pro-social behavior. The procedure should purge our estimates of some of the unseen household fixed heterogeneities, thus allowing us to test the strength of the association between individual attributes and pro-social behavior after removing stable household traits. We found that, even after controlling for unseen household fixed heterogeneity, changes in household cash earnings and changes in opinion about other Tsimane' visiting the village bore a positive and a significant association with changes in household investments in pro-social behavior. The *growth rate* in household cash earnings related significantly with the *growth rate* in household pro-social behavior. Doubling the growth rate of household cash income would increase the growth rate of household investment in pro-social behavior by 2.8* % (p=0.02). Improving the opinion of the household head about Tsimane' visitors bore a positive association with household investment in pro-social behavior. Doubling the good opinion of the household head about Tsimane' from other

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villages, would correlate with an increase of household investment in pro-social behavior of 26% ($p=0.02$).

In our second test for robustness, we ran a household fixed-effect model using as explanatory variables the same personal and group incentives to invest in pro-social behavior used in the previous models. We found that after removing household fixed-effects, household cash income was positively and significantly associated with personal investments in pro-social behavior. Furthermore, the coefficient resembles those found in the previous models. After conditioning for household fixed-effects, we found an income elasticity of household investment in pro-social behavior of 0.03 ($p=0.01$). Investments in pro-social behavior by households in the rest of the village also bore a positive relation with own investment in pro-social behavior after controlling for household fixed-effects: doubling the investments in pro-social behavior by other households in the village was associated with an increase of 68% in investment in pro-social behavior by the excluded household ($p=0.001$).

In our last model, we explore the possible direction of causality between household investment in pro-social behavior and household cash income. To do so, we regressed household investments in pro-social behavior during the second year of the survey (dependent variable) against explanatory variables during the first year of the survey. By lagging explanatory variables by a year, we can partially abate biases from possible reverse causality but we realize the procedure does not remove the biases from omitted variables that affect both the outcome and the lagged explanatory variables. We found that household investments in pro-social behavior during the second year were not related to household cash income during the first year. The coefficient for the variable

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household cash income during the first year was of 0.005 ($p=0.60$). Furthermore, with the exception of the variable age and age squared, none of the other explanatory variables collected during the first year were significantly related to household investments in pro-social behavior during the second year. The weak results might stem from two reasons. First, in lagging explanatory variables in a two-year panel we effectively reduce the sample size by a half, so standard errors will increase and with it the likelihood of finding weak statistical relations. Second, the length of the lag period will attenuate the strength of the association even if there were causal effects. Lagging right-side variables by an entire year may have diluted the strength of the association too much; a shorter lag might have produced stronger effects.

We ran a similar model but using as a dependent variable the logarithm of household cash income during the second year of the survey and the logarithm of household investment in pro-social behavior during the first year as one of the explanatory variables. In so doing, we try to assess whether pro-social behavior might affect income, rather than the other way around. We found that the household investments in pro-social behavior during the first year of the survey (explanatory variable) were positively associated with household cash income (dependent variable) during the second year of the survey. Doubling household investments in pro-social behavior during the first year of the survey was associated with a 91% increase in cash income during the second year of the survey ($p=0.02$).

Discussion and Conclusion

Scholars have debated the role of personal and group incentives in shaping pro-social behavior. In this article we tested the relative weight of various personal and group incentives to invest in pro-social behavior among Tsimane' households while controlling for village fixed attributes. Two findings deserve discussion. First, we find that some personal incentives bear a significant association with household decisions to display pro-social behavior. Second, group incentives do not explain household pro-social behavior once we control for the role of fixed attributes of villages, but village fixed attributes explain a non-trivial share of the variation in the data.

The role of personal incentives. First, the importance of personal incentives to invest in pro-social behavior has been well documented in the literature on social capital in industrial nations (Glaeser et al. 2002; Putnam 2000; Knack and Keefer 1997), but has been questioned in recent anthropological research using experiments (Henrich et al. 2005; Paciotti and Hadley 2003; Sosis and Ruffle 2003). Henrich and his colleagues found that personal-level economic and demographic variables did not explain behavior in experimental games within or across groups in small-scale, pre-industrial societies. They collected individual-level information on the sex, age, level of formal education, and wealth of participants, and found that none of the individual-level variables bore a significant association with pro-social behavior after controlling for village of residency.

A possible explanation for the difference in findings might stem from differences in the methods used. Researchers studying pro-social behavior in industrial nations and our own research use data from daily interactions, whereas Henrich and his colleagues use data from experimental games. In daily interactions people face some constraints that

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might disappear in experimental games. For example, an elder Tsimane' man might not want to share game meat because he might be less successful in hunting than a young Tsimane'; a pound of wildlife in the hands of an old Tsimane' might have more value than a pound of wildlife in the hands of a younger hunter. The same man might display the same amount of pro-social behavior as a young Tsimane' when neither faces cost in accessing the resource to be shared, as would happen in a laboratory experiment.

Among the various personal incentives that might affect decisions to invest in pro-social behavior we consistently found that the age of the household head and the amount of cash income bore a significant relation with pro-social behavior. Even after controlling for unseen fixed effects of people and villages, we found an inverted U-shaped relation between the age of the household head and the household investments in pro-social behavior. Our finding meshes with the findings of Glaeser and others in the USA (Glaeser et al., 2002; Putnam 2000). We found that pro-social behavior peaked at about 45 years of age, similar to the inflection point found by Glaeser and his colleagues (40-50 years of age).

We also found a consistent relation between investments in pro-social behavior and the amount of cash income earned by Tsimane' households. We found that, even after removing unseen individual heterogeneity and controlling for village fixed attributes, household cash income bore a positive relation with household investments in pro-social behavior. Yet our data suggest that the income elasticity of pro-social behavior is low in real terms when using contemporaneous measures of household cash income and pro-social behavior. Assuming the relation is causal and that it goes from income to pro-social behavior, our coefficients suggest that one would have to double

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current household cash income to observe an increase of current household investment in pro-social behavior of only 3.6%. Other authors have also observed a positive association between pro-social behavior and cash income (Glaeser et al. 2002) or economic growth (Grootaert and van Bastelaer 2002; Woolcock and Narayan 2000). Findings from other researchers suggest that the relation between monetary income and pro-social behavior is stronger than the results we found. A possible explanation for the lack of a stronger relation between the two variables in our data is the way in which we measured income. Glaeser et al (2002) used monetary income, which captures most types and the largest share of income in an industrial society. We restricted the analysis of income to cash income, which captures only about 15% of the total income among the Tsimane' – with the balance coming from the value of own-consumption, which we did not measure (Godoy et al. 2002). By restricting the measure of income to only a part of total income, we might have reduced the variance of income and biased the parameters estimated. Furthermore, we took the logarithm of income. Since 191 households had earned no cash income, we lost 27 % of the observations. Although results held up whether we use the raw data or the logarithm of income, the transformation to logarithms might explain why we found a weaker relation than those found in other studies.

We found that the pro-social behavior elasticity of household income is much higher when investments in pro-social behavior occurred before earnings took place than when the two events occurred at the same time. Doubling household investment in pro-social behavior during the first year of the survey was associated with an increase of 91% in household cash income the following year. The finding has two implications. First, it suggests that causality might go from investment in pro-social behavior to cash income,

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rather than from cash income to investments in pro-social behavior. We cannot settle the direction of causality with our data because both variables -- household income and pro-social behavior -- might reflect the role of unmeasured third variables. Nevertheless, our results are a first step in identifying the direction of causality between the two variables. The finding suggests that household investment in pro-social behavior might have private returns that occur over a long time.

Group incentives. We found that after controlling for village fixed effects many of the personal and group incentives to invest in pro-social behavior that at first mattered lost their significance. This is logical since various forms of fixed village heterogeneity would correlate positively with both pro-social behavior and with personal and group attributes. Village dummy variables alone explained about 21% of the variation in our data. This finding is higher than the estimates of Henrich et al. (2005) and Gurven (2004) among the Tsimane' in underlying the importance of group fixed characteristics. They found that group dummy variables accounted for approximately 12% of the variance in individual offers in experimental games among the Tsimane'. We found that fixed characteristics of the group explained more than three times the variation that Glaeser and colleagues (2002) found in industrial societies (6%). The difference in results between Glaeser et al. and Henrich et al. and our own research might stem from differences in the socioeconomic setting of the studies. Mobility and anonymity in industrial nations might make it unlikely for neighborhood effects to exert an influence on personal decisions. In contrast, in small-scale, pre-industrial rural societies, where people are linked by ties of blood and marriage, and interact every day, group pressure may gain significance.

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We conclude with two suggestions for future research on possible reasons for the occurrence of pro-social behavior. First, researchers might want to pay more attention to village fixed characteristics. For example, researchers studying the reasons behind pro-social behavior should control for overall kinship relations, land productivity, and other characteristics in a village that are likely to remain fixed in the short run and that might have a direct influence in pro-social behavior. Second, findings from this and from previous research suggest that pro-social behavior and cash income bore a positive association. Researchers might now want to move on to explore the direction of causality between the two variables.

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Table 1: Incentives to invest in pro-social behavior: Summary of the hypotheses and proxies

Hypotheses that support personal incentives		Variables
H1	Pro-social behavior first rises and then falls with age	<i>Age, Age²</i>
H2	The higher cash income, the higher pro-social behavior,	<i>Cash income</i>
H3	The lower shocks, the higher pro-social behavior	<i>Credit by others</i>
H4	The lower number of conflicts, the higher pro-social behavior	<i>Positive opinion, Negative opinion</i>
Hypotheses that support group incentives		
H5	The higher the pro-social behavior of others in the village, the higher own pro-social behavior	<i>Gifts and help by others</i>
H6	The lower income inequality, the higher pro-social behavior	<i>Gini coefficient of income inequality</i>
Hypothesis that support village characteristics		
H7	Village-level variables explain a considerable part of the variation in pro-social behavior	<i>Village dummies</i>

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Table 2: Correlation coefficients between different measures of pro-social behavior (n=700)

	Staple gift	Wildlife gift	No food gift	Help food	Help no food
Wildlife gift	0.65 (0.001)				
No food gift	0.49 (0.001)	0.45 (0.001)			
Help food	0.31 (0.001)	0.34 (0.001)	0.23 (0.001)		
Help no food	0.39 (0.001)	0.39 (0.001)	0.28 (0.001)	0.27 (0.001)	
Total gift/help	0.73 (0.001)	0.67 (0.001)	0.53 (0.001)	0.50 (0.001)	0.47 (0.001)

Note: Probability in parenthesis adjusts significance levels for multiple comparisons using Šidák method.

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Table 3: Definition and summary statistic of variables used in regression analysis for Tsimane' Amerindians over 16 years of age during February 2001-April 2002

<i>Name</i>		<i>Definition</i>	<i>N</i>	<i>Mean</i>	<i>Std Dev</i>
<i>Dependent variable</i>					
<i>Pro-social behavior</i>		Number of times adults in the household gave or helped people in other households during the seven days before the interview. In regression, entered in logarithms	700	14.5	14.35
<i>Explanatory variables</i>					
Hypothesis #		Personal incentives			
H1	<i>Age</i>	Age of one randomly selected household head, in years	703	33.1	12.24
H2	<i>Cash income</i>	Cash earned by all adults during the 14 days before the interview, in <u>bolivianos</u> (1 US dollar = 6.31 bolivianos)	700	156	328.4
H3	<i>Credit</i>	Credit of adults in other households in the village, in <u>bolivianos</u>	703	39.9	116.06
H4	<i>Attitude toward Tsimane'</i>	Perception of Tsimane' visiting the village, 1: positive opinion, 2: neutral opinion, 3: negative opinion.	581	1.1	0.50
Group incentives					
H5	<i>Gifts and help by others</i>	Average number of times other households in the village gave or help	74	14.4	8.43
H6	<i>Gini coefficient of village income</i>	Gini coefficient of village cash earning per male-adult equivalent during the two weeks before the day of the interview	70	0.6	0.14
<i>Control variables</i>					
<i>Adults in household</i>		People over 16 years of age living in the household	703	3.1	1.50
<i>Households in village</i>		Number of households in village	74	17.6	9.96

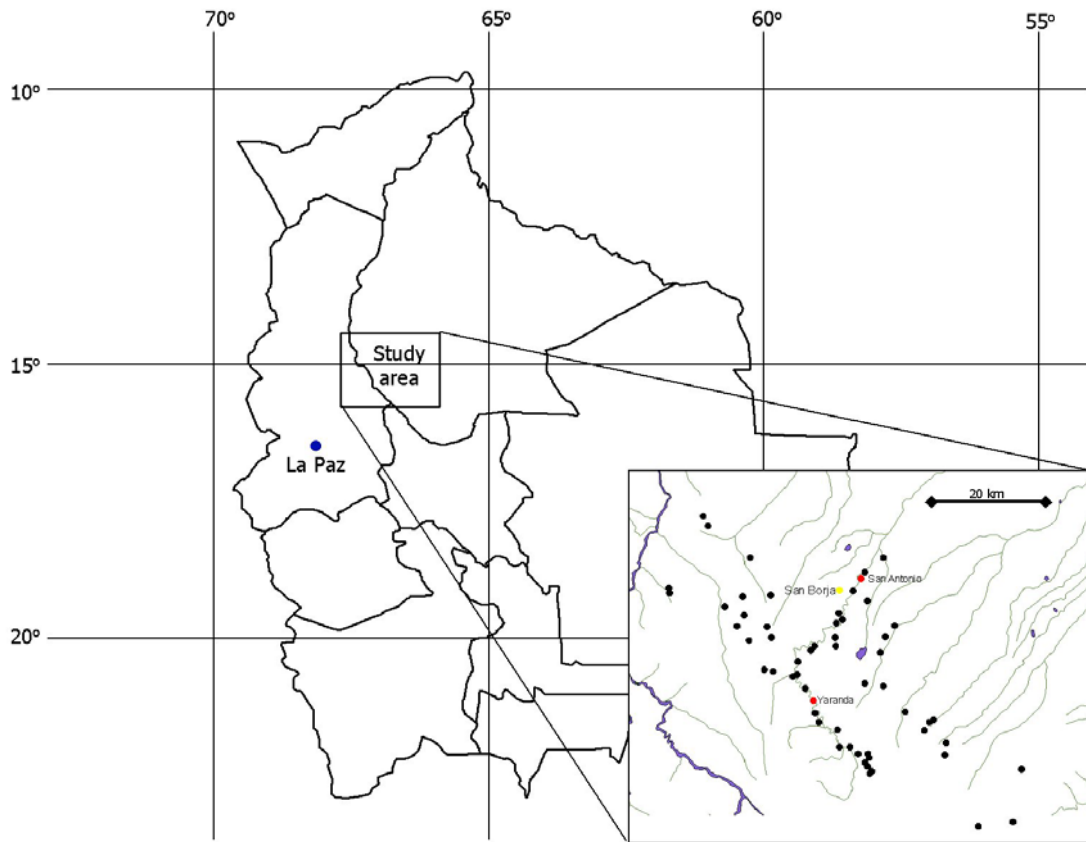
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Table 4: Ordinary least square regressions with robust standard errors and clustering by village. Dependent variable: household investments in pro-social behavior (in logarithms)

		[1]	[2]	[3]	[4]	[5]
Personal incentives						
H1	<i>Age</i>	.044***	^	^	.037***	.031**
	<i>Age</i> ²	-.001***	^	^	-.0004**	-.0003
H2	<i>Cash income, log</i>	.037***	^	^	.033***	.034***
H3	<i>Credit by others</i>	-.001	^	^	-.001*	-.0001
H4	<i>Positive opinion</i> ^a	-.227	^	^	-.215	-.040
	<i>Negative opinion</i> ^a	-.663*	^	^	-.562**	-.425
Group incentives						
H5	<i>Gifts by others, log</i>	^	.623***	^	.679***	-.198
H6	<i>Gini coefficient of village income</i>	^	-.455**	^	-.059	-.001
Village fixed characteristics						
H7	<i>Village dummies</i>	^	^	Yes	^	Yes
Control variables						
	<i>Adults in household</i>	.012	-.002	^	.0007	-.007
	<i>Households in village</i>	-.007	-.003	^	-.004	-.010
	<i>Year</i>	-.022	.012	^	-.017	-.001
	Observations	554	665	673	550	550
	R2	0.08	0.14	0.21	0.20	0.30
<p>Note: All regressions have a constant, not shown. ^a Dummy variable, excluded category “neutral opinion”. *, **, and *** significant at the $\leq 10\%$, $\leq 5\%$ or $\leq 1\%$ level. ^: variables intentionally omitted. H1 to H7 refers to hypotheses in Table 1.</p> <p>[1] Personal incentives (H1 - H4) [2] Group incentives (H5-H6) [3] Village fixed characteristics (H7) [4] Personal and group incentives without village dummies (H1- H6) [5] Personal and group incentives with village dummies (H1- H7)</p>						

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Figure 1: *Bolivia and the study area, showing market town (San Borja) and the villages on the survey.*



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