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Covariates of Private Time Preference: A Pilot Study Among the Tsimane' Indians of the Bolivian Rain Forest

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A pilot study with 257 adult (16+ years) Tsimane' Indians, a group of horticulturalists and foragers, in the Bolivian rain forest was done to test hypotheses about the socioeconomic and demographic covariates of time preference. Subjects were asked to make a choice between receiving one candy now or two candies at the end of an interview that lasted 1.5 to 2 h. Results of a multivariate probit regression suggest that education was associated with greater desire for immediate gratification and illness was associated with greater likelihood of willingness to wait. Age, sex, nutritional status, income, and wealth played a weak role in willingness to delay gratification.

KEY WORDS: Impatience; Private time preference; Tsimane' Indian's Delay of gratification; Discount rate; Bolivia.

Our valuation of the future affects how much we consume, invest, and save, and the lifestyle we pursue. Because it touches on so many areas, people's valuation of the future affects how an entire economy operates. As Wilson et al. (1997) point out, despite the importance of private time preference—our willingness to substitute consumption over time or to delay gratification—we know relatively little about its origin or socioeconomic consequences, and what little we know comes mainly from industrial societies (Kirby and Marakovic 1996; Loewenstein 1992; Pender 1996; Thaler and Loewenstein 1989). Drawing on information from the Tsimane' Indians in the Bolivian rain forest, we try to fill the gap by estimating the effect of socioeconomic and demographic variables on

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people's willingness to delay gratification. The variables we test come from the writings of social scientists and from the Tsimanes' own explanations of patience.

The information presented is unique in several ways. First, the information lets us test the common idea that people in simpler rural economies have high rates of discount because they are too poor to wait. Second, by turning to a simple rain forest economy one can test whether hypotheses about time preference developed in Western societies also hold true in very different social and economic settings. Third, a study of time preference in a foraging and horticultural economy may reveal patterns that are harder to discern when economies become far more complex. The experiment we did will be hard to replicate in the future because markets are rapidly absorbing indigenous people of the rain forest.

PATIENCE AMONG THE TSIMANE'

The Tsimane', a group of swidden horticulturalists and foragers, number about 5,000 people and live in the plains and in the rain forests of the department of Beni, Bolivia. Over the past three decades they have become more sedentary owing to encroachment by outsiders and to the establishment of public schools and health facilities. More Tsimane' have started to sell rice, logs, and thatch palm, and to work as wage laborers in nearby logging camps, cattle ranches, towns, and the farms of highland colonists (Chicchón 1992; Godoy et al. 1998a, 1998b).

There does not seem to be a close analog to the concept of time preference in the Tsimane' language. Time preference or private discount rate refers to a person's willingness to delay gratification. The closest we came to the concept of time preference was to identify Tsimane' conceptions of patience, but the two concepts to not overlap in full. The colloquial word for patience in Tsimane' or in English connotes the idea of delaying gratification, but it also connotes the idea of waiting even if waiting brings no future gratification. The Tsimane' word for patience or to be patient, *tyum'chuti* or *dyichchuti*, connotes the idea of "to be quiet," "holding," and "keeping back" for future use.

At one level, the idea of delaying gratification is rare among the Tsimane'. For instance, the Tsimane' do not invest in the maintenance of tools and equipment. They leave valuable tools or hand-woven bags (which take many days to make) thrown in open courtyards. Unlike many other Amazonian Indians, the Tsimane' do not plant fruit trees for future use. The trees they have are the ones that sprout on their own. Although this may reflect lack of planning for the future, it also reflects rules of ownership. People have clear rights of ownership to food crops, but they do not have rights of ownership of usufruct to trees (unless trees are planted in one's garden). Because any Tsimane' can pick the fruits of a tree in the forest, they do not have incentives to plant trees.

During field work we asked several Tsimane' in an informal way to identify people whom they considered patient and impatient. Tsimane' singled out two brothers, Dionisio and Jorge, 33 and 20 years of age, as examples. Dionisio lives in one of the largest villages of the Tsimane', where he completed the fifth grade and

excelled as a student. Many organizations working in the Tsimane' territory have offered him employment, but he has declined and has decided to stay in his village, where he hunts and farms. He clears large patches of forest to put in crops for his family to sell. He is willing to wait many months for crops to mature and goes hunting for days on end. Jorge is more impulsive, the Tsimane' say, because "he moves around and speaks too much" and likes to work with others. Jorge, like his brother, has studied up to the fifth grade, but unlike Dionisio has decided to move out of the village and get a job as a forest guard. At planting time, he rushes to the village from the logging camps to clear and plant fields, which are small and made in haste. Dionisio says Jorge is impulsive because Jorge has lived and worked in towns and cattle ranches, where he has been exposed to a rapid pace of life.

The Tsimane' have explanations about why some people are more willing to delay gratification than others. The Tsimane' way that age makes people more willing to wait for future rewards. The young, they say, are more likely to be impulsive, to pack up and leave to another village without warning in search of better game or employment. They also say that willingness to delay gratification runs in families; parents who are willing to wait breed children who are willing to wait, and they point to many examples of the transmission of willingness to wait along kinship lines. Last, the Tsimane' say that women are more likely to want meat now rather than later. They put pressure on husbands to hunt and to grow crops with a short waiting period from planting until harvest.

Theory and the results of studies by social scientists, have shown that schooling (Becker 1996), age (Green et al. 1994; Rogers 1994; Thaler 1981; Winston and Woodbury 1991), prospects for longevity (Hawkes 1993; Wilson and Daly 1997), income (Cropper et al. 1992; Hausman 1979; Lawrance 1991), and gender (Kirby and Marakovic 1996; Pender 1996) modulate private discount rates. The goals of our empirical analysis are to (a) estimate the effect of these variables on subjective time preference and (b) test some of the Tsimanes' explanations of patience.

METHODS

During June to August 1996, interviews were conducted with 352 adult ($\geq$16 years of age) Tsimane' in 209 households and 18 villages straddling different levels of integration to the market. The survey was the second pilot study to examine the effects of markets on the welfare and on use of natural resources by the Tsimane' (Godoy et al. 1998b). During the survey we collected psychological, anthropometric, demographic, and socioeconomic information from the male and from the female household heads. Interviews lasted 1.5 to 2 h.

About 20 min into the interview, we asked subjects roughly the following question: "We realize you may be getting tired from answering our questions. We would like to give you a rest. Would you like to have one candy now or two candies at the end of the interview?" If the subject wanted the candy now, we asked a second question: "Would you like to have one candy now or three candies at the end of the interview?" Depending on the person's response, we delivered the candies on the

spot or at the end of the interview. The candies were hard, wrapped in paper, did not melt, and so could have been saved for sharing or for consumption later on. On several occasions we saw mothers crack the candy with their teeth and give pieces to nearby children.

Based on their responses, we grouped subjects as "very willing," "willing," or "unwilling" to delay gratification. We labeled "very willing" those subjects who said from the outset they would wait and take two candies at the end of the interview, "unwilling" those subjects who wanted one candy immediately irrespective of the size of the later rewards, and "willing" those subjects who waited until the end of the interview, but only after we had raised the reward from two to three candies. For reasons discussed in the next paragraph, we eliminated from the analysis subjects who were "willing" to delay gratification ($n = 48$).

The Tsimane' may have perceived the option of having fewer candies now rather than more candies later as a bargaining game. Those who chose to wait may have been the better bargainers rather than those more willing to wait. Because we spent many hours and sometimes even several days in one village, people who had answered our questions early on could have told other villagers to wait until we raised the reward. We did not record the time of each interview, so we cannot estimate whether those who took the test later were more likely to turn down the option of having two candies. To remove the potential bias, we eliminated from the statistical analysis the "willing" subjects, or those who waited to have three candies at the end of the interview.

In addition to time preference we collected information on the following explanatory variables: total income (wage income + imputed farm income + remittances received), wealth (value of 13 physical assets), illness (days confined to bed the 2 weeks before the interview), maximum formal education of subject and subject's parents, sex of subject, age, nutritional status (body mass index [kg/m^2]), and distance from the village to the town of San Borja. We measured distance in a straight line using a geographic positioning system (GPS). All reported p values are two-tailed.

DATA AND ECONOMETRIC MODEL

Table 1 contains definition and descriptive statistics of the variables used in the analysis. Although we interviewed 352 subjects, we only use information from 257 subjects in the statistical analysis. The loss of 95 subjects comes from eliminating the category "willing" and from missing values for the age variable. Many Tsimane' could not estimate their age, and we did not attempt to place them in an age cohort.

Close to 90% of the 257 subjects were "very willing" to delay gratification. The mean age of subjects in the sample was 30 years. Thirty-five percent of the subjects were women. Only 14% of the sample had a parent who had attended school; the average subject had 1.7 years of schooling. During the 2 weeks before the interview, subjects reported having been ill 3.04 days. Average household income in the previous year and wealth were 2,368 Bol and 2,912 Bol; both variables displayed

Table 1. Definition and Summary Statistics of Variables ($n = 257$)

Variable	Mean or percent	SD	Min	Max
Dichotomous				
Very willing	89.88%			
Female	35.01%			
Parental education	14.39			
Continuous				
Age	30.66	11.56	16	78
Education	1.74	2.40	0	14
BMI	23.03	2.54	17	31
Income	2368.00	2464.00	11	14712
Wealth	2912.00	2729.00	110	17543
Illness	3.04	3.77	0	14
Distance	29.89	15.31	3	82

Note. For dichotomous variables, percentages rather than means reported. Name of dichotomous variable equated with value of one (e.g., female =1 if subject is a woman). For meaning of "very willing" and "unwilling" see text. For continuous variables, age = age of subject in years; education = years of completed education; BMI = body-mass index (kg/m^2); wealth = value in *bolivianos* (*Bo*) of 13 assets (e.g., animals, tools); illness = days confined to bed during 2 weeks before the interview; income = imputed farm income + wage income + remittances in *bolivianos* (1 US = 5.05 *Bo*); distance = distance in kilometers in a straight line from village to town of San Borja.

high variance (1 US dollar = \$5.05 *bolivianos*). The average village was 30 km from the town of San Borja.

We used a multivariate probit regression to estimate the effect of explanatory variables on the probabilities of being "very willing" to delay gratification. Probabilities were estimated at the mean value of explanatory variables. The coefficients in Table 2 are the probabilities of delaying gratification when all explanatory variables are held constant at their mean value and the variable of interest increases by one unit above the mean of the sample. For instance, in Table 2, 1 more year of education above the sample mean of 1.74 years of education reduces the probability of being "very willing" to delay gratification by 1.6%.

We chose a probit model rather than discriminant analysis because discriminant analysis works less well when using dummies as explanatory variables. (Kennedy 1993: 236: Press and Wilson 1978). In the analysis we use dummies for variables such as sex and parental education. Because probit and logit models produce similar results when estimating probabilities at the mean value of explanatory variables (as we do in this analysis) (Kennedy 1993), the choice of a probit regression over a logit regression is arbitrary and does not affect the results. We re-estimated the regression of Table 2 using a logit model and found essentially the same results.

RESULTS

Table 2 contains the regression results. The results suggest that schooling is associated with lower willingness to delay gratification. One more year of schooling lowered the probability of a subject being "very willing" to wait by 1.6% ($z = -2.41$; $p = 0.016$). The only other variable that showed a statistically significant relation at the 95% confidence level or above was illness. Each additional day of illness during

Table 2. Covariates of Being "Very Willing" to Delay Gratification ($n = 257$)

Variable	Coefficient	Robust SE	Z	Two-tailed p (z)	Mean of X variable
Age	−0.02	0.17	−0.15	0.88	30.66
Female	3.71	3.62	0.91	0.36	0.35
Education	−1.69	0.71	−2.41	0.01	1.74
Parental education	−0.87	4.70	−0.19	0.84	0.14
BMI	−0.20	0.56	−0.36	0.72	23.03
Income	1.93	1.60	1.18	0.23	7.20
Wealth	−2.45	2.12	−1.17	0.24	7.59
Illness	0.98	0.52	2.04	0.04	3.04
Distance	−0.12	0.11	−1.16	0.24	29.89
Pseudo R^2	0.08				

Note. Regression is probit with probabilities estimated at the mean value of explanatory variables. Probit includes robust standard errors and no constant. Dependent variable is a dichotomous variable, "very willing" to delay gratification (1 = very willing, 0 = unwilling; "willing" category deleted, see text). Income and wealth are expressed in natural logarithms.

the past 2 weeks above the sample mean of 3.04 days of illness increased the likelihood of being "very willing" to wait by 0.98% ($z = 2.04$; $p = 0.042$).

The income variable bore the correct, positive, sign predicted by economists, but the wealth variable did not (Cropper et al. 1992; Hausman 1979; Lawrance 1991); neither variable was statistically significant. Contrary to what the Tsimane' say, women seemed to be more willing to wait than men, and age did not seem to make people more willing to delay gratification. Being a woman was associated with a 3.7% greater likelihood of waiting for future rewards. People from villages farther away from the town of San Borja were less willing to wait. None of the relations discussed in this paragraph were statistically significant at the 95% confidence level or above.

DISCUSSION

Two reason for the weak statistical results (other than for the variables education and illness) may have to do with (a) errors in the measurement of the dependent variable, and (b) the type and value of the reward.

Errors in the Measurement of the Dependent Variable

First, we did not monitor whether those who chose the early option ate their candy when we gave it to them, or whether they waited until after the interview. If they did not eat the candy until later we should not equate the delayed option with delayed consumption. Second, because we did the interviews at different times of the day, we may have interviewed some people when they were hungry and others when they were full. Present hunger would have affected preferences for candy now rather than for candy later. We tried to proxy hunger in part by measuring body mass index. Third, some Tsimane' may have mistrusted us and felt that their chances of getting the delayed option were lower. Taking a candy now would have eliminated

the trust problem. Last, some mothers opted to have the candy now so they could give it to their children and have less distractions in answering the interviewer's questions.

Type and Value of the Reward

We chose candy rather than money, clothing, or other goods to measure the ability to delay gratification for four reasons. First, we had to carry the rewards to villages, generally on foot and often far away. It was difficult to take bulky or heavy goods. Second, not all Tsimane' use money; in remote villages money has little or no value. Third, the use of other light, portable items, such as cigarettes or coca leaves, posed ethical issues. Fourth, the Tsimane' like candy. They often buy it for their families when they go to town and give it to each other as gifts.

The choice of food to measure the ability to delay gratification fits with the findings of social psychologists that people's preference for food is strong and mirrors closely their ability to delay gratification or to make impulsive choices (Kirby and Marakovic 1996; Mischel et al. 1989). However, the choice of candy to measure private time preference over a short time may not capture with accuracy time preference for economic investments that take place over a longer time or for more important economic decisions.

CONCLUSION

We draw two tentative conclusions from this pilot study. First, contrary to what we might have expected from a poor foraging and horticultural rain forest economy, most (89.88%) Tsimane' were willing to delay gratification. Second, contrary to what Becker and Mulligan say (Becker 1996: 11; Becker and Mulligan 1997), we found that schooling seemed to make people less willing to delay gratification. Further support for the idea that schooling may raise a person's subjective time preference in a simple rural economy comes from an unpublished study with 406 subjects in four horticultural Amerindian societies in the tropical lowlands of Bolivia. In that study we elicited people's private time preference by having them make nine nonhypothetical, intertemporal choices between nontrivial rewards. The results of a multivariate OLS regression of private time preference as a dependent variable against all the same explanatory variables used in Table 2 suggests that each additional year of schooling raised a person's private discount rate by 15% ($p = 0.018$).

Only further empirical work, with better models, larger samples, and better metric of time preference, will allow us to estimate with more accuracy the covariates of private time preference. It is unclear whether we will be fortunate to have enough time to find simple rural economies to examine these topics.

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