

Does Culture Matter in Economic Behavior? Ultimatum Game Bargaining Among the Machiguenga of the Peruvian Amazon

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During the last 20 years experimental economists have demonstrated that human economic reasoning substantially deviates from the predictions of positive game theory under a number of important conditions—including risk, bargaining, cooperation, and so forth [see Douglas D. Davis and Charles A. Holt (1993) or John H. Kagel and Alvin E. Roth (1995) for overviews]. In response to this, some economists have begun to modify economic theory to incorporate what we have learned from this laboratory research (Gary E. Bolton, 1991; Ernst Fehr and Klaus M. Schmidt, 1997). Like most efforts to model human behavior in economics, these new approaches, implicitly or explicitly, make certain universalist or panhuman assumptions about the nature of human economic reasoning. That is, they assume that humans everywhere deploy the same cognitive machinery for making economic decisions and, consequently, will respond similarly when faced with comparable economic circumstances. Here, I address this assumption with experimental evidence (Ultimatum Game results) from the Peruvian Amazon. Comparisons of the Machiguenga result with a Los Angeles control experiment and existing cross-cultural data suggest that economic decisions and economic reasoning may be heavily influenced by cultural differences—that is, by socially transmitted rules about how to behave in certain circumstances (economic or otherwise) that may vary from group to group as a consequence of different cultural evolutionary trajectories. Consequently, if experimental games are to be taken seriously, in that they capture aspects of economic reasoning relevant to real life, and if the Machiguenga results stand the test of scrutiny and can be replicated elsewhere, then the assumption that humans share the same economic decision-making processes must be reconsidered.

I. The Ultimatum Bargaining Game

The Ultimatum Game (hereafter abbreviated UG) is a simple bargaining game that has been extensively studied by experimental economists. In this game, two players are allotted a sum of money (termed the “stakes”). The first player, called the “proposer,” offers a portion of the total sum to a second person, called the “responder.” The responder can either accept or reject the proposer’s offer. If the responder accepts, she (or he) receives the amount offered and the proposer receives the remainder (the initial sum minus the offer). If the responder rejects the offer, then neither player receives anything. Players typically receive payments in real money and usually remain anonymous to other players, but not to the experimenters, although experimental economists have extensively manipulated both of these variables. In the Machiguenga and Los Angeles experiments described herein, players were always anonymous to other players (but not the experimenter), and the stakes were large relative to previous UG experiments and the subjects’ socioeconomic status.

Previous UG experiments clearly demonstrate two important things. First, game behavior substantially deviates from the predictions of positive game theory (under standard preferences). Positive game theory (specifically, subgame-perfect equilibrium and money maximization) unambiguously predicts that proposers should offer the smallest, nonzero amount possible, and responders should always accept. For example, if \$20 is allocated to a pair of players with the smallest unit being \$1, then the proposer should offer \$1 to the responder and keep \$19 for herself. Responders should always accept any nonzero offer—responders face a choice between 0 and something (in the subgame-perfect case, between \$0 and \$1). In contrast, experimental subjects from industrial societies behave quite differently: the modal offer is typically 50 percent and the mean offer

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averages between 40 and 50 percent of the total. Responders usually accept average offers, but often reject offers lower than 20 percent of the total sum (Colin F. Camerer and Richard H. Thaler, 1995; Roth, 1995).

Second, although UG results consistently and substantially deviate from the predictions of game theory, these results are very robust. Experimental economists have systematically studied the influence of various factors on the game's results, including stake size¹ (Paul Tompkinson and Judy Bethwaite, 1995; Elizabeth Hoffman et al., 1996; Lisa A. Cameron, 1999), degree of anonymity (Robert Forsythe et al., 1994; Bolton and Rami Zwick, 1995), context (Hoffman et al., 1994; James Konow, 1996), and "culture" (Roth et al., 1991; Robert Slonim and Roth, 1998; Cameron, 1999), and concluded that each has little or no effect on players' behavior.

Most important in the present context: existing experimental data and analyses have shown that people from many parts of the world (Europe, Asia, and North America) behave quite similarly in the UG. In studies from places as different as Ljubljana (Slovenia), Pittsburgh, Tokyo (Roth et al., 1991), Yogyakarta (Indonesia) (Cameron, 1999), Tucson (Hoffman et al., 1994), and Los Angeles, proposers make similar mean offers (40 to 50 percent of the total), and responders frequently reject low, "inequitable" offers.

This robust pattern of UG behavior has led many economists to develop new models, which posit that humans possess either an innate taste for costly punishment, an innate sense of fairness, or some combination of both (Bolton and Zwick, 1995; Camerer and Thaler, 1995; Roth, 1995; Konow, 1996). However, my UG data indicate that the Machiguenga behave very

differently from subjects drawn from industrialized populations, and therefore, that notions about what is fair and/or what deserves punishment are culturally variable—meaning that people behave differently as a consequence of having grown up in different places. Because of the potential importance of the Machiguenga society to interpreting the data, I will first briefly describe the lifeways of the Machiguenga and then present the results.

II. The Machiguenga

Traditionally, the Machiguenga lived (and some continue to live) in mobile single-family units and small extended-family hamlets scattered throughout the tropical forests of the southeastern Peruvian Amazon, subsisting on a combination of hunting, fishing, gathering, and manioc-based swidden horticulture. Economically independent at the family level, this Arawakan-speaking people possess little social hierarchy or political complexity, and most sharing and exchange occurs within extended kin circles. Cooperation above the family level is almost unknown, except perhaps for cooperative fish poisoning (Michael G. Baksh, 1984).

During the last 30 years, missionaries, markets, and government-administered schools have sedentized and centralized most of the Machiguenga into a number of villages in a continual process of increasing market integration. As these demographic changes have strained local game and wild food resources, the Machiguenga have gradually intensified their reliance on horticultural products, especially manioc (a starchy root crop). In an effort to buy increasingly available Western goods, many Machiguenga farmers have begun to produce cash crops (primarily coffee and cocoa), raise domesticated animals (e.g., chickens, ducks, and guinea pigs), and participate in limited wage labor (usually for logging or oil companies; see Joseph Henrich, 1997).

Although most Machiguenga now live in small communities of about 300 people, they remain primarily a family-level society. This means that families fully produce for their own needs (food, clothing, etc.) and do not rely on institutions or other families for their social or economic welfare, although there is a constant demand for market items such as machetes, salt,

¹ For example, Cameron's (1999) analysis of ultimatum game data from Indonesia, where she was able to provide sums equivalent to approximately three months' salary for test subjects, strongly rejects the hypothesis that higher stakes move individuals closer to game-theoretic behavior. Similarly, Hoffman et al. (1996) tested the effect of raising the stakes from \$10 to \$100 dollars, and found they could not "reject the hypothesis that the offers are identical." Generally, the data suggest that proposers move away from game-theoretical predictions and toward a fifty-fifty split; responders, consequently, accept these proportionately higher offers more frequently.

sugar, and steel axes. With the exception of recent river trips to the nearest (minimum eight-hour trip) towns, anonymous transactions are almost unknown. When local bilingual schools (Machiguenga-Spanish) are not in session and the incessant rains of the wet season make travel difficult, many families move away from the community to live in their distant gardens, often located two to three hours away from the village (Henrich, 1997).

III. Methodology

To deal with the particular challenges of performing experiments in the Machiguenga ethnographic setting, I had to modify the typical experimental procedures used in the Ultimatum Game. First, I gathered 12 men together between the ages of 18 and 30 under the auspices of "playing a fun game for money." I explained the game to the group in Spanish using a set script written in simple terminology like "first person" to refer to the proposer and "second person" for the responder (Spanish is a second language for the Machiguenga). After this I had a bilingual school teacher (an educated Machiguenga) reexplain the game in the Machiguenga language (translating from my script), and display the money that we would be using to make payments. After this, each participant entered my house (the guest hut) individually. We explained the game a third time, and I asked a number of hypothetical, practice questions intended to test the participants' comprehension of the game. We reexplained parts of the game as necessary. Often numerous examples were necessary to make the game fully understood. After the individual confidently answered at least two hypothetical questions correctly, I would submit the actual question with a pile of 20 *soles* (Peruvian money) in view. The following day, after having successfully gotten 12 responses and paid out some money, I began seeking randomly selected individuals to play the game. Most people had already heard of the game and were eager to play. I privately explained the game to each individual (usually in his or her house) and ran through the same testing procedure as the previous day. During this process several people were rejected because they, after 30+ minutes of explanation, could not understand the game—at least they

could not correctly answer the hypothetical questions.

The initial 12 players were volunteers, but the next 30 players were selected at random from my demographic survey. Similarly, most players were randomly assigned to their roles—proposer or responder—prior to playing the game; however, players were not informed of their respective roles until after they had correctly answered the two hypothetical questions. To prevent some of the initial 12 individuals from guessing with whom they might be paired, I began by assigning the first five players to the role of proposer, after which I then switched to randomly assigning the roles. The last three players were all responders, to even out the numbers of proposers and responders. I paired responders with proposers by randomly selecting from among the outstanding offers. Machiguenga players were told that their anonymous partner was another member of their community (Camisea), but nothing more was said about how this individual would be chosen, nor about their age, sex, or family.

Demographically, Camisea contains 260 people from 36 households, with about 70 adults. These 36 households can be roughly divided into 12 extended families. The player pool contains 14 females and 28 males. The females ranged in age from 24 to 37 years; the males ranged from 17 to 56. The mean age for all the players was 26.3 years.

Although such things as procedural differences seem unlikely to explain the substantial differences observed between the Machiguenga and the typical robust results—considering that procedural variations in the UG have been extensively tested and nothing approaching these differences has ever emerged—I repeated a nearly identical version of the Machiguenga UG with UCLA graduate students in Los Angeles to control for (1) stake size, (2) "community closeness," (3) experimental procedures, (4) instructional details, (5) the age of players, and (6) the experimenter himself. First, the Machiguenga's 20-*soles* stake equals about 2.3 days' pay from the logging or oil companies that occasionally hire local labor. To match this amount, I set the UCLA stake at \$160, which is about 2.3 days' pay for a graduate student working as a "reader" (\$9–\$10 per hour after taxes).

Second, because the Machiguenga were told that they were playing with an anonymous person *from their community*, which contains about 70 adults, I limited the UCLA experiment to graduate students in the Department of Anthropology (also a community of about 70 adults), and informed the subjects accordingly. Third, as with the Machiguenga, all UCLA subjects received the game instructions both written and verbally, in a one-on-one situation with the experimenter, and had to answer hypothetical test questions before actually playing the game. Unlike the Machiguenga, UCLA students also had to sign a consent form before playing. Fourth, in both cases I used the same written instructions (translated into English at UCLA), and the same pattern of examples and test questions. Fifth, the average age of Machiguenga subjects was 26.3 years, whereas UCLA graduate students have an average age of 25.7 years.

Finally, in both experiments I was the primary investigator: I explained the game, presented the examples, and posed the questions to the subjects. Although it is certainly true that I am not perceived in the same way by these two groups, this experiment does control for some aspects of experimenter bias. In typical UG experiments, subjects do not usually know the experimenter, but I am known in both groups, and players may need to interact with me in the future. So, if knowing the experimenter and expecting future interaction with him causes people to behave more fairly, then we should expect both Machiguenga and UCLA graduate students to behave more fairly—double-blind experiments have produced “less-fair” results (see Hoffman et al., 1994). One might even suggest that the Machiguenga should behave especially fairly to “look good” in front of a “rich” Westerner with many useful items to give out. Second, if in the course of administering the game I unconsciously display leading facial expressions, use suggestive tones, or exhibit some other personal qualities that cause people to propose and accept low amounts, then the control group should reveal similar behavior—previously cross-cultural researchers have worried about this and attempted to test for it (see Roth et al., 1991 p. 1071). Note that, at UCLA, unlike the Machiguenga situation where I was

accompanied by a local assistant, I worked alone with subjects during the experiment.

IV. Results

Table 1 shows UG results from the Machiguenga, the Los Angeles control group, and a number of other experiments performed in different parts of the world. Clearly, the Machiguenga data differ substantially from the patterns found in other UG results. In comparison with other high-stakes games in Yogyakarta (Indonesia) and Los Angeles (the control), where the mean offers were 44 and 48 percent, respectively, Machiguenga proposers offered only 26 percent. This result also contrasts with games using more typical stakes: mean offers in Tokyo, Pittsburgh, Yogyakarta, and Tucson are all 44 percent or 45 percent of the total—almost double that of the Machiguenga. All the experiments have modes at 50 percent, except in the low-stakes game in Yogyakarta, where it is 40 percent, and among the Machiguenga, where the modal offer drops to 15 percent. Table 1 provides the p -values for the Epps-Singleton nonparametric tests (EST) and the Mann-Whitney nonparametric tests (MW), which confirm that the distributional characteristics of the Machiguenga data are quite different from both the other high-stakes games.²

On the receiving end, responders from industrial societies often reject offers below 20 percent (see “Rej < 20 percent” in Table 1), although these offers are quite rare. For example, proposers in both Los Angeles and Pittsburgh made 0 and 1 offers below 20 percent, respectively. Machiguenga responders, however, almost always accept offers less than 20 percent, and nearly half of the total offers (10 of 21 offers) were below 20 percent. The overall rejection rate for the Machiguenga was also quite low (0.048), especially when compared

² The Epps-Singleton nonparametric statistical test is ideal for the discrete, nonnormally distributed data typically produced by ultimatum games (see Forsythe et al., 1994). This test compares the overall distributional characteristics of two data sets, rather than just their central tendencies (as does the Mann-Whitney test). This is important because often the mean of a UG data set captures little about the overall data.

TABLE 1—SUMMARY OF CROSS-CULTURAL ULTIMATUM GAME DATA AND STATISTICAL TESTS

Data factors	Los Angeles	Machiguenga	Yogyakarta ^b (high-stakes)	Yogyakarta ^b	Tucson ^c	Pittsburgh ^a	Tokyo ^a	Jerusalem ^a
Number of pairs	15	21	37	94	24	27	29	30
Stake size	\$160	\$160	\$80–120	\$10–15	\$10	\$10	\$10	\$10
Mean	0.48	0.26	0.44	0.44	0.44	0.45	0.45	0.36
Mode	0.50	0.15	0.50	0.40	0.50	0.50	0.50	0.50
Standard deviation	0.065	0.14	0.11	0.17	0.072	0.096	0.21	0.16
Rejection frequency	0	0.048	0.081	0.19	0.083	0.22	0.24	0.33
Rej < 20 percent	0/0	1/10 = 0.1	0/0	9/15 = 0.6	—	0/1	2/4 = 0.5	5/7 = 0.71
EST <i>p</i> (LA) ^d	—	0.0000	0.081	0.0000	—	0.089	0.030	0.010
EST <i>p</i> (Mach) ^d	0.0000	—	0.0000	0.0000	—	0.0000	0.0032	0.0011
MW <i>p</i> (Mach) ^e	2.64E-5	—	1.22E-5	3.64E-5	—	3.06E-5	0.002	0.049
EST <i>p</i> (Pitt) ^d	0.09	0.0000	0.99	0.023	—	—	0.24	0.16

Notes: The complete data set used to generate this table may be obtained in soft or hardcopy, by request, from the author.

^a Pittsburgh, Tokyo, and Jerusalem data are from round 1 games in Roth et al. (1991). Roth et al. used the round 10 data (the last round) for interstudy comparison. Using either round 1 or round 10 to compare to a single-shot game generates analytical ambiguities. In round 10 players may have modified their strategy through learning, whereas in round 1 players know it's a repeated game (but not repeated with the same person), so they may also make strategic adjustments compared to a single-shot game.

^b The Yogyakarta data come from Cameron (1999)—the data were extracted from bar charts and the "errors" were omitted in the reanalysis. The high-stakes data are from a second-round game, after having played the low-stakes (\$10–\$15) game. This may explain the decrease in the standard deviation from the low-stakes game.

^c The Tucson data are from Hoffman et al. (1994).

^d EST *p* gives the *p*-value from the Epps-Singleton nonparametric test for Los Angeles (LA), the Machiguenga (Mach), and Pittsburgh (Pitt) compared against each of the other populations.

^e MW *p* gives the *p*-value for the Mann-Whitney nonparametric test (corrected for ties and continuity) for the Machiguenga compared against each of the other populations.

with Tokyo, Pittsburgh, Jerusalem, and Yogyakarta. Interestingly, in addition to the difference in the central tendency of the Jerusalem experiment, it also reveals the highest overall rejection rate and the highest rejection rate of offers below 20 percent. Moreover, Jerusalem shows the second highest proportion of offers less than 20 percent, second only to the Machiguenga.

Discussions, postgame interviews, and observations of body language gleaned from both the Machiguenga and Los Angeles experiments provide some further explanatory insights into the differences between Machiguengas and Westerners. The Machiguenga often had difficulty articulating why they were willing to accept low offers, but several individuals made it clear that they would always accept any money, regardless of how much the proposer was getting. Rather than viewing themselves as being "screwed" by the proposer, they seemed to feel it was just bad luck that they were responders, and not proposers. Los Angeles players, in contrast, claimed they would reject "unfair" offers (below 25 percent usually), and a few claimed

they would reject any offer below 50 percent. Correspondingly, some Los Angeles proposers, when asked why they offered 50 percent, said they were thinking of offering less, and that most people would accept less, but they figured there were some people out there who might reject an offer below 50 percent, so they wanted to be sure to get the \$80 (half of the \$160 stake). The few Machiguenga who offered 50 percent, when asked why, said that fifty-fifty was "fair." When asked if they thought their fellow Machiguengas would accept less, they said "Yes, for sure." Many Los Angeles proposers, particularly those who seemed to know exactly what they were going to offer immediately (rather than pondering over it for five minutes or so like many other Los Angeles proposers) said they offered 50 percent "to be fair."

Taken together, these data suggest that Machiguenga responders did not expect a balanced offer, and Machiguenga proposers were well aware of this. The few Machiguenga proposers who offered 50 percent were, without exception, those who had had greater exposure and dealings with Westerners and especially

North American evangelical missionaries—so they may have acquired some Western notions of fairness from these contacts. Los Angeles proposers were a mix of people concerned with fairness and people concerned with avoiding punishment. Interviews suggest that many Los Angeles proposers accurately assessed the potential behavior of responders (according to responder claims), and adjusted their behavior to ensure offer acceptance.

Besides the substantial differences found between the Machiguenga and other subject populations, we observe differences between Los Angeles and Yogyakarta using high stakes, and between Pittsburgh and Yogyakarta using lower stakes (see Table 1). Coupled with the previously observed difference between Pittsburgh and Jerusalem (Roth et al., 1991), it becomes increasingly difficult to account for UG behavior without considering that, perhaps, subjects from different places arrived at the experiments with different rules of behavior, expectations of fairness, and/or tastes for punishment.

V. Conclusion

As the first test of the UG's robustness outside of industrialized societies (and one of the few experimental economics games ever performed in such a context), the Machiguenga UG suggests that culturally transmitted behavioral variation may substantially affect decision making. This result amplifies Roth et al.'s (1991) similar, but more tentative conclusion. After four UG experiments in which they carefully controlled for stake size, procedural variations, translation differences, and currency scales, Roth et al. (1991) concluded that the small, significant differences found between Tokyo, Pittsburgh, and Jerusalem can best be explained as "cultural differences." Later, Roth (1995), in examining the difference found between American and Israeli proposers, suggests that these results indicate a difference in what is perceived as "fair," or what is "expected" under the circumstances. My comparison of Machiguenga and Los Angeles subjects yields a similar conclusion, only more extreme. Machiguenga proposers seem to possess little or no sense of obligation to provide an equal share to responders, and responders had little or no expectation of receiving an equal share nor any desire to

punish unequal divisions. The modal offer of 15 percent seemed quite "fair" to most Machiguenga.

This evidence generates at least three important questions: (1) Where do people get their rules, expectations, or notions of fairness from? (2) Why do these rules, expectations, and notions seem to vary among groups of people? and (3) How much can these varying rules, expectations, and notions affect real economic behavior? One approach to these questions is to treat humans as social animals who acquire many of their behavioral rules, rule calibrations, beliefs, and practices from other humans via social learning [see Robert Boyd and Peter J. Richerson (1985) for a theoretical treatment]. The second question can then be addressed by specifying the cognitive apparatuses, imitation rules, or interactional processes that maintain similarities within groups. The third question depends on how important social learning is for economic behavior. If the Machiguenga results can stand the test of scrutiny and can be replicated elsewhere, then cultural transmission can substantially affect economic decisions. If cultural differences do greatly influence economic behavior, then the implicit assumption that all humans share the same economic decision-making processes, the same sense of fairness, and/or the same taste for punishment must be brought into question.³

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³ This by no means suggests that we cannot generalize about human behavior. Rather, it suggests we need a theory of culture, or of cultural transmission, to do so.

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