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TRUST, CULTURAL DEVICES, AND EFFICIENCY IN GAME EXPERIMENTS*

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Abstract

The purpose of this paper is to investigate how trust and cultural devices affect the outcomes of ultimatum, dictator, and trust games. Of our particular concern is how such devices increase efficiency. In order to pursue this purpose, I performed experiments involving the above three standard games and their variants. In the variant games the subjects were either allowed to punish their opponents without bearing their own costs or forced to play the games in the presence of several other subjects (third parties). The experimental results demonstrate that such cultural devices of punishment and monitoring increase efficiency.

I. *Introduction*

The purpose of this paper is to investigate how trust and cultural devices affect the outcomes of ultimatum, dictator, and trust games. Of our particular concern is how such devices increase efficiency. In order to pursue this purpose, I performed experiments involving the above three standard games and their variants. This paper reports the results of those experiments and considers their implications.

In the standard trust game, the experimenter forms pairs of subjects and nominates one member of each pair to be the proposer and the other the responder. The experimenter gives, say, 1,000 yen to the former, who then divides it into two parts, one for himself and the other for the latter (the divided amount may be zero). The experimenter triples the amount the former divided for the latter and gives the tripled amount to the latter, who is then allowed to return some portion of this given amount to the former as an expression of thanks.

The proposer's payoff in this game is the sum of the amount he divides for himself and the amount his responder returns. On the other hand, the responder's payoff is the amount he receives from the experimenter net of the amount he returns to his proposer.

The subgame perfect Nash equilibrium of this trust game is the state in which the proposer takes all 1,000 yen and gives nothing to his responder, if played by those who believe that all human beings are egoistic or individually rational. An egoistic responder will not

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return any amount in response to his proposer's positive offer. Thus, if the proposer gives a positive amount to his responder in an experiment, the former can be considered as thinking that human beings are not necessarily pure egoists.

In the standard ultimatum game, the experimenter forms pairs of subjects as above and gives 1,000 yen to the proposer, who then proposes how to divide the amount between him and his responder. If the latter accepts the proposal, the initially proposed amount for each will be each player's payoff. If he rejects it, the payoff for each will be zero.

If the above division of money is made only in integers, the subgame perfect Nash equilibrium is the state in which the proposer gives one yen to his responder and keeps the rest for himself. An individually rational responder will not reject that offer; otherwise his payoff would be zero. On the other hand, the proposer can maximize his payoff by giving only one yen to his responder. In contrast, if the proposer gives more than one yen in an experiment, he must believe that his responder is other than an individually rational person.

In the dictator game, after forming pairs as above, the experimenter gives 1,000 yen to one member of each pair (the dictator), and tells him to divide it into an amount for himself and that for the other member (again the divided amount may be zero). The game ends when the dictator has determined the division and it has been carried out. The payoffs are exactly as divided by the dictator. This play is called the dictator 'game', even though it is not actually a game, since the opponent of the dictator is not allowed to choose a strategy. It is obvious that an egoistic dictator will keep all 1,000 yen for himself.

What is striking about these three types of games is that experimental outcomes tend to differ markedly from theoretical predictions. In many experiments involving the ultimatum game, those responders who were offered small amounts tended to reject them. This means that they punished those proposers who had done them an injustice, although they knew that rejection would mean them incurring a loss or a cost. Thaler (1988) and Guth and Tietz (1990) include surveys of ultimatum game experiments. The former emphasizes that the proposers in these experimental games tend to give their responders an amount between 30% and 40% of that given by the experimenter. See also Fehr and Gachter (2000a, 2000b) for related arguments.

Berg, Dickhaut, and McCabe (1995) conducted a trust game experiment involving mutually anonymous opponents. They report that in thirty out of thirty-two pairs, the proposers gave a positive amount of money to their responders. On the other hand, eleven responders out of these thirty pairs returned more than the amounts initially given by their proposers. When the subjects knew the social norm (the results of past game experiments), they behaved with more trust and trustworthiness. In addition, the responders tended to return more when the proposers gave more, which those authors interpret as the responders' act of rewarding kind behavior by bearing their own costs.

Even in such a simple game as the dictator game, a significant number of dictators in experiments give positive amounts of money to their opponents. One interpretation of this fact is that dictators feel guilty for keeping the entire amount given by the experimenter. Another is that they have a sense of equality or concern for others.

Camerer and Thaler (1995) advocate the following idea regarding the disparity between predictions of game theory and the results of game experiments: namely, that fairness becomes important, even in a one-shot game, because the subjects are influenced by the manners of daily life. My claim is that many such manners are formed in conformance with long-term human

relationships. Although Camerer and Thaler distinguish manners from altruism, I think that the latter can be contained in the former.

There are other researchers with similar ideas. On the basis of various experiments with many ethnic groups in different countries, Henrich, Boyd, Bowles, Camerer, Fehr, Gintis, and McElreath (2001) claim that the assumption of pure egoists is not supported by experimental results because attitudes and mindsets in ordinary lives influence the behavior of experimental subjects. Indeed, the experimental results differ greatly among different ethnic groups, and these authors interpret this fact as meaning that social institutions and cultural fairness criteria affect subjects' preferences and expectations. Roth, Prasnikar, Okuno-Fujiwara, and Zamir (1991) also point out cultural differences in fairness on the basis of the cross-national differences in experimental results of the ultimatum game.

Using the concept of strong reciprocity, Gintis (2000) discusses the importance of cooperative behavior and punishment of the uncooperative in situations irrelevant to kinship or repeated games. One defect of reciprocal altruism generated in repeated games is that it hardly leads to cooperation in cases where it is most needed, e.g. in wars, epidemics, and famines that are likely to bring about a collapse of repetition.

Gintis (2000) claims that if a sufficiently large number of individuals have strong reciprocity, society and groups can survive even when facing crises like the above. Strong reciprocity is akin to self-sacrifice and altruism. From a different standpoint, Hirshleifer (1999) maintains that the existence of different strategies benefits society.

This paper will examine the results of trust-related game experiments conducted by the author. These experimental games include both the above three standard types of games and variant games devised by the author. One feature of the former experiments performed by the author is that the numbers of subjects were sufficiently large to enhance the credibility of the conclusions drawn from them. In fact, almost 200 samples were collected in all experiments. This large sample size enables us to undertake some reliable regression analyses.

In the variant of the ultimatum game, responders were allowed to punish their proposers without bearing their own costs, which facilitated punishment. In the variants of the dictator and trust games, the participants played the games in the presence of several other subjects, which facilitated monitoring by third parties in particular. Punishment and monitoring in these variant games can be interpreted as corresponding to some cultural devices that are intended to promote cooperation and/or efficiency.

Since trust is a basic concept in this paper, it may be useful to provide its somewhat rigorous definition here. I define individual A's trust in individual B as A's belief that B will do what B said or (in case B did not say anything) what is considered to be ethical in society. This belief needs to be expressed in terms of A's subjective probability, the value of which depends on many factors, such as culture, social relations between A and B, the matter at hand, and A's experiences.

The structure of this paper is the following. In Section 2 the results of my experiment of the standard ultimatum game are examined. Section 3 discusses the experimental results of the variant of the standard ultimatum game. Section 4 is concerned with the dictator game and its variant game. In Sections 5 and 6, the standard trust game and its variant game are discussed, respectively. Conclusions follow in Section 7.

TABLE 1. ULTIMATUM GAME: PAYOFF DISTRIBUTIONS

Payoff Class	(a) Proposers ($N=196$, $m=53.6$)	(b) Responders ($N=196$, $m=33.3$)
0	12.8	14.3
1～9	0.0	2.0
10～19	0.0	2.6
20～29	0.5	6.6
30～39	2.0	25.5
40～49	2.0	20.4
50～59	31.1	24.0
60～69	20.9	2.6
70～79	20.9	1.5
80～89	4.6	0.5
90～99	4.1	0.0
100	1.0	0.0

II. *Standard Ultimatum Game*

This section examines the experimental results of the standard ultimatum game organized by the author. The method of this experiment was the following. The subjects were 196 university students whose major fields were social sciences, predominantly economics majors. Each subject played the standard ultimatum game twice, once as a proposer and the other time as a responder, each time with a different opponent: the same pair never playing twice in order to avoid retaliation or other interactive actions across games. This method generated 196 experimental results (samples) of this game.

The experimenter gave 100 points (rather than 1,000 yen) to each proposer and let him make a decision as to how to divide the points within his pair. After he had made the decision and offered a proposal, his responder decided whether or not to accept it. If it were accepted, the payoff of each player would be exactly the same as the proposer's decision. If not, the payoff of each would be zero. The subjects were given certain incentives to seek as many points as possible, which also applied to all subsequent experiments. Hoffman, McCabe, and Smith (1996), Cameron (1999), and others show that experimental results are generally insensitive to the magnitude of incentives in most experiments.

Table 1 shows the results of this experiment in the form of distributions of payoffs for the proposers and responders, which are expressed in percentage terms. Here N stands for the number of subjects (sample size) and m the mean payoff. The same is true of other tables. Thus, for example, those with payoffs between 50 and 59 points represented 31.1% of all subjects in the case of proposers and 24.0% in the case of responders. More than 70% of the payoffs of the proposers are distributed between 50 and 79 points. About 13% of proposers have zero payoffs because their proposals were rejected.

In contrast, about 70% payoffs of the responders are distributed between 30 and 59 points. The reason why more responders have zero payoffs is that some responders accepted the proposal of 100 points for the proposer and zero points for the responder. There are also minor exceptional cases in the following, but they may not be mentioned.

The mean payoffs are 53.6 points for the proposers and 33.3 points for the responders. The proposers' mean payoff is larger because of the structure of this game, i.e., the proposer has an

extremely advantageous position in this game. In fact, if he is allowed to choose only nonnegative integers, the payoffs in the subgame perfect Nash equilibrium in this game are 99 points for the proposer and 1 point for the responder, as mentioned in the previous section. It is true that this prediction of game theory is rarely realized in experiments, since the subjects consider fairness as well as self-interest. However, proposers in this experiment can, in fact, offer proposals that are relatively advantageous to them but unlikely to be rejected.

These experimental results of the standard ultimatum game suggest that real human beings are not necessarily interested merely in their self-interests. They also decide their actions by taking values such as fairness into consideration. Hence, where a player expects that he is going to obtain an extremely unfair payoff, he is likely to punish, by bearing his own costs, the opponent responsible for the unfairness. Consequently, the sense of fairness that the players possess needs to be considered when exact human behavior is to be analyzed.

In order for a responder to punish his unfair proposer in the standard ultimatum game, the former himself needs to accept the worst state (zero payoffs, not only for the proposer but also for himself). The very existence of this punishment cost causes many responders to accept low payoffs. With this fact in mind, proposers offer proposals that are relatively advantageous to themselves.

The 13% or so of responders who rejected offers actually punished the unfair behavior (excessive pursuit of self-interests) of their opponents. Obviously, those responders were not pure egoists. In contrast, the fact that many proposers' payoffs are between 60 and 79 points and many responders' payoffs are between 30 and 49 points implies that there are many somewhat selfish proposers who offered proposals with higher payoffs for themselves and many somewhat selfish responders who refrained from punishing unfair proposers.

III. *A Variant of the Ultimatum Game*

If the rule of the standard ultimatum game is changed so that responders can punish their opponents without bearing their own costs, it becomes possible to analyze the nature of the payoffs considered fair by the former. The latter, on the other hand, decide their offers taking this into account. Hence, experiments enable us to elucidate what payoff profile is generally considered fair for game players.

For this reason I transformed the standard ultimatum game into the following variant game. Namely, the behavioral rule for the proposer is the same as before, but the responder is now allowed to reduce the points the proposer determined for himself while keeping his points at the level determined by the proposer. More explicitly, when the proposer offers a profile of p points for himself and q points for the responder ($p+q=100, p\geqq 0, q\geqq 0$), the responder is allowed to impose a punishment equal to r ($0\leqq r\leqq p$) on the proposer so that the proposer's payoff becomes equal to $p-r$.

In this variant game, the responder can punish the proposer without bearing his own cost, the amount of punishment being largely dependent on the fairness belief held by the former. Generally speaking, Homo economicus in neoclassical economics are completely indifferent to other individuals' incomes or utility levels, but Homo sapiens are very interested in them. Fairness in question here is concerned with the relative magnitude of the two players' payoffs.

Table 2 presents the experimental results of this variant game. What is prominent in this

TABLE 2. VARIANT OF ULTIMATUM GAME: PAYOFF DISTRIBUTIONS

Payoff Class	(a) Proposers ($N=196$, $m=43.7$)	(b) Responders ($N=196$, $m=45.5$)
0	4.1	0.5
1～9	0.5	2.0
10～19	3.1	1.5
20～29	4.1	2.0
30～39	8.7	9.2
40～49	26.0	30.1
50～59	40.8	45.4
60～69	9.7	5.1
70～79	2.0	1.5
80～89	0.5	0.5
90～99	0.5	1.5
100	0.0	0.5

table is that the payoff distributions of the proposers and responders are quite similar. In particular, for both types of players the proportion of payoffs between 50 and 59 is the largest and that of payoffs between 40 and 49 is the second largest. In contrast, most payoffs in Table 1 were distributed between 50 and 79 points for the proposers and between 30 and 59 points for the responders respectively.

The mean payoffs of the two types of players shown in Table 2 are almost the same: the mean payoff is 43.7 points for the proposers and 45.5 points for the responders. A comparison between Tables 1 and 2 reveals that introducing the possibility of costless punishment has reduced the proposers' payoffs and increased those of the responders. Most proposers in this variant game offered a proposal with smaller points for themselves and larger points for the responders because they expected that they would incur punishment if they offered a proposal that was too advantageous to them. This is also evident in the fact that the number of subjects with zero payoff is much fewer in Table 2 than Table 1.

There is another important matter. The sum of the mean payoffs for the proposers and responders is 86.9 points in Table 1 and 89.2 points in Table 2 respectively. Although the increment is small, this difference suggests that the introduction of costless punishment is likely to increase efficiency in the ultimatum game.

It is beneficial to examine in more detail the offers the proposers made and the nature of the punishments the responders carried out. Table 3 shows in percentage terms the frequency of combinations of the proposers' offer to themselves and the corresponding punishment the responders imposed. It suggests that a larger offer to a proposer tends to induce a larger punishment.

The table reveals that those proposers who made offers between 50 and 59 points to themselves incurred no or relatively light punishments. In fact, more than a third of all subjects evaded punishment by making offers between 50 and 59 points to themselves. Furthermore, 71.5% of the proposers who made offers between 50 and 59 points to themselves evaded punishment. Though not clearly shown in the table, 31.6% of all proposers made an offer of 50 points to themselves and completely evaded punishment. Among those who made an offer of 50 points to themselves, 87.3% evaded punishment.

TABLE 3. VARIANT OF ULTIMATUM GAME: DISTRIBUTION OF PROPOSERS' OFFERS TO THEMSELVES AND RESPONDERS' PUNISHMENTS ($N = 196$)

Proposers' Offers to Themselves	Responders' Punishments											
	0	1～9	10～19	20～29	30～39	40～49	50～59	60～69	70～79	80～89	90～99	100
0	0.0											
1～9	0.5											
10～19												
20～29	0.5											
30～39	2.0											
40～49	9.7	1.5	1.5									
50～59	34.7	4.6	7.7	1.0		0.5						
60～69	7.1		3.1	8.7	0.5	1.0						
70～79	2.6		1.5	1.0	0.5	2.0	1.0					
80～89	0.5					1.0	1.5	1.0				
90～99	0.5					0.5					0.5	
100											0.5	0.5

Tables 2 and 3 elucidate that many subjects possess a culture of strong fairness in relation to this game situation. It should be emphasized that each subject's payoff obtained in this game was independent of his effort. In other words, he did not obtain a high payoff by exerting effort. If this game had required the exertion of effort, different fairness criteria might have been applied.

It is interesting to note that the average payoffs of the proposers and responders converge and efficiency increases when the latter are allowed to punish the former at no cost. Cultural efforts and institutions that enable punishment of unfair behavior at low cost have favorable effects. Real world examples corresponding to these observations are attitudes that actively punish those who do unfair things as well as institutions that encourage the disclosure of injustices. They increase efficiency because such cultural factors generate self-restraint and subsequent cooperation.

IV. *Dictator Game and its Variant*

Next, we examine the experimental results of the standard dictator game and its variant. The subjects were the 196 students who participated in the above experiments of the ultimatum game and its variant. As in the previous experiments, the experimenter gave each of the proposers (dictators) 100 points. All subjects played this game with new opponents.

If individuals in the real world were pure egoists, the dictators in this game would keep all 100 points to themselves. Hence, if they give a positive amount to their opponents, they can be judged not as pure egoists but as having some degree of altruism.

Table 4 reports the experimental results of the standard dictator game undertaken by the author. Most payoffs of the dictators are distributed between 50 and 100 points, with those between 80 and 100 points quite large in proportion. The mean payoff for the dictators is 81.9 points, which is much greater than that of 53.6 points for the proposers in the standard ultimatum game. This is because the dictators have no risk of incurring punishments. In short, although this experiment reveals the selfishness of human beings, the fact that the dictators

TABLE 4. DICTATOR GAME: DICTATORS' PAYOFF DISTRIBUTION

Payoff Class	($N=196$, $m=81.9$)
0	1.0
1〜9	0.5
10〜19	0.0
20〜29	0.5
30〜39	0.5
40〜49	0.0
50〜59	10.2
60〜69	7.1
70〜79	10.7
80〜89	17.3
90〜99	27.0
100	25.0

TABLE 5. VARIANT OF DICTATOR GAME: DICTATORS' PAYOFF DISTRIBUTION

Payoff Class	($N=196$, $m=77.4$)
0	1.5
1〜9	0.0
10〜19	0.0
20〜29	1.0
30〜39	0.5
40〜49	3.1
50〜59	14.9
60〜69	7.7
70〜79	8.7
80〜89	16.9
90〜99	28.7
100	16.9

gave an average of about 20 points to their opponents indicates that they also have some degree of altruism at the same time.

I also devised a variant of the standard dictator game and attempted an experiment, the results of which we shall now examine. The standard dictator game is played in a 'locked room', whereby only the dictator and his opponent know what decision the former has made. (In the above experiment, even the experimenter did not know it because the experiment guaranteed anonymity.) Decision making in locked rooms tends to be advantageous to those who have power.

For this reason, the experimenter ordered each dictator and his opponent to play this variant game in front of eight spectators or third parties. Because both subjects and spectators were students of the same university, some of them may have been friends or acquaintances. The aim of this experiment is to examine simply how the existence of 'others' eyes' plays the role of psychologically punishing unjust behavior, since this game involves no explicit punishment that affects the points obtained by the players.

The experimental results are presented in Table 5. The mean payoff for the dictators is now 77.4 points, which is slightly lower than that in the standard dictator game shown in Table 4. It is noteworthy that while 25.0% of the dictators obtained 100 points in Table 4, the corresponding proportion is now only 16.9%. If others' eyes are present, human beings exercise some self-restraint, even in this simple game. This fact suggests that it is beneficial to society and organizations to release detailed information about the decisions made by those who have power. The effects of others' eyes must be much stronger in the real world than in experiments, since they definitely affect the evaluations and reputations of such decision makers and determine their future payoffs in many other ensuing games that will arise there.

V. *Standard Trust Game*

The standard experimental trust game was originally invented to measure the extent to which individuals trust others or how much they invest in others on the basis of trust. In other

TABLE 6. TRUST GAME: PROPOSERS' OFFERS TO THEMSELVES

Payoff Class	($N=188$, $m=40.2$)
0	33.0
1～9	0.0
10～19	2.1
20～29	3.7
30～39	6.4
40～49	2.1
50～59	11.7
60～69	9.6
70～79	16.0
80～89	10.1
90～99	3.7
100	1.6

TABLE 7. TRUST GAME: PAYOFF DISTRIBUTIONS

Payoff Class	(a) Proposers ($N=188$, $m=103.2$)	(b) Responders ($N=188$, $m=116.4$)
0	0.0	1.6
1～19	0.0	1.1
20～39	1.6	3.7
40～59	3.7	6.9
60～79	10.6	14.4
80～99	32.4	10.1
100～119	20.2	13.8
120～139	8.5	8.0
140～159	20.2	24.5
160～179	2.7	1.6
180～199	0.0	3.7
200～219	0.0	6.4
220～239	0.0	0.5
240～259	0.0	2.7
260～279	0.0	1.1
280～299	0.0	0.0
300	0.0	0.0

words, it measures the degree to which the subjects expect their opponents to pursue self-interests. In the real world, high trust tends to generate cooperation and efficiency. In this game experiment, trust and trustworthiness also lead to higher payoffs.

The subjects the author used for this experiment were those who had experienced the previous experiments, but with the size now reduced to 188. As before, the experimenter gave 100 points to each proposer. Subsequently, he tripled the points each proposer decided to give to the responder.

Table 6 presents the distribution of the points the proposers offered to themselves. What is salient here is that one third of the proposers gave all 100 points to their responders. In a pair composed of purely individually rational human beings, the proposer would not give any points to his responder (the former would keep 100 points for himself). In this experiment

TABLE 8. TRUST GAME: DISTRIBUTION OF PROPOSERS'

Proposers' Offers to Themselves	Proposers' 0〜19	20〜29	30〜39	40〜49	50〜59	60〜69	70〜79	80〜89	90〜99
0			0.5	0.5	1.6	0.5			0.5
1〜9									
10〜19								0.5	
20〜29		0.5	0.5					0.5	
30〜39				0.5	0.5	0.5			
40〜49							0.5	0.5	0.5
50〜59					0.5		1.1	1.1	2.7
60〜69							1.1	4.8	2.7
70〜79							6.9	5.9	1.6
80〜89								5.9	2.7
90〜99									2.7
100									

such pairs existed in only a negligible proportion.

The payoffs in this game are finalized after the responder has determined how many points to give back to the proposer. Table 7 shows the distributions of payoffs thus finalized. On average the responders enjoy higher payoffs, the mean payoff for the proposers being 103.2 points and that for the responders 116.4 points. This is because the latter have the power to determine the allocation of the tripled points. If the former had very strong distrust in the latter, however, the mean payoff for the former could exceed that for the latter. The fact that most payoffs are less than 160 points is common to both distributions in Table 7, with no other noteworthy similarities.

As far as the mean payoffs are concerned, the proposers in this experiment do not seem to have gained any benefits by trusting their responders and investing some points. Even if the proposers keep all 100 points, they will achieve with certainty a payoff of 100 points, which is almost equal to the mean payoff for the proposers in Table 7. In contrast, if trust can exert a full effect, the proposer's payoff becomes equal to 150 points, the case in which the proposer gives the entire 100 points to his responder, who then divides the tripled points equally between the two.

Nevertheless, if the average joint wealth is taken into account, the proposer's trust in the responder brought about considerable benefits in this experiment. The mean payoff for the responders is as large as 116.4 points: this would have been zero if the proposers had not trusted them at all and invested no points. If only the mean payoffs were considered, it is the responders that obtained almost all the benefits of trust in this experiment. If the proposers had known this fact beforehand, they might not have given any points to the responders because of risk aversion.

Behind the payoffs shown in Table 7 are the relationships between proposers' offers and responders' returns. In order to see them, let x denote the points a proposer offered to himself and y his payoff, and apply a regression analysis with x as the independent variable and y as the dependent variable. Then, the regression equation estimated by the OLS becomes:

$$\hat{y} = \underset{(41.9)}{124.9} - \underset{(9.47)}{0.54}\,x \qquad R^2 = 0.33 \tag{1}$$

OFFERS TO THEMSELVES AND THEIR PAYOFFS ($N = 188$)

Payoffs								
100～109	110～119	120～129	130～139	140～149	150～159	160～169	170～179	180～300
4.8		2.1	1.1	0.5	18.6	1.1	1.1	
				0.5	0.5	0.5		
		1.1	1.1					
1.6	1.1	2.1						
			0.5					
5.9	0.5							
	1.1							
0.5	0.5	0.5						
1.1	0.5							
1.1								
1.6								

where the numbers in parentheses are the absolute values of the corresponding *t*-values.

This equation demonstrates that those proposers who offered smaller points to themselves achieved higher payoffs. The negative relationship shown in equation (1) suggests that behavior based on trust tends to bring about advantageous results. This fact could not be revealed when only the mean payoffs are considered as above.

Table 8 shows a detailed distribution of the combinations of the points the proposers offered to themselves and their payoffs. It provides comprehensive information about the behavior of all the subjects in this experiment. The noteworthy fact in the table is that the proportion of the proposers who offered zero points to themselves and achieved payoffs between 150 and 159 points is as large as 18.6%. Although not shown in the table, all these proposers obtained a payoff equal to 150 points.

The proportion of proposers who achieved a payoff between 150 and 159 points (more precisely, 150 points) among those who offered zero points to themselves is 56.5%. In effect, they divided the maximum possible joint wealth evenly with their responders. These responders were not egoists because they gave half of the 300 points back to their proposers, even though they were allowed to keep all of them. They responded with cooperation to the cooperation of the proposers or with trustworthiness to the trust of the proposers. This result is consistent with Rabin (1993) who holds that individuals tend to sacrifice their interests for the sake of those who are kind to them.

The case in which proposers offered zero points to themselves is convenient to measure the relative importance placed by the subjects between trust and the pursuit of self-interests. A proportion of 32.9% of the entire proposers offered zero points to themselves, a relatively large number. Among such proposers, those whose payoffs were less than 100 points amounted only to 10.9%.

The mean payoff for the proposers who offered zero points to themselves is 130.1 points, which is in stark contrast with the mean payoff of 103.2 points for *all* proposers. As far as this experiment is concerned, those proposers who highly trusted their opponents were eventually handsomely rewarded. Incidentally, those responders who could not gain much trust put a higher priority on securing reasonably high payoffs for themselves rather than exhibiting trustworthiness.

TABLE 9. VARIANT OF TRUST GAME: PROPOSERS' OFFERS TO THEMSELVES

Payoff Class	($N=188$, $m=25.2$)
0	49.5
1～9	0.5
10～19	4.3
20～29	6.4
30～39	7.4
40～49	2.7
50～59	11.2
60～69	2.7
70～79	6.4
80～89	3.7
90～99	2.7
100	2.7

It is of interest to see the relationship between a proposer's offer to his responder (pre-tripled values) and the points the responder returned. Let the former be the independent variable x and the latter the dependent variable y for a regression analysis. Then, the estimated equation becomes the following:

$$\hat{y} = \underset{(7.45)}{-29.09} + \underset{(27.02)}{1.54\,x} \quad R^2 = 0.80 \tag{2}$$

It is quite impressive in this equation that an additional point offered by the proposers to the responders is rewarded with the latter's return of about 1.54 points on average, which represents almost half the triple of one point.

VI. *A Variant of the Standard Trust Game*

I also devised a variant game of the standard trust game, whose experimental results are examined in this section. The subjects in this variant game played the standard trust game in the presence of other subjects, as in the variant dictator game. An experiment of this game makes it possible to measure how others' eyes affect trust, trustworthiness, and related behavior.

In this experiment I formed many groups of about five pairs. Each pair played the standard trust game in front of the other pairs within its group. More concretely, all the pairs first played the game in turn before the others' gaze, then playing it again in the same way. The first was a demonstration, which allowed all pairs within the group to observe how the others behaved. Without this demonstration, some pairs would have been unable to properly observe the behavior of the other pairs before their decision makings.

This observation of others' behavior has actually two functions. The first is to provide an opportunity for each player to know the other players' values or ideas, which has the effect of promoting socialization. The second is to provide an opportunity to monitor the behavior of the other players, which has the effect of deterring the players from taking overly-egoistic

TABLE 10. VARIANT OF TRUST GAME: PAYOFF DISTRIBUTIONS

Payoff Class	(a) Proposers ($N=188$, $m=112.9$)	(b) Responders ($N=188$, $m=136.7$)
0	3.2	2.7
1～19	0.5	1.6
20～39	2.7	3.2
40～59	4.8	4.3
60～79	3.7	3.7
80～99	10.6	5.3
100～119	27.1	11.2
120～139	9.6	12.2
140～159	31.4	33.0
160～179	2.7	2.1
180～199	1.6	3.7
200～219	1.1	8.0
220～239	1.1	0.0
240～259	0.0	3.7
260～279	0.0	1.6
280～299	0.0	0.5
300	0.0	3.2

actions. Even in an experiment, human beings may hesitate to be too egoistic in the presence of third party spectators.

Table 9 reports the distribution of the points the proposers offered to themselves. This corresponds to Table 6 for the standard trust game. A comparison of these two tables reveals that Table 9 has more proposers who offered zero points to themselves. In fact, such proposers represent half of the total in Table 9, as opposed to only one third in Table 6. The mean in Table 6 is 40.2 points and that in Table 9 is 25.2 points, demonstrating the existence of more trust before others' eyes.

There seem to be three related reasons for this fact. The first is that trust and trustworthiness became the norm or the subjects felt that they would bring about larger payoffs. The second is that the proposers expected that the responders would not take an overly selfish action before others' eyes. The proposers' trust in the responders is higher when trustworthiness becomes the norm or when others' eyes are watching. The third is that the proposers hesitated to engage in overly distrustful behavior in front of others looking on.

Table 10 shows the distributions of the payoffs of the proposers and responders respectively. Just as in the standard trust game shown in Table 7, the mean payoff for the responders is higher than that for the proposers, the former being 136.7 points and the latter being 112.9 points. Here again most payoffs are smaller than 160 points in the two distributions, with no other prominent similarities between the two.

What should be emphasized here is that the mean payoff for the proposers is 9.7 points larger and that for the responders is 20.3 points larger than those in the standard trust game shown in Table 7. This means that efficiency has increased in this variant game, for the above-mentioned three reasons.

As equation (1), a regression equation is estimated with the proposer's offer to himself as the independent variable x and his payoff as the dependent variable y:

TABLE 11. VARIANT OF TRUST GAME: DISTRIBUTION OF

Proposers'

Proposers' Offers to Themselves	0	1～9	10～19	20～29	30～39	40～49	50～59	60～69	70～79	80～89	90～99	100～109	110～119
0	3.2	0.5		0.5	0.5	0.5	1.6					5.9	0.5
1～9													
10～19					1.1	0.5				0.5			0.5
20～29				0.5				0.5				0.5	
30～39						1.1				0.5	0.5	1.1	1.6
40～49												1.6	0.5
50～59							1.1	0.5	0.5		1.1	6.4	1.1
60～69										1.6	0.5	0.5	
70～79									1.6	0.5	0.5	1.6	1.1
80～89										2.7		1.1	
90～99											2.1	0.5	
100												2.7	

$$\hat{y} = \underset{(31.8)}{123.3} - \underset{(4.27)}{0.413}\,x \qquad R^2 = 0.09 \tag{3}$$

Here again we can see a negative relationship between the two variables as before.

Table 11 reveals a detailed distribution of the combinations of the proposers' offers to themselves and their payoffs. This corresponds to Table 8 for the standard trust game. It should be noted that the proportion of proposers who offered zero points to themselves and obtained payoffs between 150 and 159 points (actually all of them are 150 points) increased greatly from 18.6% in Table 8 to 26.1% in Table 11. This is also due to the increases in trust and trustworthiness that are generated by others looking on.

In Table 11, 52.9% of those proposers who offered zero points to themselves obtained payoffs between 150 and 159 (actually 150) points. Furthermore, only 13.8% of such proposers obtained payoffs smaller than 100 points. The mean payoff of those proposers who offered zero points to themselves is 125.5 points compared with a mean payoff of 112.9 points for *all* proposers. These results are almost identical to those shown in Table 8. The responders who gained complete trust responded with trustworthiness.

As equation (2), the following equation shows the estimated relationship between the proposer's offer to his responder (pre-tripled value) x and the points the latter gave back y:

$$\hat{y} = \underset{(2.29)}{-\,17.94} + \underset{(14.6)}{1.41}\,x \qquad R^2 = 0.53 \tag{4}$$

This result is similar to equation (2). It is again impressive that the estimated coefficient is close to 1.5.

Two thirds of the proposers in the above experiment involving the standard trust game offered positive points to themselves, while the corresponding proportion is only half in the experiment involving the variant trust game. The larger proportion in the former eventually reduced the mean payoff for the proposers. Thus, it is beneficial to devise methods to improve the inefficiency in the former. The method examined in this paper involves introducing onlookers, as discussed in the above variant trust game.

PROPOSERS' OFFERS TO THEMSELVES AND THEIR PAYOFFS ($N = 188$)

Payoffs												
120∼129	130∼139	140∼149	150∼159	160∼169	170∼179	180∼189	190∼199	200∼209	210∼219	220∼229	230∼239	240∼300
3.2	0.5	2.1	26.1	1.6		1.6	0.5	0.5				
			0.5									
	0.5			1.1								
1.1	2.1	0.5	0.5									
1.1	0.5	0.5								0.5	0.5	
		0.5										
			0.5									
0.5												

Though not examined in this paper, there are other methods that are likely to increase efficiency in the game situations considered in this paper. One is to introduce persuasion by a third party. As discussed in Arai (1995, 2001), such persuasion has a dramatic effect on promoting cooperation or efficiency. Another is to establish institutions that induce good human relations among those concerned and there are also other conceivable methods. Contrary to neoclassical ideas, trust-related beliefs are not invariant. They can actually be improved by efforts and devices, generating higher efficiency.

VII. *Conclusions*

This paper has considered certain cultural devices for increasing efficiency in trust-related games and examined their effects by performing experiments. Using the resultant large samples, it also ran some regression analyses on the relationships between interesting variables. The games used for the experiments were the ultimatum game, the dictator game, the trust game, and their variants.

The experimental results of the standard ultimatum game suggest that individuals in the real world are not interested solely in their own payoffs. What became particularly clear in the experiment of the variant ultimatum game, where responders could punish proposers without bearing their own costs, is that equality is a very important value in game situations.

Many subjects showed some altruism, even in the standard dictator game. The degree of this altruism increased when others' eyes were introduced in this game.

The experiment of the standard trust game shows in particular that there were only a negligible number of subjects who believed that human beings were pure egoists and that those who had higher trust tended to achieve higher payoffs. It became clear, among other things, that if the trust game is played before others' eyes, the degree of proposers' trust in responders increases and efficiency is thus enhanced.

This paper argued that some cultural devices or activities, such as punishment and monitoring, increase efficiency in game situations. It should be added that efficiency can be attained in organizations and society in the real world only after such cultural activities are

pursued constantly in everyday life.

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