Trust and Truth

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SSE/EFI Working Paper Series in Economics and Finance No 665
June, 2007

Abstract

In a laboratory experiment, we create relationships between pairs of anonymous subjects through a Prisoners' dilemma game. Thereafter the same subjects play a private values (sealed-bid double auction) bargaining game with or without communication. Communication substantially increases bargaining efficiency among subjects who cooperated in the Prisoners' dilemma, but has no significant effect on bargaining outcomes when one subject defected. Subjects who cooperated in the Prisoners' dilemma bid more aggressively if their opponent defected. Cooperators also lie more about their valuations when their opponent defected: Compared to the case of mutual cooperation, the cooperators' rate of honest revelation decreases from 64% to 6% and the rate of outright deception increases from 7% to 53%. Our results provide qualitatively new evidence that many people are strong reciprocators: They are willing to bear private costs in order to reward good behavior and punish bad behavior, even when the rewards and punishments are unobservable.

Keywords: bargaining, communication, honesty, trust, strong reciprocity.

JEL codes: C91, D74, Z13.

Acknowledgements: We thank Ernst Fehr, Drew Fudenberg, Uri Gneezy, Ola Granström, Erik Lindqvist, Kathleen McGinn, Robert Östling and participants at ENABLE 2006 (Munich) and First Nordic Workshop in Behavioral Economics (Oslo) for constructive comments and Henrik Edlund, Anders Grönskog, Ernesto Jimenez, Tobias Lundquist, Miranda Sigander, Maria Wåhlin and Anna Zetterqvist for research assistance. We also thank the students and their teachers at Kungsholmens High School, Huddinge High School and Södertörn University College for participation in, and help with, the pilot studies. Finally, we thank the Jan Wallander and Tom Hedelius Foundation and the Torsten and Ragnar Söderberg Foundation for financial support.

1. INTRODUCTION

For truth is precious and divine –
Too rich a pearl for carnal swine.

Samuel Butler, *Hudibras*, pt.I, canto I, l.257, (1663).

When sellers and buyers negotiate, asymmetric information can constitute an obstacle to efficient trade. In order to raise the price the seller has an incentive to claim having a high cost, and in order to reduce the price the buyer has an incentive to claim having a low valuation. Because of such misrepresentation, opportunistic traders occasionally have to forgo efficient trades – as proved by Myerson and Satterthwaite (1983).

The bilateral trade example illustrates the general proposition that asymmetric information threatens efficiency when people are less than perfectly honest. A natural question is therefore: *Who are dishonest, and when?* In economics, this question is rarely asked. Instead, economic theory usually assumes that people are dishonest whenever it benefits their own material interest. However, a series of experiments on bilateral trading behavior demonstrates that non-binding pre-play communication raises the fraction of successful trades above the maximum predicted by theory; see Hoffman and Spitzer (1982) and in particular Radner and Schotter (1989) and Valley et al. (2002). Communication improves efficiency because many people fully or partially reveal their (non-verifiable) private information.[1] Thus, we already know that in bargaining experiments not all people are dishonest all the time.

Subjects in the aforementioned experimental bargaining studies meet only once; they have neither a joint history nor a joint future. In real world bargaining, negotiators often have a positive or negative joint history. They may have cheated each other, or they may have helped each other – or one of them might have behaved well and the other poorly. In this paper we investigate whether honesty depends on history. Our main finding is that honesty is

[1] See also Valley, Neale, and Mannix (1995) and the survey in Camerer (2003, p.182-196). Gneezy (2005) conducts a related experiment on lying about private information. Of course, pre-play communication can improve efficiency for other reasons than information revelation. For example, communication helps coordination (see Farrell and Gibbons, 1989, for a theoretical analysis of pre-play communication in the double auction; for surveys of experimental evidence on coordination, see Crawford, 1997, 1998 and Camerer, 2003, Chapter 7), and promises could create commitment to a course of action (see Sally, 1995, for a survey and, e.g., Ellingsen and Johannesson, 2004, and Charness and Dufwenberg, 2006 for recent experimental results). Pre-play communication can also take the form of moral argument. The evidence in Mohlin and Johannesson (2006) indicates that cheap talk has the power to affect the opponent's moral stance.

indeed conditional. People's propensity to be honest in bilateral bargaining is heavily affected by the prior behavior of their opponents.

We create good and bad relationships in the laboratory by letting subjects play an anonymous Prisoners' dilemma game, preceded by two rounds of written communication. In order to avoid strategic cooperation, we refrain from telling the subjects that there will be an additional game afterwards. Having played the Prisoners' dilemma game and being informed about the outcome, the same pair of subjects plays an anonymous double auction bargaining game with or without communication (the communication is carried out through a chat program). They bargain over a single unit of a fictitious good, and the parties' valuations of the good are private information. Bids are sealed and simultaneous. Subjects are informed that they will not negotiate again in the future.

We find that communication significantly affects bargaining efficiency in positive relationships. The fraction of realized trade deals increases from 55% to 86% with communication. By contrast, communication has no discernible effect on bargaining efficiency in the negative relationships. Both bidding aggressiveness and communication among cooperators in the Prisoners' dilemma are strongly affected by whether the opponent cooperated or defected. In the good relationships 64% of cooperators honestly reveal their true value, and hardly any of the cooperators lie. The frequent honesty explains why communication works so well; truthful revelations enable the subjects to achieve trades even in the low value trade-zone where no trade is predicted by existing theory.

In bad relationships cooperators hardly ever reveal their true valuations, and the rate of lying is above 50%. The low level of honesty explains why communication has little effect in bad relationships; the observed communication here seems consistent with the cheap talk assumption. Cooperators also bid more aggressively in bad relationships; in fact, the bids tend to be overly aggressive compared to the profit maximizing benchmark. It seems as if cooperators punish defectors by overbidding (sellers) or underbidding (buyers) and thereby reduce the probability of trade below the highest level attainable by selfish negotiators.

Our results suggest that prior history is crucial for honest communication among negotiators. As far as we know, there is no previous experimental study that investigates the extent to which honesty is used as a reward, and Tyler, Feldman, and Reichert (2006) is the only previous experimental study to investigate whether deception is used as punishment. They find that subjects dislike people who lie to them, and lie more in return. However, the study of Tyler, Feldman, and Reichert does not involve any material costs or benefits. Therefore, as the authors acknowledge, it is possible that reciprocity is not involved. Instead,

the result could be accounted for by the "chameleon effect" – the fact that people tend to behave similarly to those that they meet (see Chartrand and Bargh, 1999). In field studies, on the other hand, there is quite a bit of evidence that deviant behaviors such as stealing and lying are related to the quality of the relationship in ways that are harder to reconcile with the chameleon effect. For example, Terris and Jones (1982) observe that loyalty and perceived equity affect employee attitudes to theft from their employers. A problem with interpreting the field data is that it is hard to disentangle actual influences from excuses and rationalizations. Our study buttresses the conventional conclusion from these studies that deviant behaviors are partly driven by reciprocity.

Apart from the applications to bargaining in markets, our results could shed light on the role of relationships in political negotiations. Consider for instance Shlomo Ben-Ami's (2001, p.152) account of the failed Camp David 2000 negotiation between Israel and the PLO:[2] *"Arafat respected Rabin. He looks nostalgically back on their friendship although this nostalgia does not correspond to reality as their relations were, in fact, not that friendly. However, the men mutually trusted each other. Rabin was an honest man who did not have any strong feelings for Arafat, but who deemed it important, or even inevitable, to establish a personal relationship with him. Barak has unfortunately proven to be completely incapable of nourishing relations of this kind with Arafat."* (Our translation.) The international relations negotiation literature has emphasized the importance of pre-negotiation (Saunders 1985; Zartman 1989; Gross Stein 1989; Montville 1993). Our results show that shared positive experiences can sweeten the bargaining atmosphere, and that shared negative experiences can poison it. Subjects who feel betrayed not only strategically overstate their valuation of the status quo relative to a possible agreement, they willingly forego some own expected gains from settlement in order to reduce the other's settlement gains.

Our experiment also suggests that people trade off honesty against material gains. Dishonesty is more common when the expected gains are large, a finding that complements and corroborates those of Gneezy (2005).

Finally, we think that our results add perspective to the literature on social preferences. The observed conditional honesty is an expression of strong reciprocity; kind people are willing to bear personal costs in order to reward kind actions and punish unkind actions. Compared to other evidence on strong reciprocity, as surveyed by Fehr, Fischbacher and Gächter (2002), Fehr and Fischbacher (2003), and Fehr, Fischbacher and Kosfeld (2005), ours

[2] Ben-Ami was Chief Negotiatior of the Israeli Delegation at Camp David.

has the special feature that the reciprocal behavior is unobservable to other subjects. Honesty in the experiment is not driven by the conscious desire for external respect. The conditional honesty of our subjects appears due to an internalized norm against cheating in good relationships.[3] Conversely, among our subjects lying is usually a secret punishment. In particular, subjects who lie excessively and bid overly aggressively rarely go to the extreme of precluding any possibility of trade, which would be the clearest possible signal of retaliation.[4]

2. DESIGN OF EXPERIMENT

A total of 334 subjects participated in the experiment; they were all undergraduate students from Stockholm School of Economics, Stockholm University, or the Royal Institute of Technology. In addition to the earnings in the experiment, subjects were paid a show-up fee of SEK 100 ($1≈ SEK 9.5 at the time of the experiment). The maximum payoff was SEK 50 in the Prisoners' dilemma game and SEK 200 in the double auction. The average total payoff was about SEK 150 for 1.5 hours of participation. We carried out ten sessions of the experiment (five sessions of each treatment). Subjects were randomly allocated between the two treatments.

2.1 Relationship phase

Figure 1 illustrates the time-line of the experiment. Subjects are divided into two groups. The groups are placed in separate rooms, A and B, at computers numbered 1-20. The subjects are randomly seated. Subjects in room B have only pens and instruction sheets, whereas the subjects in room A also have a communication sheet. The subjects have about four minutes to read the instructions of the Prisoners' dilemma, which are then read aloud by the instructors.[5]

[Insert Figure 1 about here.]

[3] Of course, it is conceivable that subjects' honesty to some extent is intended to impress the experimenters. Even if the norm is completely internalized, their may be external rewards: Frank (1987,1988) argues that the practicing of norm compliance, even when the compliance itself is unobserved, may give rise to externally recognizable character traits.

[4] Only a few subjects communicated intentions to preclude trade through extreme bids, and of these some backed down. It is unclear to what extent the remaining messages were believed.

[5] The Prisoners' dilemma instructions are reprinted in the Appendix.

The participants are informed that they have an opponent in the other room and that they both face an identical choice: to "cooperate" or to "not cooperate." For convenience we hereafter refer to these choices as "cooperate" (C) and "defect" (D). The payoffs in the Prisoners' dilemma game are shown in Figure 2. (We had previously conducted pilot studies on payoffs and framing of the Prisoners' dilemma to obtain a fairly equal distribution of positive and negative relationships.)

[Insert Figure 2 about here.]

Before deciding whether or not to cooperate the subjects are allowed to send and receive two messages on a communication sheet. The subjects are told that the communication is non-binding for the subsequent choice, and are reminded that they will be anonymous throughout and after the experiment. The subjects in room A write the first message and the communication sheet is then sent back and forth between the rooms by an assistant. The subjects have about two minutes to write each message. After both parties have written two messages, they are asked to make their choice.

After receiving the results of the Prisoners' dilemma, the subjects answer a question about if the impression of the opponent is positive, negative or neutral.

2.2 Bargaining phase

The subjects are then given new instructions for the bargaining game.[6] They read the instructions and respond to control questions which are checked by the instructors. If a subject has not correctly understood the instructions, the subject is asked to answer extra control questions. The set-up of the bargaining game is largely taken from Valley et al. (2002). The parties trade a fictitious good, Tynar. Subjects in room A are assigned the role of buyers and their opponents in room B are assigned the role of sellers. The subjects then learn their private valuations (if a buyer) or costs (if a seller). Both the buyer's valuation, v_b, and the seller's cost v_s are determined by independent and random draws from a uniform distribution ranging from 0-200 SEK in SEK1 increments. The subjects are informed that all values in this interval are equally probable. Hence the buyer's valuation can be above or below the seller's cost. Whenever the buyer's valuation of Tynar is equal or higher than the seller's valuation there is a potential for mutual gains from trade. If the buyer's offer price, p_b, is equal to or higher than

[6] The instructions for the bargaining game are reprinted in the Appendix.

the seller's asking price, p_s, trade will occur at the midpoint price $p=(p_b + p_s)/2$. If $p_b < p_s$ no trade will occur. With trade the buyer's payoff is $v_b - p$ and the seller's payoff is $p - v_s$. Absent trade, the payoff is 0 for both the buyer and the seller.

In the *communication treatment*, before submitting their bids, the subjects have 8 minutes to communicate through chat with their opponents via MSN messenger. After this second communication phase, they make their bids simultaneously. Finally, subjects are informed of the outcome of the double auction and are paid their earnings and show-up fee privately.

The *no communication treatment* is identical to the communication treatment with the exception that no communication is allowed in the bargaining phase before the double-auction. After reading their instructions and receiving their values, subjects are given about 2 minutes to consider their strategies and make their bids.

2.3 Theoretical background

Although we are primarily interested in the effect of the established relationships on bargaining behavior, and not in the bargaining behavior as such, it is useful to briefly recapitulate the received theoretical analysis.

In their seminal paper, Chatterjee and Samuelson (1983) show that without pre-play communication the double auction game has the linear equilibrium $p_s(v_s) = 2v_s/3+v/4$, $p_b(v_b)=2v_b/3+v/12$, where v denotes the upper bound of the buyer's valuation; here $v=200$. In this equilibrium, there is trade if and only if the difference between the buyer's valuation and the seller's cost exceeds $v/4$, that is, the difference in valuations must be at least one fourth of the maximum gains from trade. This fact is illustrated in Figure 3. In previous literature, the set of parameters giving rise to trade in the linear equilibrium has been called the *high value trade zone*. In the *low value trade zone:* $v_s < v_b < v_s + ¼$, there is no trade in the linear equilibrium. Myerson and Satterthwaite (1983) prove that the linear equilibrium strategies derived by Chatterjee and Samuelson yield (weakly) higher total expected gains for the two bargainers than any other equilibrium in the double auction – and indeed in any other trading mechanism. This result holds with or without communication, i.e., game theory with conventional preferences predicts that communication will not increase the maximum attainable efficiency.

[Insert Figure 3 about here.]

Of course, there is no guarantee that negotiators are able to coordinate on an equilibrium, not to speak of the equilibrium that yields the highest expected ex ante gains from trade. And even if they are able to do so, they may be unwilling: A player's preferred equilibrium at the interim stage does not necessarily coincide with the same player's preferred equilibrium ex ante. When participants can communicate after learning their private valuation, they may well try to coordinate on some other equilibrium; for an analysis, see Farrell and Gibbons (1989). When we refer to the high value trade zone and the low value trade zone below, we thus do not imply that rational and selfish agents would necessarily realize the high value trades and fail to realize the low value trades. We use the concepts merely as a rough binary measure of how hard it is to engineer trade among opportunistic players.

3. RESULTS

For the Prisoners' dilemma game, we report results for all pairs. In the bargaining game, about half the pairs have no gains from trade. Unless otherwise noted, we only include data for the subject pairs with positive gains from trade.[7] All reported p-values are two sided.

3.1 Results from the Prisoners' dilemma

The purpose of the Prisoners' dilemma game is to establish relationships between two parties. Reading the messages preceding play of the Prisoners' dilemma, we find that the vast majority of players, 324 subjects out of 334, attempted to make their opponent believe that they would play the cooperative action.[8] As we shall see, some of them were lying.[9]

We group the results of the Prisoners' dilemma into three groups: CC pairs where both subjects cooperated; CD/DC pairs where one subject cooperated and one defected; and DD pairs where both subjects defected. As can be seen in Table 1 there are 83 CC pairs, 67 CD/DC pairs and 17 DD pairs.

[Insert Table 1 about here.]

[7] As a robustness check, we have performed all the tests on the full sample as well. The results are closely in line with those we report here.

[8] The remaining 10 subjects mostly sent messages that are difficult to classify. Only one subject is adamant that (s)he will defect.

[9] Since the lie is always associated with defection, we cannot separate the two forms of bad behavior. In an experiment, Brandts and Charness (2003) find that their subjects punish opportunistic behavior that is associated

To validate our assumption that the CC pairs constitute good relationships and the CD/DC pairs constitute bad relationships, we asked the subjects after the Prisoners' dilemma game whether they harbored positive, negative, or neutral feelings towards their opponent. As can be seen in Table 1, most subjects in CC pairs (89%) harbor mutually positive feelings, whereas for most CD/DC pairs (79%) at least one person harbors negative feelings towards the opponent.[10] Table 1 also shows that the DD pairs are not easily classified as good or bad; in about a fourth of these pairs subjects harbor mutually positive feelings, but equally often at least one subject harbors negative feelings. We therefore keep the DD group as a separate category in the analysis. Since mutual defectors are so few, the statistical power is usually insufficient to admit significant inferences about this group.

More detailed comments made by subjects about the opponent also confirm that subjects harbor genuine feelings. Examples of comments made by persons in CC relationships about their opponents are: "Honest and sympathetic – the kind of person with whom one would like to do business." Another person wrote "He/she stood by his/her word – we succeeded in building up confidence." A third person described the opponent as "A wonderful person." The emotional temperature seemed to be even higher among the persons who were deceived by their opponents: "I despise him. Brat. A false person." Another person found the opponent to be a "Manipulating bastard." Someone regarded the defecting opponent as a "Typical car salesman. The sort of person who makes you lose the small hope for humanity that is left." Lastly, we include a comment made by a defector, on the character of a cooperating opponent "Slow but kind, or just rational and honest. I have kind of killed Bamse." Bamse is a warm-hearted cartoon bear, always sympathizing with the weak and outcast, that most Swedish children of the last couple of decades have been brought up with.

3.2 Trade outcomes

Turning to the results on trade outcomes, we only include pairs with positive gains from trade (50 DD pairs, 36 CD pairs and 10 DD pairs). Table 2 and Figures 4 and 5 present the results on trade outcomes. In the no-communication treatment, about 55% of the CC pairs end up trading. The fraction is close to the theoretical prediction of Chatterjee and Samuelson (1983)

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with a false message twice as hard as when the same opportunistic behavior is not associated with a false message.

[10] Usually, cooperators harbor negative feelings about defectors, but not the other way around. In pairs where at least one subjects harbor negative feelings, 52 out of 53 cooperators harbor negative feelings about a defecting opponent, whereas only 6 subjects in these pairs harbor negative feelings against a cooperator.

of 52%; i.e. the fraction of CC pairs in the high value trade zone. Almost all trades in the high value trade zone are realized, whereas only a minor fraction of trades in the low value trade zone are realized. With communication 86% of the CC pairs trade. The effect of communication on the trading frequency of CC pairs is significant at the 5% level ($p=0.022$). In the low value trade zone, the fraction of trade increases from 21% to 87%, which is statistically different from zero at any conventional level of significance ($p<0.001$).

[Insert Table 2 and Figure 4 and 5 about here.]

For the CD/DC pairs, 47% of trades are realized without communication and 53% with communication; the effect of communication is not significant. For the negative relationships communication does not markedly improve the bargaining outcomes. For the DD pairs the fraction of trades is 67% without communication and 71% with communication, but the small sample ($n=10$) makes it difficult to draw any conclusions for this group.

Table 3 reports logistic regressions estimating the effect of communication, controlling for the gains from trade. The effect of communication for CC pairs is highly significant, and the marginal effect of communication is 45.2 percentage units. The effect of communication is not significant for CD/DC or DD pairs. The regression analysis furthermore shows that there is a tendency for less trade among CD/DC pairs than CC pairs without communication. This effect is just significant at the 10% level in our two-sided test, but the marginal effect of 28.5 percentage units is sizeable.

[Insert Table 3 about here.]

3.3 Dyadic strategies

Precisely how does communication enable trade? Valley et al. (2002) divided possible dyadic (pair-wise) strategies into coordination on a single price, mutual bidding of values, and mutual revelation of values. In Table 4 we show how the nature of the relationship affects the use of communication strategies. For CC pairs, price coordination increases from 10% to 48% with communication and mutual bidding of values increases from 0% to 14%; both these effects of communication are significant at the 5% level. Mutual revelation can by definition only occur with communication, and for CC pairs mutual revelation occurs in 62% of bargaining pairs. In CC pairs both seller and buyer therefore truthfully communicated their

values in over 60% of the cases. For CD/DC pairs, communication has no significant effect on price coordination or mutual bidding of values, and the use of these strategies is close to zero. Mutual revelation of values never occurs in CD/DC pairs.

[Insert Table 4 about here.]

3.4 Individual strategies: bidding behavior

Examining individual strategies further highlights the different bidding behavior of cooperators and defectors. The bids of cooperators are shown in Figures 6 and 7. Note in particular how the bids of cooperators depend on whether the opponent cooperated or defected in the Prisoners' dilemma. Cooperators clearly bid more aggressively if the opponent defected in the Prisoners' dilemma. The effect is more pronounced with communication than without. Table 5 reports the numerical magnitudes of cooperators' bidding aggressiveness both in terms of the deviation from actual value and the deviation from the Chatterjee and Samuelson (1983) linear equilibrium.[11] Without communication, the bidding on average is close to the theoretical prediction if the opponent cooperated in the Prisoners' dilemma. If the opponent defected, the average bid increases significantly and is significantly higher than the theoretical prediction. With communication, bids are on average somewhat lower than the theoretical prediction, and if the opponent defected the bids are significantly higher than the theoretical prediction. The impact of opponent history on cooperators' bidding behavior is highly significant ($p<0.001$).

[Insert Figures 6 and 7 and Table 5 about here.]

Figures 8 and 9 summarize the bidding behavior for the defecting subjects. Opponent history seems to have no clear-cut effect in this case, an impression that is confirmed by the statistical tests in Table 6. The defectors' bids are on average somewhat higher than theoretically predicted, but the difference is not statistically significant for any single treatment. However, if we pool the bids of all defectors across the communication and no

[11] Note that the Chatterjee and Samuelson (1983) linear equilibrium predicts that seller's will bid below their cost for costs over 150 (75%) and that buyer's will bid below their value if the value is below 50 (25%). These counterintuitive results are due to the linear strategies used, and no trade is predicted to occur in these regions. In our empirical analysis we estimate the deviation from the Chatterjee and Samuelson (1983) theoretical prediction as the deviation from the cost/value in these regions.

communication treatments, the bids are on average SEK 7.78 higher than the theoretical prediction, and this difference is significant at the 5% level (p=0.024 according to the t-test).

[Insert Figures 8 and 9 and Table 6 about here.]

3.5 Individual strategies: honest revelation and deception

Let us now consider the prevalence of honest revelation and deception at the communication stage. Honesty is defined as truthfully communicating one's value, and deception is defined as misrepresenting one's value (the remaining category is secrecy – not reporting one's value).[12] As for bidding aggressiveness, we investigate how honesty and deception depends on the opponent's cooperation or defection in the Prisoners' dilemma. The results are illustrated in Figure 10. For cooperators the effect is striking. If the opponent cooperated, 64% of the cooperators truthfully reveal their values, and only 7% of cooperators deceive. If the opponent defected, these figures are essentially reversed; only 6% of cooperators are honest and 53% deceive. As seen in Table 7 these effects are highly significant.

Defectors' communication is largely unaffected by opponent history. A low fraction of defectors reveal their true values, and about half of the defectors lie in the communication irrespective of the opponent's cooperation or defection in the Prisoners' dilemma.

[Insert Figure 10 and Table 7 about here.]

As suggested by Gneezy (2005), people may trade off their desire to be honest against material payoffs. If so, we would expect a decrease in the propensity to be honest as the material benefits from lying increase. To investigate this hypothesis, we regress the probability of honest revelation on a variable, "Truthprofit," that captures the incentive to tell the truth. For sellers, Truthprofit is simply defined as the cost, c. For buyers, Truthprofit is $200-v$. The idea is that when the seller's cost is high, the seller has little to lose by telling the truth; it is unlikely that there will be trade, and if there is trade, the seller's gain will be small. A buyer with low valuation thinks likewise. A logistic regression for the dependence of

[12] A subject's communication is classified as honest if the last valuation reported to the opponent is the true valuation. Clearly, a person is more honest if all reported valuations are the true one, but the distinction is minor. Out of the 160 subjects in the communication treatment only 7 changed their reported valuation. Of these, 4 initially lie and later tell the truth. These all belong to CC pairs. Two of the remaining three subjects lied also

honest revelation on Truthprofit is reported in Table 8, using data from all pairs in the communication treatment and controlling for the relationship.[13] Truthfulness is indeed an increasing function of Truthprofit. The finding suggests that many of our subjects have a positive but finite benefit from honesty.[14]

[Insert Table 8 about here.]

3.6 Comparison with earlier findings

It is informative to compare our results to those of Valley et al. (2002), who conducted an almost identical bargaining game, but with different media of communication, and with no interaction preceding the negotiation. Valley et al. estimated the effect of written and face-to-face communication. Our chat procedure is similar to the written communication session in Valley et al., as anonymity is preserved in both these treatments. Without communication the fraction of trades in Valley et al. was 54%, which is similar to our results for no communication. With written and face-to-face communication the fraction of trades increased to 64% and 85%, respectively. The effect of written communication in our positive relationships is thus of about the same magnitude as the effect of face-to-face communication in Valley et al.

We can also compare the content of messages in the two studies. In our study, 62% of the buyers and sellers mutually revealed their values in good relationships, whereas mutual revelation never occurred in bad relationships. In Valley et al. mutual revelation of values occurred in 31% of bargaining pairs with face-to-face communication and 18% of bargaining pairs with written communication. In our study only 7% of the individuals in good relationships lied about their values, whereas 22% of the individuals lied in face-to-face communication and 44% in written communication in Valley et al. Just comparing averages in the two experiments, we see that the outcomes are quite similar. For example, the overall

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after changing their reported valuation. Incidentally, these two subjects were both in the same DD pair. The last subject, belonging to a DD pair, merely acknowledged that the true value was lower than previously claimed.

[13] Similar results obtain if we instead run an ordered probit admitting all three communication strategies; honest, uninformative, and dishonest. If we interact Truthprofit with the quality of the relationship, a likelihood ratio test cannot reject at the 10% level the hypothesis that all coefficients are identical.

[14] Hurkens and Kartik (2006) warn that other interpretations may in principle be possible. Commenting on Gneezy (2005), they observe that increased lying as a response to stronger material incentives to lie could sometimes be driven by (a reduced impact of) social preferences instead of a finite cost of lying. However, this alternative explanation appears implausible in our setting, because successful deception always entails a one-for-one transfer from the opponent towards oneself.

fraction of honest revelations is about the same, as is the overall propensity to lie. However, our aggregate findings mask two opposing effects: cooperators either reward other cooperators by being honest or punish defectors by being dishonest.

4. CONCLUSION

There is no doubt that some people closely resemble the opportunists depicted in mainstream economic theory. In our experiment, quite a few subjects sent messages indicating that they would cooperate in the Prisoners' dilemma and then defected. Still, the majority of subjects kept their promise. Among these promise-keepers, honest bargaining is common – but only when the opponent is a promise-keeper too. We therefore conclude that honesty is conditional on the quality of the relationship. We also find some evidence that honesty is for sale; people who have more to gain by deceiving their opponent are less likely to tell the truth.

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TABLES

Table 1. Results from the Prisoners' dilemma game and feelings about the opponent after the Prisoners' dilemma.

	CC pairs Number (%)	CD/DC pairs Number (%)	DD pairs Number (%)	Total Number (%)
Mutually positive feelings	74 (89)	3 (4)	4 (24)	81 (49)
At least one negative	0 (0)	53 (79)	4 (24)	57 (34)
Other*	9 (11)	11 (6)	9 (53)	29 (17)
Total	83 (100)	67 (100)	17 (100)	167 (100)

*"Other" means that one party has a neutral view, meeting a party with a neutral or positive view.

Table 2. Trade outcomes by relationship and communication treatment.

	High value trade zone Number of trades (%)	Low value trade zone Number of trades (%)	Total Number of trades (%)
CC relationships:			
No communication	13/15 (87)	3/14 (21)	16/29 (55)
Communication	5/6 (83)	13/15 (87)	18/21 (86)
p-value*	0.844	<0.001	0.022
CD/DC relationships:			
No communication	9/13 (69)	0/6 (0)	9/19 (47)
Communication	8/10 (80)	1/7 (14)	9/17 (53)
p-value*	0.560	0.335	0.738
DD relationships:			
No communication	2/3 (67)	0/0 (-)	2/3 (67)
Communication	4/4 (100)	1/3 (33)	5/7 (71)
p-value*	0.212	-	0.880

*The p-value is estimated for the difference between communication and no communication (using a contingency table Pearson chi-square test).

Table 3. Logistic regression analysis of the probability of trade.

	β	SE	p-value	Marginal effect
Constant	-1.630	0.587	0.005	
Gains from trade	0.036	0.008	<0.001	0.008
CD/DC relationship in Prisoners' dilemma*	-1.328	0.791	0.0934	-0.285
DD relationship in Prisoners' dilemma*	-2.176	1.704	0.202	-0.467
Communication in CC relationship	2.107	0.792	0.008	0.452
Communication in CD/DC relationship	0.333	0.885	0.706	0.072
Communication in DD relationship	2.670	1.961	0.173	0.573
Number of observations	96			
Chi-square	40.797		<0.001	
Log-likelihood	-43.600			
McFadden pseudo-R^2	0.319			
% individual prediction	83.333			

*The baseline category is: CC relationship in Prisoners' dilemma.

Table 4. Dyadic strategies.

	Price coordination Number (%)	Mutual bidding of values Number (%)	Mutual revelation of values Number (%)
CC relationships:			
No communication	3/29 (10)	0/29 (0)	
Communication	10/21 (48)	3/21 (14)	13/21 (62)
p-value*	0.003	0.036	
CD/DC relationships:			
No communication	0/19 (0)	0/19 (0)	
Communication	2/17 (12)	0/17 (0)	0/17 (0)
p-value*	0.124	-	
DD relationships:			
No communication	0/3 (0)	0/3 (0)	
Communication	3/7 (43)	0/7 (0)	0/7 (0)
p-value*	0.175	-	

*The p-value is estimated for the difference between communication and no communication (using a contingency table Pearson chi-square test).

Table 5. Bidding aggressiveness of cooperators in Prisoners' dilemma.

	Opponent cooperated in Prisoners' dilemma Mean (STD)	Opponent defected in Prisoners' dilemma Mean (STD)	p-value of difference t-test	 Mann-Whitney
No communication				
Deviation from cost/value	29.93*** (25.32) n=58	46.32*** (33.66) n=19	0.063	0.029
Deviation from Chatterjee-Samuelson linear strategy	3.63 (19.37) n=58	17.54** (29.01) n=19	0.063	0.072
Communication				
Deviation from cost/value	18.90*** (19.47) n=42	56.53*** (31.75) n=17	<0.001	<0.001
Deviation from Chatterjee-Samuelson linear strategy	-6.26 (24.30) n=42	25.76*** (27.56) n=17	<0.001	<0.001

***,**,*Significantly different from zero at 1%, 5%, and 10% level.

Table 6. Bidding aggressiveness of defectors in Prisoners' dilemma.

	Opponent cooperated in Prisoners' dilemma	Opponent defected in Prisoners' dilemma	p-value of difference	
	Mean (STD)	Mean (STD)	t-test	Mann-Whitney
No communication				
Deviation from cost/value	34.53*** (22.58) n=19	49.83** (31.09) n=6	0.302	0.274
Deviation from Chatterjee-Samuelson linear strategy	2.79 (21.14) n=19	11.56 (31.28) n=6	0.543	0.642
Communication				
Deviation from cost/value	38.35*** (29.42) n=17	43.00*** (36.89) n=14	0.706	0.769
Deviation from Chatterjee-Samuelson linear strategy	7.80 (19.27) n=17	12.90 (33.84) n=14	0.622	0.739

***,**,*Significantly different from zero at 1%, 5%, and 10% level.

Table 7. Individual communication strategies.

	Cooperators in Prisoners' dilemma		Defectors in Prisoners' dilemma	
	Honest revelation	Deception	Honest revelation	Deception
	Number (%)	Number (%)	Number (%)	Number (%)
Opponent cooperated in Prisoners' dilemma	27/42 (64)	3/42 (7)	3/17 (18)	8/17 (47)
Opponent defected in Prisoners' dilemma	1/17 (6)	9/17 (53)	2/14 (14)	8/14 (57)
p-value*	<0.001	<0.001	0.800	0.576

*The p-value is estimated for the difference between "Opponent cooperated in Prisoners' dilemma" and "Opponent defected in Prisoners' dilemma" (using a contingency table Pearson chi-square test).

Table 8. Logistic regression analysis of the probability of honest revelation.

	β	SE	p-value	Marginal effect
Constant	-0.249	0.379	0.512	
Truthprofit*	0.009	0.003	0.0057	0.002
CD relationship in PD**	-2.287	0.562	<0.001	-0.534
DC relationship in PD**	-2.044	0.530	<0.001	-0.477
DD relationship in PD**	-1.672	0.527	0.002	-0.390
Number of observations	160			
Chi-square	41.162		<0.001	
Log-likelihood	-87.101			
McFadden pseudo-R^2	0.191			
% individual prediction	71.88			

* Defined as 200-*v* for buyer and *c* for seller.

**The baseline category is: CC relationship in PD.

FIGURES

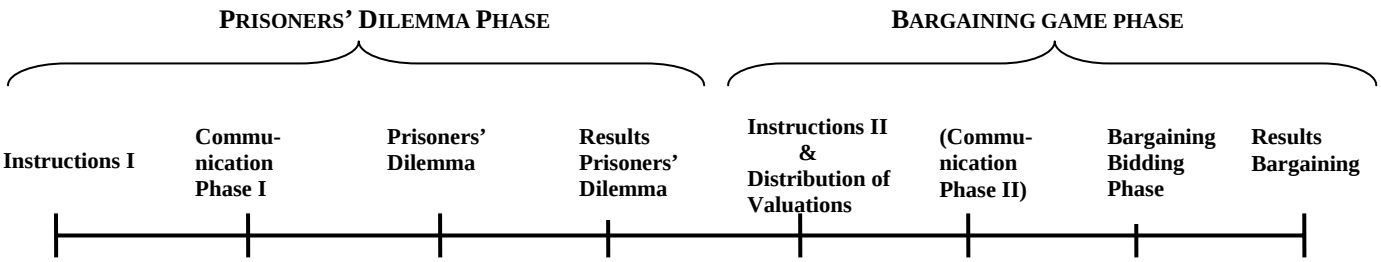


Figure 1.Timing.

	Player B: COOPERATION	Player B: NON-COOPERATION
Player A: COOPERATION	40 **40**	50 **0**
Player A: NON-COOPERATION	0 **50**	10 **10**

Figure 2. The Prisoners' dilemma game.

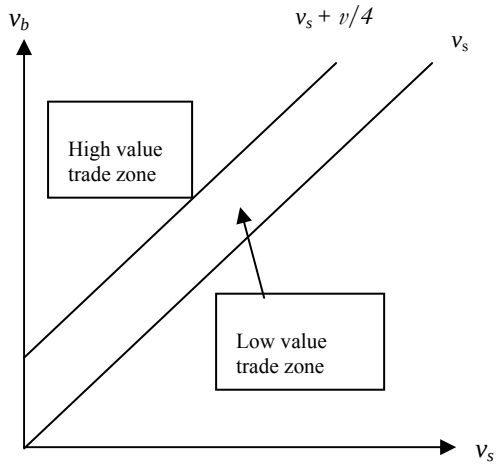
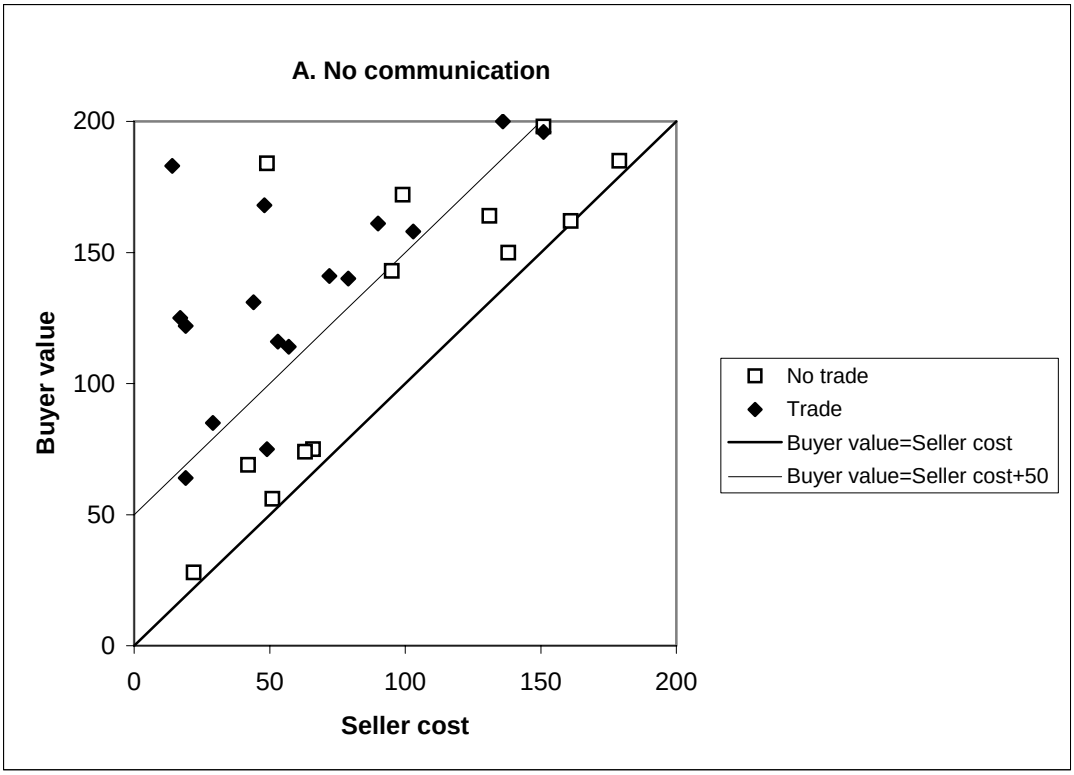


Figure 3. Chatterjee-Samuelson linear equilibrium.



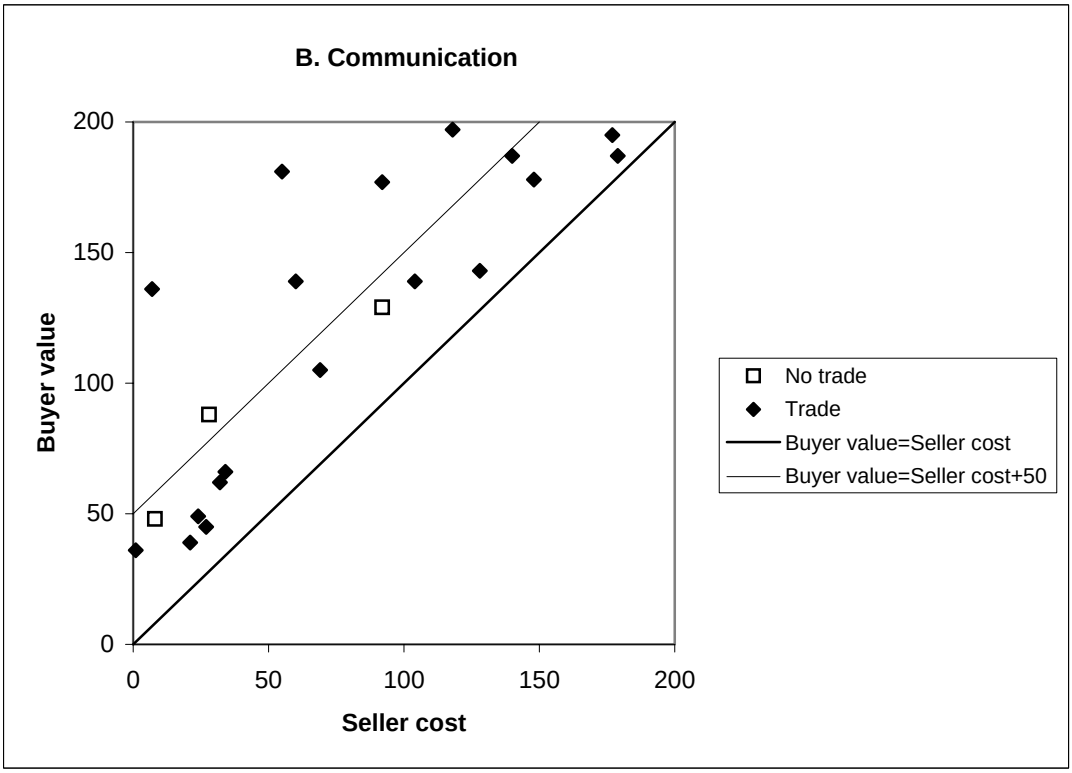
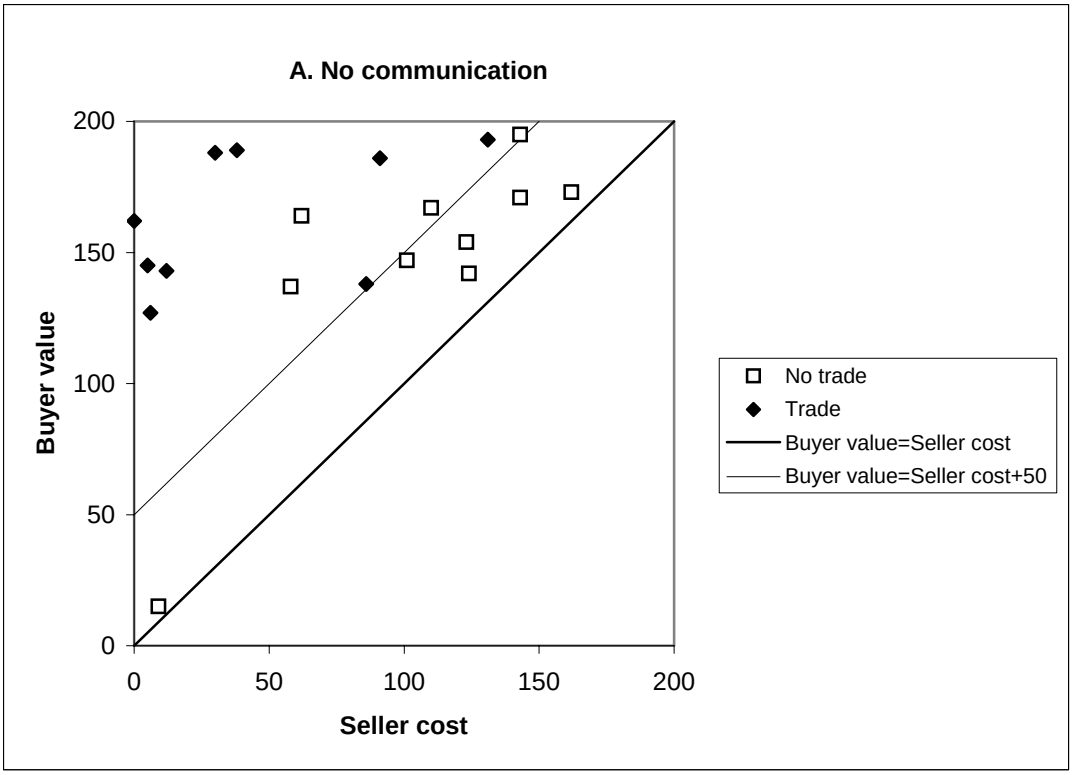


Figure 4. Trade outcomes in positive (CC) relationships.



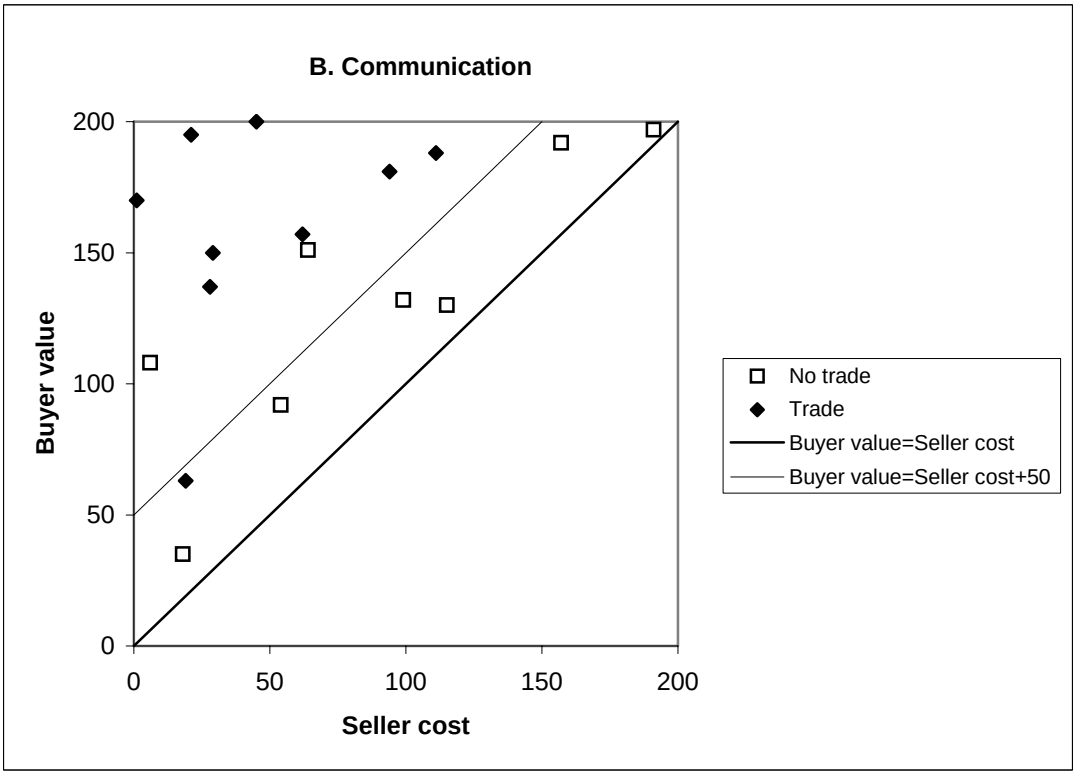
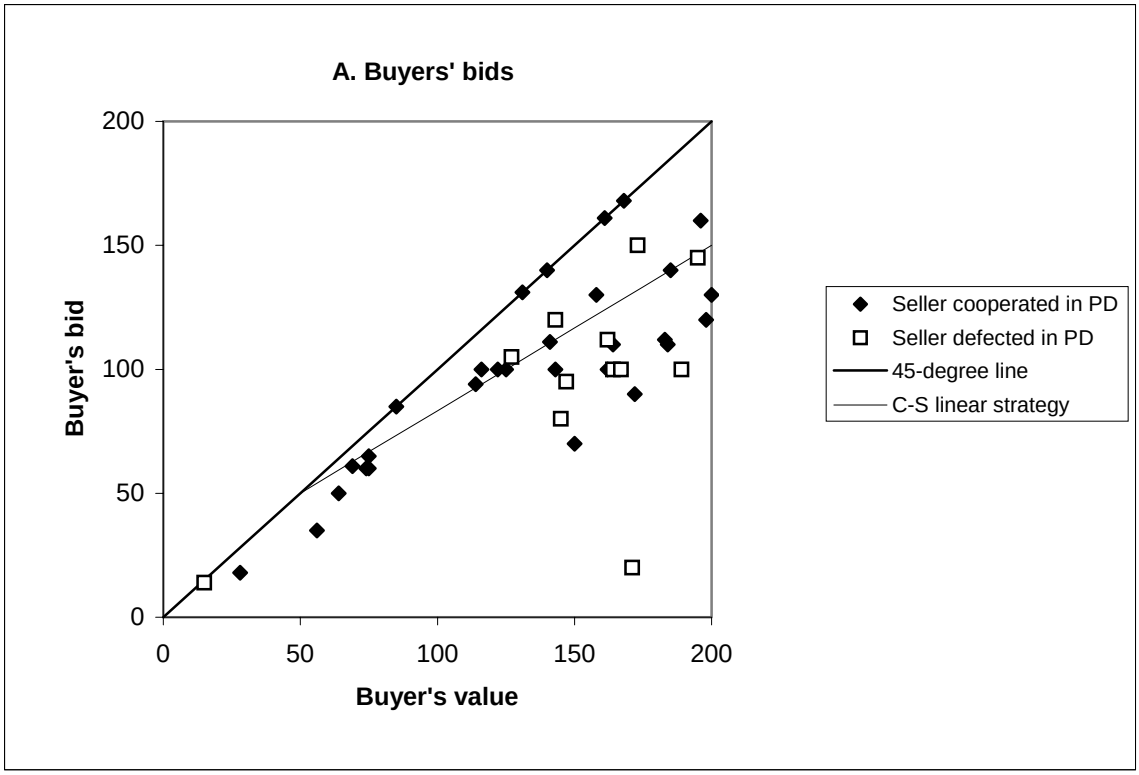


Figure 5. Trade outcomes in negative (CD/DC) relationships.



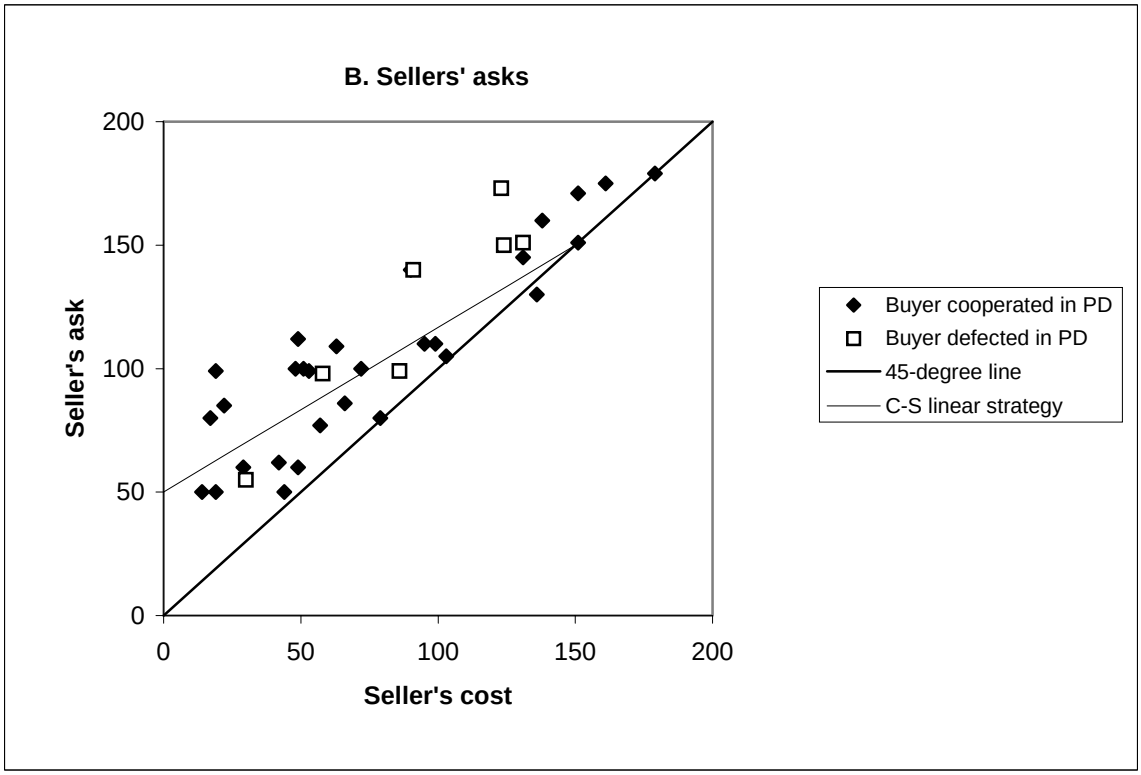
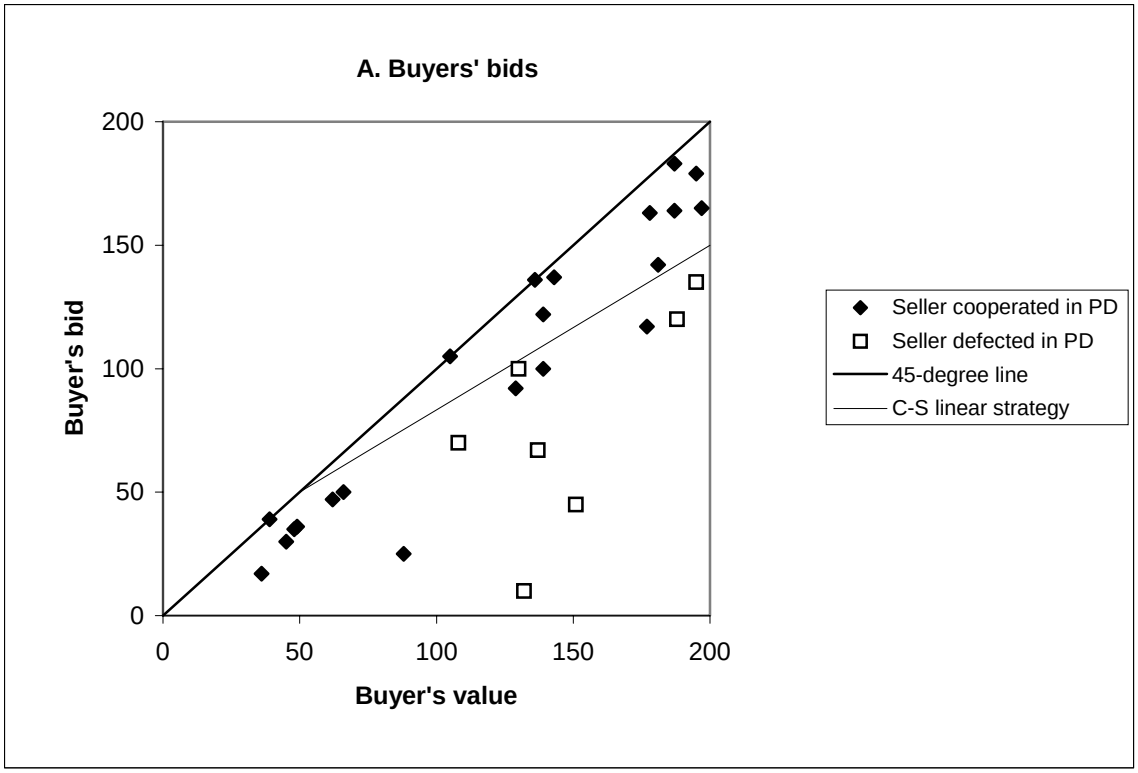


Figure 6. Bidding strategies of cooperators in the Prisoners' dilemma (PD). No communication.



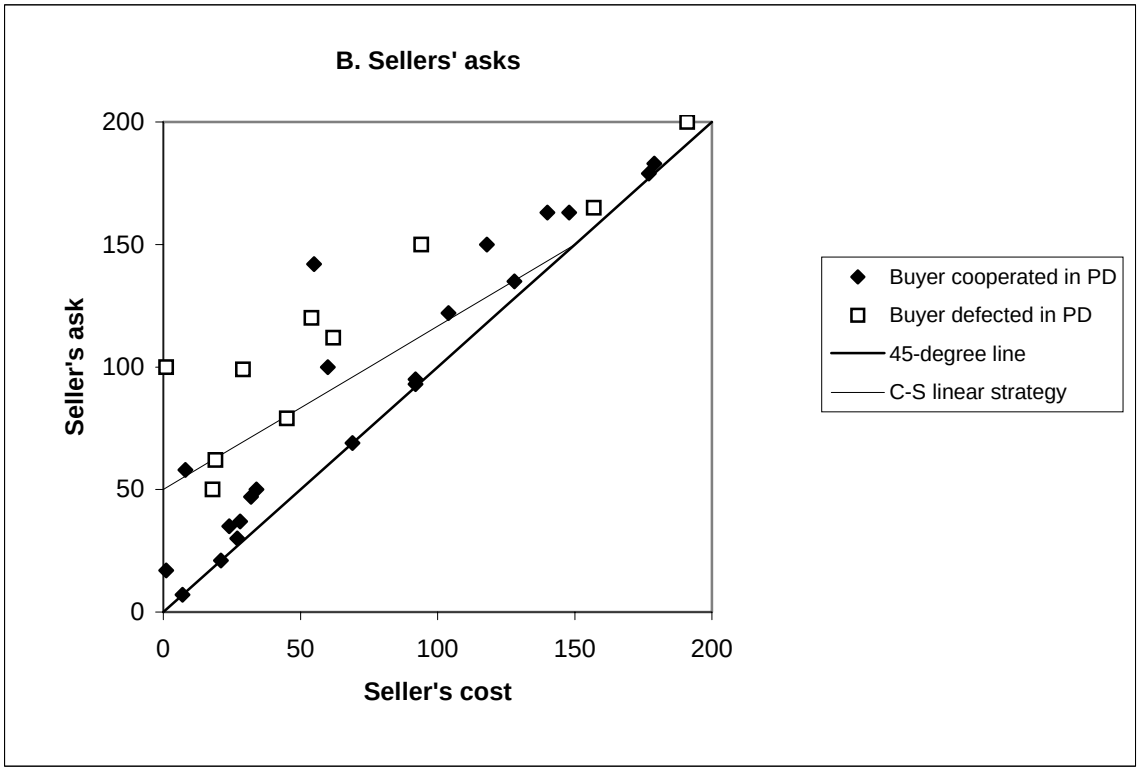
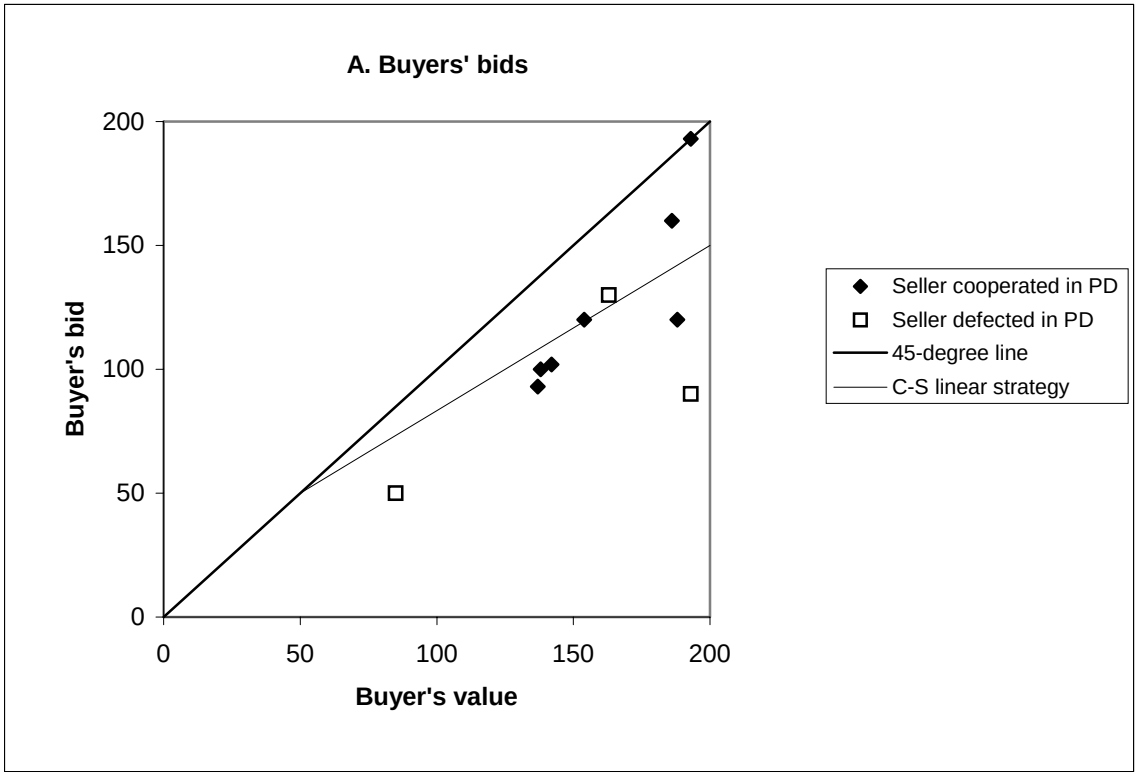


Figure 7. Bidding strategies of cooperators in the Prisoners' dilemma (PD). Communication.



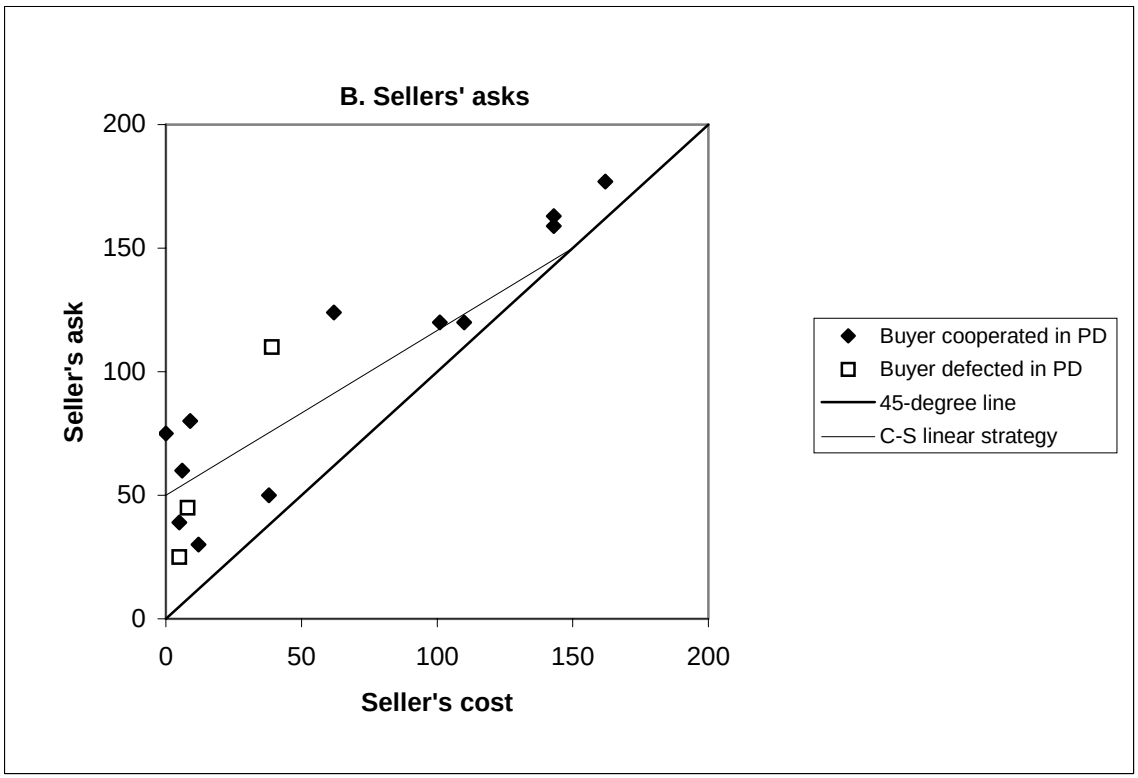
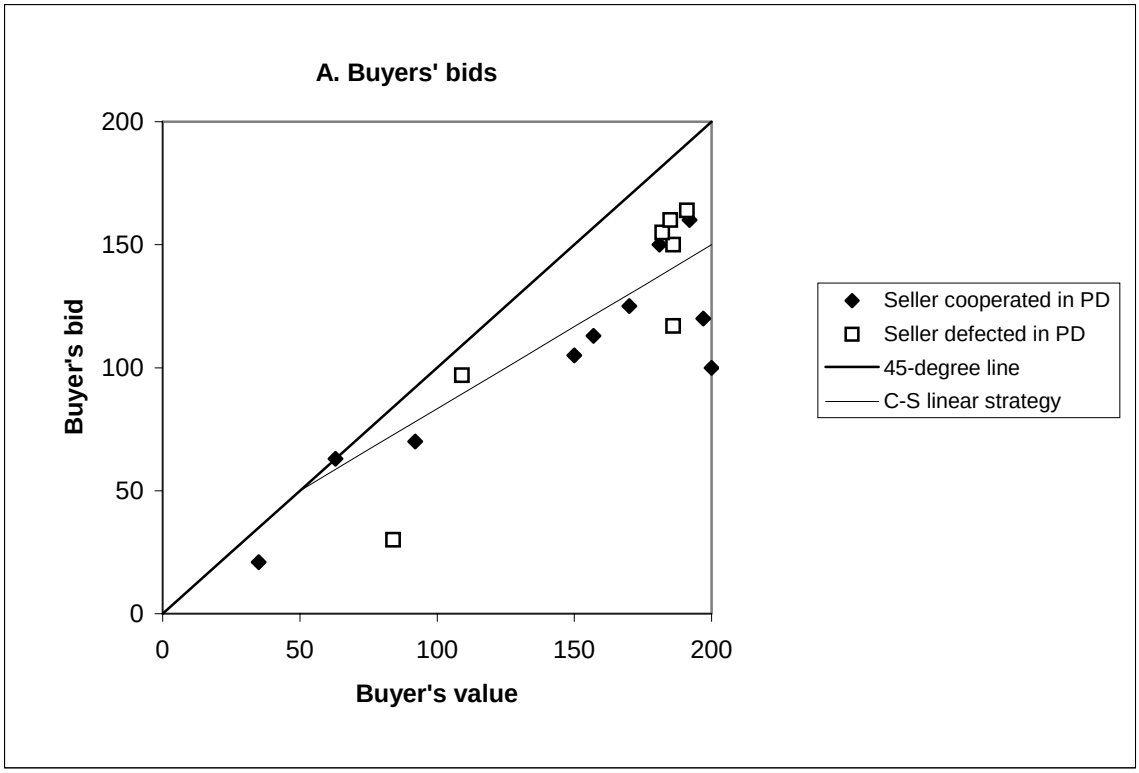


Figure 8. Bidding strategies of defectors in the Prisoners' dilemma (PD). No communication.



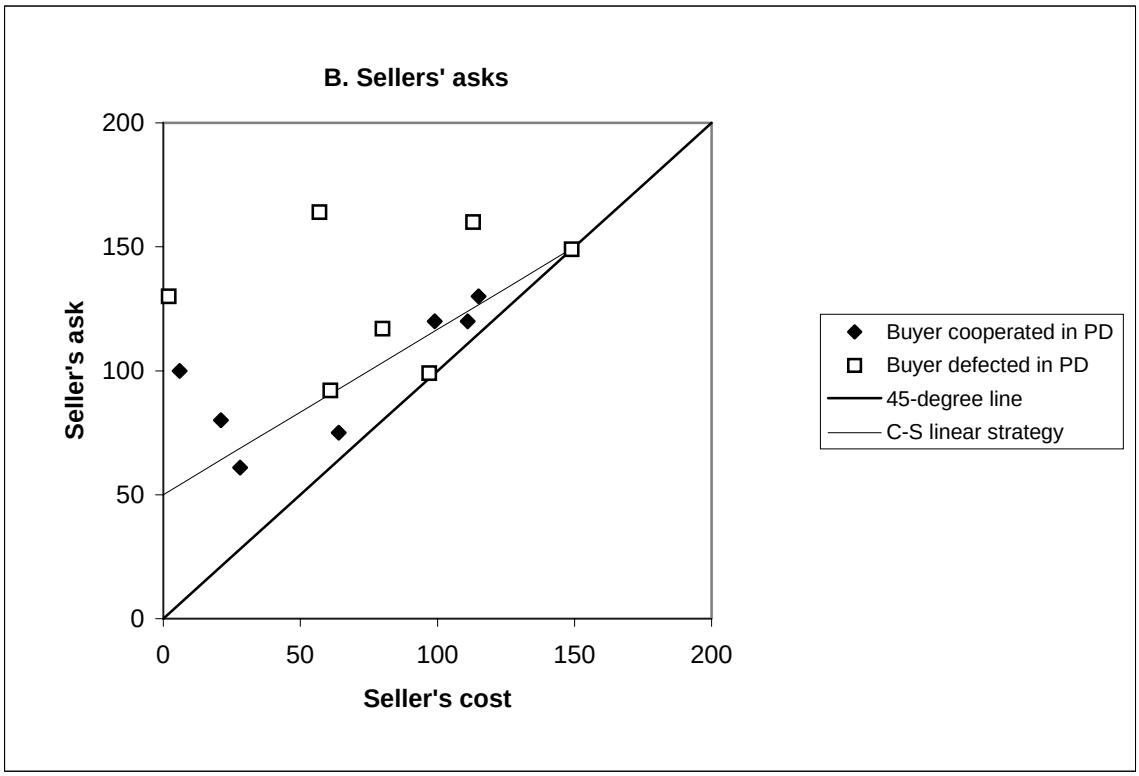


Figure 9. Bidding strategies of defectors in the Prisoners' dilemma (PD). Communication.

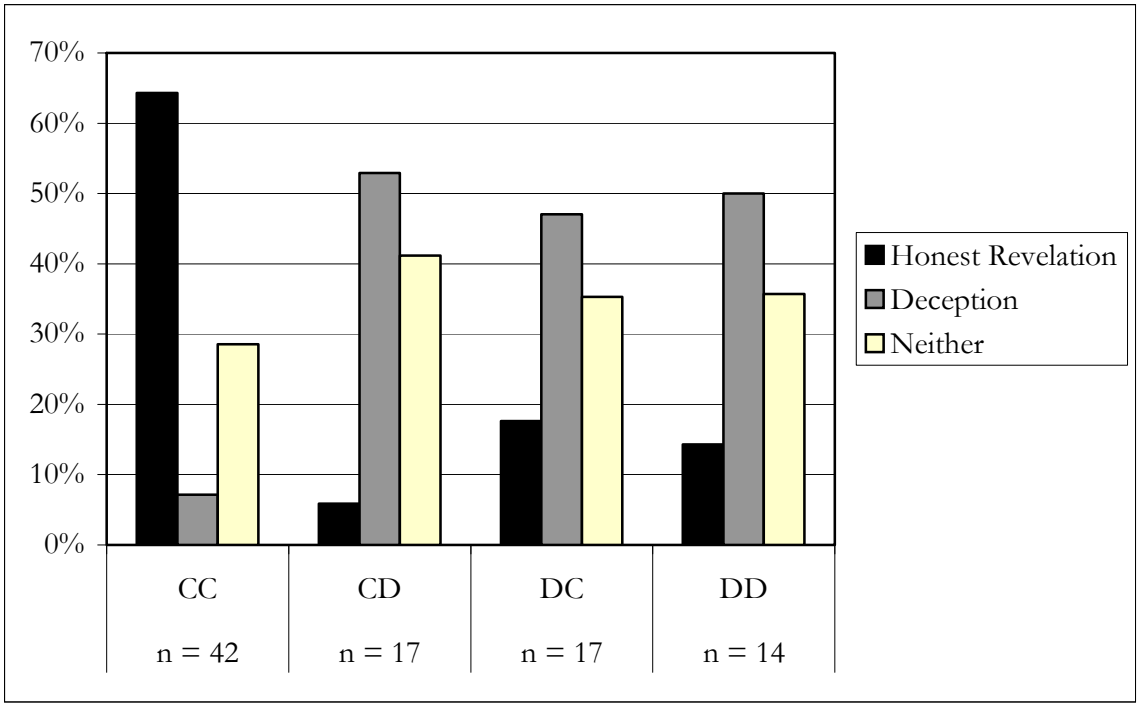


Figure 10. Individual communication strategies.

APPENDIX: EXPERIMENTAL INSTRUCTIONS

The original instructions were in Swedish. This appendix reprints a translation of the instructions for the Prisoners' dilemma and the bargaining game with communication used in the experiment. Note that the instructions use the neutral word "counterpart" rather than the word "opponent" used in the text.

1. Instructions for the Prisoners' Dilemma

INSTRUCTIONS

You are about to take part in an experiment on decision making. Read the instructions carefully. If you have any questions after having read through the instructions, then raise your hand, and one of the instructors will come to you to answer the question.

Depending on the decision you make, you have the opportunity to earn money in addition to the 100 SEK that you are guaranteed for your participation in this experiment. The sum of money that you will receive corresponds to one of the bold numbers in the table below. The money will be distributed at the end of the experiment.

You will be paired up with a counterpart in another room. The rooms are called A and B. The person sitting in room A will be called "A" and the person sitting in room B will be called "B".

Your identity will never be revealed neither to your counterpart, nor to any other person. You *are not allowed, in any way, to reveal your true identity* since this could ruin the results of the experiment.

You and your counterpart will both make a choice. The possibilities of choosing are the same for you and your counterpart. You can choose between COOPERATION or NON-COOPERATION. If you both choose COOPERATION, you will both receive 40 SEK. If you both choose NON-COOPERATION, you will both receive 10 SEK. If you choose NON-COOPERATION, whereas your counterpart chooses COOPERATION, you will get 50 SEK, and your counterpart 0 SEK. Finally, if you choose COOPERATION but your counterpart chooses NON-COOPERATION, you will get 0 SEK, and your counterpart 50 SEK.

The bold number in the bottom left corner of every field represents your pay-off, and the number in the upper right corner represents your counterpart's pay-off.

	Counterpart: Cooperation	Counterpart: Non-Cooperation
YOU: Cooperation	40 **40**	50 **0**
YOU: Non-Cooperation	50 **50**	10 **10**

Before you make your choice, you will have the opportunity to communicate with your counterpart on a communication-sheet. Person A will start by sending a message to person B. Person B will then answer person A's message on the same communication-sheet. On the same

sheet, person A will then send a second message, and finally, person B will get the opportunity to answer this message. The communication will thus in total comprise four messages, two written by you, and two by your counterpart. You can write anything you like. You are not bound by what you have written when you later make your choice. However, you are *not allowed, in any way, to reveal your true identity.*

When you make your decision, you will not know what your counterpart will choose. You must choose without knowing the decision of the other person. After every participant has made a decision, the instructors will report your result back to you.

DO NOT, NEITHER BEFORE NOR AFTER THE EXPERIMENT, DISCUSS YOUR CHOICE OR PAY-OFF WITH ANY OTHER PERSON.

We thank you for your participation, and wish you good luck!

2. Instructions for the bargaining game with communication

INSTRUCTIONS 2

You will now participate in a bargaining game. Read through the instructions and examples carefully. If you still have questions after having read through the instructions, raise your hand, and one of the instructors will come to you to answer the question.

You will now participate in a negotiation with the same person that you have interacted with before. Person A will act as a buyer and person B will act as a seller. You and your counterpart will *not* negotiate again after this negotiation.

In the negotiation, you will bargain over the price of a fictitious good, called Tynar. The buyer has a certain valuation of Tynar. The seller has a certain cost associated with selling Tynar. The buyer can earn money by buying Tynar at a lower cost than the given valuation. The seller can earn money by selling Tynar at a higher price than his/her cost.

The buyer's valuation and the seller's cost are independent from each other. Both values have been drawn from the same distribution, ranging from 0 to 200 SEK. Only integer numbers can be drawn from the distribution. Thus, the buyer's valuation can be between 0 and 200 SEK. The same applies to the seller's cost, which accordingly will be between 0 and 200 SEK.

The buyer's valuation can be above, below or the same as the seller's cost. Only the buyer will know his/her valuation and only the seller will know his/her cost. The seller and buyer can together earn up to 200 SEK in the bargaining.

If a trade of Tynar takes place, the price will be determined by both the buyer's and the seller's decision. As long as the buyer gives a higher offer than the demand of the seller, a purchase will take place in the mid-point of the two bids. For example, if the buyer offers 100 SEK and the seller demands 50 SEK, Tynar will be traded at the final price of 75 SEK [(100+50)/2].
If the buyer's offer is lower than the seller's demand, no trade will occur.

The buyer makes a profit by selling Tynar at a lower price than his/her valuation. In the same way, the seller makes a profit by selling Tynar at a higher price than his/her cost;

Buyer's Profit = Buyer's Valuation – Final Price

Seller's Profit = Final Price – Seller's Cost

See some examples below:

- Seller's Cost = 20 SEK
  Buyer's Valuation = 100 SEK
  Seller's Demand: 60 SEK
  Buyer's Offer: 80 SEK
  Buyer's Offer ≥ Seller's Demand. Trade will occur at:
  Final Price = (80+60)/2 = 70 SEK
  Seller's Profit: 70–20 = 50 SEK
  Buyer's Profit: 100–70 = 30 SEK

- Seller's Cost = 100 SEK
  Buyer's Valuation = 50 SEK
  Seller's Demand: 100 kr SEK
  Buyer's Offer: 50 SEK
  Buyer's Offer < Seller's Demand. No Trade will occur.
  Seller's Profit: 0 SEK
  Buyer's Profit: 0 SEK

- Seller's Cost = 100 SEK
  Buyer's Valuation = 120 SEK
  Seller's Demand: 110 SEK
  Buyer's Offer: 140 SEK
  Buyer's Offer ≥ Seller's Demand. Trade will occur at:
  Final Price = (140+110)/2 = 125 SEK
  Seller's Profit: 125 – 100 = 25 SEK
  Buyer's Profit: 120 – 125 = **-5 SEK.** Observe that the buyer is in this case making a negative profit, a loss. The buyer is making a loss because his offer is higher than his valuation.

Be sure not to lose money in this experiment!

Before you are to decide on your offer/demand, you will be given the opportunity to communicate with your counterpart. You will do this by means of the computer in front of you, using a program called MSN messenger. MSN is a so-called "instant messenger", which means that the message you write instantaneously reaches the recipient. In the window on your computer screen, you have already been linked to the person that you have previously interacted with. When the instructors tell you to start, you can start communicating with your counterpart for 8 minutes. You can chat about anything. As before however, we do NOT want you to reveal your true identity in any way. The instructors will let you know when 30 seconds remain. When 8 minutes have passed, you will stop typing and leave the window open.

Do NOT close down the program or any windows!

The experiment will thus be carried out in the following three steps:

1) You will be given information on your valuation or cost of Tynar. If you are a buyer, your valuation will be given to you on a paper labelled "Valuation", and if you are a seller, your cost will be given to you on a paper labelled "Cost". This number has been drawn from a random distribution. Both the valuations and the costs can take values between 0 and 200. Only integers can be drawn and every number is equally probable.

2) You will now be given the opportunity to communicate with the other person. This person is the same person as you interacted with previously. You can communicate freely via the MSN messenger for 8 minutes. You can discuss anything, but like before, you CANNOT reveal your true identity. The instructors will tell you when 30 seconds remain. **Do NOT close down any windows, or try to close down the program in any other way.**

3) After the communication phase, you will make your bid. If you are a buyer, the offer you make is the highest price you are willing to pay for Tynar. If you are a seller, the demand you write down is the lowest price at which you are prepared to sell Tynar. The sum you write down is to be given in whole SEK. You and your counterpart will make simultaneous bids. If the buyer's bid is higher than the seller's, trade will occur. In that case, the price of Tynar will lie in the mid-point. You will NOT know your counterpart's decision when you make your bid. After all participants have written down their bids, the instructors will report back your result to you.

If you have any questions, do not hesitate to ask the instructors for help.

PLEASE NOTE THAT YOU SHOULD NOT CLOSE DOWN THE PROGRAM, OR ANY WINDOWS!