Communication, Reputation, and Punishment in Sequential Bargaining Experiments

by

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Experiments on sequential bargaining have shown that subjects' behavior is far from the equilibrium prediction. Whereas previous models explain these deviations by some kind of social preferences, we investigate an alternative interpretation of behavior based on the assumption of bounded rational self-interest. Our analyses reveal that, in line with this interpretation, bargaining outcomes depend on subjects' payoff consequences from punishment. However, after preplay communication, we find a much weaker effect of these payoff consequences and a tremendous increase in the number of equal splits. This communication effect can be attributed to reputation effects only to a minor degree, if at all. (JEL: C 78, C 91, C 92)

1 Introduction

In recent years, two-stage sequential bargaining games have been the subject of many experimental studies. One reason for this intense investigation lies in the fact that in some games, such as the *ultimatum game* (see GÜTH, SCHMITTBERGER, AND SCHWARZE [1982], GÜTH [1995]) or the *trust game* (see BERG, DICKHAUT, AND MCCABE [1995]), the observed behavior does not fit with standard game-theoretic predictions, while in other games, such as the *best-shot game* (see, e.g., HARRISON AND HIRSHLEIFER [1989], GÜTH AND TIETZ [1990]), the subgame-perfect equilibrium serves as a good predictor of subjects' behavior. Numerous theoretical attempts have been made to explain these seemingly conflicting results.[1]

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[1] A first line of theories explains the observed behavior as the result of a concern for relative payoffs (FEHR AND SCHMIDT [1999], BOLTON AND OCKENFELS [2000]) or as income-based altruism combined with a preference for efficiency (ANDREONI AND MILLER [2002]). Alternative models assume some sort of reciprocity caused by the harming or helping intentions of the opponents (e.g., GEANAKOPLOS, PEARCE, AND STACCHETTI [1989]; RABIN [1993]; LEVINE [1998]; FALK AND FISCHBACHER [1998]; DUFWENBERG AND KIRCHSTEIGER [2004]). The theory by CHARNESS AND RABIN [2002] includes both the reciprocity and the efficiency factor in the individual preference model.

All these approaches have in common that they stick to the standard theoretical assumption of strictly rational behavior, but introduce some kind of "social" preferences, which turn the observed "anomalous" behavior into rational decisions. The underlying hypothesis is that some form of fairness considerations, reciprocity, and/or efficiency seeking might drive subjects' decisions in sequential bargaining games.

One of the phenomena that are often observed in bargaining experiments is that the second movers frequently use their opportunity to punish the first mover's action, that is, they bear some cost to reduce the first mover's payoff. In line with the social preference models, these observations are usually explained by reverting to fairness considerations and reciprocity. Subjects punish in order to equalize payoffs or to take revenge on decisions that mean some harm to them, i.e., that violate some shared social norm (see, e.g., FALK, FEHR, AND FISCHBACHER [2003]).

But, investigating the structure of typical sequential bargaining games, one may come to the conclusion that social preferences do not have to be the only driving force of the bargaining process. Taking the ultimatum game as an example, an alternative interpretation of bargaining behavior might be the following:

Subjects might perceive the ultimatum game as a pure conflict game in which each of them tries to bring about her or his personal advantage. What prevents the first movers from taking the total pie is the fact that the second movers are willing to punish them, i.e., to reject all offers they do not like, though this behavior results in zero payoffs to both subjects. Assuming that subjects try to get as much of the pie as they can get, this willingness to punish is not rational. But, if subjects decide in a bounded rational way and punish nonfavored moves and if this is common knowledge, the bounded rational behavior can help second movers to enforce their favored move in the long run and thereby to increase their long-run payoff above the subgame-perfect equilibrium (SPE) outcome level. If this interpretation of the behavior is right, it explains the decisions observed in ultimatum games without any reference to social preferences.

In the first part of this paper, we test this alternative interpretation using three one-shot two-stage sequential bargaining games. The test is based particularly on the following thoughts: If the second movers' punishment in sequential bargaining games is just a means to manipulate the first movers' behavior in the second movers' favor, then the subjects' behavior should be guided by the monetary payoff consequences of punishment. We specifically hypothesize that the second movers' decision to punish should be affected by the efficiency of punishment (i.e., the ratio between the second movers' punishment cost and the first movers' punishment loss). The higher the punishment efficiency is, the more second movers should punish the first movers. Furthermore, punishment only results in higher second-mover payoffs when it makes the nonequilibrium behavior more attractive for first movers. Thus, our second hypothesis is that, from the first movers' point of view, the maximum opportunity cost of choosing the equilibrium move (i.e., the difference between the first mover's payoff resulting from an exploited nonequilibrium move and his payoff resulting from a punished equilibrium move) should play an important role. The

higher these costs are, the less the first movers should be willing to play their SPE strategy.[2]

The second part of the paper combines these investigations with two additional aspects, which seem to be of great relevance in bargaining situations: the effect of preplay communication and the role of reputation. That face-to-face communication is an effective tool to alter subjects' behavior has been shown in a number of experimental studies. The reported findings particularly suggest that face-to-face communication can tremendously increase the equality of payoff distributions and the efficiency of outcomes. For example, in their two-person bargaining games, HOFFMAN AND SPITZER [1982] found that face-to-face bargaining led to a more frequent agreement on an equal split. Likewise, in an experiment on the ultimatum game, ROTH [1995] observed that face-to-face communication significantly increased the number of equal offers. Similar results were reported in the ultimatum and dictator game experiments by FREY AND BOHNET [1995] and BOHNET AND FREY [1999a], [1999b]. Furthermore, in a bargaining game with incomplete information, RADNER AND SCHOTTER [1989] compared face-to-face bargaining with the sealed-bid mechanism and found that, under all performance (efficiency) measures, the face-to-face mechanism clearly outperformed the sealed-bid mechanism.

However, up to now there has been no theory of bargaining games that consistently captures these effects of preplay communication. One possible explanation for the strong effects of preplay communication observed in experimental studies is reputation effects. Even if experimenters sort out subjects who are acquainted with each other, hiring them from the same campus raises the problem that subjects might meet again in the future and therefore might wish to avoid building up a bad reputation in the experiment. Although there are many studies analyzing the communication effect, we are not aware of any study that really controls for reputation building. Even in studies using e-mail communication (see, e.g., FROHLICH AND OPPENHEIMER [1998]; VALLEY, MOAG, AND BAZERMAN [1998]), subjects either could see the other participants during the sessions, or had contact with them before or after the experiment, or were not restricted in the content of communication, i.e., they were allowed to reveal their own identity.

In order to control for reputation effects, we ran two communication treatments. In the first treatment, bargainers had the opportunity to communicate face to face via a videoconferencing system before making their decision. In the second treatment, we excluded all possibilities for reputation effects and restricted communication to the exchange of e-mails. If reputation is really the cause of the communication effect, we should observe no behavioral changes after implementing this restricted form of communication.

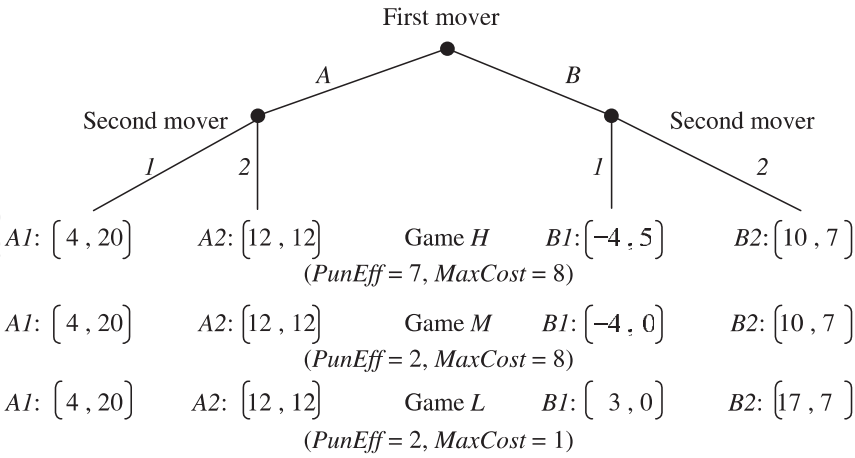
[2] YANG, WEIMANN, AND MITROPOULOS [2002] used these two measures to explain behavior in repeated-bargaining-game experiments. In accordance with our alternative interpretation of bargaining behavior, they found a positive correlation between the punishment efficiency and the second movers' frequency of punishment, and a negative correlation between the first movers' maximal opportunity cost of choosing the equilibrium move and their frequency of choosing their SPE strategy.

The paper proceeds as follows: section 2 describes the bargaining games and our hypotheses regarding subjects' behavior in the experiment. Section 3 includes the experimental design. The results of the experiment are presented in section 4. Finally, section 5 contains the conclusion and discussion of results.

2 *Games and Hypotheses*

In our study, we employed three two-stage sequential bargaining games. In these games, the first mover has to choose between the two options *A* and *B*. Informed about the first mover's decision, the second mover determines the final outcome of the game by choosing one of the two options, *1* or *2*. The games are summarized in Figure 1.[3]

Figure 1
The Sequential Bargaining Games



The three games can be characterized in the following manner. All games have a unique SPE outcome, *B2*. This outcome clearly favors the first mover. The second mover can maximize his payoff in the *A*-subgame by choosing option *1*, which is, however, much less profitable for the first mover than the equilibrium outcome *B2*. In other words, there is a conflict between the first and the second mover inherent in the monetary payoff structure of the games. While the first mover prefers the equilibrium outcome in the *B*-subgame, the second mover favors the (not subgame-perfect) Nash equilibrium in the *A*-subgame. There are two sanctioning means

[3] In our experiment, the games were presented in a 2 × 2 matrix form. See Appendix A.2.

available for the second mover: punishment and reward. If the first mover chooses the SPE action, the second mover has the opportunity to punish him by choosing the off-equilibrium action *1*. If the first mover chooses to deviate from the SPE, the second mover can reward him by realizing the efficient equal-split outcome, i.e., by deciding for the off-equilibrium action *2*. The games differ only in the first mover's and second mover's payoffs in the *B*-subgame.

Specifically, game *H* differs from game *M* only with respect to the efficiency of the second mover's punishment (*PunEff*), i.e., with respect to the ratio between the second movers' punishment cost and the first movers' punishment loss in subgame *B*.[4] While the punishment efficiency is 7 in game *H*, it is only 2 in game *M*.

Game *L* differs from game *M* only with respect to the first mover's maximum opportunity cost of choosing the equilibrium move (*MaxCost*), i.e., with respect to the difference between the first mover's payoff when his *A*-move is exploited (i.e., his minimum payoff in subgame *A*) and the first mover's payoff when his *B*-move is punished (i.e., his minimum payoff in subgame *B*).[5] While this opportunity cost is 8 in game *M*, it is only 1 in game *L*.

Given that in all three games the SPE outcome is *B2*, the (not subgame-perfect) Nash equilibrium is *A1*, and the efficient equal-split outcome is *A2*, none of the existing behavioral theories that rely on rational self-interested behavior or that assume some form of social preferences would predict a change regarding subjects' behavior across the games. That is, according to these theories, neither the second mover's punishment efficiency nor the first mover's maximum opportunity cost of choosing the equilibrium move is expected to affect subjects' behavior. This prediction is summarized in Hypothesis 1a:

HYPOTHESIS 1A *There are no behavioral changes among the three games.*

However, maintaining the assumption that subjects perceive the games as conflict games in which they strategically use any means the payoff structure provides them with in order to bring about their personal advantage, even if this hurts their narrow self-interest, the payoff differences between the games should matter for subjects' behavior. In particular, assuming that the second movers' use of punishment mirrors a calculated attempt to induce their most preferred outcome, on reducing the efficiency of punishment from game *M* to game *H*, we should observe more second movers who use their punishment option in game *H* than in game *M*. Thus, the first part of our alternative Hypothesis 1b is:

HYPOTHESIS 1B(I) *There are more second movers who choose to punish in game H than in game M.*

Assuming that the first movers' *A*-move only mirrors their calculated attempt to prevent a low payoff resulting from potential punishment in subgame *B*, on increasing

[4] Let $\pi_i(x)$ denote the payoff to player i if outcome x is realized with $i =$ first mover (FM) or second mover (SM); the efficiency of the second mover's punishment is defined as $PunEff = [\pi_{FM}(B2) - \pi_{FM}(B1)]/[\pi_{SM}(B2) - \pi_{SM}(B1)]$.

[5] The first mover's maximum opportunity cost of choosing the equilibrium move is defined as $MaxCost = \pi_{FM}(A1) - \pi_{FM}(B1)$.

the difference between their punishment payoff in subgame B and their exploitation payoff in subgame A, we should observe more first movers choosing A in game M than in game L. Thus, the second part of our alternative Hypothesis 1b is:

HYPOTHESIS 1B(II) *There are more first movers who decide for subgame A in game M than in game L.*

Since there is no solid reason to change these hypotheses for the communication treatments, we assume the hypotheses also to hold for the behavioral differences between the games after preplay communication.

The remaining hypotheses refer to the effects of preplay communication and of reputation in our experiment. Given the previous experimental results on bargaining games, which suggest a significant increase of efficient equal-split outcomes after face-to-face communication, we expect to observe such an effect also in our experiment:[6]

HYPOTHESIS 2 *In the face-to-face communication treatments, we should observe more first movers who choose A, and more second movers who reward the first mover's A-move, than in the treatments without communication.*

Finally, if reputation is the cause of the strong effect of face-to-face communication, we should observe that Hypothesis 2 does not hold for our e-mail communication treatments that exclude such effects. Thus, our last hypothesis is:

HYPOTHESIS 3 *There should be no behavioral differences between the e-mail treatments and the no-communication treatments.*

3 Experimental Design

In the experiment, we used a $3 \times 3 - 1$ matrix design with the treatment variables monetary payoff consequences from punishment (games H, M, L) and opportunity for preplay communication (none, e-mail, face-to-face via a videoconferencing system). The games were played one-shot with a total of 512 students at the Otto-von-Guericke University Magdeburg. No subject participated in more than one experiment. Table 1 summarizes the treatments and sample sizes.

At the beginning, subjects received general instructions, an identification number, and a test, which had to be filled in before the game was played.[7] After that, subjects were assigned a role as either the first or the second mover by tossing a coin.

[6] Note that we employed face-to-face communication via a videoconferencing system and not via direct contact as in the studies cited above. However, as shown by BROSIG, OCKENFELS, AND WEIMANN [2003], there are no significant differences between the effect of face-to-face communication by a videoconferencing system and the effect of direct face-to-face communication.

[7] The instructions, the pretest, and the decision formulas are included in Appendix A.2.

Table 1
Experimental Treatments

Game	Preplay communication	No. of subjects
H ($PunEff = 7, MaxCost = 8$)	none	62
	e-mail	60
	video	60
M ($PunEff = 2, MaxCost = 8$)	none	58
	e-mail	92
	video	60
L ($PunEff = 2, MaxCost = 1$)	none	60
	video	60

In the no-communication treatments, which were run in one single classroom session, subjects played the games without any form of preplay communication. After receiving the decision formulas, first movers had to make their decision between the two rows A and B. Next, they had to place their decision formula in a large envelope (which also contained a sealed envelope with a copy of their identification number), which was then returned to the experimenter. The collected envelopes were randomly handed out to the second movers. After crossing out the column they did not want, second movers put the decision formula and a copy of their identification number back in the large envelope. At the end, the large envelope contained the decision formula, the (sealed) envelope with the first mover's identification number, and the (sealed) envelope with the second mover's identification number. This rather complicated procedure guaranteed the anonymity of our random matching. Having collected the decision formulas, earnings were calculated and paid in cash one week after the experiment took place. The payment was anonymous, using the identification cards the subjects kept during the sessions.

In the communication treatments (e-mail and video), subjects were given the opportunity to communicate with their partner before the game was played. In order to be able to discuss the game, at the beginning of communication each partner received a copy of the relevant payoff matrix. In all treatments, we used soundproof cabins equipped with a computer and a videoconferencing system. In the e-mail treatment, subjects could exchange written messages with their partner for a maximum of 15 minutes via the computer. In their messages, subjects were not allowed to give any information that could reveal their identity. In the video treatment, subjects communicated by the use of a videoconferencing system. The content of the discussion was not restricted. Subjects could communicate with each other about whatever they wanted for a maximum of 10 minutes. In order to analyze the content and the course of the talk, all discussions were videotaped. In all communication sessions, we tried to ensure that subjects were not acquainted

with their partner and had no contact with him either before or after the experiment. Therefore, in addition to their registration, subjects had to sign a form, stating that they would inform the experimenter if they noticed that an acquaintance would be taking part at the same session. For the experiment, each subject was assigned to another room. Having arrived in their rooms, subjects were led one after another to their cabins, where they had to stay for the whole experiment.

After communication, first movers received the decision formula and were asked to cross out the row they did not want to choose. The collected formulas were handed out to the second movers, who then crossed out their unwanted column. After calculating the earnings, subjects were paid off one after another and left the cabins and the room separately.

In order to avoid negative payoffs in the experiment, each player received a show-up fee of 5 DM. The minimal payoff was therefore 1 DM, and the maximal 25 DM. On average subjects earned 14 DM. No experiment lasted longer than 30 minutes.

4 Results

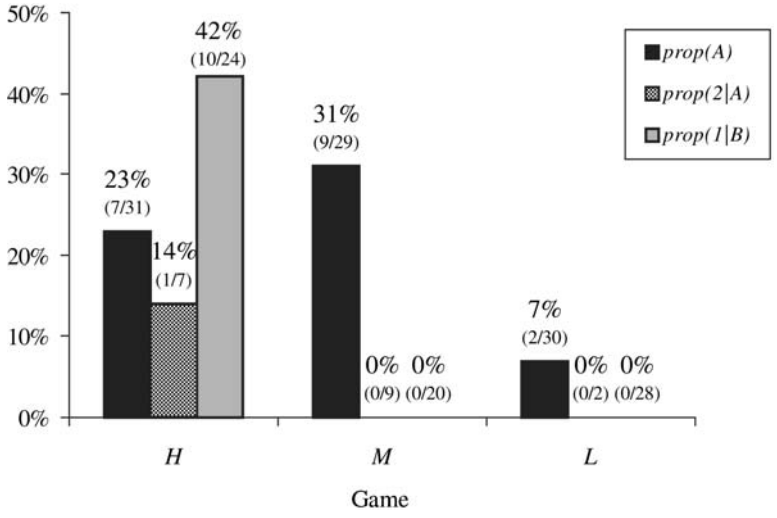
4.1 Behavior without Communication

The outcomes of the bargaining games can be fully characterized by the relative proportions of first movers and second movers choosing a non-subgame-perfect action, denoted as $prop(A)$ for the proportion of first movers choosing option A, $prop(2|A)$ for the proportion of second movers responding with option 2 to the first mover's A-action (reward), and $prop(1|B)$ for the proportion of second movers responding with option 1 to the first mover's B-action (punishment). Figure 2 presents the outcomes of the three games without communication (total numbers of observations in brackets; all data are included in Appendix A.1).

First, we compare games H and M, which only differ with regard to the efficiency of the second mover's punishment. In accordance with Hypothesis 1b(i), our results reveal that the decline of *PunEff* from game H to game M was associated with less punishment by second movers in the B-subgame. While 42% of the 24 B-moves in game H were punished, we did not observe any punishment of the 20 B-moves in game M ($p = 0.001$, χ^2 test, two-tailed). In the A-subgame, we observed no significant difference with regard to the number of second movers, who rewarded the first mover's A-move: only one of the 16 first movers choosing A in games M and H was not exploited. Moreover, there was no significant effect of *PunEff* on the first movers' behavior ($p = 0.562$, χ^2 test, two-tailed).

Comparing games M and L, i.e., reducing the first mover's opportunity cost of choosing B, but keeping *PunEff* at the same low level, we observed significantly more first movers choosing B in game L than in game M($p = 0.021$, χ^2 test, two-tailed). This observation is fully in line with Hypothesis 1b(ii). There was no significant effect of *MaxCost* on the second movers' behavior. Indeed, in the two games we observed neither punishment nor reward.

Figure 2
Proportions of Non-Subgame-Perfect Moves in Games without Communication



Summing up, the results of the no-communication treatments are in line with the predictions of our alternative interpretation of behavior. It seems that players perceive the games as conflict games in which they try to bring about their personal advantage. In particular, we did not observe any indication of social preferences (i.e., fairness, positive reciprocity, or efficiency seeking) in the *A*-subgame. Significantly, only *one* of the 18 *A*-moves was rewarded by an equal split of the pie.[8] As we will see, things change dramatically if we turn to the communication treatments.

4.2 The Communication Effect

As predicted by Hypothesis 2, when subjects had the opportunity for face-to-face communication via videoconferencing, the number of *A*-moves increased dramatically and only 5 of the 92 *A*-moves were exploited.[9] The first movers chose to play their SPE action *B* in only 13 of the 106 games with video communication, and 4 of these players were punished for this decision.

As already mentioned, this dramatic change of behavior after face-to-face communication might be rationalized by reputation effects, because the possibility of

[8] A similar lack of rewarding moves was reported in the bargaining experiments by, e.g., BOLTON, BRANDTS, AND OCKENFELS [1998], BOLTON, BRANDTS, AND KATOK [2000], CHARNESS AND RABIN [2002], and BRANDTS AND CHARNESS [2003].

[9] All differences between the video treatment and the no-communication treatment are significant on a 1% level (two-tailed χ^2 test).

Figure 3
Proportions of Non-Subgame-Perfect Moves in Games in the Video Treatments

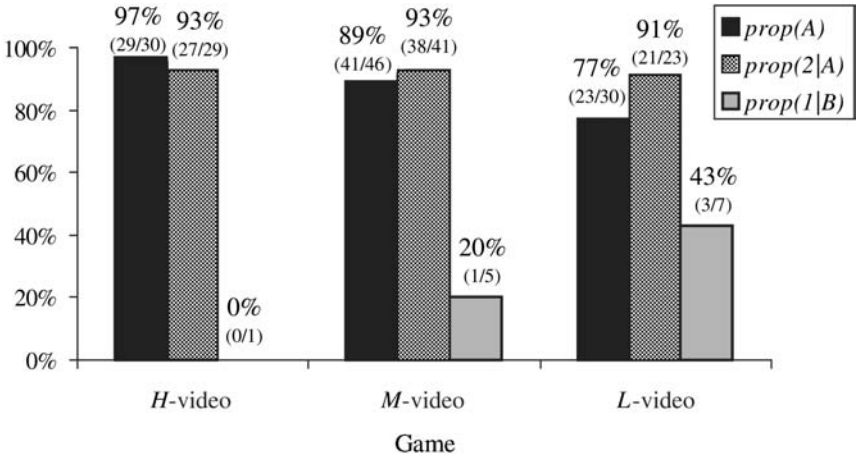
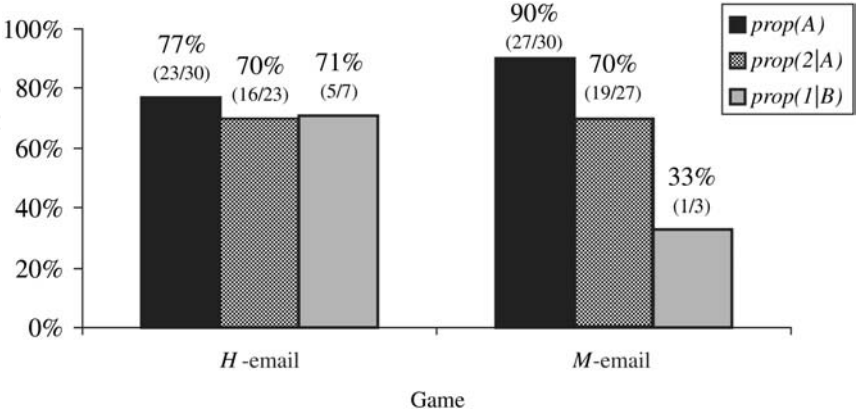


Figure 4
Proportions of Non-Subgame-Perfect Moves in the E-Mail Treatments



future interaction could have changed the incentives in the game, making the *A*-move and the respective reward more rational. In order to control for such effects, we ran the e-mail treatment of games *H* and *M* in which subjects were not allowed to reveal any personal information. If reputation is the cause for the increase of equal splits in the video treatment, we should observe no behavioral differences between the e-mail and the no-communication treatment (Hypothesis 3). As Figure 4 shows, this was not the case.

Even though subjects were allowed to communicate only via e-mail messages without any personal identification, the number of *A*-moves increased significantly, to 83% of all first mover decisions. Of these *A*-moves, 70% were answered by rewarding moves (*A2*).[10] In contrast to Hypothesis 3, the effect of communication cannot be fully attributed to reputation. However, in both e-mail treatments the ratio of rewards for the first movers' *A*-move was significantly lower than in the corresponding video treatments ($p < 0.027$, χ^2 test, two-tailed). Moreover, in the e-mail treatment of game *H*, we observed significantly fewer *A*-moves than in the video treatment of this game ($p = 0.023$, χ^2 test, two-tailed).

4.3 Behavior with Communication

As we have seen, subjects' behavior in the no-communication treatments is well in line with the idea that subjects perceive the games as conflict games and that the first movers' and the second movers' behavior depends on the monetary payoff consequences resulting from punishment. The question remains whether this is also the case in the communication treatments. Furthermore, although anonymous communication already leads to a strong increase of the equal-split outcome, face-to-face interaction reinforces this effect significantly. Therefore, the second question is where the face-to-face effect comes into play.

To answer these questions, the analyses combine subjects' decisions and the structure of their communication. Our observations reveal that irrespective of the games and communication treatments, right from the beginning of communication most of the partners explicitly stated a preference for the efficient equal-split outcome *A2*. In view of the monetary incentives of the games, there was, however, the problem of how to commit to each other. Particularly, the second movers had to convince the first movers that they would not exploit the latter's *A*-move. To solve this problem subjects appealed to mutual trust and social norms (e.g., fairness, solidarity) as well as noting second movers' opportunities to punish or reward the first mover. At the end of communication, in both treatments most of the pairs (about 70%) reached an agreement on the realization of *A2*. These observations indicate that subjects use communication to reach an agreement on the efficient equal-split outcome *A2*.

Theoretically, however, talk is cheap and there is legitimate doubt whether subjects will keep their promises. Thus, it was interesting to observe that, among the pairs committed to *A2*, on average 97% of all first movers and 87% of all second movers actually stuck to their bargain.

To test whether subjects' monetary payoff consequences from punishment, i.e., *MaxCost* and *PunEff*, have any more influence in the communication treatments, we compared the three games in the video communication treatment. Although both parameters differ among the three games, the structure of communication is rather

[10] All differences between the e-mail treatment and the no-communication treatment are significant at the 5% level.

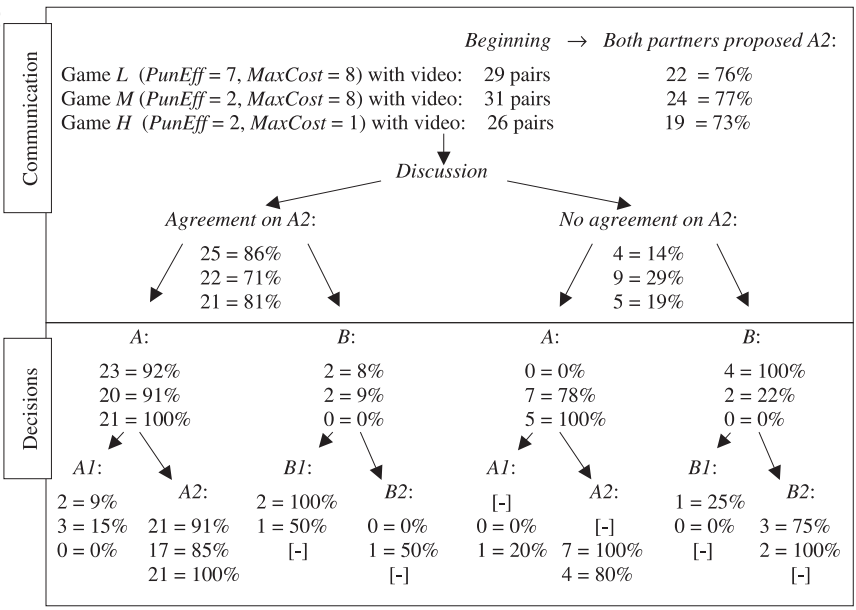
similar. As Figure 5 shows, most of the pairs focused on the efficient equal-split outcome right from the beginning of communication.

At the end of discussions, more than 79% of all pairs reached an agreement on *A2*. There was no significant difference with respect to the number of final agreements on *A2* or to their successful realization. The only statistically significant differences among the three games occurred among those without a mutual agreement.

Particularly, testing our hypotheses with the pairs who did not reach an agreement reveals that a decrease of *MaxCost* significantly decreased the number of first movers choosing *A*, which is in line with Hypothesis 1b(ii) ($p = 0.021$). As in the games without communication, *MaxCost* did not significantly influence the second movers' behavior.

Moreover, as in the games without communication, the efficiency of the second mover's punishment did not significantly affect either the number of first movers choosing $A (p = 0.505)$ or the number of second movers who rewarded this move ($p = 0.417$, χ^2 test, two-tailed). Since there were no observations for second movers' behavior in the *B*-subgame of game *H*, we cannot test whether *PunEff* influenced the number of second movers who punished the first mover's *B*-move, as predicted by Hypothesis 1b(i).

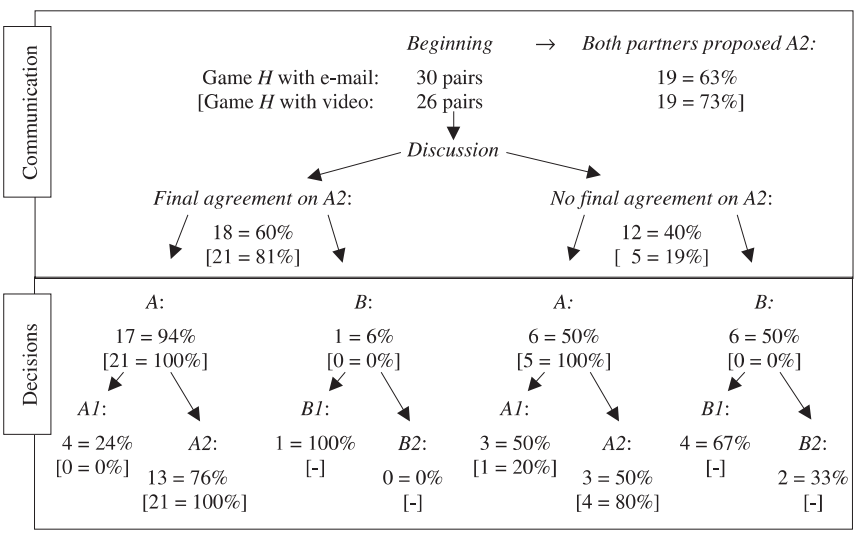
Figure 5
Communication and Decisions in the Video-Treatment of Games *H* and *L*



Summing up, in the communication treatments the monetary payoff consequences from punishment did not affect the behavior of those subjects who reached an agreement on the equal-split outcome. Our alternative Hypothesis 1b was only supported in cases without a mutual agreement.

The remaining question is, what causes the differences between face-to-face and e-mail communication. To answer this question, we first analyze the agreements and the decisions in the e-mail and face-to-face treatment of game H. As already mentioned, in these treatments communication was primarily used to reach an agreement on the efficient equal-split outcome *A2*. However, e-mail communication excluding personal identification was somewhat less effective in this regard than face-to-face communication ($p = 0.098$, χ^2 test, two-tailed). Moreover, a comparison of the two communication treatments revealed that, in the e-mail treatment, subjects were significantly less successful in realizing the agreed outcome *A2* than in the face-to-face treatment ($p = 0.019$, χ^2 test, two-tailed). In particular, this result was mainly driven by second movers, who in this treatment broke their explicit agreement on *A2* four times as often as first movers. Apparently second movers were less inclined to overcome the temptation to exploit the first mover's *A*-move when they made an agreement via e-mail. It might be that first movers were similarly less inclined to keep their promises, but they additionally had to fear the second mover's punishment. In fact, we observed that the only first mover who broke his promise to play *A* was punished by the second mover. Our data are summarized in Figure 6.

Figure 6
Agreements and Decisions in the Video and E-Mail Treatments of Game H



A comparison of the e-mail and video treatments of game *M* reveals roughly similar results. While there were no significant differences regarding first movers' decisions, after e-mail communication we observe more second movers exploiting the first movers' *A*-move than after face-to-face communication. Contrary to game *H*, however, this effect is significant only in those pairs without a mutual agreement ($p = 0.010$, χ^2 test, two-tailed).[11] These results imply that making communication more anonymous particularly affects the behavior of second movers, who are then more inclined to exploit the first movers' *A*-move.

5 *Summary and Discussion*

In this paper, we have investigated the effects of subjects' monetary payoff consequences resulting from the second mover's punishment and preplay communication in three two-stage sequential bargaining games. Our results show that both treatment variables had a significant influence on behavior. In particular, in the treatments without preplay communication, we observe that an increase in the first mover's maximum opportunity cost for choosing the equilibrium action *B* increases the number of first movers choosing the nonequilibrium action *A* and that an increase in the efficiency of the second mover's punishment increases the number of second movers punishing the first mover's *B*-move. Furthermore, we find almost all second movers exploiting the first movers' *A*-move. Only one of the 18 *A*-moves is rewarded by an equal split of the pie. These observations are in line with our alternative interpretation of the behavior, which assumes that decisions are driven by bounded rational self-interest.

Giving subjects the opportunity for communication dramatically increased the number of *A*-moves and the respective rewarding moves in all five communication treatments. Although the effect of e-mail communication was somewhat weaker than the effect of video communication, even after anonymous e-mail communication we observe significant changes of behavior. Consequently, reputation at most only partly explains the communication effect.

Analyzing the content of discussions reveals that communication is used to make an agreement on the efficient equal split outcome *A2*. The number of agreements and their successful realization are affected by the form of preplay communication, but not by the subjects' monetary payoff consequences resulting from punishment. Where communication is only through e-mail, we find somewhat fewer final agreements on *A2* and fewer realizations of this outcome. Obviously, more anonymous communication makes agreeing on the equal split somewhat more difficult, and even if subjects reach an agreement on this outcome, we observe that particularly second movers are less likely to realize it.

[11] This suggests that, if *PunEff* is lower, as is the case in game *M*, second movers feel somewhat more obliged to keep their promises even though they communicate only by anonymous e-mail messages. Comparing the e-mail treatments of games *H* and *M* did not reveal significant results, however ($p > 0.410$, χ^2 test, two-tailed).

We can only speculate about the reason for this dramatic communication effect. One approach may be to assume that, even with communication, subjects are still aware of the conflict inherent in the monetary payoff structure. Without communication, subjects are faced with uncertainty on whether their preferred outcome can be achieved, but with communication they can bargain with their partner to reach a compromise: The *second mover* loses in any case when *B* is chosen. It is thus reasonable to assume that he will not insist on his most preferred outcome *A1* in exchange for the certainty that *B* is not chosen. The *first mover* cannot be sure whether his *B*-move will be punished or whether his *A*-move will not be exploited. It is therefore reasonable to assume that the first mover will choose to refrain from the "hostile" *B*-move that might be punished by the second mover, if he can be sure that he obtains a reasonable return from the "friendly" *A*-move. Consequently, the only compromise solution for both subjects in our binary decision games seems to be *A2*. But, given that the first mover chooses *A*, why should the second mover keep his promise and choose *2* as observed in our experiment? The handiest explanation for this might be the one by FRANK [1987], who claims that there is some long-run fitness value to adherence to moral principles like honesty. Namely, he assumes that people who are willing to keep their promises have the ability to communicate this in a credible way and are able, therefore, to solve the commitment problem and to realize efficiency gains that are foreclosed to the dishonest.[12]

However, if we assume that, with communication, subjects are still in the same conflict situation as without communication, we should expect that at least the number of agreements after communication will be significantly affected by the subjects' monetary payoff consequences from punishment. In fact, we found no such effect. While this inconsequentiality of *PunEff* and *MaxCost* might be due to our binary decision environment, which does not allow for subtle changes of behavior, there is another observation that sheds some doubt on the assumption that with communication there is still a conflict between subjects. In all games, we observed a nearly equal majority of pairs (about 72%) with both partners proposing to realize *A*2 right from the beginning of communication.

Our alternative explanation, therefore, depends on the assumption that communication changes subjects' perception of the game by transforming the original conflict game into a kind of common-interest game: Without communication both partners are clearly guided by narrow self-interest, i.e., they strategically use their payoff advantages in order to implement an outcome that is solely in their own favor.[13]

[12] Recent experiments on the prisoners' dilemma game by FRANK, GILOVICH, AND REGAN [1993] and by BROSIG [2002] confirm this assumption by showing that people are able to credibly signal their willingness to cooperate, although, studying another type of bargaining games, OCKENFELS AND SELTEN [2000] came to a different conclusion. For a thorough psychological discussion of the commitment effect of communication see KERR AND KAUFMAN-GILLILAND [1994].

[13] In particular, in the *A*-subgame, in which second movers had the opportunity to reveal their social preferences by rewarding the first mover and realizing the efficient

Giving them the opportunity for communication, it is assumed that subjects' intentions are changed insofar as they now aim at realizing the efficient equal-split outcome. That is, they want to implement an outcome that generates an equal split of the maximum total payoff, thereby favoring *both* subjects. Consequently, our alternative explanation implies that communication adds some additional value to the realization of the efficient equal-split outcome and therefore reduces the conflict between the first and the second mover. This does not mean, however, that subjects are not at all aware of the conflict inherent in the monetary payoffs. Looking at the content of discussions reveals that subjects explicitly refer to the second mover's opportunities to punish or reward the first mover. But they only refer to these arguments in order to enforce the efficient equal-split outcome and not so as to implement an outcome that is solely in their own favor. Neither the number of agreements nor their successful realizations are affected by the monetary payoff consequences from the second mover's punishment. Only the decisions of a minority of those subjects, who did not agree on *A2*, are dominated by these consequences.

Although the data seem to be more in line with our second explanation, we cannot definitely reject the first approach as a possible explanation for them. However, there are at least two important insights into the communication effect, which are common for both explanations:

First, both explanations include a change in subjects' payoffs that makes it possible to solve the commitment problem associated with the realization of an outcome that was hardly ever realized without communication. While the first approach assumes some mental costs that allow subjects to agree on a compromise and prevent them from breaking their promise, the second approach assumes that communication provides some additional value to the realization of the efficient equal-split outcome that, from the outset, reduces the conflict between the first and the second mover. Second, in both explanations the medium of communication affects the change of subject's payoffs and therefore the magnitude of the communication effect. While in the first approach more anonymous communication is assumed to reduce the mental costs that allow subjects to agree on a compromise and that prevent them from breaking their promise, in the second approach it is assumed to reduce the value added to the efficient equal-split outcome.

Nevertheless, both explanations are speculative, because they rely on unobservable motives and preferences. In this sense our investigation is of an exploratory nature and should be rated as a first step toward explaining why and how communication changes subjects' behavior.

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equal-split outcome, we observed only one out of 18 subjects in the no-communication treatments who really did so. This finding rules out the existence of *social preferences*, the predominant approach in the literature, as a meaningful explanation in the interactions without communication. Technically, in terms of the social-preference theories, the weight given to the "social" part of the individual preference function has to be close to negligible to fit the above observation.

Appendix

A.1 Data

Game *H* (none) Number	First mover's decision		Second mover's decision			
	p(*A*)	*p*(*B*)	*p*(*A1*)	*p*(*A2*)	*p*(*B1*)	*p*(*B2*)
1	1	0	0	1		
2	0	1			0	1
3	1	0	1	0		
4	1	0	1	0		
5	0	1			1	0
6	0	1			0	1
7	1	0	1	0		
8	0	1			0	1
9	1	0	1	0		
10	1	0	1	0		
11	0	1			0	1
12	0	1			1	0
13	1	0	1	0		
14	0	1			1	0
15	0	1			0	1
16	0	1			0	1
17	0	1			0	1
18	0	1			1	0
19	0	1			0	1
20	0	1			1	0
21	0	1			0	1
22	0	1			0	1
23	0	1			1	0
24	0	1			0	1
25	0	1			1	0
26	0	1			0	1
27	0	1			1	0
28	0	1			1	0
29	0	1			1	0
30	0	1			0	1
31	0	1			0	1
Sum	7 (23%)	24 (77%)	6 (86%)	1 (14%)	10 (42%)	14 (58%)

Game *M* (none) Number	First mover's decision		Second mover's decision			
	p(*A*)	*p*(*B*)	*p*(*A1*)	*p*(*A2*)	*p*(*B1*)	*p*(*B2*)
1	0	1			0	1
2	0	1			0	1
3	0	1			0	1
4	0	1			0	1
5	1	0	1	0		
6	0	1			0	1
7	1	0	1	0		
8	0	1			0	1
9	1	0	1	0		
10	0	1			0	1
11	0	1			0	1
12	1	0	1	0		
13	1	0	1	0		
14	1	0	1	0		
15	0	1			0	1
16	0	1			0	1
17	0	1			0	1
18	0	1			0	1
19	0	1			0	1
20	0	1			0	1
21	1	0	1	0		
22	0	1			0	1
23	0	1			0	1
24	0	1			0	1
25	1	0	1	0		
26	0	1			0	1
27	1	0	1	0		
28	0	1			0	1
29	0	1			0	1
Sum	9 (31%)	20 (69%)	9 (100%)	0 (0%)	0 (0%)	20 (100%)

Game *L* (none) Number	First mover's decision		Second mover's decision			
	p(*A*)	*p*(*B*)	*p*(*A1*)	*p*(*A2*)	*p*(*B1*)	*p*(*B2*)
1	0	1			0	1
2	0	1			0	1
3	0	1			0	1
4	0	1			0	1
5	0	1			0	1
6	0	1			0	1
7	0	1			0	1
8	0	1			0	1
9	0	1			0	1
10	0	1			0	1
11	0	1			0	1
12	0	1			0	1
13	0	1			0	1
14	0	1			0	1
15	0	1			0	1
16	0	1			0	1
17	0	1			0	1
18	0	1			0	1
19	0	1			0	1
20	1	0	1	0		
21	1	0	1	0		
22	0	1			0	1
23	0	1			0	1
24	0	1			0	1
25	0	1			0	1
26	0	1			0	1
27	0	1			0	1
28	0	1			0	1
29	0	1			0	1
30	0	1			0	1
Sum	2 (7%)	28 (93%)	2 (100%)	0 (0%)	0 (0%)	28 (100%)

Game *H* (video) Number	First mover's decision		Second mover's decision			
	p(*A*)	*p*(*B*)	*p*(*A1*)	*p*(*A2*)	*p*(*B1*)	*p*(*B2*)
1	1	0	0	1		
2	0	1			0	1
3	1	0	0	1		
4	1	0	1	0		
5	1	0	0	1		
6	1	0	0	1		
7	1	0	0	1		
8	1	0	0	1		
9	1	0	0	1		
10	1	0	0	1		
11	1	0	0	1		
12	1	0	0	1		
13	1	0	0	1		
14	1	0	0	1		
15	1	0	0	1		
16	1	0	0	1		
17	1	0	0	1		
18	1	0	0	1		
19	1	0	0	1		
20	1	0	1	0		
21	1	0	0	1		
22	1	0	0	1		
23	1	0	0	1		
24	1	0	0	1		
25	1	0	0	1		
26	1	0	0	1		
27	1	0	0	1		
28	1	0	0	1		
29	1	0	0	1		
30	1	0	0	1		
Sum	29 (97%)	1 (3%)	2 (7%)	27 (93%)	0 (0%)	1 (100%)

Game *M* (video) Number	First mover's decision		Second mover's decision			
	p(*A*)	*p*(*B*)	*p*(*A1*)	*p*(*A2*)	*p*(*B1*)	*p*(*B2*)
1	1	0	0	1		
2	1	0	0	1		
3	1	0	0	1		
4	1	0	0	1		
5	1	0	0	1		
6	1	0	0	1		
7	1	0	0	1		
8	1	0	0	1		
9	1	0	0	1		
10	1	0	0	1		
11	1	0	0	1		
12	1	0	0	1		
13	1	0	1	0		
14	1	0	0	1		
15	1	0	0	1		
16	1	0	0	1		
17	1	0	0	1		
18	1	0	0	1		
19	1	0	0	1		
20	1	0	0	1		
21	1	0	0	1		
22	1	0	0	1		
23	1	0	1	0		
24	0	1			0	1
25	1	0	0	1		
26	1	0	0	1		
27	1	0	0	1		
28	1	0	0	1		
29	1	0	0	1		
30	1	0	0	1		
31	1	0	0	1		
32	1	0	0	1		
33	0	1			1	0
34	1	0	0	1		
35	1	0	0	1		
36	1	0	0	1		
37	1	0	0	1		
38	0	1			0	1
39	1	0	1	0		
40	1	0	0	1		
41	0	1			0	1
42	1	0	0	1		
43	1	0	0	1		
44	1	0	0	1		
45	1	0	0	1		
46	0	1			0	1
Sum	41 (89%)	5 (11%)	3 (7%)	38 (93%)	1 (20%)	4 (80%)

Game *L* (video) Number	First mover's decision		Second mover's decision			
	p(*A*)	*p*(*B*)	*p*(*A1*)	*p*(*A2*)	*p*(*B1*)	*p*(*B2*)
1	1	0	1	0		
2	1	0	0	1		
3	0	1			0	1
4	0	1			0	1
5	1	0	0	1		
6	1	0	0	1		
7	1	0	0	1		
8	1	0	0	1		
9	1	0	0	1		
10	0	1			0	1
11	1	0	0	1		
12	1	0	0	1		
13	0	1			1	0
14	1	0	0	1		
15	1	0	0	1		
16	1	0	1	0		
17	1	0	0	1		
18	1	0	0	1		
19	1	0	0	1		
20	1	0	0	1		
21	0	1			1	0
22	0	1			0	1
23	1	0	0	1		
24	1	0	0	1		
25	1	0	0	1		
26	1	0	0	1		
27	1	0	0	1		
28	0	1			1	0
29	1	0	0	1		
30	1	0	0	1		
Sum	23 (77%)	7 (23%)	2 (9%)	21 (91%)	3 (43%)	4 (57%)

Game *H* (e-mail) Number	First mover's decision		Second mover's decision			
	p(*A*)	*p*(*B*)	*p*(*A1*)	*p*(*A2*)	*p*(*B1*)	*p*(*B2*)
1	1	0	0	1		
2	1	0	0	1		
3	0	1			1	0
4	1	0	0	1		
5	1	0	1	0		
6	0	1			1	0
7	1	0	1	0		
8	1	0	0	1		
9	0	1			0	1
10	1	0	0	1		
11	1	0	1	0		
12	1	0	0	1		
13	0	1			0	1
14	1	0	0	1		
15	1	0	0	1		
16	1	0	0	1		
17	1	0	0	1		
18	1	0	0	1		
19	1	0	0	1		
20	1	0	0	1		
21	1	0	0	1		
22	1	0	1	0		
23	1	0	1	0		
24	1	0	1	0		
25	0	1			1	0
26	1	0	1	0		
27	0	1			1	0
28	1	0	0	1		
29	0	1			1	0
30	1	0	0	1		
Sum	23 (77%)	7 (23%)	7 (30%)	16 (70%)	5 (71%)	2 (29%)

Game *M* (e-mail) Number	First mover's decision		Second mover's decision			
	p(*A*)	*p*(*B*)	*p*(*A1*)	*p*(*A2*)	*p*(*B1*)	*p*(*B2*)
1	1	0	0	1		
2	1	0	0	1		
3	1	0	1	0		
4	1	0	0	1		
5	1	0	0	1		
6	0	1			0	1
7	1	0	0	1		
8	1	0	0	1		
9	1	0	0	1		
10	1	0	0	1		
11	1	0	0	1		
12	1	0	0	1		
13	0	1			1	0
14	1	0	0	1		
15	1	0	0	1		
16	1	0	0	1		
17	1	0	1	0		
18	1	0	0	1		
19	1	0	1	0		
20	0	1			0	1
21	1	0	0	1		
22	1	0	1	0		
23	1	0	0	1		
24	1	0	1	0		
25	1	0	1	0		
26	1	0	1	0		
27	1	0	0	1		
28	1	0	1	0		
29	1	0	0	1		
30	1	0	0	1		
Sum	27 (90%)	3 (10%)	8 (30%)	19 (70%)	1 (33%)	2 (67%)

A.2 Instruction, Decision Formula, and Pretests

A.2.1 Instructions (no-communication treatment)

Preliminary remarks: You are participating in an experimental analysis of individual decision-making. If you have questions concerning the experiment that are not answered by the following instructions, please give a hand signal. We will come to you and answer the questions.

During the experiment you will make a decision. In doing so you will earn money. The exact amount will also depend on your decision (possible losses will be charged against the 5 DM show-up fee). Your total earnings and your show-up fee will be paid off in cash against your identification number in the next week. Please, keep your identification number in safe custody.

Decision: You and another participant, who is randomly assigned to you, will make the following decision. One of you will first choose from the two options, TOP and BOTTOM, the one that he prefers (first mover). The other will be informed about this choice and then decide between the two options LEFT and RIGHT (second mover). That is, both of you will successively choose one of two options. The following table shows an example for a typical decision. The payoff is replaced by small letters.

		Second mover (SM)		
		LEFT		RIGHT
First mover (FM)	TOP	*a* DM for FM *b* DM for SM		*c* DM for FM *d* DM for SM
	BOTTOM	*e* DM for FM *f* DM for SM		*g* DM for FM *h* DM for SM

Example: Suppose, the first mover chooses TOP and the second mover, fully aware of the decision by the first mover, chooses RIGHT. Then, the first mover gets a payoff of *c* DM and the second mover gets a payoff of *d* DM.

In order to ensure that each participant did understand these instructions, we will run a short pretest.

Procedure: At the beginning of the experiment, we will choose by lot which of the participants is assigned to the role of the first mover and which is assigned to the role of the second mover.

Each *first mover* gets a big envelope including the decision formula. This formula contains the relevant payoffs within the table known from our example. After the first mover has decided on one of the two options, TOP or BOTTOM, he crosses out the row he does *not* want to choose. After that, he puts one of the two identification numbers into the small envelope, seals this envelope, and puts the envelope together

with the decision formula into the big envelope. The big envelopes will be collected by the experimenter and randomly assigned to the second movers.

The *second mover* sees the decision made by the first mover and then chooses between the two options LEFT and RIGHT. Like the first mover, the second mover has to cross out the option he does *not* want to choose. After that, the second mover also puts one of his two identification numbers into a small envelope and puts this envelope, together with the decision formula, back into the big envelope. To secure the anonymity of the first mover, the second mover is not allowed to open the envelope with the identification number of the first mover.

Please notice that neither before nor after the experiment will any participant get any information about the identity of his partner.

Finally, you are not allowed to communicate with the other participants during the experiment. Furthermore, in order to avoid influence on other subjects in future experiments, please do not talk to others about this session.

We thank you for your cooperation!

A.2.2 Instructions (communication treatments)

Preliminary remarks: You are participating in an experimental analysis of individual decision-making. Five minutes after you have received the instructions, we will come to you and answer any questions. If you have further questions during the experiment, please switch on the camera on the monitor. We will come to you and answer the questions.

During the experiment you will make a decision. In doing so you will earn money. The exact amount will also depend on your decision (possible losses will be charged against the 5 DM show-up fee). Your total earnings and your show-up fee will be paid off in cash after the experiment.

Decision: You and another participant, who is randomly assigned to you, will make the following decision. One of you will first choose from the two options TOP and BOTTOM, whichever he prefers (first mover). The other will be informed about this choice and then decide between the two options LEFT and RIGHT (second mover). That is, both of you will successively choose one of two options. The following table shows an example for a typical decision. The payoff is replaced by small letters.

		Second mover (SM)	
		LEFT	RIGHT
First mover (FM)	TOP	*a* DM for FM *b* DM for SM	*c* DM for FM *d* DM for SM
	BOTTOM	*e* DM for FM *f* DM for SM	*g* DM for FM *h* DM for SM

Example: Suppose the first mover chooses TOP and the second mover, fully aware of the decision by the first mover, chooses RIGHT. Then, the first mover gets a payoff of *c* DM and the second mover gets a payoff of *d* DM.

In order to ensure that each participant did understand these instructions, we will run a short pretest.

Procedure: At the beginning of the experiment, we will tell you whether you are assigned to the role of the first mover or to the role of the second mover. Both first and second mover receive a copy of the relevant payoff matrix.

[*E-mail treatment:* Before making your choice between the two options, you are given the opportunity to communicate with your assigned participant. Communication takes places in written form by computer. You can communicate about whatever you want, except that you are not allowed to reveal your identity by name, age, address, gender (please use neutral terms), field of study (that means also the names of lecturers, the subjects of lectures, or the content of lectures) or the like. If you do not follow these instructions, we have to exclude you from the experiment, that is, you will not receive a payment at the end of the experiment. Communication must not last longer than 15 minutes, but you are free to finish earlier. Please wait for further instructions.]

[*Video treatment:* Before making your choice between the two options, you are given the opportunity to communicate with your assigned participant. Communication takes place via a videoconferencing system. Communication must not last longer than 10 minutes, but you are free to finish earlier. Please wait for further instructions.]

After communication, the first mover will receive the decision formula. The first mover then has to decide on one of the two options, TOP or BOTTOM, and has to cross out the row he does *not* want to chose. After making his decision, he folds up the formula and switches on the camera on the monitor. We will then collect the decision formula and hand it out to the second mover.

The second mover sees the decision made by the first mover and then chooses between the two options LEFT and RIGHT. Like the first mover, the second mover has to cross out the option he does *not* want to chose. After making his decision, the second mover also switches on the camera on the monitor. We will then collect the decision formula.

Your earnings are calculated according to your and your assigned participant's decision.

[*E-mail treatment:* Please notice that you make your decision secretly in your cabin and that your earnings are paid off confidentially. You will not meet your assigned participant. You will not be informed about his identity, nor will he receive information about your identity. That is, you make your decision anonymously.]

[*Video treatment:* Please notice that you make your decision secretly in your cabin and that your earnings are paid off confidentially. Except in the communication phase, you will not meet your assigned participant.]

Finally, you are not allowed to communicate with the other participants during the experiment. Furthermore, in order to avoid influence on other subjects in future experiments, please do not talk to others about this session.

We thank you for your cooperation!

A.2.3 Pretest

1)

First mover (FM) \ Second mover (SM)	LEFT	RIGHT
TOP	6 DM for FM 15 DM for SM	−5 DM for FM 4 DM for SM
BOTTOM	22 DM for FM −4 DM for SM	6 DM for FM 5 DM for SM

You are the second mover. You see that the first mover has chosen option BOTTOM.

a) What is your payoff when you

(i) choose option LEFT? ..... DM; (ii) choose option RIGHT? ..... DM

b) What is the according payoff for the first mover?

(i) option LEFT ..... DM; (ii) option RIGHT ..... DM

2)

First mover (FM) \ Second mover (SM)	LEFT	RIGHT
TOP	−5 DM for FM 12 DM for SM	−5 DM for FM 12 DM for SM
BOTTOM	10 DM for FM 15 DM for SM	20 DM for FM −4 DM for SM

You are the first mover. When you choose BOTTOM,

a) which option gives you the higher payoff? Option .....

b) which option of the second mover gives him the higher payoff? Option .....

When you choose TOP,

c) does it make a difference whether the second mover chooses LEFT or RIGHT? YES NO

A.2.4 Decision Formula

First mover: Please choose one of the two options TOP or BOTTOM and cross out the row you do *not* choose.

Second mover: Please decide, in the row chosen by the first mover, on one of the two options LEFT or RIGHT, and cross out the option you do *not* choose.

Please don't forget

(i) to put one of your two identification numbers in the small envelope,
(ii) to seal this envelope, and
(iii) to put it in the big envelope.

		Second mover (SM)	
		LEFT	RIGHT
First mover (FM)	TOP	4 DM for FM 20 DM for SM	12 DM for FM 12 DM for SM
	BOTTOM	−4 DM for FM 5 DM for SM	10 DM for FM 7 DM for SM

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