# Communication channels and induced behavior

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Summary

This paper reports recent findings on the effects of cheap talk communication on behavior. It exemplifies how different communication channels influence decisions in various games and information environments and addresses possible consequences for the design of real-world economic environments.

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## A. Introduction

Communication is an element of various economic interactions. Whenever contracts have to be settled and agreements have to be made between economic agents, communication plays an essential role. That communication is also regarded as an important tool in e-commerce is recently demonstrated by eBay Inc.'s acquisition of the Luxembourg-based Skype Technologies SA, the global Internet communications company. As Meg Whitman, the President and Chief Executive Officer of eBay, put it: "*Communications is at the heart of ecommerce and community*."[1] Paying $2.6 billion for a company that uses nothing but downloadable software to make phone calls and that gives much of its service away for free seems a bit puzzling, however. Does implementing communication facilities for buyers and sellers really help to close more deals more quickly as it is argued by eBay? How does communication influence the outcome of economic interactions and, in particular, what does economics and management science say about the effects of communication?

That communication has the potential to significantly influence individual behavior was first reported by psychologists. Conducting experiments on social dilemma games they observed that communication between subjects could significantly increase cooperation rates. For example, investigating behavior in an eight-person prisoner's dilemma game, Dawes, McTavish, and Shaklee (1977) found that about 70 percent of subjects chose to cooperate after discussing the game face-to-face with their partners, while only 30 percent chose this outcome without communication.[2] These observations were later confirmed by experimental economists. Isaac, McCue, and Plott (1985) implemented face-to-face communication in a public good game experiment and observed a significantly positive effect on average cooperation rates. In a subsequent study, Isaac and Walker (1988) did not only replicate this finding, but also reported that the initial face-to-face contact between subjects had a long-lasting effect on behavior. To find out more about subjects' preferences for communication, Isaac and Walker (1991) tested whether subjects use face-to-face communication even if it is costly. Their results demonstrated that subjects communicated with each other even if they had to pay for it and they used the face-to-face contact successfully, i.e. there was still a significant increase of contributions to the public good.[3] The importance of communication for influencing individual behavior was particularly pointed out by Sally (1995). In a meta-study involving over 100 experiments on dilemma games he concluded: „*A few of the factors that should not affect a participant guided by self-interest are, in fact, quite important. Of greatest consequence are the communication variables.*" (p.78).

What are the reasons for the observed cooperation-enhancing effect of communication? In the „Handbook of Experimental Economics" Ledyard (1995, p. 158) described the state of the art of theoretical and experimental research on this effect as follows: "*We see that communication increases contributions in no-threshold environments with small (N < 15) groups. We do not know why. We also do not know what would happen in large groups.*"

This paper reports some recent results of economic research on the communication effect. It particularly focuses on the following questions: Which elements of face-to-face communication are of importance for the communication effect? Is it necessary that subjects see each other or is verbal communication enough to significantly influence behavior? How do mass media perform compared to face-to-face communication? Can online-media as video-conferences and email messages substitute direct face-to-face contacts? How do the observations made in public good games translate to bargaining settings as they are characteristic for many online interactions? What role does reputation play for the observed communication effects? How do different information structures influence behavior after communication? Is one-way communication as effective as two-way communication? Since the answers to these questions are based on economic experiments, section B shortly introduces the experimental method. Section C overviews the major results and Section D concludes.

## B. The experimental method

For a long time, economics has been viewed as a non-experimental science. Although the theoretical analysis of economic phenomena had already started in the eighteenth and early nineteenth centuries with the works of Adam Smith and Augustin Cournot, not until the mid-twentieth century did economists begin to systematically evaluate their theories under controlled laboratory conditions. Since then, there has been a rapid increase in the number of experimental studies covering a growing number of topics and research questions in economic sciences. With the growing use of the experimental method and with its success in providing an important foundation in bridging the gap between theory and observation, experimental economics is evolving into a "mainstream" subject in economic research. The award of the Nobel memorial prize in economic sciences to the experimental economist Vernon Smith in 2002 might be regarded as the most explicit sign of this development.

One of the earliest uses of the experimental method was to test the predictions made by economic theories. Traditionally, this task was regarded to be a subject only for econometrics. However, since econometricians base their tests on field data, it is often difficult for them to

properly control for the conditions under which the theories are generated. Laboratory experiments provide a greater degree of control and, therefore, make it more easy to generate replicable data under the same (ceteris paribus) conditions the theory assumes them to be. As a result, the application of experiments has turned out to be an appropriate method to test the predictions of various theories in economic sciences.

Testing theoretical predictions has not remained the only field of application for experimental economics. With the observation of regularities that could not be explained by conventional economic models, there was the need for further experiments that should generate more data in order to adjust existing theories or to develop fully new theories. For example, Allais's (1953) observation that subjects' behavior is not in line with the predictions made by expected utility theory initiated a series of subsequent experiments that were designed to test the robustness of Allais's paradoxes. Since the deviations from expected utility theory proved to be quite robust, alternative theories that should accommodate the observed violations (e.g., the prospect theory by Kahneman and Tversky, 1979, Tversky and Kahneman, 1992, or the regret theory by Loomes and Sudgen, 1982, 1987) were offered.

A third application of experiments is to offer empirically justified advice for policy makers and, therefore, to close the gap between economic theories and economic environments in the real world. One of the earliest experiments belonging to this strand of research was a study by Hong and Plott (1982), which was triggered by a dispute between the US Department of Transportation and the railroads on the regulation of the dry bulk commodity transportation industry. Recognizing "*the potential held by experimental methods for applications and policy research*" (Plott, 2001, p. xv), this experiment was followed by a series of other experiments covering the allocation of airport landing slots (Grether, Isaac, and Plott, 1981, Rassenti, Smith, and Bulfin, 1982), the pricing practices of the Ethyl Corporation (Grether and Plott, 1984), and the pricing practices in gas transportation networks (Plott, 1988). Since the 1990s, this line of research has been greatly extended. It now includes, among others, design features in the aerospace industry, in labor markets, in the telecommunications market, in e-commerce, and in environmental economics (see, e.g., the surveys provided by Roth, 2002, Sturm and Weimann, 2006, which deal with selective topics of this research).

With the growing use of experiments in all three fields of application, experimental economists have become more and more interested in the fundamental question of how certain parameters of the experimental environment influence the subjects' behavior. This part of experimental economics is still in its infancy and covers analyses of possible behavioral effects

caused by e.g., the magnitude of incentives, the presentation of the experimental task, or the composition of the subject pool. Analyzing the influence of the experimental environment is an important methodological issue for experimental research since experiments that are designed to properly distinguish between different hypotheses have to control not only for the variables that are assumed to be relevant to these hypotheses, but for all parameters of the experimental design that might have an influence on behavior. Knowing these parameters and their effects on individual behavior, thus, is an essential prerequisite for choosing the appropriate experimental design. Moreover, since these variables might play an important role in subjects' behavior in reality as well, evaluating their effects and implementing them under controlled conditions in the laboratory allows the gap between internal and external validity of experimental research to be closed.

How do the experimental studies discussed in this paper relate to the four categories of experimental research? First, they test whether the observed effects of communication are in line with the theoretical predictions. Second, since it turns out that conventional theory cannot fully explain the observed influences of communication, the studies provide a basis for the development of new theories that are able to capture the reported results. Third, the experiments give some hints about how and when communication facilities can be implemented in real economic environments. For example, they help to find out in what sense eBay might be right when stating that "*Skype can increase the velocity of trade on eBay, especially in categories that require more involved communications such as used cars, business and industrial equipment, and high-end collectibles.*"[4] Last but not least, the observed effects of different communication opportunities are also important from a methodological point of view since they help to conduct economic experiments in a more controlled way.

### C. Some experimental results on the communication effect

As has been mentioned in the introduction, there exists a number of experimental studies on dilemma games demonstrating that pre-play communication can significantly enhance contributions and, therefore, increase efficiency. From a game-theoretical point of view, however, pre-play communication in dilemma games is *cheap talk* and is not predicted to affect the subjects' decisions. Because economic theory is not sufficiently advanced to provide an explanation for the observed communication effects, systematic experimental investigations of different aspects of communication in different games and information environments can help to learn more about the underlying mechanics of the communication effect. The following paragraphs present some recent findings of experimental research on communication.

### C.I. Which elements of face-to-face contact are essential for the communication effect?

Given that most of the earlier experiments focused on face-to-face communication, it might be useful to explore in a first step which features of face-to-face communication are essential for the activation of cooperative behavior.

*Is it necessary that subjects see each other or is communication via an audio-conference enough to significantly increase cooperation rates?*

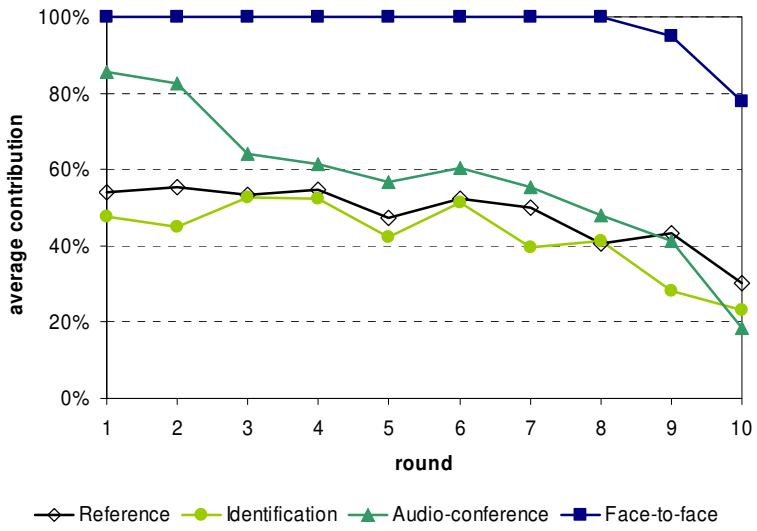
Brosig, Ockenfels, and Weimann (2003) investigated this question in a four-person public good game, which was repeated over ten rounds. In each of the ten rounds, every subject received an endowment of DM 2.00 and had to decide how much of the endowment to keep for oneself and how much to contribute to the group. Each individual contribution $x_i$ yielded a payment of $0.5 \cdot x_i$ for each of the four group members. Consequently, the payoff for each individual $\pi_i$ per round was $\pi_i = 2.00 - x_i + 0.5 \cdot \Sigma x_i$. According to the subgame perfect equilibrium prediction, subjects should keep their entire endowment for themselves, although their group-payoff would be maximized if all of them give their entire endowment to the group.

In order to separate the effects of visual and auditory communication they employed four treatments that only differed with regard to the communication opportunity. In their reference treatment, subjects played the repeated public good game without pre-play communication. In the identification treatment subjects could see their group members on a screen divided into four quads each showing another member. During the visual identification phase the signaling of game-relevant information was prohibited. In the audio-conference treatment subjects could talk to their group members via microphone and headphone for a maximum of ten minutes, but could not see each other. In the face-to-face treatment subjects were seated around a table where they could talk with each other for a maximum of ten minutes. Each of the treatments was played with five groups. The results are illustrated in Figure 1.

In line with previous research on public good games, subjects' average contribution without pre-play communication was about 48 percent of the total endowment. Interestingly, introducing pure visual identification did not significantly change this result ($p > 0.309$, two-tailed exact Mann-Whitney-*U* test[5]).[6] On average, subjects still contributed about 42 percent of their endowment. In contrast, giving subjects the opportunity to talk to their group members via an audio-conference significantly increased average cooperation rates in the first round ($p = 0.024$, two-tailed exact MW*U* test). But the cooperation-enhancing effect was not stable and subjects' average contributions soon reached the level observed in the reference and in the

identification treatment. Only when subjects communicated face-to-face and, therefore, used both the auditory and the visual communication channel nearly efficient and stable cooperation was reached.

Figure 1. Average contributions in reference, identification, audio, and face-to-face.



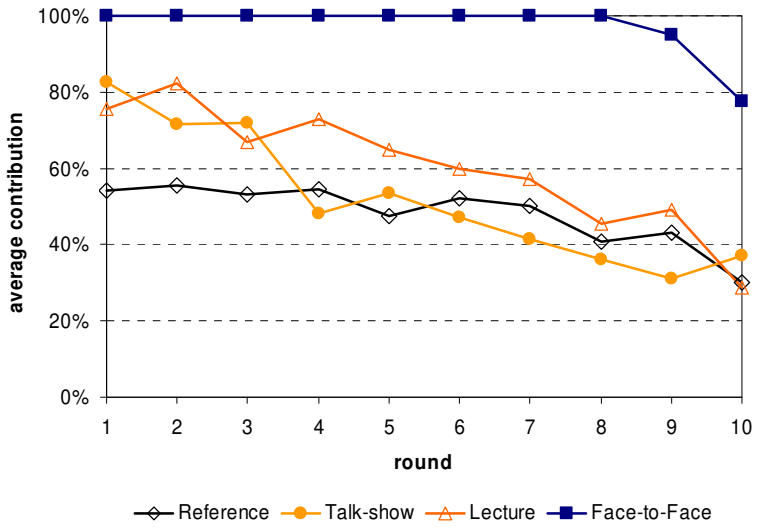

(Data source: Brosig, Ockenfels, Weimann, 2003)

*How do passive communication channels perform compared to active face-to-face contact?*

Communication in large groups is frequently executed via passive communication channels, i.e. subjects are exposed to the communication of others and cannot intervene. Given that, in reality, many public goods have to be provided in large groups (e.g., environmental goods such as clean air) it is important to know whether this form of communication can substitute the active face-to-face contact. Brosig, Ockenfels, and Weimann (2003) employed two additional treatments that provide passive communication technologies that are typically used by mass media: talk-show and lecture. In order to secure the comparability of passive and active communication channels, the observations were based on the same group size of four in all treatments. In the talk-show treatment, subjects were shown the video-taped discussion of another group of subjects. In this group subjects computed the payoff consequences resulting from various contribution decisions and pointed out the conflict between individual and group rationality. At the end of their discussion, all subjects agreed to cooperate conditioned on not being exploited.[7] In the lecture treatment subjects saw a video-lecture given by a faculty member who was not involved in the experiments. The lecturer explained the public good game, characterized both the subgame perfect equilibrium of this game and the outcome that maximizes the group payoff and described experimental finding revealing that face-to-face

communication has a substantial effect on cooperation rates. All subjects in either treatment saw the same video. Figure 2 illustrates the findings made in the two treatments.

Figure 2. Average contributions in reference, talk-show, lecture, and face-to-face.



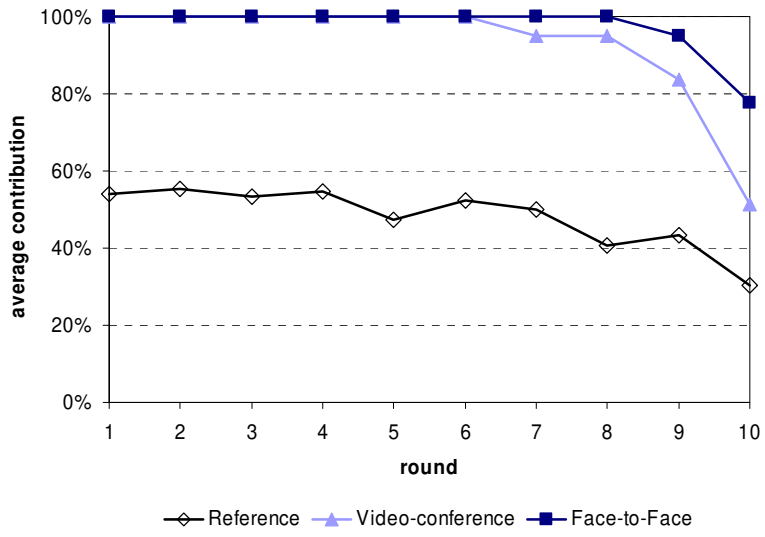

(Data source: Brosig, Ockenfels, Weimann, 2003)

In the first rounds, the two passive forms of communication resulted in somewhat higher contribution levels compared to the reference treatment (talk-show: $p = 0.032$ in round 1, lecture: $p = 0.087$ in round 2), though even in these two rounds the levels were significantly lower than the ones realized after face-to-face contact ($p < 0.049$, two-tailed exact MW*U* test). As observed with auditory communication, cooperation was not stable and broke down soon thereafter. In fact, the three treatments (audio-conference, lecture, and talk-show) did not significantly differ regarding the observed effects on individual behavior ($p > 0.221$, two-tailed exact MW*U* test). The finding that passive communication technologies are not as effective as active face-to-face communication raises rather little hope that these technologies can be used to effectively increase public good contributions in large groups.

*Can the use of online-media such as video-conferences and email messages substitute direct face-to-face contacts?*

Video-conferences and email chats are frequently implemented in economically relevant online interactions. But does communication that is based on electronic communication media reproduce the cooperation-enhancing effect of direct face-to-face communication? In their experiment, Brosig, Ockenfels, and Weimann (2003) analyzed a seventh treatment in which subjects communicated with each other via a video-conferencing system that combined the equipment used in the identification and in the audio-conference treatments.

Figure 3. Average contributions in reference, video-conference, and face-to-face.

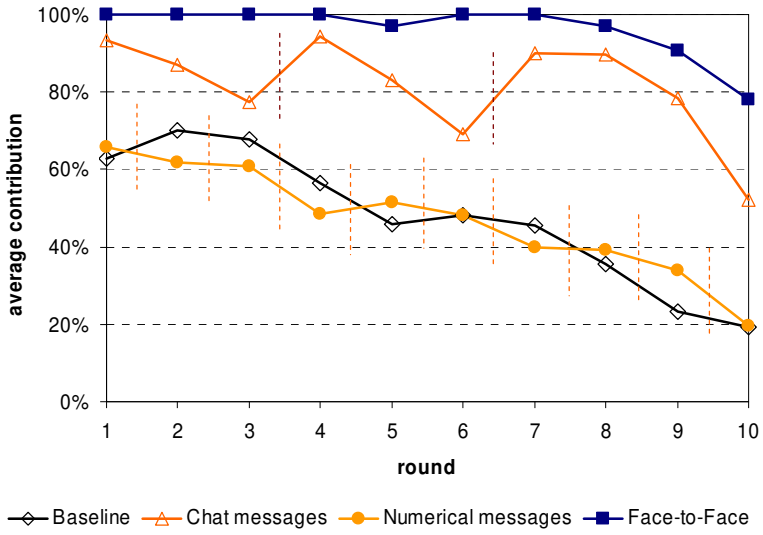



(Data source: Brosig, Ockenfels, Weimann, 2003)

In neither of the ten rounds, the average cooperation levels observed after video communication differed significantly from the average levels observed after face-to-face communication ($p > 0.245$, two-tailed exact MW*U* test). In both treatments subjects reached nearly full and stable cooperation levels. Apparently, communication via a video-conference has the same favorable features as direct face-to-face contact. What about email chats?

Bochet, Page, and Putterman (2005) compared the effects of face-to-face communication with the exchange of text messages and the exchange of numerical messages in a repeated public good game. The game design was similar to that employed by Brosig, Ockenfels, and Weimann (2003), i.e. games were played in groups of four and repeated over ten rounds. In their baseline treatment, subjects played the public good game without pre-play communication. In the chat room treatment, subjects were given the opportunity to exchange text messages with each other. In contrast to Brosig, Ockenfels, and Weimann (2003), subjects were not only allowed to communicate before the first round, but also before the fourth and the seventh round. In the numerical cheap talk treatment, each round consisted of two stages, the communication stage, in which subjects could exchange numbers representing possible contributions (to which they were not committed), and the decision stage, in which actual contributions were entered. In the face-to-face treatment subjects were allowed to see and talk to other group members for five minutes. Each treatment was played with at least 8 groups. Figure 4 illustrates the average contributions observed in the four treatments. The dashed lines mark the communication stages which were implemented after the first round.

Figure 4. Average contributions in baseline, chat, numerical messages, and face-to-face.

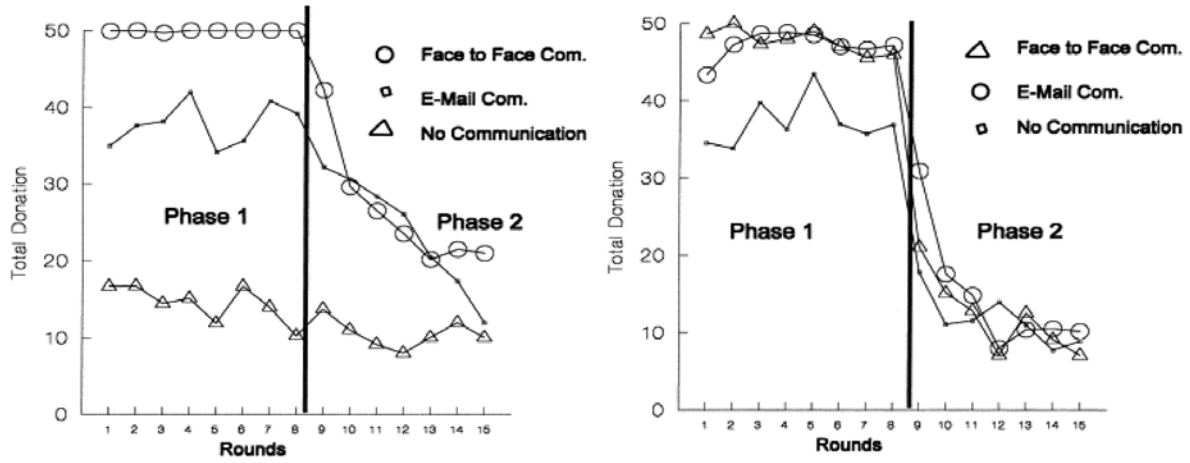



(Data source: Bochet, Page, Putterman, 2005)

Confirming previous observations, face-to-face communication resulted in nearly efficient cooperation rates while the baseline treatment produced an average contribution of about 48 percent of the initial endowment. Similar to the audio-conference treatment employed by Brosig, Ockenfels, and Weimann (2003), the exchange of text messages seemed to increase contributions, but only in rounds that immediately followed the communication stages. In total, the average contribution in the chat treatment was significantly higher than that in the baseline treatment ($p < 0.050$), but weakly significantly lower than that in the face-to-face communication treatment ($p < 0.100$, two-tailed MW*U* test). In contrast to text messages, the mere exchange of numerical messages did not affect the average level of contributions ($p > 0.100$, two-tailed MW*U* test).

That email communication has a positive influence on cooperation (though, it is not as effective as face-to-face communication) was also observed in the public good game experiment conducted by Frohlich and Oppenheimer (1998). The experiment consisted of two consecutive phases: In phase 1 subjects played seven rounds of a five-person public good game under either of three different pre-round communication opportunities: no communication, email communication, or face-to-face communication. In phase 2 subjects played another five rounds of this game without communication. Subjects were neither informed about the number of rounds that would be run in the two phases nor told that phase 2 would follow phase 1. All treatments were conducted with 5 to 6 groups.

Figure 5. Average contributions made in the first (left) and the second treatment (right).




(Source: Frohlich and Oppenheimer 1998, p. 398, 399)

Face-to-face communication led to virtually complete cooperation in phase 1, while email communication was significantly less effective in this phase ($p < 0.025$, MW*U* test). Although subjects were allowed to communicate only in the first phase and did not know about the second, both forms of communication had a positive effect on the average contribution in phase 2 ($p < 0.002$, MW*U* test on the individual level). This lingering effect did, on average, not depend on whether subjects communicated face-to-face or via emails.

In a second treatment, Frohlich and Oppenheimer (1998) changed the incentives in a way that it was profitable for subjects to contribute their total endowment in each round. As a consequence, they could no longer find a significant difference between the effects of the two communication media. This result suggests that the communication channel is less relevant when there is no conflict between the players' interests. There was also no long-lasting effect of communication on cooperation in phase 2 (in which subjects played five rounds of the conventional public good game). Apparently, average contributions are not affected by communication that is not directly related to the dilemma situation and that is conducted without knowledge about the future interaction.

## C.II. How do the observations obtained in public good experiments translate to bargaining games?

The previous findings lead to the conclusion that new electronic communication technologies as video-conferences and email messages may have a good chance to (at least) partly substitute conventional communication channels that require people to be near to each other in a physical sense. This is of particular importance for the design of economic institutions in on-

line environments. In these environments – as also in many offline settings – economic agents often have an incentive to break agreements in order to receive additional individual gains. While there have evolved institutions to prevent such a defective behavior in offline interactions (e.g., written contracts, commercial law, warranties), in online environments it is more difficult and costly for conventional institutions to prevent the interacting partners from defective behavior. In recent times, growing experimental and theoretical research has been devoted to the development of systems that can substitute for the conventional institutions in e-commerce (see e.g., Dellarocas, 2003, Bolton, Katok, and Ockenfels, 2004, 2005). Given the result that electronically mediated communication can enhance cooperative behavior, this form of communication might be used as an informal mechanism to increase the incentive to keep agreements and, therefore, to promote the efficiency of outcomes. But how do the observations obtained in public good games translate to bargaining settings, as they are more characteristic for many online environments? Particularly, given that online interactions often involve incomplete information between economic agents, there is the question on how the information structure interacts with the communication effect.

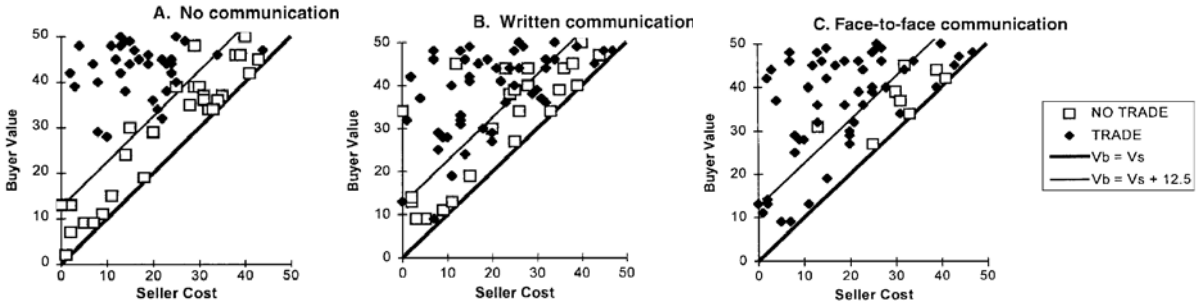
*How do conventional communication media perform in bargaining games?*

That conventional face-to-face communication can also affect bargaining outcomes was suggested by, e.g., Radner and Schotter (1989) and Roth (1995). Radner and Schotter (1989) compared face-to-face bargaining with the sealed bid mechanism in a bilateral bargaining game with incomplete information. They observed that under all performance (efficiency) measures face-to-face bargaining "*clearly out-performed the sealed-bid mechanism in all its variations tested*" (p. 209). In Roth's (1995) experiment, subjects played the ultimatum game introduced by Güth, Schmittberger, and Schwarze (1982). In this game a fixed amount of money is divided between two players. The proposer suggests a division and the responder either accepts or rejects the offer. In the former case the pie is allocated as proposed while in the latter case both players receive nothing. Roth (1995) reports that pre-play face-to-face communication increased the average offer made by proposers (42.7 percent vs. 48.5 percent) and, thus, decreased the frequency of disagreements (33 percent vs. 4 percent). Restricting the content of communication to game-irrelevant talk did not much change these results. Though, in contrast to unrestricted communication, the percentage of equal split offers did not increase after game-irrelevant talk (no communication: 31 percent, unrestricted communication: 75 percent, restricted communication: 39 percent).[8]

The effects of different pre-play communication opportunities (written, phone, face-to-face) on bilateral bargaining were analyzed by Valley, Moag, and Bazerman (1998, study 2). They employed a version of the "Acquire-a-Company" game of Samuelson and Bazerman (1985), in which two players bargain over the price of a company. The seller knows its value which is randomly drawn from a uniform distribution between \$0 and \$100. The buyer knows that the company is worth 1.5 times as much to him as it is to the seller. In the written communication treatment subjects could write notes, which were carried back and forth between bargaining partners, in the phone communication treatment subjects could talk to their partners via a telephone, and in the face-to-face communication treatment bargaining partners were send to separate areas where they could negotiate with each other. In all treatments, the content of communication was not restricted and communication lasted for about 20 minutes except for the written treatment, where subjects were given 30 minutes. The results demonstrate that face-to-face contact lead to significantly more mutually beneficial agreements (12 vs. 6, $\chi^2$ = 6.14, $p < 0.01$) and significantly less impasses than written communication (4 vs. 14, $\chi^2$ = 5.42, $p < 0.05$). Bargaining via telephone also significantly reduced the rate of impasses compared to written communication (3 vs. 14, $\chi^2 = 7.29$, $p < 0.01$). In all three communication treatments, joint gains were significantly higher than theoretically predicted (face-to-face: $t_{(20)} = 5.76$, $p < 0.0001$, phone: $t_{(20)} = 5.25$, $p < 0.0001$, written: $t_{(26)} = 3.61$, $p < 0.001$) and did not significantly differ between the treatments ($F_{(2,66)} = 2.09$, $p = 0.13$).

The effects of written and face-to-face communication compared to no communication were investigated by Valley, Thompson, Gibbons, and Bazerman (2002). Their experiment was based on a bilateral bargaining game similar to that used by Radner and Schotter (1989). In this game, a buyer and a seller were each given a randomly and independently drawn valuation for a hypothetical good. The buyer and the seller each named a price at which they were willing to transact. If the buyer's bid was greater than what the seller's asked for, the good was traded at the average of their two prices. If not, no trade occurred. In the no communication treatment subjects played the game without pre-play communication, in the written communication treatment subjects could exchange written messages for 13 minutes, and in the face-to-face treatment they were allowed to meet and talk for 6 minutes in separate rooms. In neither of the treatments the content of communication was restricted. Figure 6 illustrates the trade outcomes and includes the 45-degree line, on which the buyer's valuation $v_b$ and the seller's valuation $v_s$ are equal, and a second line, below which the Chatterjee-Samuelson linear equilibrium predicts that no trade will occur ($v_b = v_s + 12.5$).

Figure 6. Trade outcomes after no, written, and face-to-face communication.




(Source: Valley, Thompson, Gibbons and Bazerman, 2002, p. 138)

Valley, Thompson, Gibbons, and Bazerman (2002) observed that without communication 89 percent of the high value trades ($v_b > v_s + 12.5$) were realized, but only 11 percent of the low value trades ($v_s < v_b < v_s + 12.5$). With written communication a somewhat lower fraction of high value trades was achieved (82.3 percent), but a much higher fraction of low value trades (44 percent). Face-to-face communication was even more effective and resulted in significantly more high value and low value trades (94 percent and 74 percent).[9] The increase of trades after communication was attained by using two coordination strategies: agreement on a single price and mutual revelation of values. Since coordination in the face-to-face treatment was less compromised by deception, however, there were more mutually beneficent trades in this treatment than after written communication.

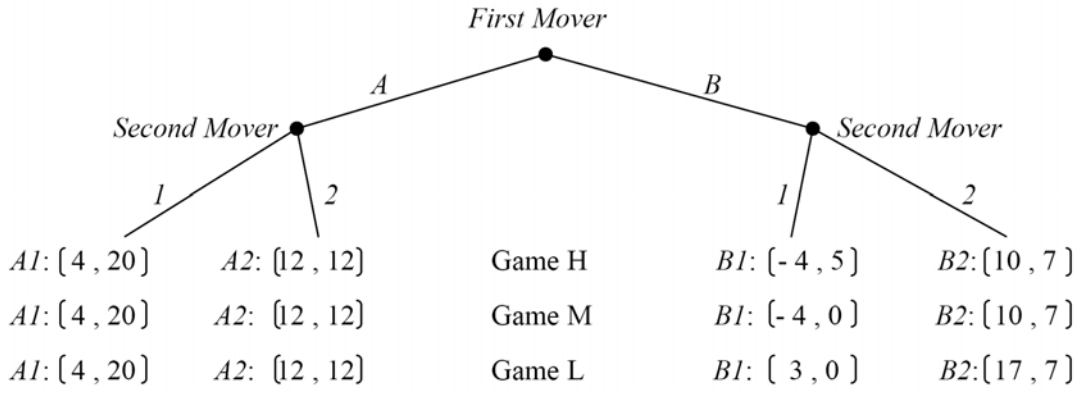
*How do online-media such as video-conferences and emails affect bargaining outcomes?*

While previous studies on bargaining games focused on conventional communication media as written messages and face-to-face contacts, Brosig, Weimann, and Yang (2004) directly tested the effects of online communication technologies on bargaining outcomes. In their study subjects played a one-shot bilateral bargaining game in which the first mover had to choose between the two options A and B and, informed about the first mover's decision, the second mover determined the final outcome of the game by deciding for either option 1 or option 2. The payoffs were chosen in a way that the first mover favors the subgame perfect equilibrium outcome in subgame B (B2) and the second mover prefers the (not perfect) Nash equilibrium in the subgame A (A1). There were two sanctioning means implemented in the payoff structure of this game: If the first mover decided for the subgame perfect equilibrium action B, the second mover had the opportunity to punish him, i.e. reduce his payoff by choosing the off-equilibrium action 1. If the first mover chose to deviate from the subgame perfect equilibrium, the second mover could reward him, i.e. increase his payoff by deciding

for the off-equilibrium action 2. The game was played under three communication conditions: no communication, email communication, and video communication. In the no communication treatment subjects played the game without any form of pre-play communication, in the email treatment, subjects could exchange email messages for a maximum of 15 minutes via the computer, and in the video treatment subjects communicated by the use of a video-conferencing system.

The specific game design allowed to test an additional feature of the communication effect: As observed in previous experimental studies subjects use communication for coordinating their behavior. The analysis of the content of communication in the public good experiment conducted by Brosig, Ockenfels, and Weimann (2003) particularly showed that "*The use of promises together with threats in the communication phase apparently serves to coordinate the attempt to reach persistent cooperation.*" (p. 22). This finding suggests that the opportunity to sanction behavior plays an important role for coordination and, therefore, for the communication effect. But how does the effectiveness of the subjects' sanctioning means interact with the communication effect? In order to investigate this question Brosig, Weimann, and Yang (2004) played three versions of the bargaining game varying the effectiveness of sanctioning means, which is according to the heuristic developed by Mitropoulos, Weimann, and Yang (2001) determined by two parameters: the efficiency of the second mover's punishment (PunEff) and the first mover's maxmin loss of choosing B instead of A (MxCost).[10]

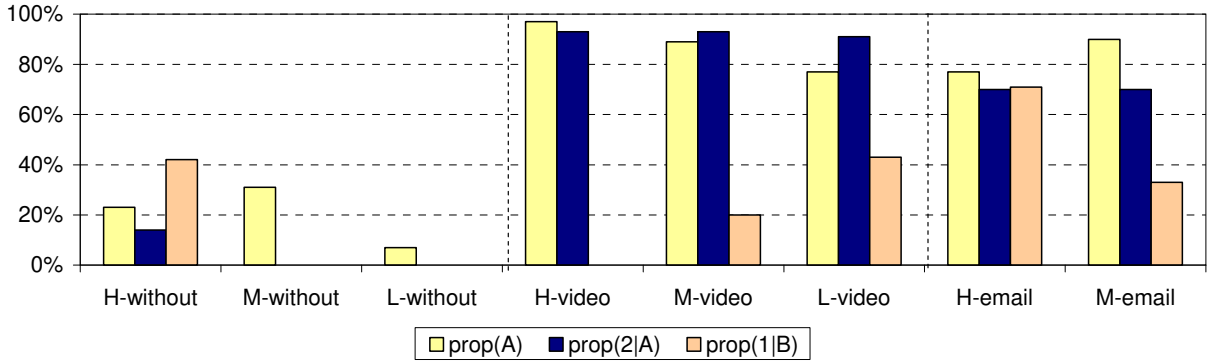
Figure 7. The three sequential bargaining games varying MxCost and PunEff.




The observations made in the treatment without communication were fully in line with the predictions made by Mitropoulos, Weimann, and Yang (2001). While reducing PunEff from game H (PunEff = 7) to game M (PunEff = 2) lead to significantly less punishment by second movers in the B-subgame ($p = 0.001$), reducing MxCost from game M (MxCost = 8) to game L (MxCost = 1) lead to a significant increase of the number of first movers choosing B in-

stead of A (p = 0.021, two-tailed $\chi^2$ test). Figure 8 presents the bargaining outcomes observed after no communication, after video communication, and after email communication. Prop(A) denotes the proportion of first movers choosing option A, prop(2|A) denotes the proportion of second movers responding with option 2 to the first mover's A-move, and p(1|B) denotes the proportion of second movers responding with option 1 to the first mover's B-move.

Figure 8. Bargaining outcomes after no, video, and email communication.




(Data source: Brosig, Weimann, and Yang, 2004)

Playing the three games after video communication significantly increased the number of first movers deciding for A and significantly decreased the number of second movers exploiting this move by choosing 1 ($p < 0.001$ for all games, two-tailed $\chi^2$ test). Although subjects explicitly referred to their sanctioning opportunities in the discussions, neither the number of pairs who agreed on the equal split outcome A2 (game H: 81%, game M: 71%, game L: 86%) nor the number of pairs in which this agreement was successfully realized (game H: 100%, game M: 77%, game L: 84%) was significantly affected by PunEff and MaxCost. Only in those pairs who could not reach an agreement, the effectiveness of sanctioning means influenced bargaining outcomes. Introducing email communication in games H and M had a similar effect on behavior. There were significantly more first movers choosing A and significantly more second movers rewarding this move by deciding for option 2 than without communication ($p < 0.005$ for all games, two-tailed $\chi^2$ test). Although, the behavioral changes after email communication were weaker than those observed after video communication (first mover: $p = 0.023$ in game H, second mover: $p < 0.027$ in games H and M, two-tailed $\chi^2$ test).[11]

Thus, similar to conventional communication media, online-communication opportunities as face-to-face contact via video-conferences and the exchange of written messages via emails significantly affect bargaining outcomes. Though, in line with the observations made in public good games, email communication is somewhat less effective than video communication.

*Is the influence of communication due to reputation effects?*

One possible explanation for the dramatic change of behavior after pre-play communication are reputation effects, i.e. effects that are due to the possibility that subjects might meet again outside the laboratory. Even in previous studies using e-mail or written communication, 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. were allowed to reveal their own identity. The email communication treatment implemented by Brosig, Weimann, and Yang (2004) was designed to control for such reputation effects. They did not only prohibit subjects to give any private information that could reveal their identity (e.g., names, addresses, phone numbers, field of study), but tried also 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 (sound-proof) cabins, where they had to stay for the whole experiment. After the experiment, subjects were paid off one after another and left the cabins and the room separately.

As reported above, even the exchange of anonymous email messages significantly changed the subjects' behavior (though, not as much as video communication). This indicates that the effect of communication can only to a minor degree be attributed to reputation effects. This is good news for online environments since it implies that even the anonymous exchange of messages can ease the realization of mutually beneficent bargaining outcomes.

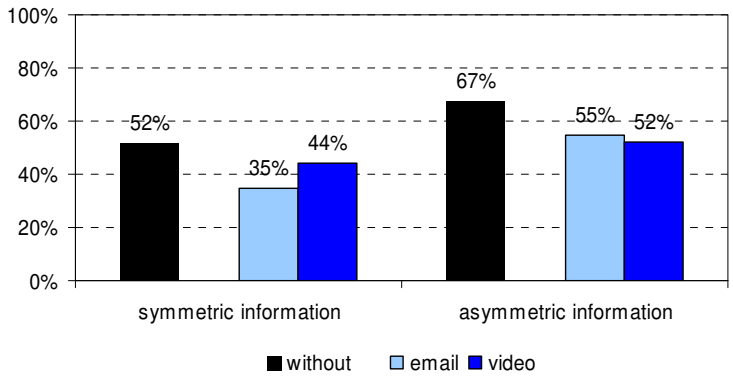
*How do different information structures influence behavior after communication?*

Although there are experiments that investigate the influence of communication in bargaining games with one-sided incomplete information (see Valley, Moag, and Bazerman, 1998), and with two-sided incomplete information (see Radner and Schotter, 1989 and Valley, Thompson, Gibbons, and Bazerman, 2002), none of these studies directly compared the communication effect between the two information environments. Given that many online interactions involve some form of incomplete information, it is important to know, however, how the effects of communication interact with the specific information structure involved in the bargaining process. Brosig, Ockenfels, and Weimann (2002) analyzed electronic bargaining with incomplete information varying the information about buyer characteristics available to the

seller (symmetric and asymmetric)[12] and the communication medium available to the bargaining partners (none, email, and video-conference). Their experiment was based on a sequential bilateral bargaining game which was played over two rounds. On the first stage of this game, the seller submitted an ask for a hypothetical good and the buyer, informed about this ask, submitted a bid on the second stage. If the buyer's bid exceeded the seller's ask, the good was traded for a price, which was halfway between the two. If not, no trade occurred. In order to determine the buyer's and the seller's valuation, two numbers were randomly and independently drawn from a uniform distribution [0, 100]. The lower number was the seller's cost and the higher number was the buyer's reservation value. This procedure ensured that the gain from trade was never negative. To facilitate statistical analyses and to make the data across treatments straightforwardly comparable, the same costs and reservation values were used in all sessions and treatments.

In the symmetric information treatment, the seller's cost and the buyer's reservation value were private information, while in the asymmetric information condition, only the cost value was private information, i.e., the seller was informed about both, his costs and the buyer's reservation value. In the two communication treatments, subjects could make proposals regarding their bids, but they were not permitted to reveal any personal information like their names and phone numbers. In the email treatment, subjects were allowed to exchange email messages for a maximum of 15 minutes via the computer and in the video treatment subjects were allowed to communicate for a maximum of 10 minutes via a video-conference.

Figure 9. Sellers' profit share realized after no, email, and video communication.




(Data source: Brosig, Ockenfels, and Weimann, 2002)

In both information treatments, introducing pre-play communication lead sellers to submit significantly lower asks than without communication ($p < 0.018$, two-tailed MW*U* test). In particular, after communication there were significantly more buyers and significantly more

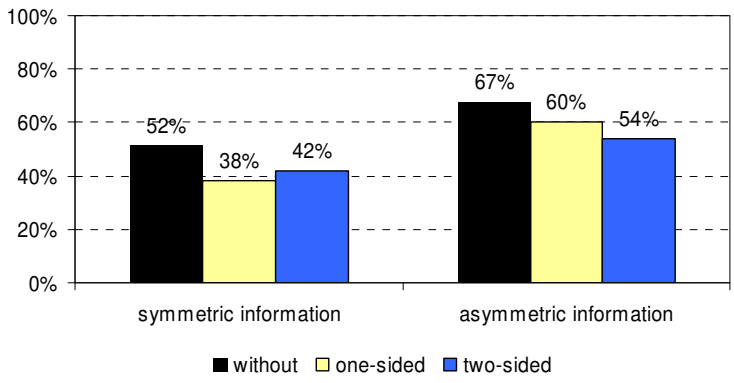
sellers who wanted to realize the equal split than in the treatments without communication ($p < 0.018$, two-tailed $\chi^2$ test). As a consequence, sellers' (buyers') profits tended to decrease (increase) with communication ($p < 0.024$ with asymmetric information, two-tailed MW*U* test).[13] In contrast to the previous study, Brosig, Ockenfels, and Weimann (2002) did not observe significant differences between the effects resulting from email and video communication ($p > 0.341$, two-tailed MW*U* test and two-tailed $\chi^2$ test).

In line with economic theory, giving sellers additional information about the buyer's reservation value significantly increased their average share of the total gain from trade. This was not only true without communication, but was also observed after pre-play communication ($p < 0.016$, two-tailed MW*U* test). As theoretically predicted, there was no significant difference in buyers' behavior across the two information treatments.

*Is one-way communication as effective as two-way communication?*

Interactions in online environments often involve some form of one-way communication, i.e. only the sellers can send messages. Brosig, Ockenfels, and Weimann (2002) employed two additional treatments with one-way communication (email and video) in their study in order to test whether the direction of communication has any effect on bargaining behavior.[14] In the two one-way communication treatments, only the seller was allowed to communicate. His message was transferred to the buyer together with the decision formula filled in with the seller's ask. Similar to the two-way communication treatments, the seller could use the message to make proposals regarding the buyer's bid, but was not permitted to reveal any personal information. While the email message transferred to the buyer was restricted to 20 lines on the computer screen, the video message could not exceed 5 minutes.

Figure 10. Sellers' profit share realized after no, one-way, and two-way communication.

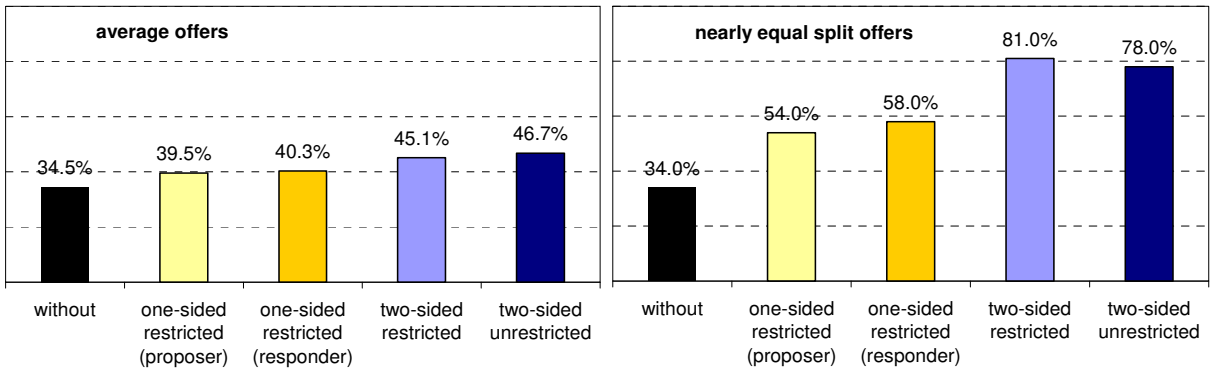



(Data source: Brosig, Ockenfels, and Weimann, 2002)

While uninformed sellers submitted significantly lower asks with both, one-way and two-way communication, informed sellers significantly reduced their asks only with two-way communication ($p < 0.018$, two-tailed MW*U* test). That is, one-way communication did not significantly affect the informed sellers' behavior. Similar to two-way communication, one-way communication resulted in significantly lower (higher) profit shares for sellers (buyers) ($p < 0.041$, two-tailed MW*U* test). This was true for both information treatments, though with asymmetric information the effect of one-way communication was somewhat weaker than the effect of two-way communication ($p < 0.090$, two-tailed MW*U* test). The medium used for one-way communication (email vs. video-conference) had no additional effect on behavior.

The previous findings demonstrate that even one-way communication can significantly decrease the sellers' profit shares and, therefore, reduce the inequality between the buyers' and the sellers' profits (which was particularly observable in the treatments with informed sellers). Although, one-way communication was somewhat less effective in this respect than two-way communication. Schmidt and Zultan (2004) report similar findings regarding the direction of communication. In their study on the ultimatum game they particularly investigated the effect of one-way communication that was restricted to game-irrelevant talk. In total, they employed five treatments: one without pre-play communication, two with restricted one-way video communication (proposer talks, responder talks), and two with two-way video communication (restricted, unrestricted). In the one-way communication treatments, either the proposer or the responder could send a video message to the partner which was restricted to two minutes.

Figure 11. Behavior observed after no, one-way, and two-way communication.




(Data source: Schmidt and Zultan, 2004)

Schmidt and Zultan (2004) could qualitatively replicate the results reported by Roth (1995): Both forms of two-way video communication increased average offers and decreased the frequency of disagreements.[15] Introducing restricted one-way communication had rather little

effects on behavior, however. This was not only true with regard to average offers, but also with regard to the percentage of (nearly) equal split offers (proposer talks: $p < 0.100$, responder talks: $p < 0.050$, one-tailed MW$U$ and $\chi^2$ tests).

## D. Conclusions

What can we learn from these experiments? First of all, cheap talk matters. Even in its most restricted and anonymous forms, communication can significantly affect behavior in various game and information settings. Allowing subjects to actively and unrestrictedly communicate with each other using both the visual and the auditory communication channel has the strongest effect on decisions, however. What does theory say regarding the observed effects of communication? Until now, not much. Although there exist game-theoretic models that can capture some effects of cheap talk communication in coordination and coordination-like types of games, in interactions that include strong incentives to lie, the predicted impact of cheap talk is very limited (see the reviews by Farrell and Rabin, 1996 and Crawford, 1998). Given that communication is a fundamental element of many economically relevant interactions in the real world, economic theory is quite silent about an important part of real-world economic environments. Further research is needed in order to develop new theories that can capture the behavioral effects of communication. The studies presented in this paper were dedicated to provide a first basis for the development of such new theories, but might also stimulate future experimental research on this topic.

Finally, let's come back to the example mentioned at the beginning of this paper. Is eBay right when arguing that implementing the online communication facilities provided by Skype helps to increase the number of trades? According to the experimental findings reported in this paper, the exchange of emails and, even more, face-to-face communication via video-conferences support the coordination of behavior and, thus, can raise the number of mutually beneficent outcomes. This is also true for environments that include some form of incomplete information as it is characteristic for online platforms like eBay. Moreover, since in online environments it is less costly for economic agents to break the agreed terms of trade, e.g., to send goods in a lower than the agreed quality, the implementation of online communication channels as informal reputation mechanisms can help to increase the incentive to keep agreements and, therefore, promote the efficiency of trade. Particularly in transactions where the quality of the traded goods is quite difficult to observe (e.g., used cars, high-end collectibles), communication might, thus, become an central instrument to facilitate trade in e-commerce.

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## Notes

[1] BBC NEWS, http://news.bbc.co.uk/go/pr/fr/-/1/hi/business/4237338.stm, 2005/09/12.
[2] Other examples include the studies conducted by Radlow and Weidner (1966), Jerdee and Rosen (1974), and Caldwell (1976).
[3] Similar results on the effect of face-to-face communication were reported in economic experiments on common pool resource games (e.g., Ostrom and Walker, 1991, Ostrom, Gardner, and Walker, 1994, Hackett, Schlager, and Walker, 1994).
[4] BBC NEWS, http://news.bbc.co.uk/go/pr/fr/-/1/hi/business/4237338.stm, 2005/09/12.
[5] The Mann-Whitney-*U* test is in the following abbreviated as MW*U* test.
[6] This finding seems to be in contrast to the so-called 'social distance' hypothesis formulated by Hoffman, McCabe, Smith (1996, 1999) and Bohnet and Frey (1999a, b). According to this hypothesis visual identification reduces the ‚social distance' between subjects and, thus, helps to induce other-regarding behavior.
[7] Note that the discussion patterns were typical for subjects' active communication.
[8] However, when including offers around the equal split, restricted communication seemed to be as effective as unrestricted communication. See also Schmidt and Zultan (2005), who re-examined Roth's (1995) experiment with regard to responder behavior.
[9] Since the results regarding trade outcomes could be confounded by differences in the gains from trade across treatments, Valley, Thompson, Gibbons, and Bazerman (2002) ran logistic regressions on the 192 observations with positive gains from trade. According to their results, the coefficient on face-to-face communication was significantly positive and the coefficient on written communication was weakly significantly positive.
[10] Let $\pi_i(x)$ denote the payoff to player $i$ if outcome $x$ is realized with $i$ = first mover (FM), second mover (SM). The two parameters are then defined as PunEff = $[\pi_{FM}(B2) - \pi_{FM}(B1)] / [\pi_{SM}(B2) - \pi_{SM}(B1)]$ and MxCost = $[\pi_{FM}(A1) - \pi_{FM}(B1)]$.
[11] There were no significant differences between email and video communication regarding the proportion of second movers who punished the first mover's B-move (game H: 5/7 vs. 0/1, game M: 1/3 vs. 1/5).
[12] In the internet, information about consumer characteristics can easily be gathered and mined, while it is often more difficult for buyers to obtain similar information about sellers' cost. For example, in 2000 online-retailer Amazon charged different customers different prices for the same item. While the company insisted that the price differentials were random in order to determine "*the right balance between how much Amazon could charge and still maintain a good sales volume*" (USA Today 09/29/00) many customers accused Amazon of basing their prices on billing information and purchasing history obtained by earlier software interaction.
[13] Note that communication did not significantly affect the buyers' rejection behavior.
[14] While such effects were not explored in previous research on bargaining games, studies on coordination games suggest that the direction of communication can have a significant influence on behavior (e.g., Cooper, DeJong, Forsythe, and Roth, 1989, 1992).
[15] Asking responders to condition their decision to all feasible offers that the proposer could choose, Schmidt and Zultan (2004) additionally observed that they were willing to reject higher offers with unrestricted two-way communication and to reject lower offers with restricted two-way communication compared to the treatment without communication.