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**An Experiment on the Hypothesis of  
Involuntary Truth-Signalling in Bargaining**

by  
AXEL OCKENFELS and REINHARD SELTEN

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**Abstract**

The paper examines face-to-face interaction in a simple two-person bargaining game with incomplete information about the division of a fixed sum of money in which each bargainer can either have costs to be subtracted from her bargaining agreement payoff or not. The bargaining events are observed by onlookers who make guesses of the cost situations of the participants. The work of Gauthier (1978) and Frank (1987, 1988), among others, suggests that the onlookers' detection accuracy exceeds chance accuracy because of involuntary signals inherent in the behavior of the bargainers. It is shown that cost guesses are somewhat more accurate than chance, but also that this effect is entirely explainable by the onlookers' information about objective features of the bargaining process, namely the bargaining time and the final result.

**Keywords**

bargaining, experiments, face-to-face, truth-signalling

**JEL codes**

C70, C91, D70, D82

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**Authors**

Axel Ockenfels  
Faculty of Economics and Management  
University of Magdeburg  
P.O. Box 4120  
D-39016 Magdeburg, Germany  
axel.ockenfels@ww.uni-magdeburg.de

Reinhard Selten  
Laboratorium für experimentelle Wirtschaftsforschung  
University of Bonn  
Adenauerallee 24-42  
D-53113 Bonn, Germany

# 1. Introduction

It is often suggested in the literature that bargainers cannot convincingly lie because they cannot avoid involuntary signals like facial movements or voice inflection which provide hints about the emotional state of the speaker. The philosopher David Gauthier, for instance, built his theory of "Morals by Agreement" on the premise that people are "translucent" in the sense that they are able "to detect others' sincerity or insincerity" (1978, p. 181). Also, many papers in evolutionary game theory are based on this assertion to which we shall refer as the *hypothesis of involuntary truth-signalling* in the following. Robson's (1990) "secret handshake" model as well as Frank's (1987, 1988) approach to the evolution of cooperation in prisoner's dilemmas may be the most prominent models that make use of the hypothesis of involuntary truth-signalling in an evolutionary context. Ekman (1985) is a well-known advocate of the hypothesis in psychology. Varieties of the hypothesis of involuntary truth-signalling have been proposed by Hirshleifer (1987) and Schelling (1978) in papers which have found less attention, and probably also by others. As far as we know, however, nobody has ever supplied convincing empirical evidence for the hypothesis in a bargaining context. Gauthier and Frank explicitly put the hypothesis of involuntary truth-signalling into such a context. It is therefore of interest to examine the hypothesis in experimental bargaining games.

In an experiment by Frank, Gilovich and Regan (1993) subjects before playing a prisoner's dilemma had the opportunity to talk to their opponents about the problem and were then asked to predict whether they would cooperate or not. It turned out that they succeeded much more than randomly expected in correctly predicting non-cooperative behavior but to a much smaller extent cooperative behavior. The paper does not report the content of the conversations. It is possible that some subjects openly or implicitly declared that they did not want to cooperate and therefore were expected not to do so. Therefore the experiment does not clarify the question what was deducible from verbal statements and what was due to the recognition of involuntary signals. Moreover, the payoff scheme was such that most of the variance was due to a random payoff component added in order to make it impossible for the subject to find out afterwards whether an opponent has cooperated or not. Therefore the behavior in the games was relatively unimportant for the final payoff. There was no payment for the correctness of the prediction.<sup>1</sup>

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<sup>1</sup> In a similar experiment by Brosig (1998), subjects were first classified as "cooperative" or "individualistic" with the help of a pre-game unrelated to the prisoner's dilemma game. The results of the prisoner's dilemma experiments suggest that cooperative subjects are somewhat better in predicting the opponents' decisions than individualistic subjects and that both sub-groups are somewhat better than randomly expected.

In the psychological literature the question whether deception can be detected has been addressed in quite a number of investigations. An overview is given by Zuckerman et al. (1981). In these studies subjects are usually told by the experimenter whether they should lie or tell the truth and no monetary incentives are supplied. A typical task was that a subject should talk badly about somebody else whom he liked and appreciated or she should praise somebody whom she did not think to be worthy of praise at all. In the paper by Miron Zuckerman et al. (1981, p. 26) we find the following summarizing statement:

"In fact, the examination of actual percentage accuracy indicates that most of the results fall in the .45 - .60 range with a chance level of .5 (see Kraut, 1980; Knapp and Comadena, 1979; Miller and Burgoon, 1981)."

The paper also investigates the question what is the basis of this detection capability. Treatment conditions varied according to whether the face or the body could be seen or not and whether speech could be heard or not. Surprisingly, the highest detection capability was observed when speech could be heard and the body could be observed but not the face. This suggests that facial clues are misleading rather than informative. Moreover, most of what is transmitted by speech seems to be discovered also by those who only saw transcripts. Zuckerman et al. (1981, p. 27) summarize the results as follows:

"The surprising finding, of course, is the power (i.e., the accuracy) of the word, either written or spoken. The assumption that non-verbal channels are more important in the communication of deception than the verbal clues is simply not true (see DePaulo, Rosenthal, Green, and Rosenkrantz, 1981)."

The psychological studies suggest that the hypothesis of involuntary truth-signalling has some merit even if the effects are weak. However, this may be due to the nature of the task because subjects told to tell lies may feel quite different about this than a bargainer who misrepresents his situation. Therefore it is of interest to investigate the hypothesis of involuntary truth-signalling in the context of bargaining experiments. Unlike the subjects in the psychological experiments, the subjects in the environment of our bargaining experiment are motivated by non-negligible monetary incentives and are free to choose whether they want to tell the truth or not.<sup>2</sup>

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<sup>2</sup> The design of our experiments is similar to unpublished pilot experiments by Selten and Stoecker (1978) performed at the University of Bielefeld under less controlled conditions. Bargainers and onlookers were non-academics visiting the University at an "open day". The results with respect to the capability of detection were similar to those of the study reported here. However, bargaining was not video-taped and the number of bargaining events was rather small. Many questions raised here cannot be examined with the help of this material.

The bargaining situation with incomplete information underlying our experiment is very simple. Two bargainers have to divide a fixed sum of money but they may or may not have costs to be deducted from the bargaining results in case of an agreement. There is two-sided incomplete information about the cost situation of the other player. Selten (1975) applied the noncooperative model by Harsanyi and Selten (1972) to this bargaining situation. Experiments on the basis of the same noncooperative bargaining model were performed by Hogatt et al. (1978). Kuon (1994) theoretically and experimentally applied the Rubinstein model (1985a, 1985b) of alternating bid bargaining to a similar situation. The experiments presented here are not based on a complex noncooperative bargaining model but on face-to-face interaction followed by just one round of simultaneous agreement proposals.

## 2. The experiment

The experiment consisted of two sessions. In each session 24 subjects participated as bargainers. In addition to this a number of other subjects, 42 in session 1 and 46 in session 2, had the role of onlookers. The bargainers were students of the University of Magdeburg studying a variety of fields, mostly economics, in different semesters. We tried to avoid bargaining between people who were acquainted with each other. Bargainers were only matched into a bargaining pair if they declared that they did not know each other. All onlookers were students of economics.

### *2.1 Procedure*

A session was a sequence of 12 bargaining events. In each bargaining event two subjects bargained about the division of DM 30. The bargaining was face-to-face, video-taped and observed by the onlookers. The bargainers separately arrived about twenty minutes before their bargaining events, read the instructions and gave up all rights with respect to the video recordings to the experimenter (see appendix A for all instructions). Then the bargainers had to throw a dice in order to determine whether they would have costs of DM 12 or not. In the case of a throw of 1, 2, 3 subjects had costs and in the case of a throw of 4, 5, 6 there were no costs. The cost situation of a bargainer was private information. The costs were subtracted from the subject's agreement payoff if agreement was reached.

At the start of the bargaining event, two bargainers were brought to a lecture hall, where they talked for maximally 10 minutes. The bargainers could stop their conversation earlier if they wanted to do so. Afterwards each bargainer separately and secretly filled in forms in which each of both wrote down the agreement reached according to his or her understanding.

Moreover, each of them had to fill in a guess about whether the other one had costs or not. Afterwards both bargainers, one after another, were led to a separate room where the payments were made, unobserved by the other bargainer and the onlookers. If both forms agreed with respect to the division of the DM 30, payments according to the agreement were made with costs deducted if there were any. If the forms were in disagreement the bargainers received zero payoffs from the game. In addition to the payoff from the game, each bargainer received a show up fee of DM 10. Overall, average bargainer earnings were DM 19,88 with a minimum of DM 10 and a maximum of DM 29. The average time needed for the whole experiment was about half an hour.

Onlookers were fully informed about the bargaining rules. They were seated in the lecture hall such that they had a good view on the bargainers but could not communicate with their neighbors. The task of the onlookers was to guess who among the bargainers had costs and who had no costs. The guessed cost situation for each bargainer was marked with a cross in a decision form. The onlookers were paid according to the following scheme in each session: DM 300 were divided among those who had the highest number of correct guesses achieved, DM 100 were divided among those who had the second highest number of correct guesses, and DM 50 were divided among those who had the third highest number of correct guesses. The maximum earnings in session 1 and 2 were DM 100 and DM 300, respectively. Session 1 lasted about 80 minutes and session 2 about 70 minutes.

## *2.2 Remarks*

Theoretically it is possible that an agreement is reached in which one bargainer with costs receives less than DM 12. In the instructions the bargainers were told that in the case of costs they had to insist on at least DM 12 if they did not want to face a loss. Losses would be deducted from the show up fee. In fact, losses did not occur.

The instructions explicitly told the subjects to try to maximize their payoffs. This was done in order to direct attention as much as possible to the money payoff.

The experimental setup did not permit a bargainer to prove to the other one that he had costs. Also, after the bargaining, it was kept secret whether a bargainer had costs or not. The onlookers did not get any information about which of their guesses were correct.

Bargainers were not permitted to communicate with each other before the bargaining and were separated after the bargaining event in order to provide no easy opportunities for retrospective communication. They were also not able to see any bargaining events other than their own one. Communication among onlookers was prohibited and successfully prevented.

### 3. Experimental data

Table 1 shows the results of all bargaining events. In the following we explain the entries into the table together with some summary remarks:

*Column 1* [bargainer identification number]: Each bargainer has an identification number consisting of the bargaining event number and a letter *A* or *B*. The first twelve bargaining event numbers refer to session 1 and the second twelve to session 2.

*Column 2* [bargaining costs]: The entry is 1 if the bargainer had costs and zero if he had none. In session 1 twelve out of the 24 bargainers had costs whereas in session 2 only eight out of the 24 bargainers had costs.

*Column 3* [outcome]: The entry shows the game payoff in German marks before the deduction of costs. 18 of the 24 bargaining pairs agreed on DM 15 for each of both. Only in one case conflict was reached. In five cases an agreement was reached in which one bargainer received more than the other.

*Column 4* [correctly guessed by opponent]: In the case of an entry 1 the opponent correctly guessed whether the bargainer had costs or not. In the case of an entry zero the opponent's guess was wrong. The percentage of correct guesses by bargainers in both sessions is 52.1%.

*Column 5* [onlooker hit rate]: The entry is the percentage of correct guesses over all onlookers of the session. The star indicates significance according to the two-sided binomial test at the significance level of 5%. The test is based on the null hypothesis that both guesses are equally probable. The average percentage of correct guesses by onlookers in both sessions is 55.2%.

*Column 6* [cost assertion]: Entry 1 indicates that the bargainer explicitly asserted in the bargaining event that he had costs. In the case of an entry zero she did not make such an assertion. In those bargaining events in which both bargainers asserted costs, a "(f)" indicates that the bargainer was the first of both who asserted to have costs.

Twelve of the 20 bargainers who had costs correctly asserted that they had costs. Twelve of the 28 bargainers without costs falsely asserted that they had costs. Nobody ever said explicitly that they had no costs.

*Column 7* [first aggressive demand]: We use the term "aggressive" for demands of more than DM 15 and an entry of 1 indicates that the bargainer was the first one to make an aggressive demand. Otherwise the entry is zero. If one of both bargainers has an entry 1,

obviously the other one must have an entry zero. In seven cases, none of both bargainers asked for more than DM 15 for themselves so that both entries are zero.

*Column 8* [first fair demand]: We refer to a demand of exactly DM 15 as "fair". Entry 1 indicates that the bargainer was the first one to make a fair demand. Otherwise the entry is zero. In the bargaining event 13 none of both bargainers had an entry 1 because an aggressive demand was accepted before a fair demand was made. In all other cases there was a player who first faced a fair demand.

*Column 9* [bargaining time]: The entry shows the time until the end of the bargaining conversations in minutes. The maximum of ten minutes was reached only once in bargaining event 7. The average bargaining time was 2.30 minutes.

*Column 10* [male/female]: "m" stands for male and "f" for female. 9 out of the 48 bargainers were female.

*Column 11* [economics student]: "ec" stands for economics student and "n-ec" for other students. 32 of the 48 bargainers studied economics.

1 bargainer identification number	2 bargaining costs	3 out- come [DM]	4 correctly guessed by opponent	5 onlooker hit rate [%]	6 cost assertion	7 first aggressive demand	8 first fair demand	9 bargaining time [min]	10 male/ female	11 economics student
1A	0	15,0	1	78,6*	0	0	1	0,5	m	ec
1B	0	15,0	1	71,4*	0	0	0		m	n-ec
2A	0	15,0	0	83,3*	0	0	0	0,3	m	ec
2B	1	15,0	0	28,6*	0	0	1		m	n-ec
3A	1	15,0	0	66,7*	1	0	0	1,0	m	ec
3B	0	15,0	0	54,8	1 (f)	0	1		m	n-ec
4A	1	0,0	0	38,1	1	0	1	8,0	m	n-ec
4B	1	0,0	0	71,4*	1 (f)	1	0		m	ec
5A	1	15,0	1	57,1	0	0	0	0,7	f	n-ec
5B	1	15,0	0	81,0*	0	1	1		f	ec
6A	1	15,0	0	54,8	1 (f)	1	1	3,0	m	ec
6B	1	15,0	1	38,1	1	0	0		m	n-ec
7A	0	15,0	0	42,9	0	1	0	10,0	m	ec
7B	1	15,0	0	19,0*	1	0	1		m	ec
8A	1	15,0	0	7,1*	1 (f)	0	1	3,0	m	ec
8B	1	15,0	1	54,8	1	1	0		m	n-ec
9A	0	15,0	1	50,0	1 (f)	1	1	1,5	m	ec
9B	0	15,0	1	69,0*	1	0	0		m	ec

1 bargainer identification number	2 bargaining costs	3 out- come [DM]	4 correctly guessed by opponent	5 onlooker hit rate [%]	6 cost assertion	7 first aggressive demand	8 first fair demand	9 bargaining time [min]	10 male/ female	11 economics student
10A	0	15,0	1	76,2*	0	0	0	0,2	m	ec
10B	0	15,0	1	92,9*	0	0	1		f	ec
11A	0	13,0	1	100,0*	0	0	1	1,0	m	ec
11B	0	17,0	0	14,3*	1	1	0		m	ec
12A	1	16,0	1	47,6	1	1	0	5,0	m	ec
12B	0	14,0	1	90,5*	1 (f)	0	1		m	ec
13A	0	17,5	0	32,6*	1	1	0	2,3	m	n-ec
13B	0	12,5	1	87,0*	0	0	0		m	n-ec
14A	1	15,0	0	60,9	1 (f)	1	1	3,3	f	ec
14B	0	15,0	1	41,3	1	0	0		m	ec
15A	1	15,0	0	34,8	0	0	0	0,7	f	ec
15B	1	15,0	1	32,6*	0	0	1		m	ec
16A	0	15,0	1	56,5	0	0	0	0,8	m	n-ec
16B	1	15,0	0	52,2	0	1	1		f	ec
17A	0	18,0	1	19,6*	1	1	0	3,6	m	ec
17B	0	12,0	1	95,7*	0	0	1		m	ec
18A	0	19,0	0	6,5*	0	1	0	1,2	m	ec
18B	0	11,0	0	93,5*	0	0	1		m	ec
19A	1	15,0	1	26,1*	1	0	1	4,0	m	ec
19B	1	15,0	1	76,1*	1 (f)	1	0		f	n-ec
20A	0	15,0	0	54,3	1	0	0	1,2	m	ec
20B	1	15,0	0	21,7*	0	0	1		m	n-ec
21A	0	15,0	1	91,3*	0	0	0	0,2	m	n-ec
21B	0	15,0	1	93,5*	0	0	1		m	n-ec
22A	0	15,0	1	50,0	1 (f)	1	0	0,3	f	ec
22B	0	15,0	1	45,7	1	0	1		m	ec
23A	0	15,0	0	21,7*	1	1	0	2,4	m	ec
23B	0	15,0	1	54,3	0	0	1		f	n-ec
24A	0	15,0	0	73,9*	0	1	0	0,9	m	ec
24B	1	15,0	0	39,1	0	0	1		m	n-ec
average session 1	50,0%	13,75	50,0%	57,8%	58,3%	33,3%	50,0%	2,85	87,5% males	70,8% economists
average session 2	33,3%	15,00	54,2%	52,5%	41,7%	37,5%	45,8%	1,74	75,0% males	62,5% economists
average both sessions	41,7%	14,38	52,1%	55,2%	50,0%	35,4%	47,9%	2,30	81,3% males	66,7% economists

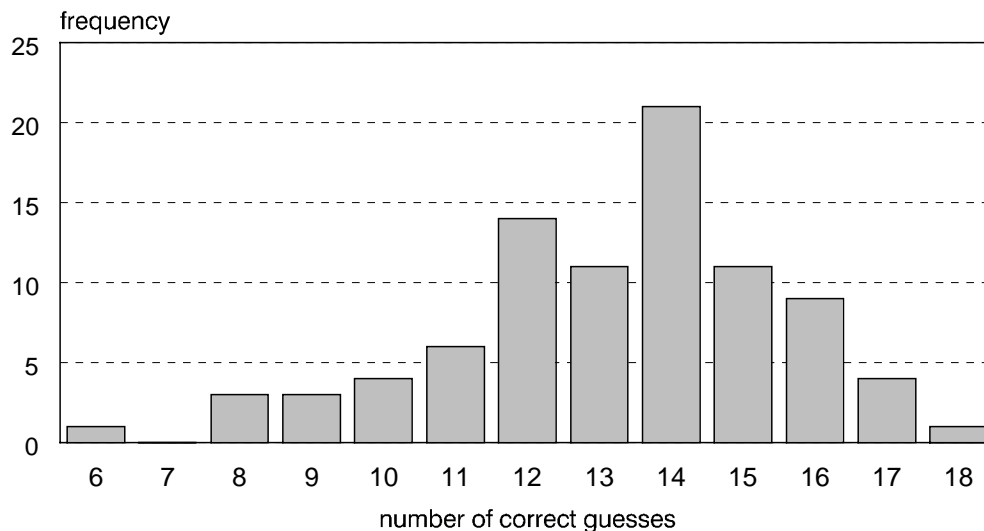
**Table 1: Bargaining data**



## 4. Overall detection capability

In this section, we look at the question whether the data show a significant overall detection capability or, in other words, whether the percentage of correct guesses is significantly higher than the randomly expected 50%. However, we do not want to make the assumption that the probabilities of correct guesses are the same for different onlookers and different bargainers judged by the same onlookers. If there is no overall detection capability one would expect a mean value of 12 correct guesses of an onlooker.

Figure 1 shows the distribution of the 88 numbers of correct guesses of an onlooker.<sup>3</sup> The mode and the median of the distribution is 14 and the mean is 13.22. We test the null hypothesis that the data summarized by figure 1 are a sample from a distribution with mean value 12. This hypothesis is rejected by the Wilcoxon signed rank test on a very high level of significance ( $p = .000$ , two-sided). As we shall see later, this result needs to be interpreted with care. In some cases it is easy to make a correct guess on the basis of very simple criteria which have nothing to do with involuntary signalling of truth.



**Figure 1:** *Distribution of correct guesses of an onlooker*

We now turn our attention to the guesses of the bargainers about their opponent's cost situation. These guesses are correct in only 52.1% of all cases. In comparison to the onlookers who correctly guessed in 55.2% of all cases (cf. table 1), the bargainers were less accurate. The difference between the two numbers is very small and seems to be compatible with the

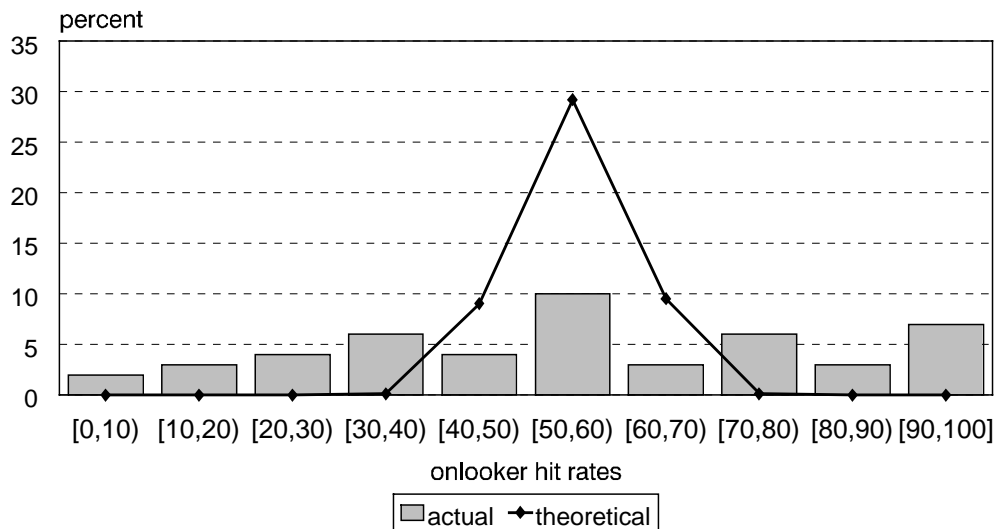
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<sup>3</sup> The individual guesses of all onlookers are shown in the table "onlooker data" in appendix B. This table also shows the percentage of correct guesses for each onlooker along with the gender.

idea that the probability of a correct guess is not different for bargainers and onlookers. It is difficult, however, to support this impression by an adequate statistical test, since probabilities must be suspected to be different for different onlookers and for different bargainers judged by the same onlookers.

The bargainers' judgements on the cost situations of their opponents correlate with the onlooker hit rates (columns 4 and 5 in table 1). The biserial rank correlation coefficient is .337 which is not very high but the associated Mann-Whitney  $U$ -test is significant at the level  $p = .021$  (two-sided).

Figure 2 shows the distribution of onlooker hit rates over bargainers listed in column 5 of table 1. The figure also exhibits the theoretical distribution which would be obtained if the probability of a correct guess were the same for every bargainer, namely the observed overall relative frequency 55.2% of correct guesses, and also independent of each other.



**Figure 2:** *Distribution of hit rates over bargainers*

Obviously, the theoretical distribution does not agree with the data. According to the theoretical distribution, at least one hit rate either greater than 80% or smaller than 30% has a probability of less than 5%. Nevertheless such hit rates are observed in 19 of 48 cases.

Our findings suggest that the probabilities of a correct guess by an onlooker are different for different bargainers. It appears that the cost situation of the bargainer is easy to assess in some cases and very difficult to be correctly guessed in some other cases.

As we have explained above, the stars in column 5 indicate that the corresponding onlooker hit rate is different from 50% at the two-sided significance level of 5%. This is the case for 29 of the 48 hit rates. In 18 of these 29 cases the hit rates are above 50%, but in 11 cases they are below. For these 11 bargainers the guesses of the onlookers are significantly worse than random. As far as there is a capability of detecting the true cost situations, it fails miserably in these cases.

## 5. The influence of objective features of the bargaining process on the correctness of guesses

Why is it that onlookers have a very good capability to judge the cost situations of some bargainers and a very bad one for others? In order to find the reasons, we analyze the objective features of the bargaining process in this section. By objective features we mean characteristics of the bargaining process which can either be clearly seen in the transcripts or which are in other ways apparent from the bargaining process without any information coming from visual channels like facial expression and body postures or auditory channels like voice intonation. Such features are the final bargaining result and the bargaining time. The features clearly indicated by the transcripts are the cost assertions and the first aggressive and first fair demand. In this respect the transcripts are unambiguous.<sup>4</sup>

In connection with the objective features of the bargaining process, three different questions suggest themselves: Which objective features are good indicators of the cost situations of the bargainers? To what extent are these objective features responsible for the fact that onlookers judge the true cost situations somewhat more accurately than randomly expected? Which other features influence the guesses of the onlookers?

In the following, we shall first look at those features which are good indicators of the actual cost situation; these are the final bargaining result and the bargaining time. It will then be shown that these features are responsible for the better than randomly guessing success of the onlookers. Finally, we shall present a probit analysis of the onlookers' guessing behavior that takes into account other objective features.

### *5.1 Actual costs, cost guesses and final bargaining results*

In five bargaining events the final bargaining result was asymmetric in the sense that an agreement was reached in which one bargainer received a higher share of the gross payoff of

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<sup>4</sup> The transcripts (in German) are available from Axel Ockenfels upon request.

DM 30 than the other one. In such situations the onlookers tend to judge that the bargainer with the higher gross payoff has costs and the bargainer with the lower payoff has no costs. In fact, on average over all five bargaining events, the onlookers guess in 75% that the bargainer with the higher gross payoff has costs and in 93.6% of all cases that the bargainer with the lower gross payoff has no costs. The second tendency is fully justified in each of the five cases. The bargainers with the lower gross payoffs have no costs. The first tendency, however, is mistaken. Among all five bargainers with a higher gross payoff, only one has costs.<sup>5</sup>

The data just discussed show that a lower gross payoff in an asymmetric final result is a good indicator of no costs. Contrary to this, however, a higher gross payoff is not a good indicator of costs. For instance, the bargainer with the highest gross profit (DM 19) had no costs, but 93.5% of the onlookers guessed that he had costs.

The guessing tendencies of the onlookers in face of asymmetric bargaining results are also reflected by a highly significant negative rank correlation coefficient of  $-0.540$  ( $p = .001$ , two-sided) between a bargainer's gross payoff and the onlooker hit rates (columns 3 and 5 in table 1). The onlookers make strong use of the fact that a lower gross payoff is a good indicator for no costs and thereby improve their hit rates.

Conflict with zero payoffs for both bargainers was reached in only one bargaining event. In this event, both bargainers had costs. For one of the bargainers, 62% of the onlookers guessed that he had costs but for the other one only 29%. One might think that a conflict indicates a high probability for both bargainers having costs. However, in the one case observed in our data, the onlookers do not seem to be guided by such considerations.

## *5.2 Actual costs, cost guesses and bargaining time*

Five bargaining events ended after extremely short times of at most half a minute. In all these cases an agreement of equal gross payoffs of 15 was reached. Within the time of half a minute, the bargainers cannot do much more than to express their willingness to accept a fair division. This led us to the decision to draw the line between extremely short and other bargaining events at half a minute.

Only one of the ten bargainers involved in the five extremely short bargaining events had costs; nine had no costs. The onlookers had the tendency to make a guess of no costs if the bargaining time was extremely short. On average a bargainer involved in the five bargaining

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<sup>5</sup> In three of the five cases the lower gross payoff was higher than DM 12; in one it was DM 12 and in another one DM 11. At least in the last case it is almost obvious that the bargainer with the lower gross payoff had no costs, even if it was not excluded by the rules that a participant with costs accepted less than his costs of DM 12.

events was judged by 75% of the onlookers to have no costs. Also, the one bargainer who had costs was judged by 70% of the onlookers not to have costs. The average hit rate for the short bargaining events is 71.1%.

In the bargaining events lasting for more than half a minute, 50% of the bargainers had costs and the onlookers on average judged 55% of them to have no costs. The average hit rate in these cases is only 51%.

Within the bargaining events lasting more than half a minute, there seems to be no difference between longer and shorter bargaining times with respect to the actual cost situations. Median tests used to examine these questions do not yield significant results. However, there is a sharp difference between the extremely short and the longer bargaining events. A four field table  $\chi^2$ -test yields a significance of  $p = .022$  (two-sided) for the difference of actual costs.

As we have seen, a short bargaining time is a good indicator of both bargainers having no costs. The onlookers make use of this indicator and thereby increase their hit rates considerably above random level in these cases.

### *5.3 Hit rates unaided by bargaining time and result asymmetry*

In this section, we want to examine the question whether the objective criteria based on short bargaining time and lower gross payoff in asymmetric results explain the fact that onlookers succeed in achieving hit rates which on the average are significantly better than random. For this purpose, we define an *adjusted hit rate*. In order to do this, we look at the *reduced set* of bargainers without the ten participants involved in extremely short bargaining events and the five participants who received lower gross payoffs than their opponents. The adjusted hit rate of an onlooker is his hit rate for the remaining bargainers in this reduced set.

The mean adjusted hit rate of the 88 onlookers is 44.5%. Based on a normal approximation we can compute a 99%-confidence interval for the mean of the distribution of adjusted hit rates. The lower bound of this confidence interval is 41.07% and the upper bound is 47.99%.

It is safe to conclude that without the criteria of extremely short bargaining time and lower gross payoff in an asymmetric bargaining result, the capability of the onlookers to make correct judgements about the true cost situations is worse than random. The upper limit of the 99% confidence interval is clearly below 50%.

Obviously, these results speak against the involuntary truth-signalling hypothesis. Unaided by the objective criteria of short bargaining time and lower gross payoff, the onlookers do not perceive involuntary signals which help them to form correct guesses. On the contrary, to

some extent, onlookers seemed to be systematically misled as the 99%-confidence interval suggests.

#### 5.4 Correlations among objective features and their relation to actual costs

It is the purpose of this section to describe the interrelationship between the objective features of the bargaining process and their connection with actual costs. In addition to the criteria of lower gross payoff and short bargaining time, we also look at the presence of cost assertion, first aggressive demand and first fair demand (columns 6, 7, and 8 in table 1). All these features are zero-one variables. The value of the lower gross payoff criterion is defined as 1 if the gross payoff is lower than DM 15 and zero otherwise. Similarly, the value of the short bargaining time criterion is defined as 1 if the bargaining time does not exceed half a minute and zero otherwise.

The correlations among the objective features are shown in table 2. The table also shows correlations with the presence of actual costs (according to column 2 in table 1). The significance of correlations of the lower gross payoff and short bargaining time criteria with actual costs confirm what has been pointed out earlier in this respect. The other three correlations of actual costs with the remaining three objective features are not significant.

objective features	short bargaining time	cost assertion	first aggressive demand	first fair demand	actual bargaining costs
lower gross payoff	-.175	-.205	-.253	.219	-.288*
short bargaining time		-.308*	-.273	.021	-.330*
cost assertion			.305*	-.125	.169
first aggressive demand				-.274	.081
first fair demand					.204

\* significant on the 5%-level (two-sided).

**Table 2:** *Correlations among objective features and their relation to actual costs*

There are only two significant correlations among the objective features: one between the short bargaining time criterion and cost assertion and one between cost assertion and first aggressive demand. The first one is due to the fact that cost assertions are not typical for short bargaining times. The second one may be due to a tendency to buttress first aggressive demands by cost assertions.

The positive correlation between first fair demand and actual bargaining costs is in an unexpected direction. It suggests that somebody with costs is more likely to make a first fair demand than somebody without costs. However, this effect is not significant. All other correlations are in the expected directions.

A correlation which is not expressed by table 2 is that between the presence of cost assertions of both bargainers in the same bargaining event. The data convey the impression that a cost assertion on one side is responded by a cost assertion by the other side. In order to examine this impression statistically, we construct a null hypothesis based on a simple theory proceeding from the assumption that bargainers with and without costs have probabilities of making a cost assertion which do not depend on the situation and the behavior on the other side. We estimate the probabilities by the relative frequencies observed in the data and then compute expected values for the numbers of bargaining events with two, one, or no cost assertions. With this simple theory as null-hypothesis, we performed a  $\chi^2$ -test which yields significance of  $p = .055$  (two-sided). The test confirms the impression that a cost assertion on one side provokes a defense by a cost assertion on the other side. Not only the number of cases in which both bargainers made a cost assertion but also the number of those in which none of them made a cost assertion is greater than randomly expected under the null hypothesis.

### *5.5 A probit analysis*

In the following we want to look at the question which objective features have a significant influence on the guessing behavior of the onlookers. We shall try to answer this question with the help of a probit model. Table 3 shows the results. The independent variables are the five objective features discussed above (cf. table 2) and the dependent variable is the guess of an onlooker about the cost situation of a bargainer (cf. table 'onlooker data' in appendix B). There are 88 onlookers, each of whom had to make 24 guesses.

variables	parameter values	<i>t</i> -values
constant	- 1.770	- 11.236
lower gross payoff	- 1.093	- 7.826
short bargaining time	- .427	- 5.315
cost assertion	.140	2.215
first aggressive demand	.610	9.215
first fair demand	- .242	- 3.968

**Table 3:** *Probit model*

Admittedly, the probit analysis makes strong independence assumptions which are unlikely to be satisfied. The same behavior is attributed to each onlooker and all guessing events are assumed to be independent of each other. Nevertheless, the probit analysis has some descriptive relevance even if the underlying model cannot really be taken seriously.<sup>6</sup>

The statistical analysis indicates that all five objective features have significant influence on the cost guesses (all absolute values of the *t*-values are greater than two). In particular, the probit analysis reveals a strong influence of the variable first aggressive demand on the cost guess. This influence is smaller than that of the lower gross payoff criterion but greater than that of the short bargaining time criterion. The strong influence of the variable first aggressive demand in the probit analysis is in contrast to the small correlation of the variable with actual costs. This suggests that trying to make the first aggressive demand is to some extent effective in conveying the impression of costs. To a lesser degree something similar can be said about cost assertions. The first fair demand, however, seems to suggest an absence of costs to the onlookers, even if the correlation with actual costs is slightly positive.

The influence of the cost assertions on the guesses of the onlookers does not seem to depend on whether they are correct or not. Twelve bargainers correctly assert that they have costs and twelve others make false cost assertions. In the case of true cost assertions, 47% of the onlookers on average guesses the presence of costs. The corresponding percentage for

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<sup>6</sup> We also performed Mann-Whitney *U*-tests which for every one of the five variables compared the 88 independent hit rates for the criterion value zero with the hit rates for the value one. All these tests are significant on the 1%-level (two-sided). For the variables first aggressive demand, first fair demand, and cost assertion, the same tests were performed for the adjusted hit rates. These tests are significant at the 1%-level (two-sided) for first fair and first aggressive demand and yield  $p = .073$  (two-sided) for cost assertion. All effects go in the same direction as in the probit analysis.



false cost assertions is 55%. The reduced set of bargainers underlying the adjusted hit rates shows a similar picture. Here, the percentages are 47% for eleven true cost assertions and 51% for six false cost assertions. The differences between the percentages are in the opposite direction of what one would expect according to the involuntary truth-signalling hypothesis.

## 6. Conclusions

The results of our experiments clearly speak against the involuntary truth-signalling hypothesis. As we have seen, the capability of onlookers to make cost guesses which are somewhat more frequently correct than randomly expected can entirely be explained by the objective criteria of lower gross payoff and short bargaining time. These readily available features of the bargaining process (and not involuntary signals) enable the onlookers to guess somewhat more accurately than chance.

The adjusted hit rates which eliminate the influences of the two objective criteria reveal a guessing accuracy worse than chance. The 99%-confidence interval for the mean of the adjusted hit rates has a lower bound of .41 and an upper bound of .48. One can conclude that at least on average the onlookers not only fail to profit from involuntary signals but are even somewhat misled by what they observe if they cannot rely on the criteria of lower gross payoff and short bargaining time.

We have also seen in section 5.5 that on average the onlookers cannot distinguish true from false cost assertions. Of course, these findings do not exclude the possibility that among the onlookers there are some whose truth detection capabilities are much better than the average and others for whom these capabilities are much lower than the average. However, as far as we can see, the data show no evidence in this direction. In any case, the assumption of a widely spread culturally acquired truth detection capability does not find support by our experimental study.

In the literature, we often find comparisons between face-to-face and anonymous game interaction (Dawes et al., 1977; Isaac and Walker, 1988; Radner and Schotter, 1989; Frey and Bohnet, 1995; Sally, 1995; Valley et al., 1998; Frohlich and Oppenheimer, 1998). The general conclusion is that face-to-face interaction leads to more cooperation and more egalitarian outcomes. In this connection, one sometimes finds explanations based on the involuntary truth-signalling hypothesis referring to the theoretical work of Robert Frank. Although our study does not examine the difference between formal anonymous interaction and face-to-face bargaining, our results suggest that any differences which may be there are not due to involuntary truth-signalling. Yet alternative explanations are not difficult to find. Face-to-face

interaction may per se create more cooperation, more trust and more consideration of the interests of the other participants (cf. Roth, 1995, for a related point of view).

The involuntary truth-signalling hypothesis may have some merit in other contexts as they occur in the psychological experiments discussed in the introduction. Involuntary-truth signalling, however, does not seem to take place in the context of bargaining situations.

## Bargainer Rules

Everybody knows that it is difficult in negotiations to assess how far the bargaining partner can give in, e.g., when buying a used car. In our experiment you will be placed in the following bargaining position, in which bargaining skills are required.

1. You bargain with a randomly chosen bargaining partner about the division of DM 30.
2. Before the bargaining event, you throw a dice in order to determine whether you have costs of DM 12 or not. In the case of a throw of 1, 2, 3 you have costs and in the case of a throw 4, 5, 6 you do not have costs. In the case of costs, DM 12 are subtracted from your bargaining outcome. Your cost situation will be marked at the bottom of this page. Nobody besides you and the experimenter knows your cost situation. You do not know whether your bargaining partner has costs. Nor will the information about the cost situation of any bargainer be revealed to anyone after the experiment has been completed.
3. The bargaining event lasts maximally 10 minutes but could stop earlier if you want to do so. After the bargaining event, each of the bargainers writes down the agreement reached according to his or her understanding in the *bargainer form* on the next page. If the bargainer forms match in the division of the DM 30 then you receive a corresponding payoff deducted by the costs if you have costs. Note that a bargainer with costs has to demand at least DM 12 if he or she does not want to suffer a loss. (Losses are deducted from the DM 10 that every bargainer receives for the participation in the experiment). If the bargainers cannot agree upon a division, if the bargainer forms do not match, or if the outcomes sum up to more than DM 30, neither bargainer receives a payoff from the bargaining.
4. The bargaining is video-taped and observed by students.
5. Try to realize the highest possible payoff.

From now on until the end of the experiment you are not permitted to communicate with other participants outside the bargaining event. If you have any questions, please raise your hand.

costs

no costs

## Statement

1. I agree that I am video- and audio-taped during my participation in the experiment. I waive all claims that may arise in connection with the taping.
2. I agree that the tapes are preserved by the university for an indefinite time and are used for scientific analyses.

Date:

Signature:

## Bargainer Form

Bargainer identification number:

Please fill in:

Field of study:

Sex:

m

f

Division of DM 30:

for me:

DM

for my bargaining partner:

DM

I guess that my bargaining partner ...

had costs.

did not have costs.

## Onlooker Rules

In a moment you will be witness of 12 bargaining events in which your assessment skills are demanded. Earlier, the bargainers obtained the following bargaining instructions:

1. You bargain with a randomly chosen bargaining partner about the division of DM 30.
2. Before the bargaining event, you throw a dice in order to determine whether you have costs of DM 12 or not. In the case of a throw of 1, 2, 3 you have costs and in the case of a throw 4, 5, 6 you do not have costs. In the case of costs, DM 12 are subtracted from your bargaining outcome. Your cost situation will be marked at the bottom of this page. Nobody besides you and the experimenter knows your cost situation. You do not know whether your bargaining partner has costs. Nor will the information about the cost situation of any bargainer be revealed to anyone after the experiment has been completed.
3. The bargaining event lasts maximally 10 minutes but could stop earlier if you want to do so. After the bargaining event, each of the bargainers writes down the agreement reached according to his or her understanding in the *bargainer form* on the next page. If the bargainer forms match in the division of the DM 30 then you receive a corresponding payoff deducted by the costs if you have costs. Note that a bargainer with costs has to demand at least DM 12 if he or she does not want to suffer a loss. (Losses are deducted from the DM 10 that every bargainer receives for the participation in the experiment). If the bargainers cannot agree upon a division, if the bargainer forms do not match, or if the outcomes sum up to more than DM 30, neither bargainer receives a payoff from the bargaining.
4. The bargaining is video-taped and observed by students.
5. Try to realize the highest possible payoff.

Your task is to guess from the bargaining process who among the 24 bargainers has costs and who has no costs. In a bargaining event, one, both, or neither bargainer may have costs. DM 300 are divided among those onlookers who achieve the highest number of correct guesses, DM 100 are divided among those who achieve the second highest number and DM 50 among those who have the third highest number.

From now on until the end of the experiment you are not permitted to communicate in any form during the whole experiment. If you have any questions, please raise your hand now.

# Onlooker Form

Onlooker identification number:

Field of study:

Sex:  m  f

Please mark the bargainers who you think have costs with a cross:

Bargaining event	Bargainer A	Bargainer B
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

*Appendix B: Onlooker data*

The following table shows the actual cost situation of each bargainer and the individual guesses of all onlookers together with the number of correct guesses for each onlooker and the gender. The onlookers in each session are sorted after their numbers of correct guesses. All onlookers are undergraduate students of economics.

session 1 cost (guess) = 1	1A	1B	2A	2B	3A	3B	4A	4B	5A	5B	6A	6B	7A	7B	8A	8B	9A	9B	10A	10B	11A	11B	12A	12B	correct guesses	male/ female	
1	0	0	0	0	1	0	0	1	1	1	1	1	0	0	0	1	1	0	0	0	0	0	1	0	0	17	f
2	0	0	0	0	1	1	1	1	1	1	0	1	0	1	0	0	0	1	0	0	0	1	1	0	17	f	
3	0	0	0	0	1	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0	17	m	
4	0	0	0	1	1	1	0	1	1	1	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	16	f
5	1	1	0	1	0	0	1	0	1	1	0	1	1	0	1	1	0	0	0	0	0	0	1	1	0	16	f
6	0	1	0	0	1	0	1	1	0	1	1	1	1	1	0	0	1	0	0	0	0	0	1	1	0	16	f
7	0	0	0	0	1	0	0	1	1	1	1	0	1	0	0	1	0	0	1	0	0	0	1	1	0	16	m
8	0	0	0	0	1	0	0	1	0	1	0	1	0	0	0	1	1	0	0	0	0	0	1	1	0	16	m
9	0	0	0	1	1	0	0	1	1	1	1	0	1	0	0	1	0	1	0	0	0	0	1	0	0	16	m
10	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	16	m	
11	0	1	0	0	1	1	1	1	0	0	0	1	0	1	0	1	0	0	0	0	0	0	1	1	0	16	m
12	1	1	0	1	0	0	0	1	1	1	1	0	1	0	0	1	0	0	0	0	0	0	1	1	0	15	f
13	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	15	f
14	1	0	0	1	0	0	1	1	1	1	1	0	0	0	1	0	0	1	1	1	0	1	1	0	15	f	
15	0	1	1	1	0	1	1	1	1	1	1	0	1	1	0	1	0	0	0	0	0	0	1	0	0	15	f
16	0	0	0	1	1	0	1	1	0	0	1	0	0	0	0	0	1	0	1	0	0	0	1	1	0	15	f
17	0	0	1	1	0	1	1	0	1	1	1	0	0	1	0	1	0	1	0	0	0	0	1	0	0	15	m
18	0	1	0	1	0	0	0	0	1	1	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	15	m
19	1	0	0	1	1	1	0	0	1	1	1	0	1	0	0	1	1	0	0	0	0	0	1	1	0	14	f
20	1	0	0	1	1	1	0	0	0	1	1	0	1	0	1	1	1	0	1	0	0	0	0	1	0	14	f
21	0	1	0	0	1	1	1	1	0	1	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	14	f
22	0	0	0	0	1	1	0	1	1	1	1	1	1	1	0	0	1	1	0	0	0	0	1	0	0	14	f
23	1	0	0	0	1	0	0	1	0	0	0	1	1	0	0	1	0	0	0	0	0	0	1	1	0	14	m
24	1	0	0	0	1	1	1	1	0	1	1	0	0	0	0	1	1	0	0	0	0	0	1	1	1	14	m
25	0	1	0	0	1	1	1	1	0	1	1	1	0	0	0	0	1	0	0	0	0	0	1	0	0	14	m
26	0	1	0	0	1	0	0	0	1	1	1	0	1	0	0	1	0	0	1	0	0	0	1	1	0	14	m
27	0	0	0	0	1	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	14	m
28	0	0	0	0	1	1	0	1	1	1	1	1	1	0	0	1	1	0	0	0	0	0	1	0	1	14	m
29	0	0	0	0	1	1	0	1	0	1	1	1	1	0	0	1	1	0	0	0	0	0	1	0	0	14	m
30	0	0	0	0	1	0	0	0	0	1	1	1	1	0	0	0	0	1	0	0	0	0	1	1	0	14	m
31	0	0	0	0	0	1	1	1	0	1	0	0	0	1	0	1	1	0	0	0	0	0	1	1	1	14	m
32	1	0	0	0	0	0	1	1	0	1	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	13	f
33	0	0	1	1	1	0	1	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	13	m

34	0	0	0	0	1	1	0	1	0	1	1	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	12	f
35	0	0	0	0	1	1	0	1	1	1	1	0	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	12	f
36	0	1	0	0	1	0	0	0	1	1	0	1	1	0	0	1	1	0	0	0	1	0	0	0	1	0	0	12	m
37	0	0	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	m
38	0	0	0	0	1	0	0	1	0	1	0	1	1	0	0	1	1	1	0	0	1	0	0	1	0	1	11	m	
39	0	1	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	10	m	
40	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	9	m	
41	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1	1	0	1	0	0	0	8	m	
42	1	0	1	0	0	0	0	0	1	1	0	0	1	0	0	0	1	1	1	1	1	0	1	0	0	0	6	m	
average session 1 [%]	21,4	28,6	16,7	28,6	66,7	45,2	38,1	71,4	57,1	81,0	54,8	38,1	57,1	19,0	7,1	54,8	50,0	31,0	23,8	7,1	0,0	85,7	47,6	9,5	13,88	59,5 males			

session 2 cost (guess) = 1	13A	13B	14A	14B	15A	15B	16A	16B	17A	17B	18A	18B	19A	19B	20A	20B	21A	21B	22A	22B	23A	23B	24A	24B	correct guesses	male/ female	
43	1	0	1	0	1	1	0	1	1	0	1	0	1	1	0	1	0	0	0	0	0	1	1	0	0	18	f
44	0	1	1	0	1	0	0	1	1	0	1	0	1	1	0	1	0	0	0	1	1	1	0	0	1	17	f
45	1	0	1	0	1	1	1	1	1	0	1	0	1	1	0	1	0	0	1	1	1	1	0	1	1	16	f
46	0	0	1	1	1	1	0	0	1	0	1	0	0	1	0	1	0	0	1	0	0	0	1	1	0	15	m
47	1	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	15	f
48	0	0	1	0	0	0	0	1	1	0	1	0	0	1	0	1	0	0	1	1	1	1	1	0	1	15	m
49	0	0	1	0	0	0	1	1	1	0	1	0	0	1	0	0	0	0	0	0	0	1	0	1	1	15	f
50	0	0	0	1	0	1	1	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	0	14	m
51	1	0	1	0	0	0	1	1	1	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	14	m
52	1	0	1	0	0	0	1	1	1	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	14	m
53	0	0	1	1	0	0	0	0	1	0	1	0	0	1	1	0	0	0	1	0	0	0	0	0	1	14	m
54	0	0	1	0	1	1	0	0	1	0	1	0	0	1	1	0	0	0	1	1	1	1	1	0	1	14	m
55	1	1	1	1	1	0	1	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	14	m
56	1	1	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	1	0	0	0	14	f
57	1	0	1	1	0	1	0	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	0	0	14	m
58	0	0	0	1	0	0	0	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	13	f
59	1	0	0	1	1	1	0	1	1	0	1	0	0	1	0	0	0	0	1	0	1	1	1	0	0	13	f
60	1	0	1	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	1	0	1	0	0	0	13	m
61	1	0	0	1	0	0	1	1	1	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	1	13	m
62	1	0	1	0	0	0	0	0	1	0	1	0	1	1	1	0	0	0	0	0	0	1	0	1	0	13	m
63	1	0	0	1	1	0	1	1	0	0	1	0	0	0	1	1	0	0	1	0	0	0	1	0	1	13	m
64	1	0	1	1	0	0	1	1	1	0	1	0	0	1	1	1	0	0	0	1	1	1	0	0	1	13	m
65	0	1	0	1	1	1	0	0	0	0	1	0	1	0	1	0	1	1	0	0	1	0	0	0	1	13	f



66	1	0	1	0	0	0	0	0	0	1	0	1	0	1	1	0	0	0	0	1	1	1	1	0	1	13	m
67	0	0	1	0	0	0	1	1	1	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	12	m
68	1	0	1	1	0	1	0	0	1	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	12	m
69	0	0	0	1	0	0	0	1	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	12	m
70	1	0	1	0	0	1	1	1	1	0	1	0	1	1	1	0	1	0	0	0	0	0	0	0	0	12	f
71	1	0	0	0	1	0	0	0	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	12	f
72	0	0	1	0	0	1	0	0	1	0	1	0	0	0	0	1	0	1	1	1	0	1	0	1	12	f	
73	0	0	0	1	1	0	0	0	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	12	f
74	1	1	0	1	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	12	f
75	1	0	1	1	1	1	1	0	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	12	m
76	1	0	1	1	0	0	1	1	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	12	f
77	1	0	1	1	0	0	1	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	12	f
78	1	0	0	1	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	11	m
79	1	0	1	1	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	11	m
80	0	0	0	1	1	0	1	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	11	m
81	0	1	0	1	0	0	1	1	1	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	11	m
82	1	0	0	0	1	0	1	1	1	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	10	m
83	1	0	1	0	0	0	1	1	1	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	10	f
84	1	0	0	1	0	1	0	0	1	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	10	m
85	1	0	1	1	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	9	f
86	1	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	9	m
87	1	0	1	1	0	0	1	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	8	f
88	1	0	0	1	0	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	f
average session 2 [%]	67,4	13,0	60,9	58,7	34,8	32,6	43,5	52,2	80,4	4,3	93,5	6,5	26,1	76,1	45,7	21,7	8,7	6,5	50,0	54,3	78,3	45,7	26,1	39,1	12,61	56,5% males	

**Table: Onlooker data**

## Literature

- Brosig, Jeannette (1998): Communication and Individual Cooperation – An Experiment, discussion paper, University of Magdeburg.
- Dawes, Robyn M., Jeanne McTavish and Harriet Shaklee (1977): Behavior, Communication, and Assumptions about Other People's Behavior in a Commons Dilemma Situation, *Journal of Personality and Social Psychology*, 35(1), 1-11.
- DePaulo, B.M. and R. Rosenthal (1979): Telling Lies, *Journal of Personality and Social Psychology*, 37, 1713-1722.
- DePaulo, B.M., R. Rosenthal, C.R. Green, and J. Rosenkrantz (1981): Verbal and Nonverbal Revealingness in Deceptive and Nondeceptive Communications, discussion paper University of Virginia.
- Ekman, Paul (1985): Telling Lies – Clues to Deceit in the Marketplace, Politics, and Marriage, New York, London: W.W. Norton.
- Frank, Robert H. (1987): If Homo Economicus Could Choose His Own Utility Function, Would He Want One with a Conscience?, *American Economic Review*, 77(4), 593-604.
- Frank, Robert H. (1988): Passions Within Reason: The Strategic Role of Emotions, New York: W.W. Norton.
- Frank, Robert H., Thomas Gilovich and Dennis T. Regan (1993): The Evolution of One-Shot Cooperation: An Experiment, *Ethology and Sociobiology* 14, 247-256.
- Frey, Bruno S., and Iris Bohnet (1995): Institutions Affect Fairness: Experimental Investigations, *Journal of Institutional and Theoretical Economics*, 151, 286-303.
- Frohlich, Norman, and Joe Oppenheimer (1998): Some Consequences of E-mail vs.Face-to-Face Communication in Experiment, *Journal of Economic Behavior and Organization*, 35, 389-403.
- Gauthier, David (1978): *Morals by Agreement*, Clarendon Press, Oxford.
- Harsanyi, John C., and Reinhard Selten (1972): A Generalized Nash Solution for Two-Person Bargaining Games with Incomplete Information, *Management Science*, 18, P80-P106.
- Hoggatt, Austin C., Reinhard Selten, David Crockett, Shlomo Gill, Jeff Moore (1978): Bargaining Experiments with Incomplete Information, in: H. Sauermann (ed.), *Bargaining Behavior, Contributions to Experimental Economics*, 7, Tübingen, J.C.B. Mohr, 127-178.
- Isaac, R. Mark, and James M. Walker (1988): Communication and Free Riding Behavior: The Voluntary Contribution Mechanism, *Economic Inquiry*, 26, 585-608.

- Knapp, M.L., and M.E. Comadena (1979): Telling It Like It Isn't: A Review of Theory and Research on Deceptive Communications, *Human Communication Research*, 5, 270-285.
- Kraut, R.E. (1980): Humans as Lie Detectors: Some Second Thoughts, *Journal of Communication*, 30, 209-216.
- Kuon, Bettina (1994): Two-Person Bargaining Experiments with Incomplete Information, Berlin et al.: Springer Verlag.
- Miller, G.R., and J.K. Burgoon (1981): Factors Affecting Assessments of Witness Credibility, in: R. Bray and N. Kerr (eds.), *The Psychology of the Courtroom*, New York: Academic Press.
- Orbell, John M., Alphons J.C. van de Kragt and Robyn Dawes (1988): Explaining Discussion-Induced Cooperation, *Journal of Personality and Social Psychology*, 54, 811-19.
- Rubinstein, A. (1985a): A Bargaining Model with Incomplete Information about Time Preferences, *Econometrica*, 53, 1151-1172.
- Rubinstein, A. (1985b): Choice of Conjectures in a Bargaining Game with Incomplete Information, in: Roth, A.E. (ed.), *Game Theoretic Models of Bargaining*, Cambridge: Cambridge University Press, 99-114.
- Robson, Arthur (1990): Efficiency in Evolutionary Games: Darwin, Nash and the Secret Handshake, *Journal of Theoretical Biology*, 144, 379-96.
- Roth, Alvin E. (1995): Bargaining Experiments, in: Kagel, John, and Alvin E. Roth (eds.), *Handbook of Experimental Economics*, Princeton: Princeton University Press.
- Sally, David F. (1995): Conversation and Cooperation in Social Dilemmas: Experimental Evidence from 1958 to 1992, *Rationality and Society*, 7, 58-92.
- Selten, Reinhard (1975): Bargaining under Incomplete Information – A Numerical Example, in: Becker, O., and R. Richter (eds.), *Dynamische Wirtschaftsanalyse*, Tübingen: J.C.B. Mohr, 136-168.
- Valley, Kathleen L., Joseph Moag and Max H. Bazerman (1998): 'A Matter of Trust': Effects of Communication on the Efficiency and Distribution of Outcomes, *Journal of Economic Behavior and Organization*, 34, 211-238.
- Zuckerman, Miron, Bella M. DePaulo and Robert Rosenthal (1981): Verbal and Nonverbal Communication of Deception, *Advances in Experimental Social Psychology* 14, 1-59.