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**Working Paper**

## An Experimental Study on Bargaining Behavior in Economic and Ethical Environments

Volkswirtschaftliche Diskussionsbeiträge, No. 56-95

**Provided in Cooperation with:**

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*Suggested Citation:* Klemisch-Ahlert, Marlies (1995) : An Experimental Study on Bargaining Behavior in Economic and Ethical Environments, Volkswirtschaftliche Diskussionsbeiträge, No. 56-95, Universität Siegen, Fakultät III, Wirtschaftswissenschaften, Wirtschaftsinformatik und Wirtschaftsrecht, Siegen

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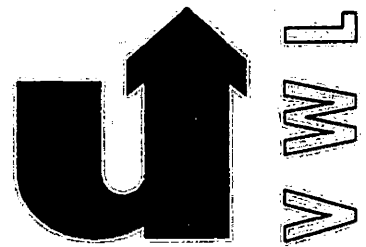
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**VOLKSWIRTSCHAFTLICHE  
DISKUSSIONSBEITRÄGE**



**An Experimental Study  
on Bargaining Behavior  
in Economic and Ethical Environments**

**Marlies Klemisch-Ahlert**

**Revised Version September 1995**

**UNIVERSITÄT - GESAMTHOCHSCHULE - SIEGEN  
FACHBEREICH WIRTSCHAFTSWISSENSCHAFTEN**

# **An Experimental Study on Bargaining Behavior in Economic and Ethical Environments**

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\*For helpful discussions and constructive comments I am very grateful to Wulf Gaertner, Werner Güth, Reinhard Selten and Reinhard Tietz. I thank Jochen Jungeilges for his hints concerning the statistical analysis. I also thank Antje Fitschen-Lischewski and Cornelia Weilke, who made a great effort to help me with the experiments and their evaluation. Financial support of Deutsche Forschungsgemeinschaft and Fritz Thyssen Stiftung is gratefully acknowledged.

## **Abstract**

We investigate bargaining processes with two opponent parties, each consisting of two subjects. The parties negotiate about the distribution of a certain amount of money. The sum of the payoffs of the four subjects is not constant. The payoff situations are asymmetric. Between the two parties, verbal communication is not allowed. Proposals and answers are written on forms. The discussion between the two subjects in the same party is recorded on tapes.

We vary the shape of the payoff situations, the size of the payoff scales and aspects of the ethical environment of the experiments.

We evaluate the distributive principles and norms the subjects apply when they formulate their bargaining marks and expectations, as well as their justifications for these principles. In addition, we analyze the bargaining processes and the resulting agreements.

# 1 Motivation and Design of the Study \*)

## 1.1 Motivation

In his fundamental paper of 1950, Nash constructs a model of a bargaining situation with two persons and formulates a set of axioms which uniquely characterize a bargaining solution, the so-called Nash solution. In Nash's model preferences of the persons over a set  $X$  of feasible alternatives are expressed by cardinal v. Neumann–Morgenstern utility functions. Among the alternatives in  $X$  there exists a certain alternative  $x_0$ , the alternative of disagreement, often called status quo. In the general case of  $n \geq 2$  persons, the pair  $(X, x_0)$  is mapped by the utility functions of the persons onto a pair  $(S, d)$  in an  $n$ -dimensional utility space.  $(S, d)$  is called a bargaining situation with  $n$  persons, if  $S$  is a convex and compact subset of  $\mathbb{R}^n$ , if  $d$  is an element in  $S$ , and if there exists an alternative  $x$  with an image  $s$  in  $S$  such that every person strictly prefers  $x$  to  $x_0$ , i.e.  $s > d$ . For every bargaining situation a bargaining solution  $f$  selects a point  $f(S, d)$  in  $S$ .

The classical solution concepts make use of the assumption that the whole information which is relevant for the bargaining problem can be represented in the utility space. In addition, the solutions are characterized by axioms claiming strong rationality requirements which are expressed by relations between utility levels.

Nash himself pointed out that using utility functions in bargaining models is a strong idealization, as there are many important properties of bargaining problems which are not representable in utility spaces.

Yaari and Bar–Hillel (1984) have run an experiment with questionnaires on the distribution of commodities between two individuals. Among the

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\*) Parts of this section are literally cited from Klemisch–Ahlert, M.: *Distributive Results in Bargaining Experiments*. In: Gaertner, W. and Klemisch–Ahlert, M. (1992)

solutions from which the respondents were asked to choose were the Nash bargaining solution, the Kalai–Smorodinsky solution and others. The results show that for different distributive problems having the same representation in utility space the solutions chosen by the respondents depend on special economic, social or ethical aspects of the situations. Schokkaert and Overlaet (1989) have reported similar results for some other types of distributive problems. They also consider the sharing of losses.

Persons' judgement on the justice of distributions apparently depend on dimensions such as

- needs of the persons involved in the problem
- their possibility to enjoy certain goods
- their endowments and skills
- their effort or productivity or contribution to a cooperative product
- their rights or legitimate claims.

Applied principles may vary dependent on the type of the environment of the distributive problem and dependent on the objects to be distributed. Experimental studies have to concentrate on a reduced number of aspects to be controlled. Gaertner (1992) argues in support of this procedure: "Therefore, it may seem justified to partition a social state into sub-categories such as political rights and liberties, basic health and longevity, the quality of the environment, the provision with material goods and services, and other aspects and then decide with respect to each component." The studies we mention in the following deal with the allocation of monetary payoffs under certain controlled environmental conditions. We concede that this is only a small aspect of what is meant by a social state.

A comparison given by Güth (1989) of the distributive results in dictatorship games, reward allocation games, and ultimatum bargaining games shows that changes in the experimental environment have severe effects on the behavior of the subjects. From the results of several ultimatum bargaining experiments it follows that the subjects nearly never choose the game the-

oretic solution. At least, when the payments in the experiments are rather low, strategically irrelevant aspects have a strong influence on the bargaining behavior.

In dictator experiments and ultimatum bargaining experiments the strongness of the selfishness of the players seems to be influenced by the moral justification of their position. In the experiments Güth describes, this justification has to be deduced from the experimental environment, e.g. the talent of a person or her ability to win a strategic game or an auction.

In addition, the impact of an economic variation on the behavior of the players can be observed. Higher total amounts of payoffs lead to higher proportional demands of the players. In this case, players also seem to investigate the situation more precisely and to behave more carefully.

In reward allocation experiments, a contribution standard is observed. Inferior players tend to split the total payment proportional to the contributions of the persons. Contributions are the obvious basis for them to legitimate their claims. Therefore, this type of equity principle seems to be stronger than the equal split tendency. The superior allocators more often choose equal rewards.

In Selten's Laboratory of Experimental Economics in Bonn experimental two-person characteristic function games have been conducted. The economic conditions that were varied in these bargaining experiments were the status quo of the bargaining situations  $(v(1), v(2))$ , the value of the two person coalitions  $v(12)$  which is the value to be divided by the two persons, and the scale factor for the payoffs. Uhlich (1988, 1990) introduces a descriptive area theory for this type of experiments, the Negotiation Agreement Area (NAA) for nonnegative status quo points. The theory is extended by Rockenbach and Uhlich (1989) to situations with negative threat points. The authors show that in comparison with normative theories the NAA is the area theory with the best predictive success. The NAA is defined with the

aid of three aspiration levels: the maximal aspiration level for the strong player (Player 1)  $A_1^{max}$  and for the weak player (Player 2)  $A_2^{max}$ , and the attainable aspiration level for the weak player  $A_2^{att}$ . The last level is defined by the equal surplus norm. The lower bounds for the payoff of the strong player is defined by  $\frac{A_1^{max}}{A_1^{max} + A_2^{max}} v(1, 2)$ , and the lower bound for the payoff of the weak player is  $\frac{A_2^{att}}{A_1^{max} + A_2^{att}} v(1, 2)$ . The NAA is then bounded by these values after some corrections with respect to the prominence level. The proportionality factors of the bounds reflect the different positions of the players in the game. The factor of the strong player is defined by the proportion of his maximal aspiration level to the sum of both maximal aspiration levels, whereas the factor of the weak player is deduced from his attainable aspiration level that involves the thought of equal split of the surplus.



## 1.2 Design of the Study

We mentioned some examples of interviews and experiments in order to demonstrate how solutions to distributive problems may depend on economic, social or ethical dimensions of the experimental environment. We are interested in some of these dimensions and we design some classes of bargaining experiments with identical payoff constellations and different environments.

It is our aim to evaluate the distributive principles the subjects apply in the experiments, when they formulate their bargaining marks and expectations, as well as the justifications for the principles. We are also interested in their considerations concerning the principles and justifications their opponents apply. In addition we observe the bargaining process and the resulting agreements.

We try to answer to following questions:

- Which principles do the subjects apply dependent on their bargaining position?
- How do the applied principles and the agreements depend on the economic or ethical environment of the experiments?
- How does the agreement depend on these principles?

We investigate bargaining situations with two opponent parties, Group *A* and Group *B*, each group consisting of two subjects. Group *A* is formed by Players 1 and 2, Group *B* by Players 3 and 4. The parties bargain about the distribution of a certain amount of money. In contrast to the experiments of Uhlich and Rockenbach, the sum of the payoffs of the four subjects is not constant. It depends on the agreement of the parties. The situations are asymmetric, i.e. the two parties have different payoff functions. Between the two parties, verbal communication is not allowed. Proposals and answers are written on forms.

We would like to restrict the set of possible variations for our study to the following types:

We choose some fixed payoff sets and embed them into four different kinds of experimental environments. The first environment is defined only by the payoffs. In the second environment the payoffs are enlarged by multiplication with the factor 2.5. In the third type of experiments the positions in the game are filled with subjects dependent on their contribution to a collective task, which has to be performed previously. In the fourth environment payoffs of one party are connected to additional payments to indigents. These payments are remitted as gifts to certain social services, selected by the subjects.

The variants of the sets of feasible payoffs for the two parties are given in Figure 1.1. The Pareto optimal boundary (in terms of payoffs) of a situation and the status quo (0-payoffs for all persons) define the feasible payoff set.

Different variants are generated from Situation 1 by truncating the top or the right part of the triangle at certain levels. The subjects don't know this two-dimensional graphic representation of the feasible payoff constellation. The material they receive consists of payoff tables and offer forms (Figure 1.2 shows an example of a payoff table and Figure 1.3 an offer form).

**Situations**  
 (Payoffs per person (DM) of group A and B)

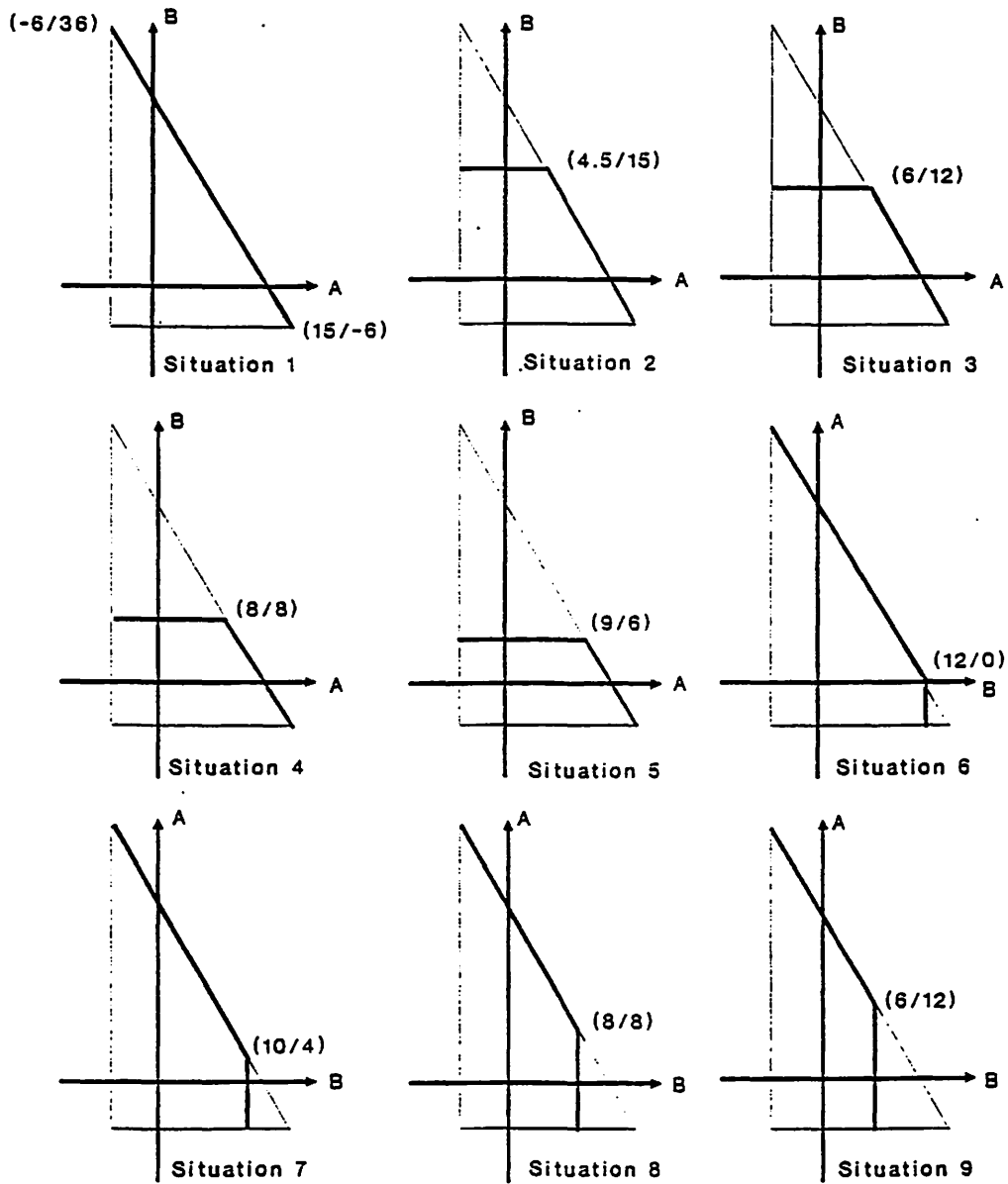


Figure 1.1

Konflikt 2:2.5

Auszahlungstabelle

Gruppe A

Auszahlung für Spieler 1 und 2 in DM pro Spieler	A	Auszahlung für Spieler 3 und 4 in DM pro Spieler
90	-15	
85	-12,50	
80	-10	
75	-7,50	
1/6 70	-5	
65	-2,50	
2/6 60	0	
3/6 55	-2,50	
4/6 50	5	
5/6 45	7,50	
6/6 40	10	
7/6 35	12,50	
8/6 30	15	
9/6 25	17,50	
10/6 20	20	
11/6 15	20 3/4	
12/6 10	20	
13/6 5	20 1/2	
14/6 0	20 1/4	
-5	20	
-10	20	
-15	20	

Auszahlung für Spieler 1 und 2 in DM pro Spieler	B	Auszahlung für Spieler 3 und 4 in DM pro Spieler
90	-15	
85	-12,50	
80	-10	
75	-7,50	
70	-5	
65	-2,50	
60	0	
55	2,50	
50	5	
45	7,50	
40	10	
35	12,50	
30	15	
25	17,50	
20	20	
15	20 3/4	
10	20	
5	20 1/2	
0	20 1/4	
-5	20	
-10	20	
-15	20	

Negative Auszahlungen sind Zahlungen, die ein Spieler an den Experimentator zu leisten hat.  
 Abstände werden auf Millimeter genau gemessen. Die Auszahlungen für Abstände zwischen ganzzahligen Zentimeterwerten werden linear interpoliert.

Figure 1.2

Experiment vom 14.11.90 Konflikt: 2.8 x 2.5  
 Spieler 1: \_\_\_\_\_ Spieler 2: \_\_\_\_\_  
 Spieler 3: \_\_\_\_\_ Spieler 4: \_\_\_\_\_

Uhrzeit: 18 13

Vorschlag von Spieler <u>1</u> u. <u>2</u> Runde <u>13</u>	Spieler 1 / 2 Je <u>40</u> DM	Spieler 3 / 4 Je <u>10</u> DM	Spieler <u>3</u> Annahme <input type="checkbox"/> Ablehnung <input checked="" type="checkbox"/>
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Uhrzeit: 18 17

Vorschlag von Spieler <u>3</u> u. <u>4</u> Runde <u>14</u>	Spieler 1 / 2 Je <u>22</u> DM	Spieler 3 / 4 Je <u>19</u> DM	Spieler <u>1</u> Annahme <input type="checkbox"/> Ablehnung <input checked="" type="checkbox"/>
--	----------------------------------	----------------------------------	---

Uhrzeit: 18.19

Vorschlag von Spieler <u>1</u> u. <u>2</u> Runde <u>15</u>	Spieler 1 / 2 Je <u>37.5</u> DM	Spieler 3 / 4 Je <u>11.25</u> DM	Spieler <u>3</u> Annahme <input type="checkbox"/> Ablehnung <input checked="" type="checkbox"/>
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Uhrzeit: 18.20

Vorschlag von Spieler <u>3</u> u. <u>4</u> Runde <u>16</u>	Spieler 1 / 2 Je <u>15</u> DM	Spieler 3 / 4 Je <u>17.50</u> DM	Spieler <u>1</u> Annahme <input type="checkbox"/> Ablehnung <input checked="" type="checkbox"/>
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Uhrzeit: 18 22

Vorschlag von Spieler <u>1</u> u. <u>2</u> Runde <u>17</u>	Spieler 1 / 2 Je <u>34,-</u> DM	Spieler 3 / 4 Je <u>13,-</u> DM	Spieler <u>3</u> Annahme <input type="checkbox"/> Ablehnung <input checked="" type="checkbox"/>
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Uhrzeit: 18 27

Vorschlag von Spieler <u>3</u> u. <u>4</u> Runde <u>18</u>	Spieler 1 / 2 Je <u>30</u> DM	Spieler 3 / 4 Je <u>15</u> DM	Spieler <u>1</u> Annahme <input type="checkbox"/> Ablehnung <input checked="" type="checkbox"/>
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Figure 1.3

At the beginning of an experiment the experimenter assigns the player numbers to the subjects, without telling the numbers to the subjects. In the first, second and fourth environment, the numbers are determined randomly. In the third environment the persons have to pass a multiple choice test in microeconomics, directly before the bargaining games are played. The ranking of the results of the subjects in the test defines the positions in the bargaining conflicts. The subjects are told that proportional to their commonly achieved numbers of points in the test a factor will be chosen by which a standard payoff situation will be multiplied. In addition they are informed that the strongness of their positions in the bargaining game played afterwards will depend on their individual contribution to the total amount of points.

The two groups are led into optically and acoustically separated rooms. There they receive the payoff table. They have ten minutes of time to discuss the table with their team partner. Afterwards they are told to which group they belong, which player number they have, and which group has to make the first offer. Player 1 acts for Group A, Player 3 acts for Group B. The two parties communicate on offer forms, on which they have to write down their offers by turns. The party which has to make the next offer has up to ten minutes of time for this decision. The acting player of the opposing party decides in a third room whether he accepts the offer or not. Afterwards he gives reasons for his decision to his team partner. Every player has the possibility to declare "Disagreement" at any time. In this case the game is finished and the players receive their disagreement payoffs (0 DM). If some acting player (Player 1 or 3) accepts an offer, then an agreement is reached, the game is finished, and the players receive the payoffs specified by the accepted offer.

In each group's room a tape recorder is installed which records the discussions between the two players in the same party and the arguments of the acting player when he explains his decisions to his partner.

The subjects of our experiments are undergraduate students of economics and business administration at the University of Osnabrück. Nearly all of them had no knowledge of Game Theory and none of them had participated in a game theoretic experiment before. The subjects were instructed in a 30 minutes session immediately before the experiment started. Each subject played in two or three different situations (dependent on the types of the ethical environments) with different partners and different opponents.

### 1.3 Data

We are able to analyze the following data of every game: the economic and ethical environment of the situation; the time sequence of offers by the two parties and the result of the game; the principles and their justifications the players use in their discussions and reasoning of their expectations and behavior.

From the whole set of data we choose the following variables of each game for our analysis:

- the result of the game (in payoffs)
- the number of rounds
- the length of the game (in minutes)
- the time sequence of offers.

From the discussions on the tapes we gather the following aspiration levels of every group. These levels are observable in nearly all of the games we played (cf. Tietz and Bartos (1983))

- the planned bargaining goal
- the agreement seen as attainable
- the lowest acceptable agreement
- the expected planned bargaining goal of the opponents
- the expected lowest agreement of the opponents.

We sometimes have further information on planned threats to break-off negotiations and expectations about break-off conditions of the opponents. Often we know expectations about the first offer of the opponents.

We analyze the data of 47 games with 80 subjects. In the following table we show in which environments each basic situation is repeated and how many repetitions have been played. In this table the basic situations are named by their numbers. If the term \*2.5 is added to a number, this characterizes a situation which is generated by multiplying the payoffs of a basic situation by 2.5. The letter Q means that positions are assigned according to the results of a quiz. The letters A or B mean that Group A resp. B negotiates also for indigents.

Situation (S)	1	1 * 2.5	1 * 2.5 Q	1 * 2.5 A	1 * 2.5 B				
Number of Repetitions (#)	4	2	1	1	1				
S	2	2 * 2.5	3	3 * 2.5	4	4 * 2.5	5	5 * 2.5	5 * 2.5 Q
#	2	2	2	2	2	2	4	2	1
S	6	6 * 2.5	6 * 2.5 Q	7	7 * 2.5	8	8 * 2.5		
#	2	2	1	3	2	2	2		
S	9	9 * 2.5	9 * 2.5 Q						
#	2	2	1						

We tried to repeat every basic situation and multiplied basic situation at least twice. Since Situations 1 and 5 have some special features which we will describe in the following sections, we played them more often. Because of the explorative character of the study we felt justified to decide this. One difficulty with the quiz-experiments was that we needed eight subjects to participate at a certain date. The second difficulty was that it took more than half an hour to let the subjects answer the questions and to evaluate the



test. So the subjects had to invest more than two hours of time altogether for the instruction, the first game with a basic situation, the test and the second game with the quiz-situation. We were only able to recruit enough subjects for two dates. Therefore we got the data of four quiz-games. Also the experiments with payments to indigents needed more time and additional preparation. We decided to choose one situation, namely situation  $1 * 2.5$ , to be played in two different variants of this type of environment. The purpose of these games was not the statistical evaluation of the data, but a comparison of the discussed principles and arguments to repetitions of Situations 1 and  $1 * 2.5$ .

The aspiration levels, norms and justifications mentioned in the discussion on the tapes are subscribed by two persons independently. The protocols are compared afterwards. There were not many differences that had to be clarified. The aspiration levels could be recognized very unequivocally. In addition changes in the negotiation behavior have been noted in the protocols.

## 2 Monotonicity Results

### 2.1 Introduction

In the experiments we observe that the subjects discuss and apply five distributive principles.

First, there is the equal payoff principle which means that all persons receive the same amount of money. Then there are two principles that are derived from proportionality considerations. The subjects either choose the maximal payoffs for the two groups and calculate their ratio, or they take the maximal payoffs in the individual rational part of the payoff constellations in order to form a ratio. The principles then claim that the ratio between the payoffs of the persons in Groups *A* and *B* should be equal to the ratio of their respective maximal values. In our situations with a status quo of 0-payoffs, the second principle defines the Kalai–Rosenthal (1978) solution and the third principle defines the Kalai–Smorodinsky (1975) or Gauthier (1985) solution in payoffs. The fourth principle is the equality of the ratio between the payoffs of the two groups and the transformation rate between the payoffs of the groups. The transformation rate in our situation is 1 : 2. This means that, for example, a concession of 1 DM per person of the first group implies a payoff gain of 2 DM for each person in the other group. This principle which is defined for payoffs corresponds to a property of the Nash solution (1950) in utility spaces. The fifth principle is the maximization of the sum of the payoffs of both groups.

Since we vary the shape of the feasible payoff pairs in a systematic way by changing truncation levels, it is possible to construct functions that describe how the payoffs change with respect to the five distributive principles.

In the following sections we investigate a certain kind of interdependence between the payoff situation of a game and the agreement or the planned

bargaining goals of the groups. We compare the observed relations to those defined by the distributive principles.

In ultimatum bargaining experiments a tendency to equality of payments in the results is observed. Higher total amounts of payoffs lead to higher proportional demands of the superior players. There seems to be a competition between the principle of equal payoffs and the selfishness of the superior player to exploit his strategic power. The tendency to selfishness becomes stronger when the feasible payoff increases. In dictator experiments there has been observed a politeness ritual. This means that the “dictators” sometimes resign to exploit their positions. In reward allocation experiments the inferior players tend to split the total payment proportional to the contributions of the persons. Contributions are the obvious basis for them to legitimate their claims. Therefore, they use the proportionality principle and not the equal-split principle. The superior allocators more often choose equal rewards. They do not need a justification for this behavior. From these results (Güth, 1989) we learn that the behavior of players in these games is guided by different distributive norms. Often there is more than one principle that could be applied. Which norm a player chooses depends on the type of game, on the position in the game, on the experimental environment (size of the payoffs, how the players get their positions) and on the possible justifications for the application of the norm.

In the following sections we try to find out which principles the subjects in our experiments use to formulate their goals for a negotiation in a game, and which compromise between different principles is made in the agreements. In addition we investigate the effect of enlarged payoff scales on the agreements and the goals.

## 2.2 Rank Regression Analysis

The statistical procedure we describe in this section has been proposed by Iman and Conover (1979). We use the notation of Conover (1980). The rank regression analysis is a nonparametric method for a monotonic regression of a bivariate data set. It is used in cases where a linear relation between the two variables cannot be expected, but it seems reasonable to assume a monotonically increasing or decreasing relation. In addition the method has the advantage of being applicable even to data sets with a small number of independent observations like in our study.

### Rank Transform Regression

Let  $(X_i, Y_i)_{i=1, \dots, k}$  be the data set which is a random sample from some bivariate distribution. There is no assumption made on the type of the distribution.

To find the estimate of the regression of  $Y$  on  $X$  the following procedure is used.

- a) Calculate the ranks  $R(X_i)$  of the variables  $X_1, \dots, X_k$  and the ranks of  $R(Y_i)$  of the variables  $Y_1, \dots, Y_k$ . In the case of ties average ranks are used. This means in the case of no ties, the smallest value receives the rank 1 and the highest value the rank  $k$ .

b) The least squares regression line on the ranks has to be found.

$$y = A + B x, \quad (1)$$

where  $y$  stands for the ranks of the  $Y_i$ ,  $i = 1, \dots, k$ ,  
and  $x$  for the ranks of the  $X_i$ ,  $i = 1, \dots, k$ .

The formulas to derive  $A$  and  $B$  are

$$B = \frac{\sum_{i=1}^k R(X_i)R(Y_i) - k(k+1)^2/4}{\sum_{i=1}^k (R(X_i))^2 - k(k+1)^2/4}, \quad (2)$$

$$A = (1 - B)(k + 1)/2. \quad (3)$$

c) For each rank  $R(Y_i)$ ,  $i = 1, \dots, k$ , we can calculate the estimated rank of  $X_i$ ,  $\hat{R}(X_i)$  with respect to the linear regression (1):

$$\hat{R}(X_i) = (R(Y_i) - A)/B \quad i = 1, \dots, k. \quad (4)$$

d) For each  $\hat{R}(X_i)$ ,  $i = 1, \dots, k$ , we have to find the estimate  $\hat{X}_i$ .

If  $\hat{R}(X_i)$  is equal to the rank of some observation  $X_j$ ,  $\hat{X}_i$  is defined to be  $X_j$ .

If  $\hat{R}(X_i)$  lies between two adjacent ranks of observations  $X_j$  and  $X_\ell$  with  $X_j < X_\ell$ , then  $\hat{X}_i$  is found by linear interpolation between  $X_j$  and  $X_\ell$ :

$$\hat{X}_i = X_j + \frac{R(X_i) - R(X_j)}{R(X_\ell) - R(X_j)}(X_\ell - X_j). \quad (5)$$

If  $\hat{R}(X_i)$  is smaller than the smallest observed rank or greater than the largest observed rank,  $\hat{X}_i$  cannot be calculated this way. Linear extrapolation is not possible. Then there is no estimate for  $\hat{X}_i$  in this case.

e) In order to find the end points of the regression, choose the smallest observation and the largest observation from  $X_1, \dots, X_k$ . Let us call them  $x_{(1)}$  and  $x_{(k)}$ .

We have to calculate  $\hat{E}(Y | X = x_{(1)})$  and  $\hat{E}(Y | X = x_{(k)})$  in the following way:

We know  $R(x_{(1)})$  and  $R(x_{(k)})$  and therefore we can estimate the ranks  $R(y_{(1)})$  and  $R(y_{(k)})$  by applying the regression (1).

$$R(y_{(1)}) = A + B R(x_{(1)}) \quad \text{and} \quad (6)$$

$$R(y_{(k)}) = A + B R(x_{(k)}).$$

Now we have to find the estimates  $\hat{E}(Y | X = x_{(1)})$  and  $\hat{E}(Y | X = x_{(k)})$  by linear interpolation between ranks of the observations of the  $Y_i$ ,  $i = 1, \dots, k$ .

This procedure is similar to (d).

If  $R(y_{(1)})$  is equal to the rank of an observation  $Y_i$ , then

$$\hat{E}(Y | X = x_{(1)}) = Y_i.$$

If  $R(y_{(1)})$  lies between two adjacent values  $Y_i$  and  $Y_\ell$  with  $Y_i < Y_\ell$  and  $R(Y_i) < R(y_{(1)}) < R(Y_\ell)$ , then

$$\hat{E}(Y | X = x_{(1)}) = Y_i + \frac{R(y_{(1)}) - R(Y_i)}{R(Y_\ell) - R(Y_i)}(Y_\ell - Y_i).$$

If  $R(y_{(1)})$  is smaller than the smallest observed rank of  $Y_i$ ,  $i = 1, \dots, k$ ,  $\hat{E}(Y | X = x_{(1)})$  is defined to be the smallest observed  $Y_i$ .

If  $R(y_{(1)})$  is greater than the largest observed rank of  $Y_i$ ,  $i = 1, \dots, k$ ,  $\hat{E}(Y | X = x_{(1)})$  is equal to the largest observed  $Y_i$ .

The analogous definitions hold for  $\hat{E}(Y | X = x_{(k)})$ .

f) After all points of the rank transform regression have been calculated they can be plotted with  $\hat{X}_i$  as the abscissa and  $Y_i$  as the ordinate and with the end points

$$(x_{(1)}, \hat{E}(Y | X = x_{(1)})) \text{ and } (x_{(k)}, \hat{E}(Y | X = x_{(k)})).$$

g) If we connect the points with straight lines, this graph represents an estimate of the regression of  $Y$  on  $X$ .

If  $B > 0$ , all straight lines have to be increasing, in the case  $B < 0$  they have to be decreasing. In the first case, we estimate  $Y$  for a given  $X$  by a monotonic increasing (not necessarily linear) function, in the second case by a monotonic decreasing function. The definition set of this function is the full range of the observation of the  $X_i$ ,  $i = 1, \dots, k$ , because of the calculation of these end points.

We have chosen this method to analyse the relations between the shapes of the situations of our experiments, represented by the truncation levels of the payoff sets, and variables like payoff pair of the agreements and aspiration levels like planned bargaining goals. We do not expect linear relationships between these variables, but we expect some monotonicity relations. Since we do not have information on the distribution of the variables, we do not want to assume a certain type of distribution. This method does not need these assumptions. It leads to an estimate of the investigated variables (e.g. payoff ratios of the groups) for the range of all possible truncation levels. This means we receive an estimation not only for the situations we have played, but also for all situations with truncation levels inbetween. Since in general we will not receive a linear relationship between truncation levels and our observed variable, the type of non-linearity, i.e. changes and differences in the slopes of the straight line connecting the regression points, will lead to additional observations and interpretations.

## 2.3 Monotonicity in Payoff Ratios of the Agreements

In this section we investigate the relationship between the truncation level of a situation and the ratios of the payoffs in the agreements of the games. There are four data sets with a realization of two variables. The data sets are defined by the type of the truncation (whether the basic triangle is truncated from above or from the right) and by the size of the payoffs (basic payoff constellations are multiplied by 2.5). We calculate rank transform regressions for the resulting four data sets Situations 1 2 3 4 5, Situations 1 2 3 4 5 \* 2.5, Situations 1 6 7 8 9 and Situations 1 6 7 8 9 \* 2.5 seperately.

The index  $i$  of the variables in the rank transform regression numerates the different experiments within one data set. The variables  $X_i$  are the truncation levels, where the basic Situation 1 has the truncation level 36 in combination with Situations 2 3 4 5 (\* 2.5) and the level 15 in combination with Situations 6 7 8 9 (\* 2.5). From the collected data we take the agreements payoffs as a pair  $(Z_A|Z_B) = (\text{payoff for each person in Group } A|\text{payoff for each person in Group } B)$  and calculate the ratio  $\frac{Z_B}{Z_A}$ . Since for a given situation different agreements lead to different ratios, the agreements can be reconstructed from the ratios, if the truncation level is known. (For agreements that are strongly Pareto optimal in the payoff set, the information on the truncation level is not necessary.) Therefore, investigating the ratios  $\frac{Z_B}{Z_A}$  we do not loose information on the agreement payoffs.

The estimates of the rank transform regression of  $Y$  on  $X$  are plotted in the figures at the end of this section.

In these figures the proportion of the payoff of each person of Group  $B$  to the payoff of each person of Group  $A$  with respect to certain distributive principles can also be found.

The line "Equal" belongs to the principle "equal payoffs to all persons"



and has the constant level 1.

The line “Prop<sub>T</sub>” defines the payoff ratio for the principle that chooses a point in the payoff set with a payoff ratio identical to the payoff ratio of the maximal payoffs of each person in the whole payoff set.

The line “Prop<sub>IR</sub>” does the same for the principle that is defined by the proportion of the maximal payoffs of each person in the individually rational part of the payoff set.

The line called “Nash” represents the ratio of a payoff pair that would be defined by the Nash bargaining solution applied to the payoff set.

These curves have been calculated for all possible truncation levels between 0 and 36 for truncation of the basic situation from above and between 0 and 15 for truncation from the right.

Let us consider the graph “Payoff” of the rank transform regression analysis for the Situations 1 2 3 4 5. The line segments are strictly increasing. This means the higher the truncation level on the axis of Group *B* is, the greater is the estimated payoff ratio of a person in *B* to a person in *A*. The estimated ratios are close to 1, i.e. close to “Equal”.

We define a position of a group to be stronger than the position of the other group, if the estimated payoff of a person in this group is greater than that of a person in the other group. We observe that in this data set “strength” switches at a truncation level of 13.28. For levels lower than this, Group *A* has a stronger position than *B*, for higher levels vice versa.

There are some estimated points for levels between 6 and 7, where the estimated payoff ratios are higher than the “Nash” curve which in this area is defined by the kink of the payoff situation. This means that agreements are predicted that are weakly Pareto optimal but not strongly Pareto optimal and that this type of agreements has been observed. We describe this phenomenon in Section 3.2.

Now we consider the Situations 1 2 3 4 5 \* 2.5. Again the rank transform regression shows a monotonically increasing relation between the truncation level and the payoff ratio  $B/A$ . Comparing the slopes of the lines connecting the estimated points of the Situations 1 2 3 4 5 and 1 2 3 4 5 \* 2.5 we find that they are steeper in the situations with the multiplied payoffs. Here, changes of the truncation levels lead to more drastical changes of the payoff ratios.

The switch point for the strength of the groups is in this case estimated as a truncation level of 8.76. This truncation level is close to Situation 4, where the "Equal" principle leads to the kink of the payoff set ("Nash"), i.e. these two principles fall together. This means that the payoff pair of the kink can be used as an estimate for the strength of the positions. The group with the higher payoff in the kink has the stronger position. Of course, the kink of a payoff situation is a focal point. In the payoff tables the players get, this is a point such that one group has a constant payoff above or below.

The stronger groups can exploit their position better in Situations 1 2 3 4 5 \* 2.5 than in 1 2 3 4 5. The estimated payoff ratio in Situation 1 \* 2.5 for Group  $B$  is 2.92, which is even more than the "Prop<sub>T</sub>" principle would predict. If we compare this to the estimated payoff ratio in Situation 1 for Group  $B$ , which is 1.39, we find that the ratio is more than twice as large. For truncation level 6, where Group  $A$  is the stronger group, we have the payoff ratio  $B/A$  of 0.71 for Situation 1 \* 2.5 and 0.74 for Situation 1. In this case too, the stronger group is relatively better off in the agreements when the payoffs are multiplied.

For truncation levels between 26 and 36, i.e. truncations outside of the individually rational part of the payoff sets, payoff proportions are predicted that are greater than the values defined by any principle. For instance in Situation 1 \* 2.5, the maximal payoff of each person in Group  $B$  is 90 DM and the maximal payoff of  $A$  is 37.50 DM. From the tapes we learn that the possibility to win an amount of nearly 100 DM makes an enormous impression on all players. This leads to a more than proportional increase of

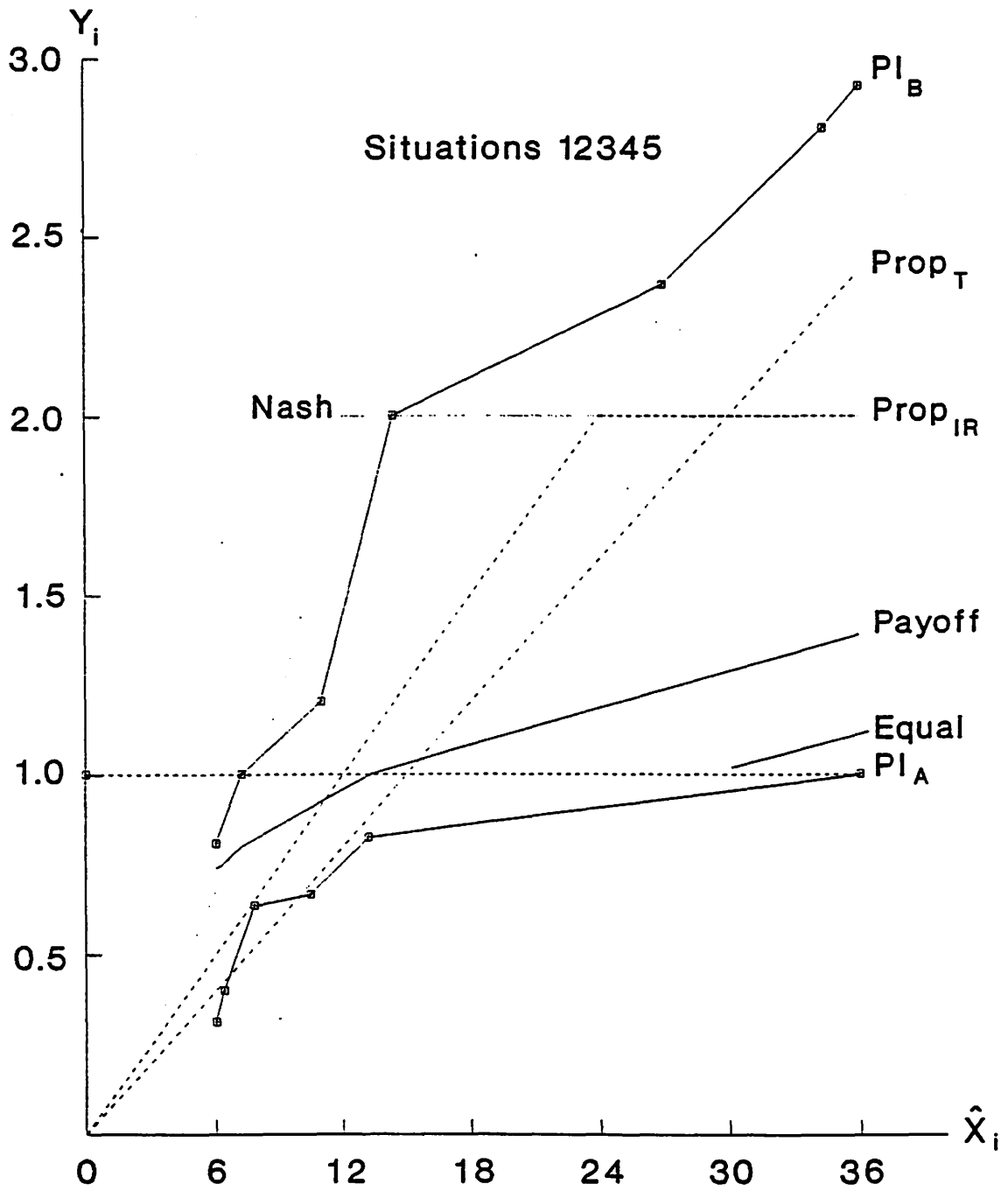
the payoff ratio in favor of Group *B*. We will discuss this observation more detailed when we describe the estimation of the planned bargaining goals of the groups.

In Situations 6789 the assignment of the names *A* and *B* to the groups is changed so that the group with the constant part in the payoff table is again Group *B*. We also change the names of the groups in Situation 1. Now this situation has the truncation level 15 for Group *B* (former Group *A*), which means that no truncation takes place.

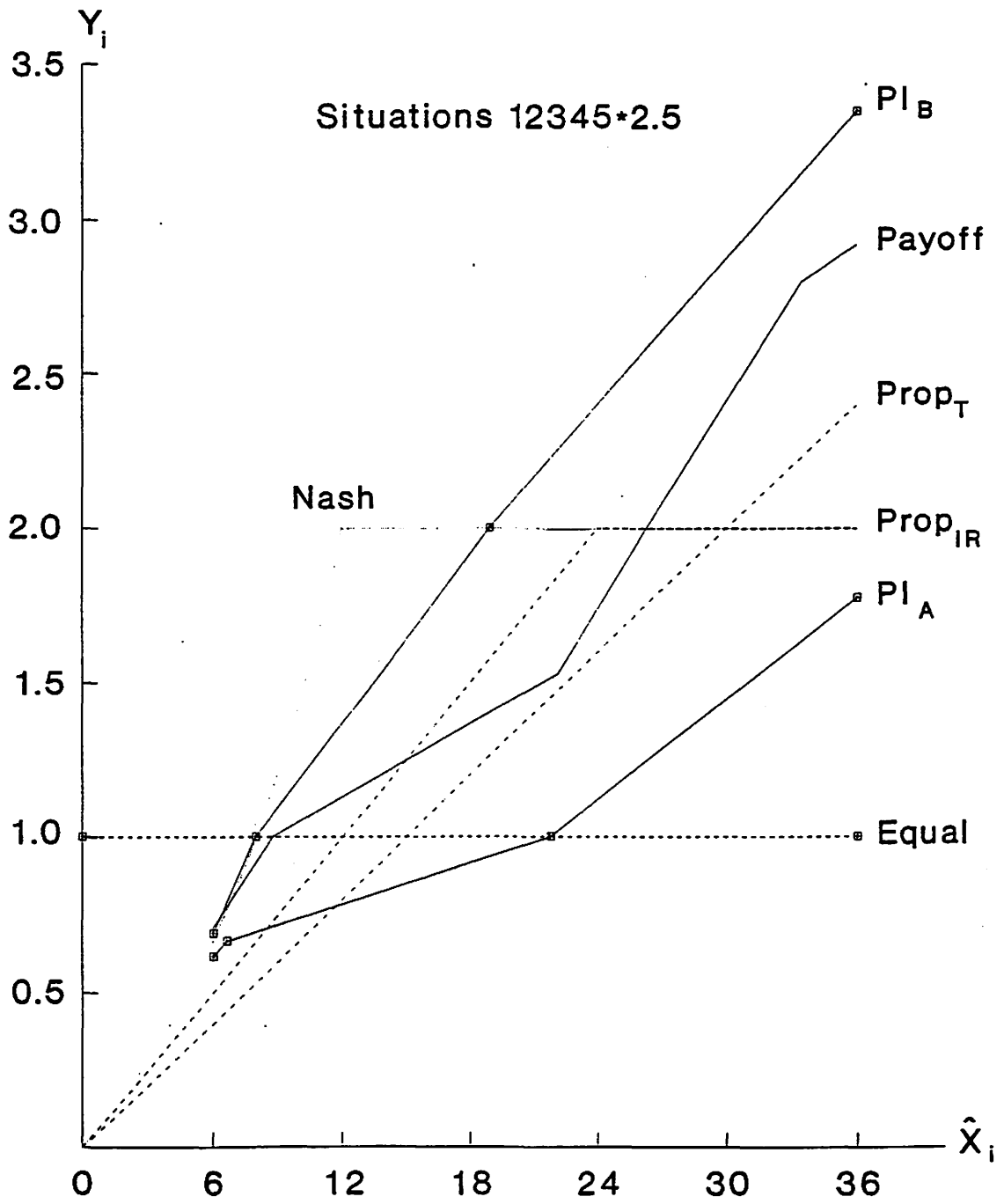
In these situations Group *A* always is the stronger group. In the rank transform regression of the payoff ratios  $B/A$ , the estimated curves for the data sets 16789 and  $16789 * 2.5$  lie below the "Equal" line. Again both curves are increasing. This is the same monotonicity property of payoff ratios dependent on truncation levels as in the data sets 12345 and  $12345 * 2.5$ . Comparing the payoff ratios of both data sets we find that the multiplied payoff scale leads to an estimated payoff ratio curve that lies between or close to the "Prop" lines, whereas in the standard Situations 16789 the estimated values are greater and lie between the "Equal" line and the "Prop" lines. Therefore we have an observation analogous to the data sets 12345 and  $12345 * 2.5$ . The multiplication of the payoffs of a given situation by 2.5 leads to estimated agreements where the weaker party is relatively worse off.

From the four data sets we observe a monotonicity relation between the payoff ratios and the truncation levels. And we find that the multiplied payoff scales lead to a relatively greater estimated success of the stronger party. This tendency is also observed in dictatorship experiments and ultimatum bargaining experiments (cf. Güth 1989).

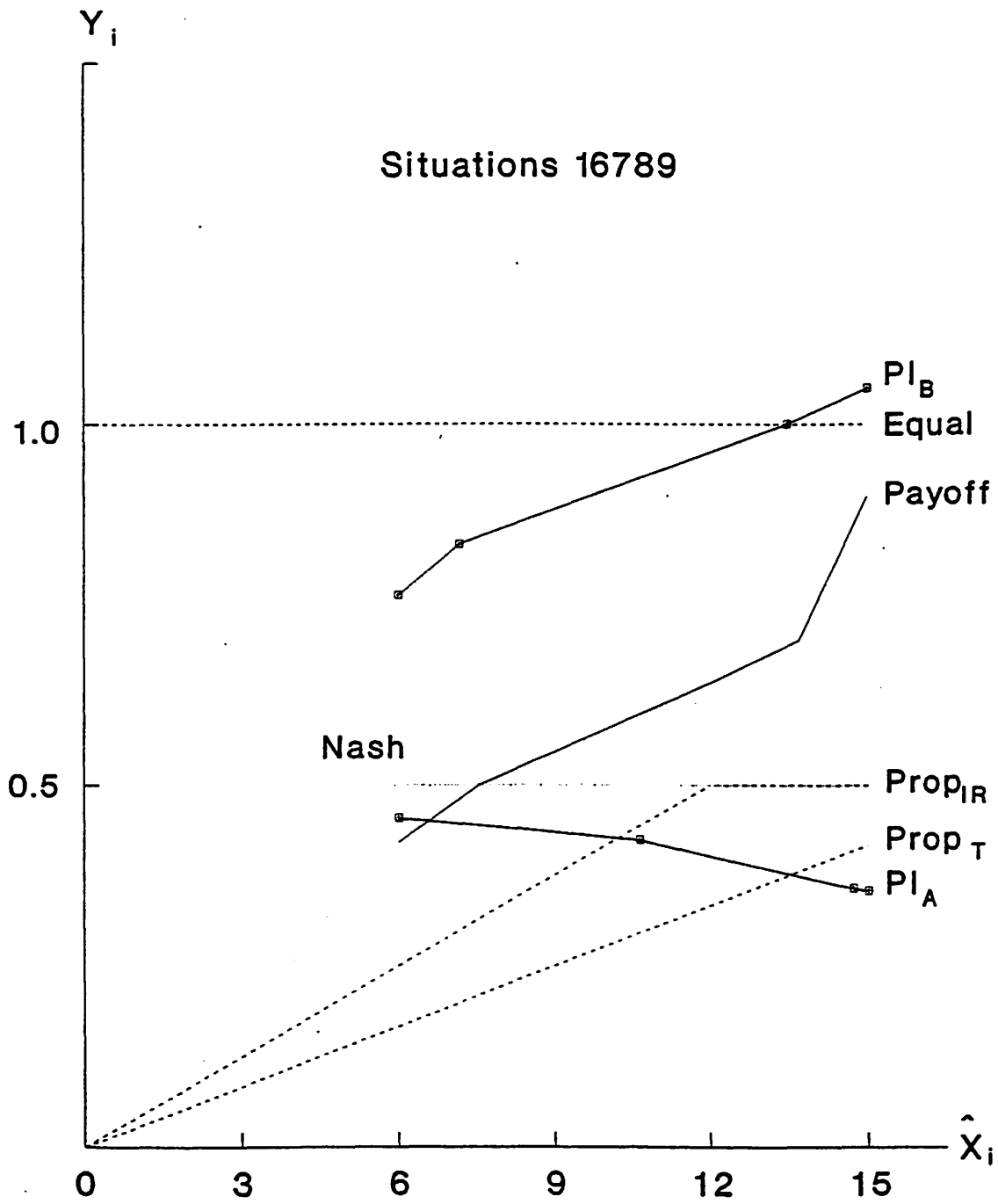
**Planned Bargaining Goals and Payoffs**  
**in Ratios B/A**



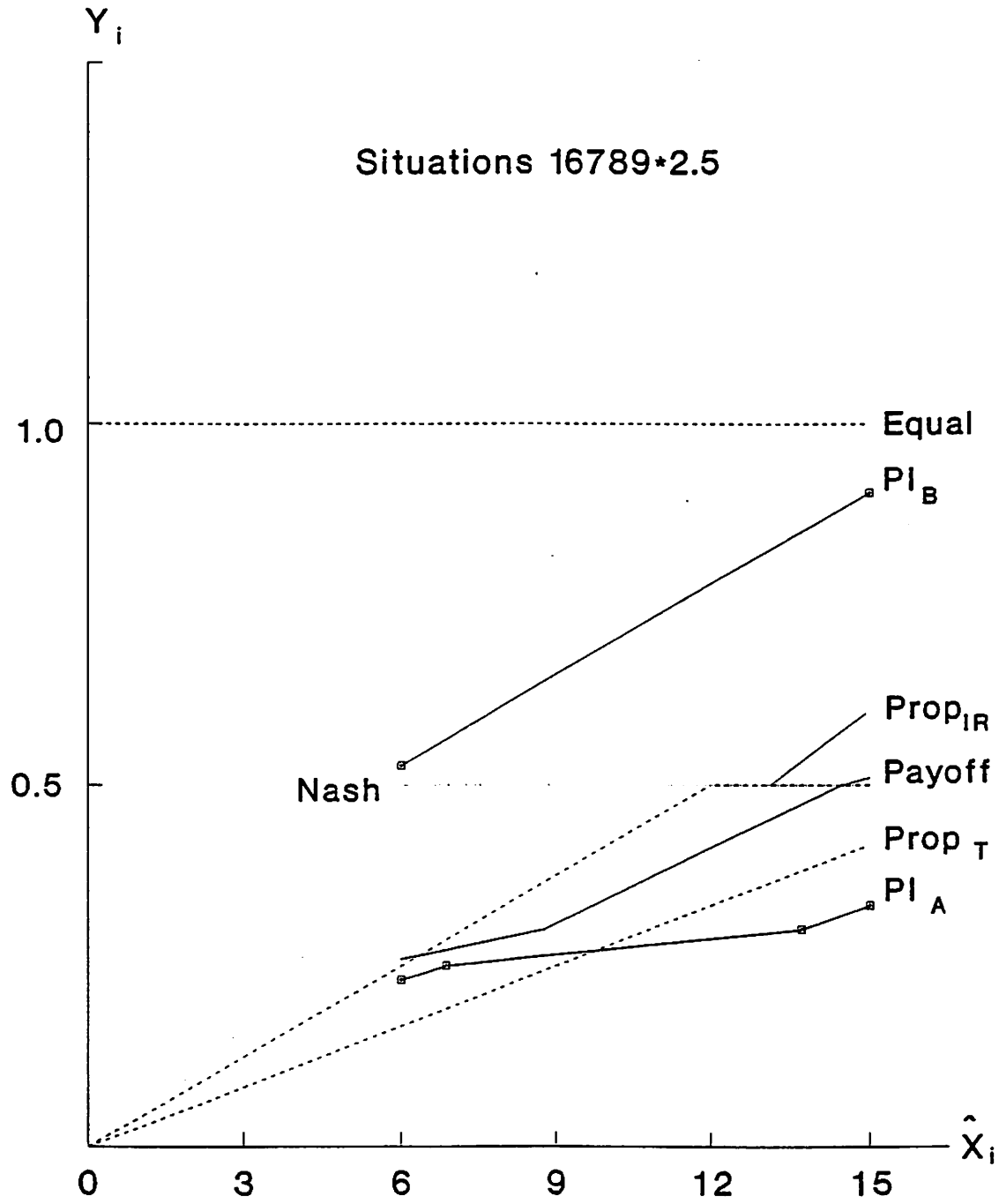
**Planned Bargaining Goals and Payoffs**  
**in Ratios B/A**



Planned Bargaining Goals and Payoffs  
in Ratios B/A



Planned Bargaining Goals and Payoffs  
in Ratios B/A



## 2.4 Monotonicity in Planned Bargaining Goals

Planned bargaining goals depend on the norms and their justifications the subjects have in mind when they are faced with a given bargaining situation. We concentrate the analysis on planned bargaining goals because this kind of aspiration levels is the one that is most independent of the anticipation of the negotiation process. Therefore we can try to explain the goals of a group by norms they apply and the agreement as a solution of the conflict between the different norms of the groups.

In the experiments each group had about ten minutes of time to discuss the payoff table without knowing whether they were *A* or *B*. During this period nearly all groups put themselves into the two positions and thought about what they would want to get, if they were Group *A* or Group *B*. When they were told which group they are, again they thought about their plans for the game. Sometimes they came up with a revised goal. As the data for the variable "Planned Bargaining Goal of Group *A* (*B*)" we choose the point in the payoff table that belongs to the payoff Group *A* (*B*) really wants to get in an agreement. Either the data is taken from the discussion before the game starts or from the discussions during the first rounds. If a group does not name a unique point, but describes an interval in which the planned bargaining goal lies, we choose the midpoint of this interval as the data for their planned bargaining goal. If a group only discusses their own payoffs and comes up with a planned goal leading to a set of payoff constellations that are all weakly Pareto optimal, we choose the unique point from this set which is strongly Pareto optimal in payoffs. This problem sometimes occurs in truncated situations, when the subjects in Group *B* plan to get their maximum payoff, which equals the truncation level. In this case, we choose the kink of the payoff set as their planned bargaining goal. Our reason for this choice is the following: If their plans would be not to give the payoff belonging to the kink to their opponents, they would pronounce this. They



would name an interval or a point in the interior of the weakly Pareto optimal set of the truncation line instead of discussing only their own payoff level.

It is interesting to remark that the goals could be determined for both groups in nearly all games. In general the statements on goals are made very early in the discussion, not later than during the first three rounds. There is only one game of Situation 6 where Group *B* names a goal of 10 for *A* and 7 for *B* after the 8th round of 12 rounds. Plans usually are not the subject of the discussions in later rounds. Therefore they can be analysed from the tapes unequivocally and can be assumed to be constant for a game.

For each game in the four classes of situations 1 2 3 4 5, 1 2 3 4 5 \* 2.5, 1 6 7 8 9 and 1 6 7 8 9 \* 2.5 we observe the planned bargaining goals of each group as a point of the payoff possibility set of a given game. Let e.g.  $(G_A^A | G_B^A)$  be the planned bargaining goal of Group *A* in a given game. Then we define  $Y^A = \frac{G_B^A}{G_A^A}$  to be the variable for the rank transform regression.  $Y^A$  is the ratio of the payoffs of Group *B* and Group *A* that are observed to be the planned bargaining goals of Group *A*. Analogously we define  $Y^B$  for the planned bargaining goals of Group *B*. We call these variables "Planned Bargaining Goals of Group *A* (resp. *B*) in Ratios *B/A*". These variables are unique representations of the planned bargaining goals of the groups for the same reasons we have given when we discussed the use of payoff ratios in Section 2.3.

The eight rank transform regressions of the planned bargaining goals of each group in ratios *B/A* on the variable truncation level of the situation have been calculated. The graphical representations of the estimated ratios are given in the figures at the end of the previous section together with the estimates for the payoff ratios in the agreements.

### Situations 1 2 3 4 5, Group A

For the Situations 1 2 3 4 5 the rank transform regression shows an increasing relation between the truncation levels and the planned bargaining goals in ratios  $B/A$  for both groups. For truncation levels between 13 and 36, where Group  $B$  is the stronger party, the estimated planned bargaining goal of Group  $A$  lies below, but close to the "Equal" line. This means that in these situations Group  $A$  plans to get about the same payoff as Group  $B$ , but for lower truncation levels a little more than Group  $B$ . We remark that for truncation levels between 15 and 36, the equal payoff principle is the best distributive principle for Group  $A$  from the set of discussed and applied principles. For truncation levels between 6 and 13, the estimated planned bargaining goals of Group  $A$  in ratios  $B/A$  lie close to the "Prop<sub>T</sub>" principle. Four of five estimated data lie below this line, one data lies between the "Prop<sub>IR</sub>" line and the "Prop<sub>T</sub>" line. For truncation levels below 15, the "Prop<sub>T</sub>" principle is the best principle for Group  $A$ . This turns out also to be the area where Group  $A$  is stronger than Group  $B$ .

### Situations 1 2 3 4 5, Group B

The estimated planned bargaining goal of Group  $B$  is close to the kink of the situation for truncation levels below 15. There the kink is the payoff pair belonging to the "Nash" principle. From the set of discussed principles, this is the best one for  $B$  for low truncation levels. For truncation levels below 8, Group  $B$  has estimated goals that are not strongly Pareto optimal in payoffs. This means that, if the kink is lower than (8|8) for Group  $B$ , envy plays a role. Group  $B$  wants to get her maximal payoff but in addition plans not to give their opponents their best payoff under this restriction, because this would be more than their own payoff. Therefore the estimated plans of Group  $B$  are Pareto dominated by the kink of the situation. For truncation levels greater or equal to 15, the estimated planned bargaining goal of Group  $B$  in ratios lies above all ratios that are defined by the distributive principles. From the tapes we learn that in these cases the persons in Group  $B$  say that

they are the stronger group and that they use the proportionality principle over the total payoff set to calculate their goals. In Situation 1 for instance they have to evaluate the ratio  $36/15$ . The groups who discuss this ratio, round the result to values close to 3. Then they search for a prominent point in integer amounts of DM without amounts in Pf in the payoff table that would reflect this ratio (cf. Albers and Albers, 1983). Sometimes they choose a point that is even more favorable to them than the ratio they have in mind. The maximal goal that is formulated in Situation 1 by a Group *B* leads to a ratio of 4.0. The combination of rounding in favor of Group *B* and searching for an appropriate prominent point again in favor of Group *B* explains the difference between the planned bargaining goal of Group *B* and their best principle "Prop<sub>T</sub>".

#### Situations 1 2 3 4 5 \* 2.5, Group *A* and Group *B*

The rank transform regression of the planned bargaining goals of the groups in ratios  $B/A$  on the truncation level of the situations is also monotonically increasing for the Situations 1 2 3 4 5 \* 2.5. In this case the estimated planned bargaining goals of Group *A* in ratios  $B/A$  lead to a curve that intersects the "Equal" line at a truncation level of 21.8. This means that for high truncation levels the estimate implies that Group *A* plans to get less than equal payoffs. In comparison to the data set 1 2 3 4 5 the plans of Group *A* are relatively less demanding when the payoffs are multiplied by 2.5. For truncation levels lower than 21.8 we estimate a nearly linear relation between the ratio and the truncation level. For a level of 6, the estimated goal lies close to the kink of the payoff set of Situation 5 \* 2.5.

For the truncation level of 6 the estimated goal for Group *B* lies also close to the kink of Situation 5 \* 2.5. Here the difference between the goals of the opponent groups is very small. The curve of the estimated planned bargaining goals of Group *B* for the Situations 1 2 3 4 5 \* 2.5 is very similar to the curve for the Situations 1 2 3 4 5. The estimated goals are a little bit

less demanding in the area of truncation levels lower than 20 and a little bit more demanding for higher truncation levels.

We observe that the gap between the curve of Group *A* and Group *B* is smaller in the class of situations with multiplied payoffs. This is mainly due to the observation that the estimated goals of Group *A* assign a higher payoff to Group *B* for all truncation levels and that the estimated goals of Group *B* assign a higher payoff to Group *A* in situations where *A* has the “stronger” position. The multiplied payoff tables seem to induce the groups to formulate goals that are less demanding for themselves. The goals are less incompatible for situations where the strength of the position is not very different.

#### Situations 1 6 7 8 9, Group *A*

In contrast to our expectation, the rank transform regression of the planned bargaining goals of Group *A* on the truncation levels of the situation is slightly decreasing. The values of the payoff ratios  $B/A$  of the goal points lie between 0.35 and 0.45. For a truncation level of 15 which means no truncation in Situation 1 with changed names of the groups, the estimated goal of Group *A* is close to the “Prop<sub>T</sub>” line. This is the same observation as in the Situations 1 2 3 4 5 with Group *B*. In addition there is the same rounding-up effect, which leads to an estimated point below the “Prop<sub>T</sub>” line. The lower the truncation level is, the stronger becomes the position of Group *A*. The planned goal of *A* intersects the “Prop<sub>IR</sub>” line which is the second best principle for *A* and then approaches the “Nash” curve. For a truncation level of 6 (Situation 9) the estimated goal is close to the kink of the payoff set (12|6), which would be the Nash bargaining solution in payoffs. We think that it is possible to generalize the estimated goals of Group *A* to points that give Group *A* a little bit more than twice as much as Group *B* gets. For very strong positions of *A* this group seems to have less demanding goals, but goals are nearly constant, nearly independent of the truncation level. This

can be interpreted as the generosity not to exploit a very strong position.

#### Situations 16789, Group B

In these situations Group *B* has the weaker position. The rank transform regression estimates an increasing relation between payoff ratios of the goals and truncation levels. For the level of 15, where the position of *B* is the best in comparison to the other levels the goal lies close to the “Equal” line. For weaker positions it lies between the “Equal” line and 0.76. This means that for very weak positions, Group *B* deviates from the equal payoff principle in favor of Group *A*, their goals are less demanding in these cases.

#### Situations 16789 \* 2.5, Group A

Here we find an estimated curve for the planned bargaining goals of Group *A* that is slightly increasing, but similar to the Situations 16789 nearly constant. Comparing the games with standard payoffs and the games with multiplied payoffs we find that the enlarged payoff scale leads Group *A* to goals with higher payoffs for themselves. They are here more demanding than in the standard situations. For a truncation level of 15, again there is the rounding up effect of Situation 1 \* 2.5. For very strong positions of Group *A*, this group gives up goals that lie close to the “Prop<sub>T</sub>” line but uses goals that lie close to the second best principle, the “Prop<sub>IR</sub>” principle.

#### Situations 16789 \* 2.5, Group B

The rank transform regression estimates a linear, increasing relation between the payoff ratios of the goals of Group *B* and the truncation level. The only estimated points are a point close to the kink of Situation 9 \* 2.5 as a goal for *B*, and a goal close to the equal payoff point of Situation 1 \* 2.5. Equal payoffs is the best principle for Group *B*, and it seems to be used to formulate the goal for situations with a relatively weak position. For a very weak position the second best principle is used.

Analogously to the comparison of the data sets for Situations 12345 and

1 2 3 4 5 \* 2.5 we observe that the goals of the opponents are closer to each other for the multiplied payoff scales than for the standard scales.

### Goals and Agreements

In the graphical representations of the rank transform regressions for payoff ratios of goals and agreements, the estimate of the agreement payoffs lies between the estimate of the goals of Group *A* and *B*. There is only one exception in the data of Situations 1 6 7 8 9. For a truncation level close to 6, the curve "Payoff" intersects the curve "Pl<sub>A</sub>". But the difference of the estimates for Situation 9 (truncation level 6) is neglectible small.

Compared with the multiplied situations, in the standard situations 1 2 3 4 5 and 1 6 7 8 9 the "Payoff" curve lies closer to the goal curve or parts of the goal curve belonging to the weaker group. This implies that in the situations with the multiplied payoff scale, the "Payoff" curve lies closer to the goal curve of the respective stronger group, though in these cases the weaker group pronounces already less demanding goals than in the standard situations. For the interdependence of goals and agreements, this means that in the multiplied situations the weaker group tends to make larger concessions, first when they formulate their goals and second concerning the agreement. With respect to the stronger groups we learn that they have more demanding goals in the multiplied situations. In addition in these cases they are relatively more successful in achieving an agreement close to their goal.

The "Pl" curves nearly everywhere have a greater slope for the stronger group than for the weaker group. We remark that for Situations 1 2 3 4 5 and 1 2 3 4 5 \* 2.5 and low truncation levels Group *A* has the stronger position. The only exception of this observation we find in the data set 1 2 3 4 5 for truncation levels around 10. This implies that an improvement of the payoff table for the stronger group leads to an increase of their goal ratio that is relatively higher than what their weaker opponents give up in their goal ratios.

Let us now consider the amounts each group wants to get for herself in her goal. We observe from the estimates that Group *B* wants to have more, the higher the truncation level is. In all situations except for the data set 16789 we find that Group *A* wants to get less if the truncation level is raised. For situation 16789 we can say that their goal is constant. This means that the ratio of what Group *B* and Group *A* want to get increases monotonically with increasing truncation levels. This is accompanied by an increase in the payoff of Group *B*. This observation can be used to formulate a monotonicity axiom for normative bargaining solutions on economic situations with goals.

## **3 Norms in Economic and Ethical Environments**

### **3.1 Introduction**

In this section, we describe some observations in single experiments. First, we deal with a phenomenon of agreements allocating non strongly Pareto optimal payoff pairs. We investigate the arguments the subjects use in the discussions with their group partner when they decide upon their offers. From the bargaining behavior in some of the games we can conclude that envy plays a role. The effect of envy is due to a certain power of the equal payoff principle. In some experiments this principle was not dominated by a collective efficiency principle defined by the strong Pareto efficiency in payoffs.

Second, we compare experiments with an environment where the positions of the subjects in the games are assigned according to their result in a quiz to games with randomly assigned positions. Since it was hard to recruit eight participants for an experiment at a certain date, we could only play four games with a quiz environment. Therefore, a statistical evaluation of

differences in agreements, goals and other variables is not possible. We think, however, that it is interesting enough to find out and to describe the special features of these games.

Third, we present two variants of Situation 1\*2.5, where the payoffs of one group are connected to payments to indigents. We describe some arguments that occurred in the discussions of the groups. In addition, we compare the values of the games with Situation 1 \* 2.5 in the standard environment.

### **3.2 Strong Pareto Optimality in Payoffs or Envy? \*)**

In this section we will describe a phenomenon that is implied by the conflict between the different principles the strong and the weak groups apply in the games. In two of four repetitions of Situation 5 (cf. Figure 3.1) this conflict is solved by a non-strongly Pareto optimal agreement. Here Pareto optimality is defined in terms of payoffs for the players.

We start with the description of an experiment of May 17, 1990. The payoff constellation is defined by Situation 5. The positions in the game were assigned randomly to the subjects. Group A had to make the first offer. The agreement after 22 rounds of bargaining which lasted 45 minutes was 7.50 DM for each player in Group A and 6 DM for each player in Group B.

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\*) The main part of this section is literally taken from Klemisch-Ahlert, M.: *Distributive Results in Bargaining Experiments*. In: Gaertner, W. and Klemisch-Ahlert, M. (1992)



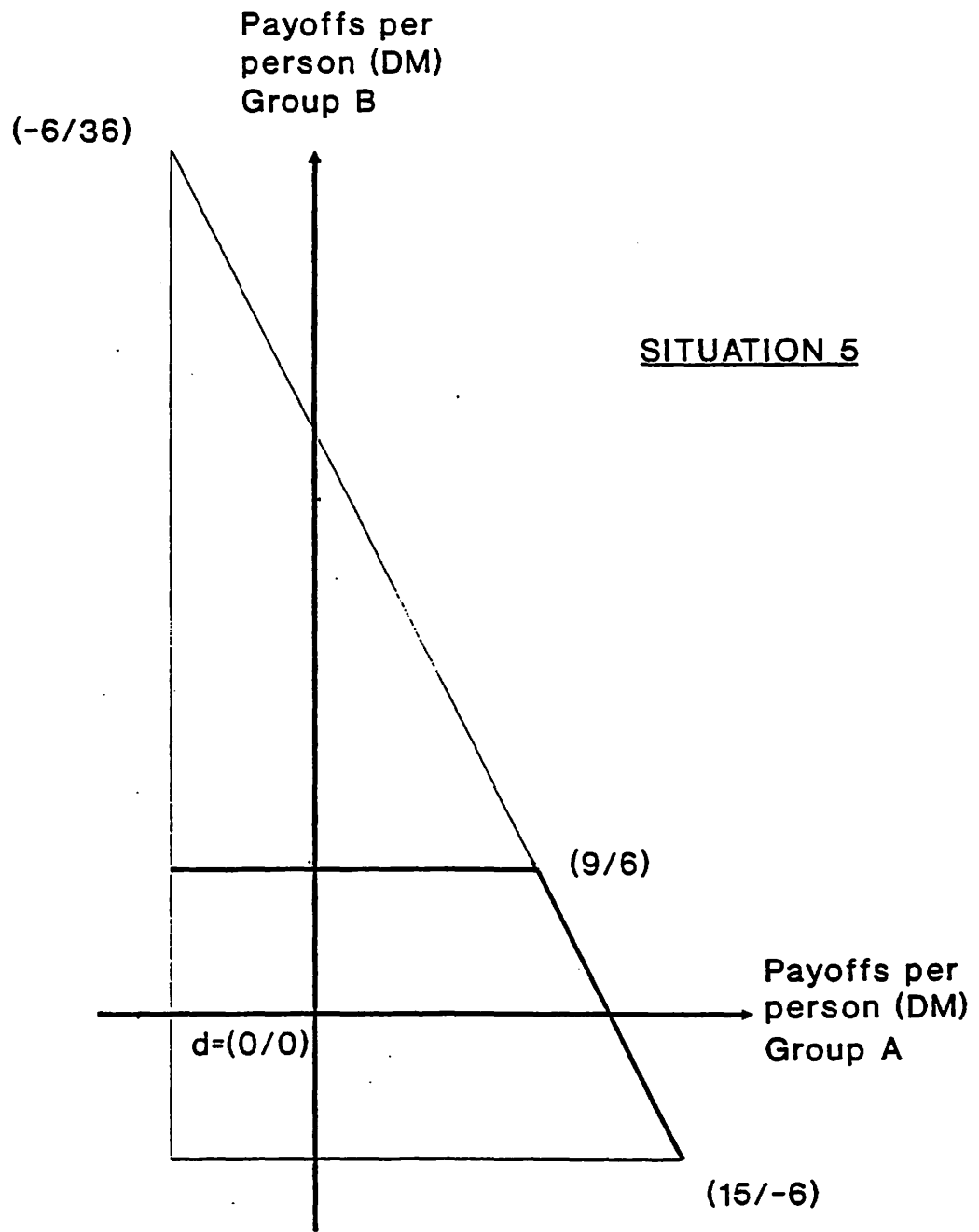


Figure 3.1

The planned bargaining goal of Group A was (10|4) which corresponds to the proportionality principle over the whole payoff set. The agreement that was seen as attainable and the lowest acceptable agreement by Group A was (9|6). Group A expected that their opponents were planning to receive (9|6) and that this outcome would also be their lowest agreement.

Group B's planned bargaining goal was (6|6), which is the equal payoff solution. The agreement they saw as attainable was (7|6) which was also their lowest acceptable agreement. Group B expected that their opponents were planning to get (9|6) and that A's lowest agreement was (7|6).

First there was a conflict between the principles the groups used in order to form their planned goals, and in addition, there was a conflict between the expectation of Group A and the aspiration levels of Group B. Because the groups could not discuss these conflicts with each other, the consequence was a long bargaining process (cf. Figure 3.2).

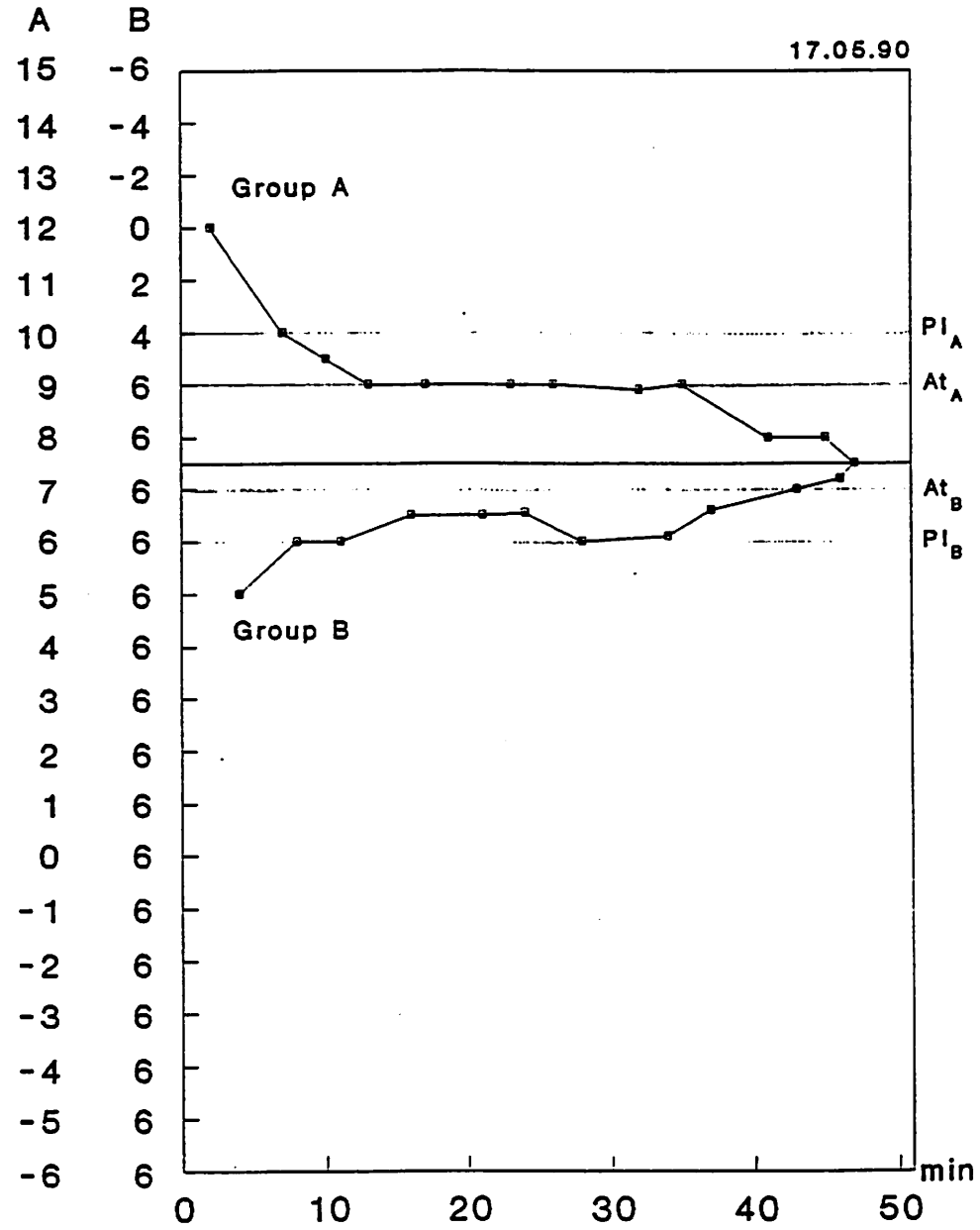
Group A did not want to accept non-strongly Pareto optimal outcomes, because if Group A were in the position of Group B it would grant each of its opponents 9 DM. Group B also discussed the non-strongly Pareto optimal interval between (6|6) and (9|6), saying "Actually we should be indifferent between these outcomes but we don't give any money away. (9|6) means that each of the others will receive 3 DM more than we do." In addition, they argued that indeed they could at most get 6 DM, but nearly everywhere in the payoff space.

Interestingly, they saw it as "giving money away" if the other party received more than equal payoffs. It seems to us that they wanted to express a reduction in preferences.

The positions of the groups were very unyielding. Only because of the great length of the bargaining procedure, Group A decided to make an offer lower than (9|6).

# SITUATION 5

Payoffs  
per person



$PI_i$  = Planned Bargaining Goal of Group  $i$   
 $At_i$  = Agreement Seen as Attainable for Group  $i$

Figure 3.2

In the experiment of November 14, 1990 we chose the same economic and ethical environment as in the former experiment. The agreement was (8|6) after 14 rounds in 44 minutes.

The planned bargaining goal of Group A was (10|4), the agreement that was seen as attainable was (9|6), the lowest acceptable agreement was (7|6) or (8|6). Group A expected that its opponents were planning to receive (6|6) and that their lowest agreement would be (9|6).

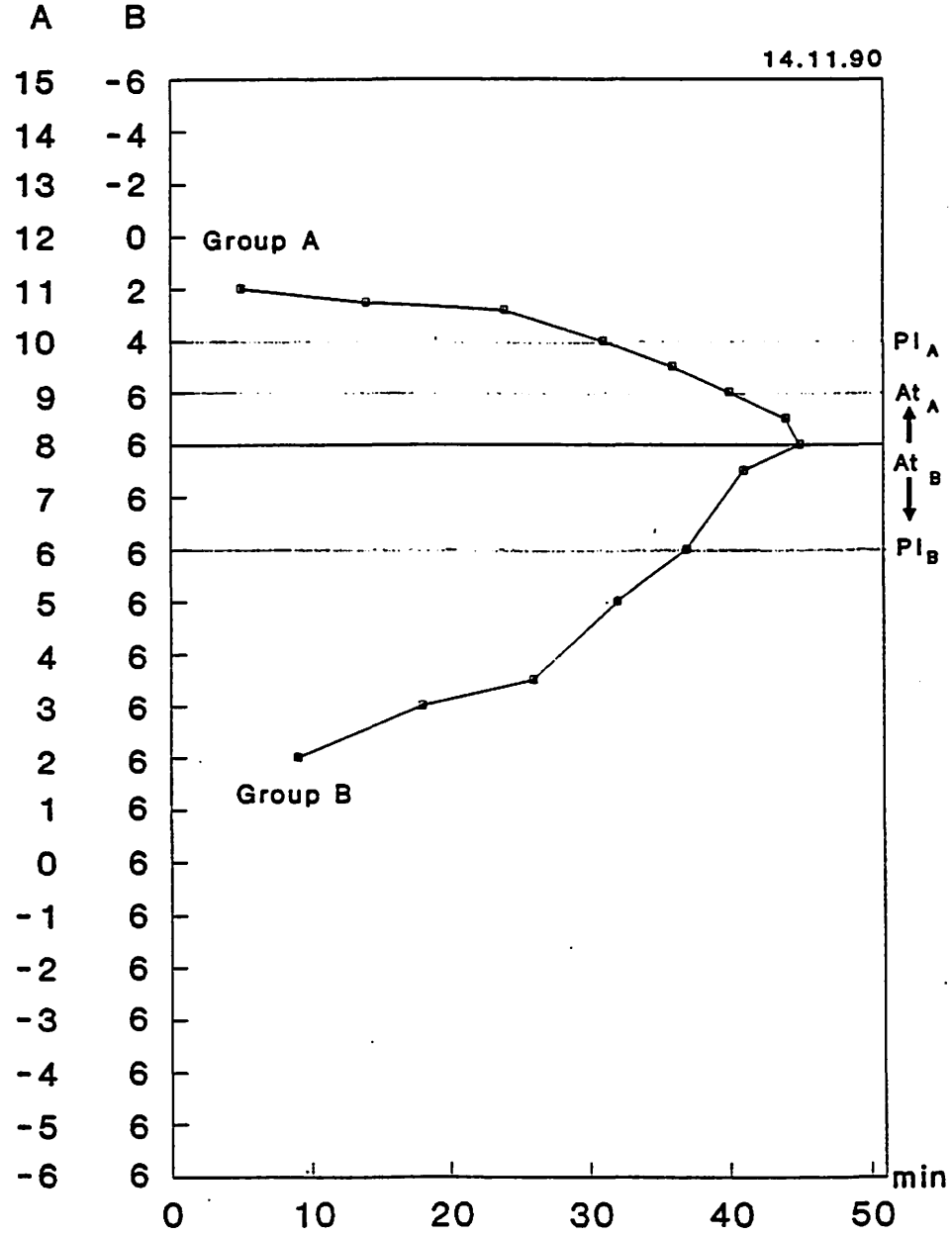
Group B's planned bargaining goal was (6|6). Any outcome between (6|6) and (9|6) was seen as attainable. The lowest acceptable agreement was (9|6). Group B expected that Group A was planning to get (10|4). Their expectations about the lowest acceptable agreement of Group A are not clear. Between the two players in Group B, there was a discussion how to deal with the outcomes between (6|6) and (9|6). Player 3 suggested to aspire to (6|6) and not to give the opponents more money without fighting. Player 4 said that he and his partner should be indifferent between the points in the interval from (6|6) to (9|6). He asked his partner for his reasons and he asked whether he simply wanted to be beastly. Player 3 argued that they were disadvantaged by the random assignment of the groups, and that he therefore did not perceive and did not want that the opponents should get 3 DM more than Group B.

Group A argued that (9|6) should be attainable because fundamentally it would not hurt Group B.

The bargaining process of this experiment is represented in Figure 3.3. The difference from the first experiment is that the conflict between the principles leading to the aspiration levels of the groups was not that strong in this case. Both groups discussed every bargaining step at great length, and they involved former steps of their opponents in their considerations.

# SITUATION 5

Payoffs  
per person



$PI_i$  = Planned Bargaining Goal of Group  $i$   
 $At_i$  = Agreement Seen as Attainable for Group  $i$

Figure 3.3

In the other repetitions of Situation 5 there was no conflict between the lowest acceptable agreements of the groups. Therefore the bargaining procedures were very short, at most 6 rounds in 10 minutes. The agreements were (9|6). The phenomenon of non-strongly Pareto optimal agreements also occurred in other situations. When the equal payoff outcome was dominated by a strongly Pareto optimal payoff constellation, often the weak group discussed how to deal with the principle of equal payoffs.

We can conclude from this that envy plays a role in the distribution of money in our bargaining experiments. Envy may lead to non-strongly Pareto optimal payoff agreements. Does this mean that the strong Pareto principle as a collective rationality requirement does not hold? We cannot conclude this from our observations. The Pareto principle is defined for preferences. The strong Pareto principle is compatible with our results, if we define the preferences of a person not only as dependent on her own endowment in money, but also on the set of allocations of money to all persons involved in the distributive problem. Then, for instance, in our Situation 5 envy implies that Group B strictly prefers (6|6) to (9|6). In this case, even (6|6) is a strongly Pareto optimal outcome in preferences.

In a forthcoming paper we will develop a normative bargaining theory on economic situations for two persons. These economic situations will be defined by a set of feasible allocations of commodities, an initial allocation and utility functions of the persons. The observations we describe in this section lead to a definition of an economic situation, where the utility level of each person does not only depend on her own commodity bundle but may also depend on the commodity bundle of her opponent, i.e. on the whole allocation. Therefore it is possible in our normative model that an agreement allocation belonging to a strongly Pareto optimal outcome in utility space is not strongly Pareto optimal in commodities.

### 3.3 Environments with Contributions

On each afternoon of May 15 and May 16, 1990 there was a set of eight subjects each participating in our experiments. The subjects were recruited from the macroeconomic lectures for students in their fourth semesters. They studied business administration or economics at the University of Osnabrück. The 16 students had never played a game in our experiments before. After the instructions, they were randomly assigned to groups of two players and played one of the nine standard situations. Then they met in a large room and had to pass a multiple choice test in microeconomic theory. They were told that each person could gain 20 points in the quiz and that, dependent on their common total number of points, the scale of payoffs for the next games would be determined. The following relationship between points and factor for the payoffs was given to them at the blackboard.

points	0-20	21-40	41-60	61-80	81-100	101-120	121-140	141-160
factor	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0

In addition they knew that the positions in the next games would be assigned dependent on their individual numbers of points: high numbers would lead to strong positions, low numbers to weak positions. Then they had to fill in the questionnaire of the quiz. The number of points was evaluated afterwards. The factor was ascertained and the subjects were assigned to groups for the following games. The number of points of each subject and the constellations of the groups were written on the blackboard.

### The Experiment of May 15, 1990

The multiple choice test of May 15 had four questions with five possible answers each. An answer consisted in filling in a cross, if the subjects thought that the statement was right, or not, if they considered the statement to be wrong. There was no restriction on the number of possible right answers per question. The result of the quiz was the following:

Person	I	II	III	IV	V	VI	VII	VIII	
number of points	13	14	13	12	12	11	11	10	$\sum 97 \cong \text{factor } 2.5$

When the quiz was announced to be a test in microeconomics, one person said that she had not heard these lectures during her studies. Usually students go to these lectures in their third semester. Though the student was told that she could pass the quiz with her knowledge from the lectures of the first two semesters of studies, she announced not to make any cross in the quiz. Since six crosses had to be made, this student achieved the maximal number of points (14)...!

The games that were played were

Situation  $5 * 2.5$  Q with

Group  $A = \{\text{Person III, Person IV}\}$ , Group  $B = \{\text{Person V, Person VI}\}$

and Situation  $9 * 2.5$  Q with

Group  $A = \{\text{Person I, Person II}\}$ , Group  $B = \{\text{Person VII, Person VIII}\}$ .

The sequences of offers can be found in the graphical representations on page 58 and page 59. The letter "Q" in the headlines denotes the environments with a quiz. In the following table we compare the game  $5 * 2.5$  Q to two other games with the payoff table  $5 * 2.5$ . "PI" means planned bargaining goal of a group and "At" stands for an agreement seen to be attainable by a group.



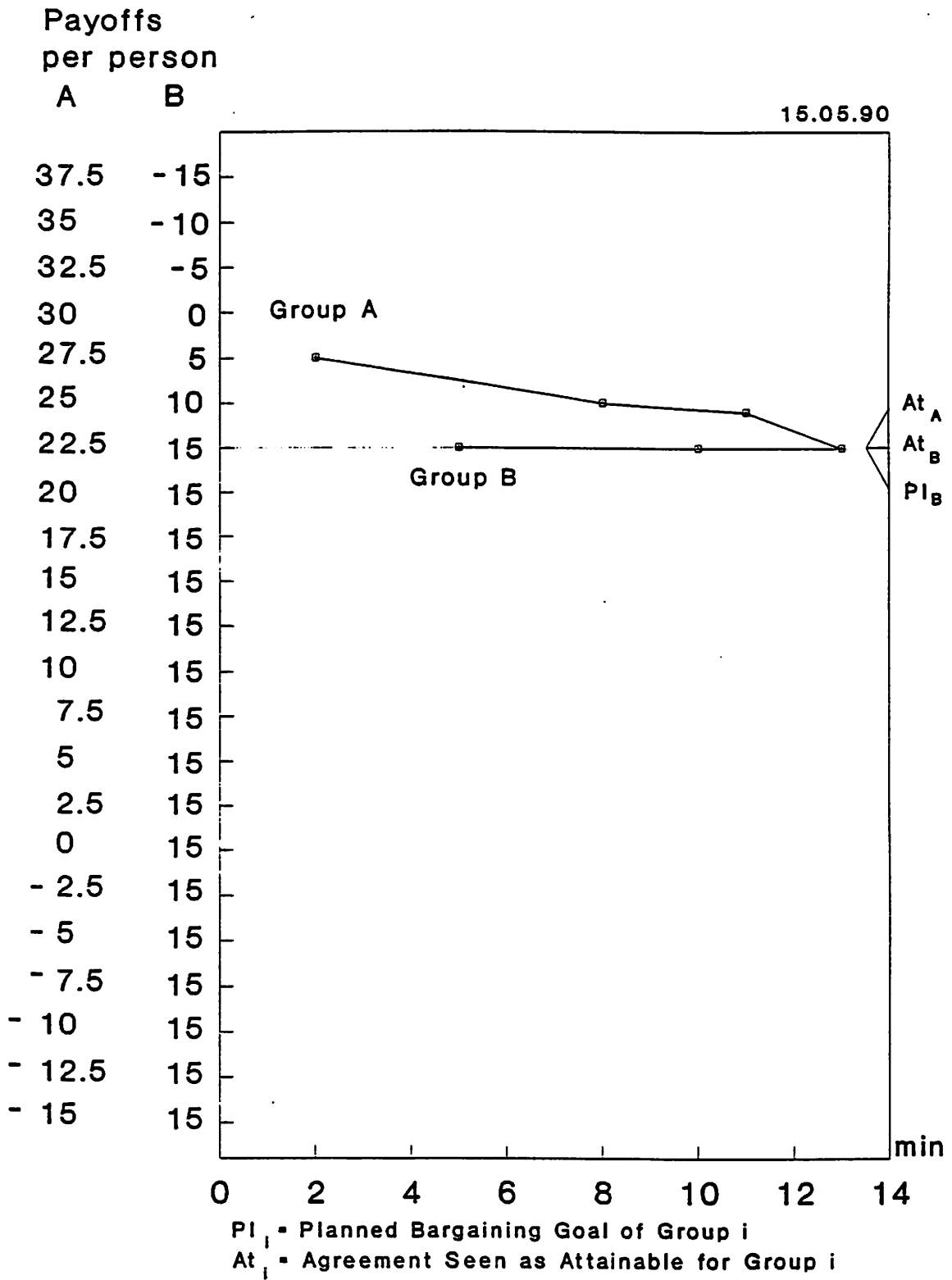
Situation	5 * 2.5 Q	5 * 2.5	5 * 2.5
Date	15.5.90	13.6.90	31.10.90
Result	(22.50 15)	(22.5 15)	(22.50 15)
# Rounds	6	3	2
Period of Time	13 min	12 min	4 min
Pl <sub>A</sub>	no data	(24 12)–(25 10)	(22.50 15)
Pl <sub>B</sub>	(22.50 15)	(22.50 15)	(22.50 15)
At <sub>A</sub>	(22.50 15)	(22.50 15)	(22.50 15)
At <sub>B</sub>	(22.50 15)	(22.50 15)	(22.50 15)

There is no special difference between the observed variables in the three games. In the discussions on the tapes of Situation 5 \* 2.5 Q, success or contribution of a group were not mentioned. The contributions of the groups were not very different. The group with the greater number of points had the better position and received a higher payoff in the agreement. From the data, however, we cannot conclude that “contribution” had an impact on the negotiation process.

Now we compare the data of the game 9 \* 2.5 Q and the data of the two experiments with Situation 9 \* 2.5.

Situation	9 * 2.5 Q	9 * 2.5	9 * 2.5
Date	15.5.90	17.5.90	10.12.91
Result	(35 12.50)	(30 15)	(45 7.50)
# Rounds	11	2	12
Period of Time	30 min	4 min	23 min
Pl <sub>A</sub>	(50 5)	(35 12.50)–(40 10)	(50 5)
Pl <sub>B</sub>	(30 15)	15 for <i>B</i>	(30 15)
At <sub>A</sub>	no data	no data	(45 7.50)
At <sub>B</sub>	(30 15)	(30 15)	(45 7.50)

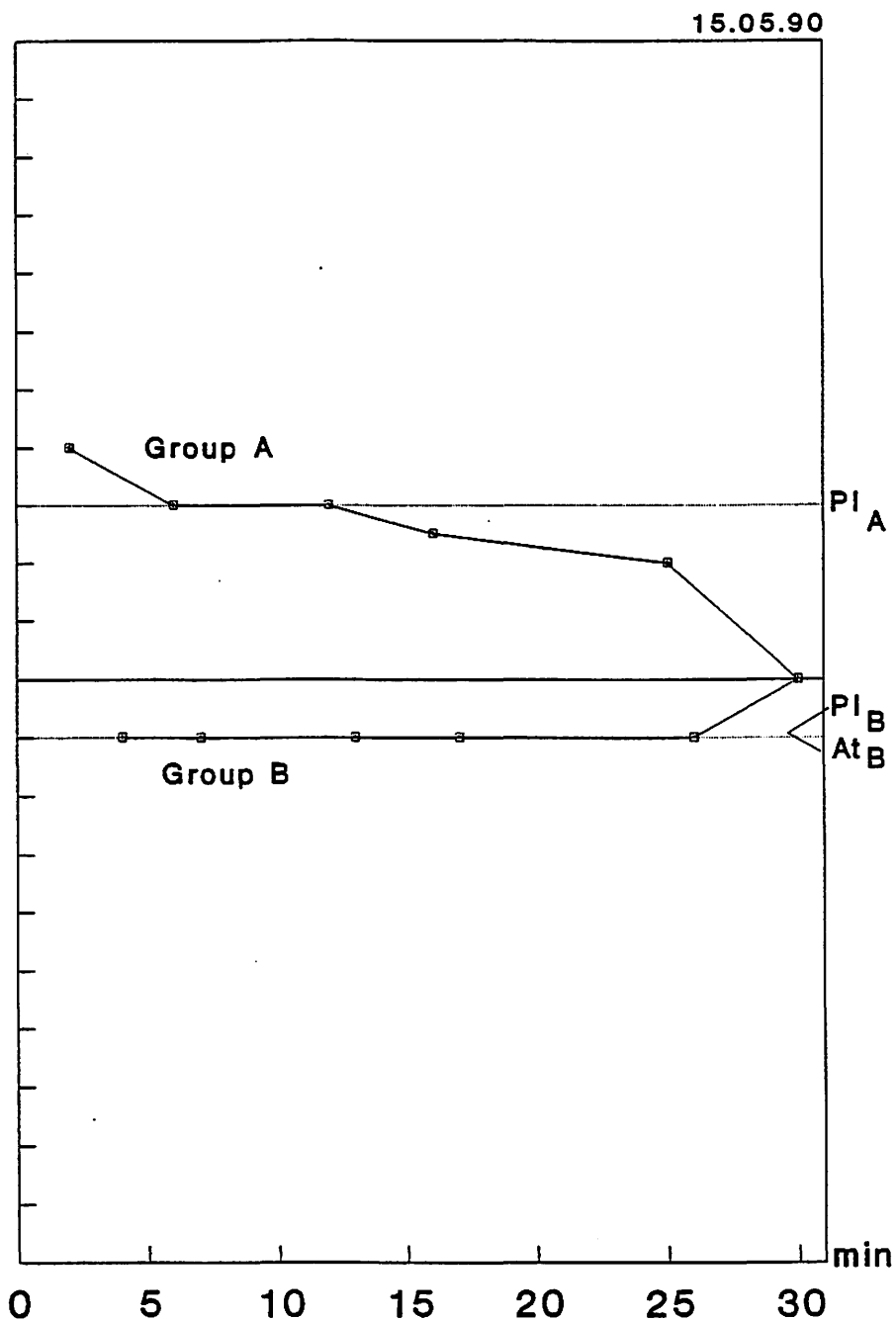
# SITUATION 5 \* 2.5 Q



# SITUATION 9 \* 2.5 Q

Payoffs  
per person

A	B
90	-15
85	-12.5
80	-10
75	-7.5
70	-5
65	-2.5
60	0
55	2.5
50	5
45	7.5
40	10
35	12.5
30	15
25	15
20	15
15	15
10	15
5	15
0	15
-5	15
-10	15
-15	15



Similar to Situation 5 \* 2.5 Q, in this case the contribution of a group to the quiz result was not mentioned. The values of variables of the experiment with quiz also occur in situations without quiz. Therefore, an influence of the quiz results on these variables cannot be assumed.

One reason for the fact that the quiz results were not mentioned in the discussions to justify claims or plans may be the following. Since one person had been successful in the test without any effort, simply by making no cross, a large number of points obviously was not necessarily the result of hard work. The intended effect of making a contribution by being good in microeconomics was disturbed. For the next experimental environment, we therefore chose another type of multiple choice test where it was not that easy to get a great number of points without knowing a considerable number of correct answers.

#### The Experiment of May 16, 1990

The multiple choice test of May 16 had four questions different from the questions of may 15, with five possible answers each. In the instructions of the test the participants were told that at least one and at most three answers per question were correct. Questions that would be answered by making no, four or five crosses would lead to zero points for this question. The quiz had the following result.

Person	I	II	III	IV	V	VI	VII	VIII	
number of points	14	14	13	12	12	12	10	9	$\sum 96 \cong \text{factor } 2.5$

Situation 1 \* 2.5 Q was then played with

Group A = {Person V, Person VI} and Group B = {Person I, Person II}

and Situation 6 \* 2.5 Q was played with

Group A = {Person III, Person IV}, Group B = {Person VII, Person VIII}.

The sequences of offers are graphically represented. The figures also show

the planned bargaining goals of the groups and the payoff pairs they assumed to be attainable. We compare the data of the situations with a quiz to the data of the multiplied situations without a quiz.

Situation	1 * 2.5 Q	1 * 2.5	1 * 2.5
Date	16.5.90	17.5.90	7.11.90
Result	(15.50 29)	(17.50 25)	(17 26)
# Rounds	28	33	64
Period of Time	69 min	84 min	124 min
Pl <sub>A</sub>	(20 20)	(20 20)	(20 20)
Pl <sub>B</sub>	(10 40)	(10 40)	(15 30)
At <sub>A</sub>	(17.50 25)	(20 20)	no data
At <sub>B</sub>	(12.50 35)	(15 30)	(15 30)

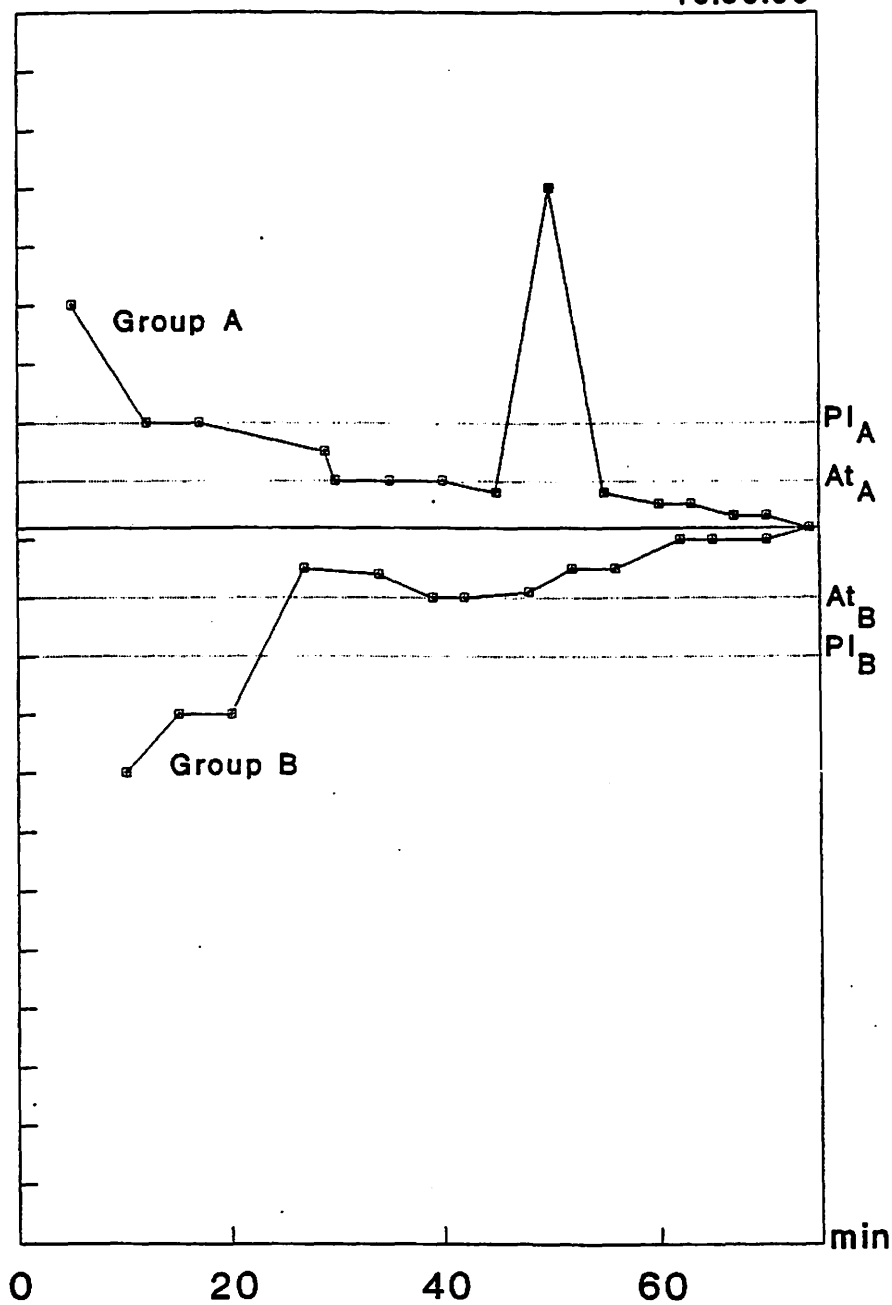
The agreement of Situation 1 \* 2.5 Q is better for Group *B* than the agreements of the Situations 1 \* 2.5. The values of what seemed to be attainable for the groups in the situation with quiz are different from the other situations. The persons in Group *A* thought that they could get 17.50 DM which is less than equal payoffs. The persons in Group *B* thought, they could get 35 DM which is more than the values in the data of the Situations 1 \* 2.5.

# SITUATION 1 \* 2.5 Q

Payoffs  
per person

A	B
37.5	-15
35	-10
32.5	-5
30	0
27.5	5
25	10
22.5	15
20	20
17.5	25
15	30
12.5	35
10	40
7.5	45
5	50
2.5	55
0	60
-2.5	65
-5	70
-7.5	75
-10	80
-12.5	85
-15	90

16.05.90

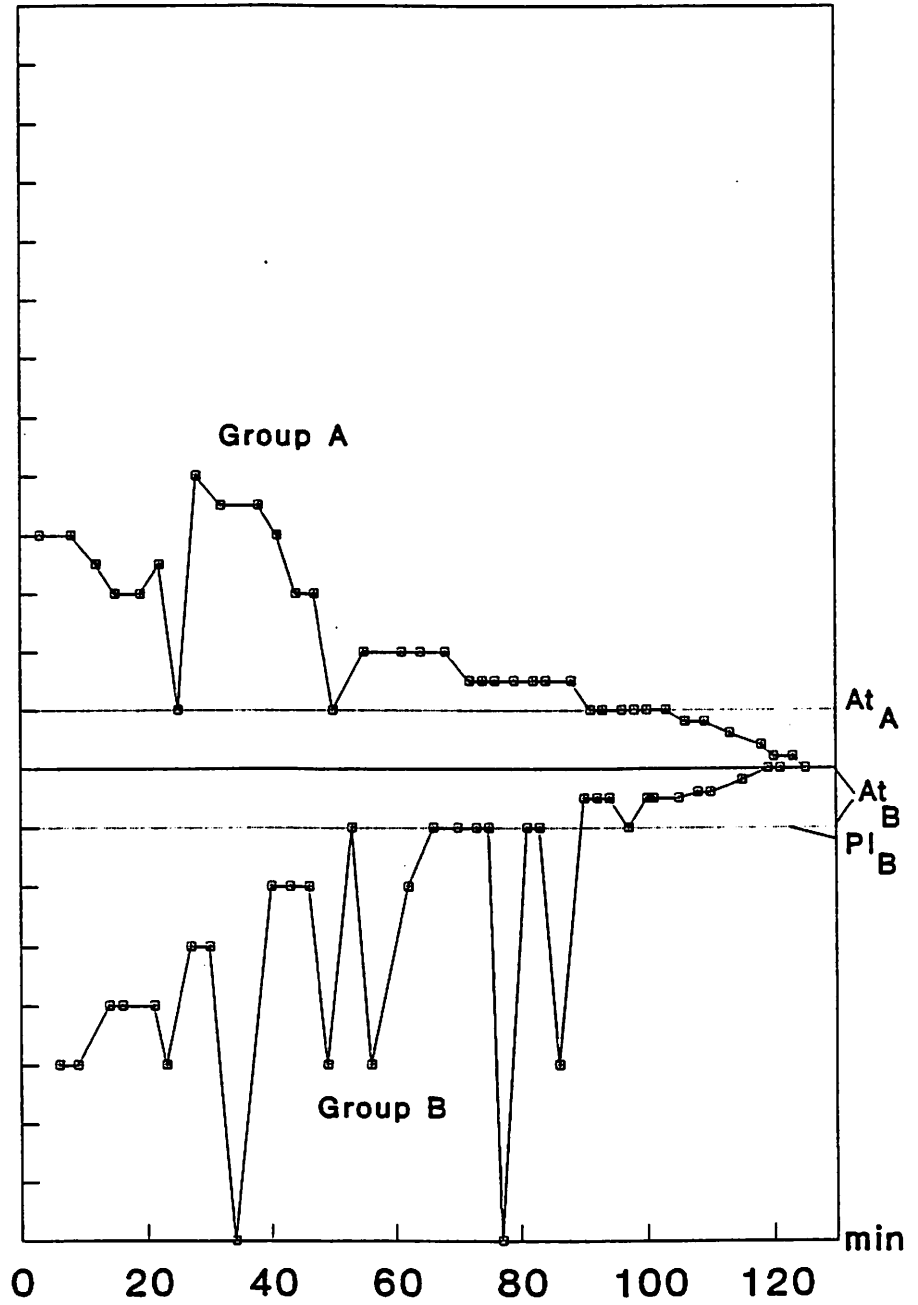


# SITUATION 6 \* 2.5 Q

Payoffs  
per person

A	B
90	-15
85	-12,5
80	-10
75	-7,5
70	-5
65	-2.5
60	0
55	2.5
50	5
45	7.5
40	10
35	12.5
30	15
25	17.5
20	20
15	22.5
10	25
5	27.5
0	30
-5	30
-10	30
-15	30

16.05.90



In the discussions of the groups the result of the quiz played a role. Group *B* mentioned that they deserved the better position. Therefore, they planned to get clearly more than Group *A*. Group *A*, too, argued with the result of the quiz. They planned to get equal payoffs, but they saw that the others would feel justified to fight for a higher payoff for them. Group *A* thought that their opponents wanted to get 40 DM or at least 30 DM. That is why they came up with a value inbetween their own goal and the expected goal of their opponents for what should be attainable in an agreement. Another indicator for the influence of the quiz result could be that the negotiation process of Situation 1 \* 2.5 Q was shorter than the others and consisted of less rounds. The difference, however, is not very drastic, all processes have been long in comparison to the average of 15 rounds and 31 minutes of all games.

Situation	6 * 2.5 Q	6 * 2.5	6 * 2.5
Date	16.5.90	13.6.90	15.1.92
Result	(25 17.50)	(24 18)	(40 10)
# Rounds	74	3	6
Period of Time	125 min	3 min	13 min
Pl <sub>A</sub>	no data	(25 17.50)	(50 5)-(45 7.50)
Pl <sub>B</sub>	(20 20)	(20 20)	(35 12.50)-(40 10)
At <sub>A</sub>	(30 15)	(20 20)-(25 17.50)	no data
At <sub>B</sub>	(20 20)-(25 17.50)	(20 20)-(25 17.50)	(45 7.50)

In the data of Situation 6 \* 2.5 Q the equal payoff principle occurred in the planned bargaining goal of group *B*. This also determined the planned bargaining goal of *B* in the game of 13.6.90. For Group *A* in Situation 6 \* 2.5 Q the ratio 2 : 1 defined what they thought would be attainable. This leads to a greater payoff for *A* than in the game of 13.6.90. The agreement in the game of 16.5.90 is a little better for Group *A* than that of 13.6.90. From these



data, however, an influence of the quiz on the negotiation process cannot be deduced. In contrast, the agreement in the game of 15.1.92 is extremely better for Group *A* than in the other games. In this game Groups *A* and *B* both had the proportionality principle over the total set in mind when they formulated their goals and payoffs of agreements seen as attainable. In this case there was no conflict between principles of the groups. The negotiation process was short. In the game of 13.6.90 the process was very short though there was a conflict between the principles. The readiness to make concessions was rather high for both groups.

The main difference between the game with a quiz to the other games of Situation 6\*2.5 was that both groups did not want to make concessions that would lead to lower payoffs than what they planned to get or thought to be attainable. In the discussion of both groups their results in the quiz played a role in the formulation of their view of the situation. The way how they got their positions may be a reason for their tough bargaining behavior, but this cannot be decided uniquely from their discussions. They did not explicitly pronounce the reason for their behavior.

From these experiments we learn that the way to operationalize the environment of a "contribution to a common production" by a quiz is rather problematic. When the result of a quiz is not absorbed by the persons as a piece of work, their success may have no influence on their bargaining behavior. In cases where good quiz outcomes are seen as a type of product, there seems to be an influence on the bargaining behavior concerning goals, agreements that seem to be attainable and toughness. In addition it is remarkable that in these games the quiz results were mentioned in the discussions of the groups. They had an influence on their reasoning. From our small data set, however, a statistical evaluation of these phenomena is not possible. In a larger data set, we could not expect to observe a contribution principle in ratios of contributions like in reward allocation experiments (cf. Güth, 1989). We would, however, expect some monotonic increase of agreements,

goals and agreements seen as attainable in favor of the better positions in comparison to the situation with random assignments of positions. With respect to distributive allocations in questionnaires this monotonicity has been observed by Yaari and Bar-Hillel (1984) and Schokkaert and Overlaet (1989).

### **3.4 Environments with Payments to Indigents**

We have run two experiments where the subjects were confronted with a different type of environment. It was the time before Christmas 1991 where at each of two afternoons four subjects first played two games with standard situations with randomly assigned positions. After these games they gathered in a room. They were given a list of 24 names of institutions helping other people or animals. The four subjects got the instruction to choose one of these institutions or any other one they liked to propose and to which they would like to transmit a gift of a size up to about 200 DM (13.12.91) or 100 DM (17.12.91). They had as much time as they wanted to discuss the object and the work of the organizations and to find an agreement. The discussions of the groups lasted about 15 minutes. On 13.12.92 the subjects chose "TWER-Hilfe", an organization of the German-Soviet-Society. On 17.12.92 the group chose "Weisser Ring", an organization helping victims of crimes. Afterwards the positions were assigned randomly to the subjects.

#### The Experiment of Dec. 13, 1991

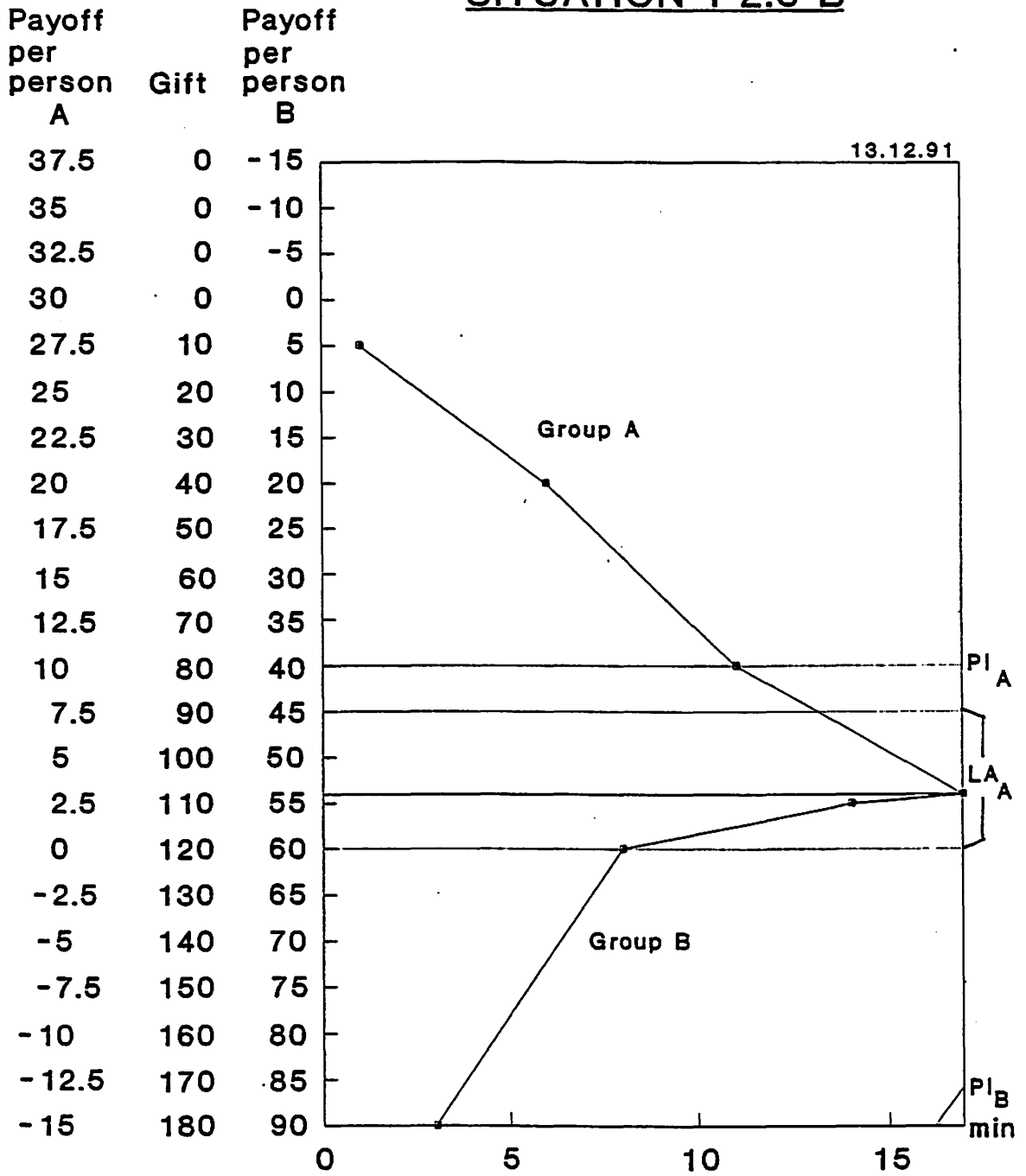
The payoffs of Group *B* were combined to the possible gifts to "TWER-Hilfe". The sum of the payoffs of the persons in Group *B* was identical to the gift. Only for negative payoffs of Group *B* the gift was zero. The payoffs of the persons in Group *A* were not connected to gifts. This group was negotiating only about its own gain. The payoff table had three columns: The payoff per person of Group *A*, the gift and the payoff per person of Group *B*. The payoff pairs of the groups were identical to Situation 1 \* 2.5.

The difference between these situations is that the stronger group negotiated about its payoffs and the gift. We called this environment Situation 1\*2.5 *B*.

Group *B* tried to reach the agreement  $(-15|180|90)$  which would have been good for the “TWER-Hilfe” and the maximal sum of payoffs for all players. They had the idea to share the payoff they would get with the members of Group *A*. They realized that their opponents would have to pay 15 DM each in this agreement, but hoped that they would understand that this was the best agreement for all participants as well as for the “TWER-Hilfe”. When Group *A* did neither accept  $(-15|180|90)$  nor the next offer of  $(0|120|60)$ , where Group *A* would not have to pay anything, the subjects in Group *B* expressed their regret that their opponents seemed not to understand their idea.

Group *A*, however, had understood the idea of Group *B*, but did not trust their opponents. They thought that Group *B* wanted to achieve a large amount of money as a gift, perhaps the maximal amount. They expected this, because it had been one of the students in Group *B* who had suggested “TWER-Hilfe” in the discussion. Group *A* wanted to have a positive payoff in an agreement. Their goal was  $(10|80|40)$  and the lowest acceptable agreement ( $LA_A$ ) between  $(7.50|90|45)$  and  $(0|120|60)$ . Finally the agreement was  $(3|108|54)$  after 7 rounds and 17 minutes. The sequence of offers and some aspiration levels are represented in the figure on the following page.

## SITUATION 1\*2.5 B



$LA_A$  = Lowest Acceptable Agreement of Group A

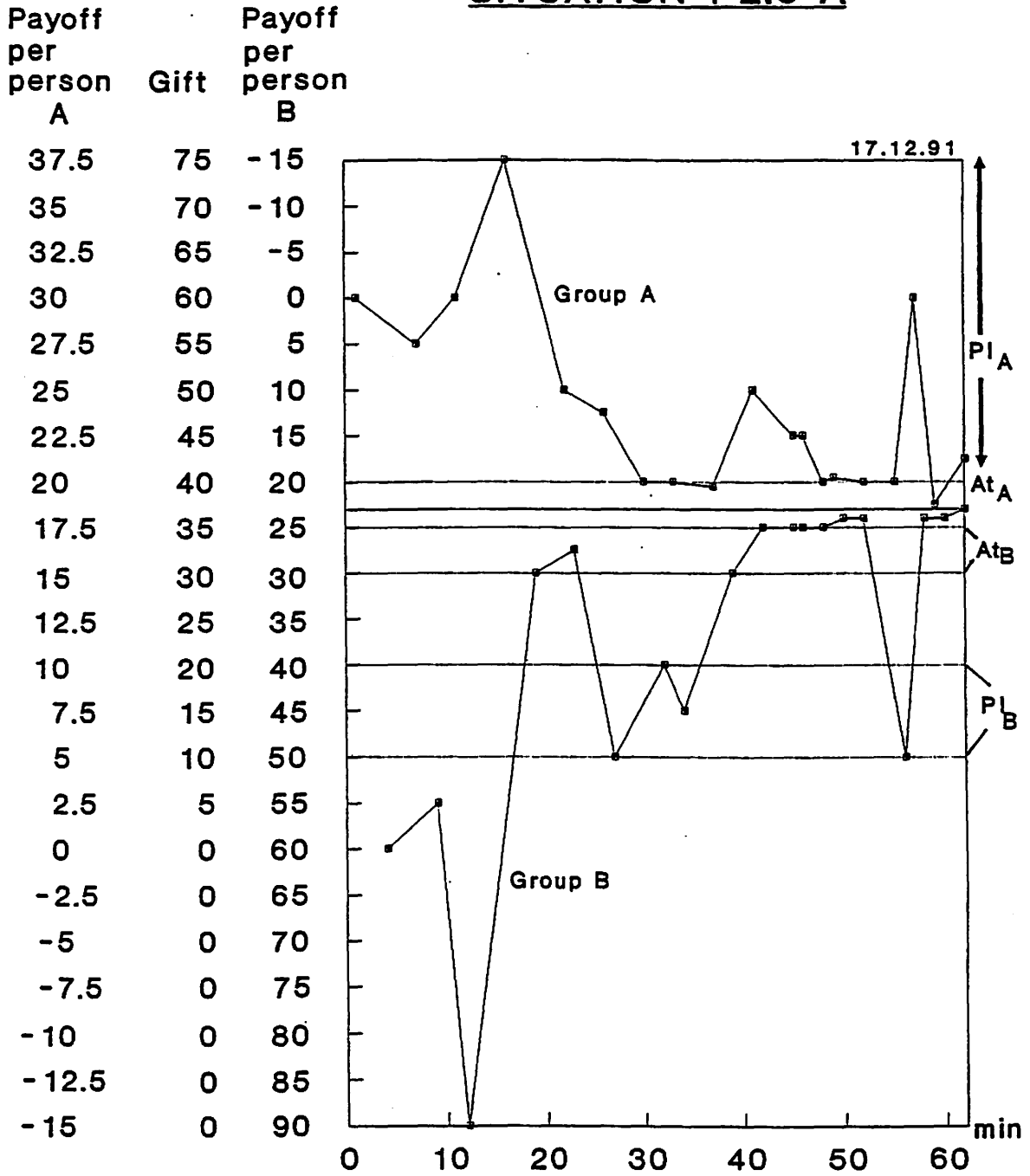
### The Experiment of Dec. 17, 1991

In this game the payoffs of Group *A* were connected to the gifts to “Weisser Ring”. Again, for negative payoffs of the persons in Group *A* the gift was zero. Otherwise the sum of the payoffs for the players of Group *A* was identical to the gift. We called this situation  $1 * 2.5 A$ . In contrast to Situation  $1 * 2.5 B$ , this time the weaker group negotiated about its payoff and the gift. The payoff constellations for the groups were the same as in Situation  $1 * 2.5$ .

Group *A* planned to get more than 20 DM for each person. They argued that if Group *B* wanted to have a clear conscience, they should agree to a gift of at least 40 DM. (20|40|20) was the point Group *A* saw as attainable. This allocation is defined by the equal payoff principle for all players.

Group *B* discussed that their opponents had the advantage of having the gift on their side. When the players in Group *B* thought about which proposal they should make, they always argued that, the higher the amount they claimed for themselves, the lower the gift would be. A gift of less than 10 DM was not acceptable to them. Therefore, they restricted the set of allocations coming into question for an agreement by this lower bound. Within this range they planned to get a high payoff. Their planned bargaining goal was between (10|20|40) and (5|10|50). Attainable seemed to them an allocation in the intervall (17.50|35|25) through (15|30|30). They thought that they already made a concession that was large enough when they offered (17.50|35|25). The gap between the acceptable agreements for the two groups led to a long negotiation process. After 62 minutes and 38 rounds the agreement was a point in the middle of the gap between their acceptable agreements. The sequence of offers and the aspiration levels are to be found on the following page.

# SITUATION 1\*2.5 A



In the following table we compare the data of the experiments with gifts to games with Situation 1 \* 2.5. This means that the payoff tables for the groups are identical in all four games, but the ethical environment is changed. We only denote the variables for payoffs of the persons in each group and not the size of the gift.

Situation	1 * 2.5 <i>B</i>	1 * 2.5 <i>A</i>	1 * 2.5	1 * 2.5
Date	13.12.91	17.12.91	17.5.90	7.11.90
Result	(3 54)	(18.50 23)	(17.50 25)	(17 26)
# Rounds	7	38	33	64
Period of Time	17 min	62 min	84 min	124 min
Pl <sub>A</sub>	(10 40)	> 20 for <i>A</i>	(20 20)	(20 20)
Pl <sub>B</sub>	(-15 90)	(10 40)-(5 50)	(10 40)	(15 30)
At <sub>A</sub>	no data	(20 20)	(20 20)	no data
At <sub>B</sub>	no data	(17.50 25)-(15 30)	(15 30)	(15 30)

The values of the variables of Situation 1\*2.5 *A* are very similar to those of the Situations 1\*2.5. In Situation 1\*2.5 *A*, both groups had planned bargaining goals that are a little more demanding than the goals in the situations with the standard environment. The reason for Group *A* to plan more than the equal payoff principle would grant them is that they were agents for "Weisser Ring". After Group *B* had defined the minimal gift to be 10 DM they felt justified to want a payoff close to the best result for them respecting this condition. In the Situations 1 \* 2.5 the Groups *A* used the equal payoff principle and the Groups *B* used the proportionality principle 1 : 2 for the individually rational payoff set or 1 : 4, a rounded proportionality principle over the total set in favor of group *B*.

Situation 1\*2.5 *B* is very different from the other three data sets. Here the aim of Group *B* to exploit the payoff table for all persons together dominated the negotiation process. In addition, Group *A* was not very demanding in

their plans. One has the impression that they were discouraged to fight for greater payoffs, when they were faced with the high amounts the other group could get and the high amounts of the gift. The only thing they wanted to make sure was to get a positive payoff.

## References

- Albers, W. and Albers, G. (1983) : *On the Prominence Structure of the Decimal System*. In: Scholz, R.W. (ed.): *Decision Making under Uncertainty*. Elsevier Science Publishers B.V., 271–287.
- Conover, W.J. (1980) : *Practical Nonparametric Statistics*. 2nd ed., John Wiley & Sons, New York.
- Conover, W.J. and Iman, R.L. (1979) : *The Use of the Rank Transform in Regression*. *Technometrics* 21, 499–509.
- Gaertner, W. and Klemisch–Ahlert, M. (1992) : *Social Choice and Bargaining Perspectives on Distributive Justice*. Springer–Verlag, Berlin, Heidelberg.
- Gauthier, D. (1985) : *Bargaining and Justice*. In: Paul, E.F., Paul, J. and Miller, F.D.jr. (eds.): *Ethics and Economics*. Blackwell, Oxford.
- Güth, W. (1989) : *Experimental Bargaining*. Paper presented at the 2nd Symposium on Distributive Justice (Bonn–Bad Godesberg, August 1989), University of Frankfurt.
- Güth, W. and Tietz, R. (1987) : *Ultimatum Bargaining Behavior - A Survey*. First version prepared for the Conference on Distributive Justice (Brussels, January 1987), University of Frankfurt.



- Kalai, E. and Smorodinsky, M. (1975) : *Other Solutions to Nash's Bargaining Problem*. *Econometrica* 43, 513-518.
- Kalai, E. and Rosenthal, R.W. (1978) : *Arbitration of Two-Party Disputes under Ignorance*. *International Journal of Game Theory* 7, 65-72.
- Nash, J.F. (1950) : *The Bargaining Problem*. *Econometrica* 18, 155-162.
- Rockenbach, B. and Uhlich, G.R. (1989) : *The Negotiation Agreement Area, "An Experimental Analysis of Two-Person Characteristic Function Games"*. Discussion Paper B-126, University of Bonn.
- Schokkaert, E. and Overlaet, B. (1989) : *Moral Intuitions and Economic Models of Distributive Justice*. *Social Choice and Welfare* 6, 19-31.
- Tietz, R. and Bartos, O.J. (1983) : *Balancing of Aspiration Levels as Fairness Principle in Negotiations*. In: Tietz, R. (ed.): *Aspiration Levels in Bargaining and Economic Decision Making*. Springer Verlag, Berlin, Heidelberg, New York, Tokyo.
- Uhlich, G.R. (1988) : *An Area Theory for Experimental Two-Person Characteristic Function Games*. Discussion Paper No. B-105, University of Bonn.
- Uhlich, G.R. (1990) : *Descriptive Theories of Bargaining*. Springer Verlag, Berlin, Heidelberg.
- Yaari, M.E. and Bar-Hillel, M. (1984) : *On Dividing Justly*. *Social Choice and Welfare* 1, 1-24.

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- 2-89 **Rüdiger Pethig**, Trinkwasser und Gewässergüte. Ein Plädoyer für das Nutzerprinzip in der Wasserwirtschaft
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