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A Classification of Bargaining Steps and their Impact on Negotiation Outcomes

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Abstract In this paper, we develop a typology of bargaining steps for multi-issue negotiations, which is derived from possible changes in single issues. By considering all combinations of such changes, we create a consistent classification of steps. This classification forms the basis of an empirical analysis of the impact of different types of bargaining steps on various outcome dimensions of negotiations. We perform an exploratory analysis based on an ex-post analysis of existing negotiation data, which was collected over several years using an Internet-based negotiation support system. Empirical results indicate a strong positive impact of log-rolling strategies and a negative impact of "hard" tactics like insistence on the chances of reaching an agreement. Contrary to expectations, hard tactics do not improve the efficiency of agreements.

Keywords Bargaining process · Offers · Typology · Electronic negotiation · Empirical study

1 Introduction

Negotiations are dynamic processes in which the parties involved communicate to exchange offers, make concessions, raise threats, or otherwise influence each other in order to reach an agreement. While it is obvious that the outcomes of negotiations are to a large extent determined by the preceding negotiation process, existing negotiation research has often been criticized for focusing too much on outcomes, and paying

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only scarce attention to processes (Brett et al. 1999; Olekalns et al. 2003; Weingart and Olekalns 2004).

Negotiation processes are inherently communication processes. During the last years, communication and the exchange of messages during negotiations have been increasingly studied. Empirical research on communication in negotiations has focussed on different message types, their frequencies in negotiations and phase structures of negotiations. More recent research has also studied factors influencing the communication structure of negotiations, and the influence of communication on negotiation outcomes (Pesendorfer and Koeszegi 2006; Srnka and Koeszegi 2007). A systematic review of much of this research is given by Weingart and Olekalns (2004).

One particularly important form of communication in negotiations is the exchange of offers. Tutzauer (1992) even argues that bargaining could be defined as the exchange of offers. Offers are distinct from other types of communication because they are more structured. They deal with the substantive level of negotiations and typically involve some quantitative component (Tutzauer 1992). Consequently, formal models of negotiation processes based on theories like game theory or decision analysis often focus on the exchange of offers.

Models describing the bargaining process as a sequence of offers can, according to Tutzauer (1992) be classified into two major groups: *static models*, which only provide some general characteristics of the process, and *dynamic models*, which describe the process on an offer-by-offer basis. Well known examples for static theories include the "level-of-aspiration theory" (Siegel and Fouraker 1960), and the "graduated reciprocation in tension reduction" approach (Osgood 1962). Early dynamic theories include the "exponential decay" approach (Kelley et al. 1967) and the "action-reaction-system" of Bartos (1974). Pruitt (1981) integrates aspiration level, initial offer, and concession rate constructs in his approach to the negotiation process. However, all these theories consider only a one-dimensional space of offers and thus cannot directly be applied to multi-issue negotiations.

Other dynamic models of the bargaining process were developed in game theory in the 1950s and early 1960s (Harsanyi 1956, 1963; Bishop 1964; Cross 1965). These models show that under plausible assumptions about concession patterns, theoretical solutions of the underlying cooperative game, like the Nash bargaining solution or the Raiffa solution, can be reached. But the main goal of these models is to provide additional arguments for the plausibility of solution concepts, they are not intended to be descriptive models of actual negotiations. Thus, there are only few empirical studies which tried to relate those models to actual bargaining behavior (Fandel 1985; Sopher 1994). While game theory models can conceptually also be applied to multi-issue negotiations, they represent the bargaining process in the utility space of the parties and aggregate multiple issues into a one-dimensional utility value. Thus, important features of multi-issue negotiation processes are not represented.

Models of the negotiation process based on concepts from decision analysis consider different bargaining steps like conceding and not conceding (Rao and Shakun 1974) or decreasing and increasing offers (Balakrishnan and Eliashberg 1995). Other approaches suggest restricted bargaining schemes to reach Pareto-optimal agreements. Contini and Zionts (1968) propose a scheme where negotiators start at their individual optima and then lower their demands continuously until an agreement is reached.

Bronisz et al. (1988) propose a bargaining scheme similar to the "single negotiation text" (Raiffa 1982) where the negotiators start at the conflict point and then search for mutually beneficial solutions until the efficient frontier is reached. While some of these approaches explicitly represent multiple issues, they only use a subset of the possible bargaining steps.

Later models explicitly considered multi-issue negotiations. John and Raith (2001) developed a model of a multi-issue negotiation process, in which the negotiators consider different issues in separate stages of the bargaining problem. Tajima and Fraser (2001) proposed a log-rolling method to support negotiations, in which the parties jointly determine a direction in attribute space leading to mutual improvement of their positions. A similar approach using incomplete information about the negotiators' preferences was developed by Ehtamo et al. (2001). But these models provide only a rather restricted perspective of multi-issue bargaining, only one issue [in the model of John and Raith (2001)] or one possible trade-off [in the model of Tajima and Fraser (2001)] is resolved in each step.

Empirical research on multi-issue bargaining processes has mainly focused on log-rolling as an important feature of the negotiation process and has studied factors that lead to log-rolling as well as its impact on the outcomes of negotiations. Milter et al. (1996) found that certain task characteristics are more likely to induce log-rolling behavior by negotiators than others, and that log-rolling improved outcomes of negotiations in terms of Pareto-optimality. However, in their study, log-rolling was measured only indirectly via the compromise on which negotiators agreed, not directly in the process.

Other studies characterized log-rolling via the simultaneous (rather than sequential) consideration of issues (Weingart et al. 1993) or as integrative (rather than distributive) bargaining (Weingart et al. 1996). In these studies, the entire bargaining process was considered to exhibit these properties (to a certain extent) and was not analyzed at the level of individual offers. Moran and Ritov (2002) characterized single offers as log-rolling or distributive by measuring the variation of values between issues, but they considered only the first offer in a negotiation.

Apart from log-rolling, empirical research on negotiation processes has considered concessions as another important characteristic of processes. Neale and Bazerman (1985) studied how decision biases of negotiators influence total concessions over the entire negotiation process. Different time patterns of concession making were compared in a survey of more than 10,000 negotiators by Hendon et al. (2003), who found that preferences for concession patterns differ across cultures. Individual concessions were studied by Wall (1981), who compared different hypotheses about the effects concessions of one negotiator have on the concession behavior of the opponent.

Our paper makes two contributions to these lines of research: (i) we develop a logically consistent typology of mutually exclusive bargaining steps, and (ii) we empirically test the impact of the usage of these bargaining steps on various measures of the outcome as well as process characteristics of negotiations.

The typology of bargaining steps for multi-issue negotiations, which we develop in this paper, is focussed on offers and defines a bargaining step via the change a negotiator makes (or does not make) between two subsequent offers. Thus other, less structured elements of the negotiation process (like arguments enhancing one's

position, or threats) are not taken into account. We also implicitly assume that offers are complete in the sense that all issues of the negotiation are specified or, equivalently, that all issues not explicitly addressed in an offer remain unchanged from the previous offer. Within this restricted view of the bargaining process as a sequence of offers, our typology is logically complete in the sense that all possible combinations of changes in offers in a multi-issue negotiation are covered.

In the empirical part of the paper, we focus on the impact of bargaining steps on outcomes. A considerable part of the existing empirical literature studies conditions under which specific types of processes, in particular log-rolling behavior, will emerge. While this is an important research question, it relies on the assumption that the type of behavior being studied is beneficial for negotiation outcomes. This assumption is likely to be fulfilled when only broad types of bargaining processes are considered, but it requires more empirical evidence when differentiated types of bargaining steps are studied. Furthermore, by focusing on the conceptually clearer relationships between processes and outcomes, the empirical part of our paper also contributes to an empirical test of the external validity of our proposed typology.

Negotiators who employ different tactics or otherwise behave differently during negotiations will employ different types of bargaining steps. Thus, it is not possible to control bargaining steps as independent variables in an experimental setting in a similar way as other factors. Our empirical research is therefore based on an ex-post analysis of existing negotiation data, which was collected over several years using the Internet-based negotiation support system Inspire (Kersten and Noronha 1999), and follows an exploratory approach. While the classification of bargaining steps which we use in this paper is logically consistent and complete, it has not yet been used in empirical studies. Therefore, we derive our research hypotheses on their effects by adapting previous results to our classification of bargaining steps. Our empirical study thus is a first step at validation of these hypotheses.

The remainder of the paper is structured as follows: in Sect. 2, we develop our typology of bargaining steps. In Sect. 3, we formulate hypotheses relating these different types of bargaining steps to outcome and process dimensions of negotiations. Sect. 4 describes the negotiation case and measurement method. Empirical results are presented in Sect. 5. Section 6 concludes the paper by discussing our main results and providing an outlook on future research.

2 Bargaining Steps

Most analytical models of bargaining represent negotiations in utility space, or consider only a single issue. In these models, concessions are the only possible form of bargaining steps. Thus models like the classical model of Harsanyi (1956) mainly address two questions: which party should make a concession, and how much should that party concede.

In multi-issue negotiations, the situation becomes considerably more complex. Negotiators take positions in the multidimensional issue space. Thus a negotiator might, in one single step, make a concession in one issue, and take a more demanding

position in some other issue. Our model therefore considers the possibility that positions in different attributes are changed in different ways.

Similarly to bargaining models in utility space, we view the entire negotiation process as a sequence of offers, which are formulated in terms of values proposed for each of n issues k ($k \in \{1, 2, \ldots, n\}$). One bargaining step is characterized by the difference (which might be zero) of the negotiator's position in each issue between two consecutive offers from the same negotiator.

Even when only few discrete values are possible in each issue, the total number of potential bargaining steps is huge. Denoting the number of possible values in issue k by m_k, the number of possible offers (packages of all issues) is given by $\prod_k m_k$, and the number of possible bargaining steps is the square of that number, as any offer can follow any previous offer. In our experiments, a case involving four issues was used, for which 5, 4, 3, and 3 values were available. This leads to 180 possible offers, and $180^2 = 32{,}400$ different bargaining steps. Thus it is not possible to perform an empirical analysis which differentiates between each possible type of bargaining steps and we therefore develop a broader classification. While differentiating between all possible steps is possible—though extremely difficult even for few discrete values—it is impossible for negotiations with at least one continuous issue as there is an infinite number of possible offers and transitions between offers in such negotiations. This gives additional justification for developing a classification of bargaining steps based on more general concepts.

Within each issue, a negotiator can increase demand, reduce it, or leave it unchanged. Representing the presence or absence of each of these three possible moves (for any issue) in a bargaining step by a binary variable generates $2^3 = 8$ possible combinations. But only 7 of these patterns can actually occur, since at least one type of move must occur in each bargaining step. We group these 7 patterns into four types of bargaining steps as indicated in Table 1. An entry of 'X' indicates that a certain type of move occurs in one or more issues, while an empty cell indicates that this type does not occur for any issue.

We group the seven possible patterns into four categories, which are formally defined below. These four categories are similar to a classification developed by Gimpel (2007), although he did not consider the underlying scheme shown in Table 1. In the formal definitions of the categories, we use the following notation: offers of a

Table 1 Changes of the demand in issues and types of bargaining steps

Change of demand in issue			Step type
Decrease	No change	Increase	
X			Concession
X	X		Concession
	X		Insistence
		X	Demand
	X	X	Demand
X		X	Trade-off
X	X	X	Trade-off

negotiator are indexed by a time index t. The value of issue k in offer t is $x_{k,t}$, and $u_k(\cdot)$ is the negotiator's marginal utility function for issue k. We formulate our definitions in terms of utility values. Similar definitions could also be formulated using just an ordinal ranking of outcomes in each issue.

We call a bargaining step a *concession*, if $u_k(x_{k,t-1}) \geq u_k(x_{k,t})$ for all k and $u_k(x_{k,t-1}) > u_k(x_{k,t})$ for at least one k. A concession therefore is a sequence of two offers where the negotiator chooses an inferior value in one or more issues but does not improve his or her position in any issue. Thus, the offer on the table after the negotiator has made a concession is dominated (from that negotiator's point of view) by the negotiator's previous offer.

A bargaining step is called a *trade-off*, if $u_k(x_{k,t-1}) > u_k(x_{k,t})$ for at least one k and $u_k(x_{k,t-1}) < u_k(x_{k,t})$ for at least one other k. A trade-off is therefore a sequence of offers where the negotiator lowers the demand in at least one issue and at the same time increases the demand in at least one other issue, possibly leaving some issues unchanged. While the other types of bargaining steps can also occur in single-issue negotiations, trade-offs are a particular feature of multi-issue negotiations.

We call a sequence of two consecutive offers of one negotiator *insistence* if $u_k(x_{k,t-1}) = u_k(x_{k,t})$ for all k. An insistence is therefore a sequence of offers where the negotiator does not change the position in any issue or chooses values with the same utility. The latter can only be the case if the negotiator's single-issue utility function is not strictly monotonic.

Finally, we call a sequence of two consecutive offers of one negotiator *demand* if $u_k(x_{k,t-1}) \leq u_k(x_{k,t})$ for all k and $u_k(x_{k,t-1}) < u_k(x_{k,t})$ for at least one k. A demand is the direct opposite of a concession, i.e. a sequence of offers where the negotiator chooses a preferred value in one or more issues but does not accept an inferior value in any issue. Thus, the offer on the table after a demand dominates the previous offer of the negotiator.

As one can see from the formal definitions, bargaining steps are categorized according to the preferences of the negotiator who uses them, and are independent of the preferences of the opponent. If a negotiator makes a concession by changing the options in one or more issues to less preferred ones, this does not necessarily mean that the opponent prefers the new offer over the last one. This will only be the case if the preferences of the two negotiators are diametrically opposed.

This self-centered approach could be seen as limitation of our typology of bargaining steps. However, negotiators do not have information about the preferences of their opponents (though they might have assumptions about them) and we therefore believe it is reasonable to base analysis and advice on their own preferences, about which they have sufficient information to classify the bargaining steps. Taking into account the preferences of both parties would also considerably increase the complexity of our typology, because then 9 instead of 3 cases would have to be considered within each issue, leading to a total of $2^9 - 1 = 511$ instead of $2^3 - 1 = 7$ possible types (which, of course, could again be grouped).

It should also be noted that our typology refers to a single step within a negotiation, and a negotiator might use different types of steps in the entire process. Thus, we do not classify and entire negotiation as exclusively "conceding" or "demanding". But by considering the relative usage of steps, we can for example say that one negotiation

process contains more or less concessions than another process, and draw conclusions from such differences.

3 Hypotheses

The usage of bargaining steps can influence a negotiation in two ways: on one hand, one can expect that the mere occurrence of a certain type of steps (like insistence) can influence the outcome of a negotiation. We therefore distinguish between negotiation processes which contain a certain type of bargaining steps at least once and negotiations in which that type of steps does not occur at all.

On the other hand, two negotiation processes can be considered as different when certain types of bargaining steps occur more frequently (and the remaining types less frequently) in one process than in the other. In order to separate this effect from the duration of negotiations, we use relative frequencies for this type of analysis.

Thus we can formulate two groups of hypotheses linking bargaining steps to negotiation outcomes: one group which considers just the occurrence of certain types of steps, and the other group which takes into account relative frequencies of steps. As we have already explained, we assume strictly opposing preferences of the negotiators. This assumption, which is consistent with the case description used for the experiments, allows us to formulate hypotheses with respect to the bargaining steps as they are perceived by one negotiator, without taking into account different combinations of preferences of the negotiators.

By focusing on the occurrence and relative frequency of bargaining steps, we still consider each negotiation as an entity and do not further analyze the internal time structure of each negotiation. At an even more detailed level, one could analyze the interactions between different types of bargaining steps used by the negotiators, or shifts in the use of certain step types over time during a negotiation. While these are interesting questions, they are beyond the scope of this first exploratory analysis of the impact of various step types on outcomes.

Since outcomes of negotiations can be defined in various ways (Tripp and Sondak 1992), we use several dependent variables in our hypotheses. One obvious outcome dimension, which has often been used in empirical studies on negotiations (Coursey 1982; Neale and Bazerman 1985; Moore et al. 1999) is whether an agreement has been reached at all.

Agreements can be analyzed at the individual and the dyad level. Different types of bargaining behavior can lead to different outcomes for the negotiator using this behavior, and also for his or her opponent. We therefore consider the individual utilities of the compromise, if one has been reached, as one outcome dimension at the individual level. At the dyad level, we use Pareto-efficiency as a measure of the quality of the compromise. Unlike the more frequently used sum of payoffs, this measure treats all efficient solutions as equal (Tripp and Sondak 1992; Teich et al. 2000). Therefore it more clearly separates the result at the dyad level—efficiency—from individual performance, which we consider as a separate outcome dimension.

In addition to these outcome measures, we also consider duration of the negotiation. Duration could be measured in several ways. Calendar time would be a natural

indicator. But Inspire is an asynchronous negotiation support system in which parties need not be online at the same time, and there can be long and varying intervals between interactions of the parties. We therefore use the number of offers exchanged as a proxy to the actual effort which the parties have exerted in conducting their negotiations.

Empirical research on concession patterns and negotiation outcomes provides three important results for our analysis (Carnevale and Pruitt 1992). First, high opening offers and slow concessions (i.e. a small difference between two consecutive offers of a negotiator) make agreement less likely and increase the time it takes to reach an agreement. Second, low opening offers and fast concessions (i.e. a large difference between two consecutive offers of a negotiator) make agreements faster and reduce the outcome of the negotiator if an agreement is reached. From the two previous findings, one can derive an inverted U-shaped relationship between the utility level of offers and the expected level of outcome of a negotiation, taking into account the possibility of failure. Negotiators who are in between these two positions achieve better expected outcomes. In a similar argument, Raiffa (1982) suggests that a Boulware strategy of suggesting a reasonable offer and making no further concessions will result in a lower probability of agreement.

In our framework, these two types of behavior are represented by the extent to which concessions or trade-off steps on one hand, or insistence or demands on the other hand, are used. Therefore, we formulate:

H1: (a) The existence, and (b) the more frequent use of concessions and trade-offs in a negotiation increases the probability that a negotiation dyad reaches an agreement while the existence/more frequent use of insistence and demands reduces the probability that a negotiation dyad reaches an agreement.

Referring again to the U-shaped relation between the utility level of offers and performance (Carnevale and Pruitt 1992) we argue that a large number of concessions will decrease the probability that a negotiation dyad reaches a Pareto-optimal agreement and also decrease the individual utility of the negotiator making the concessions. As, under the assumption of opposing preferences, demands are the direct opposite of concessions, a high number of demands should increase the probability that the negotiation dyad reaches a Pareto-optimal agreement as well as the individual utility of the agreement to the negotiator.

Mutual trade-offs of both parties in different issues are the main characteristic of a log-rolling negotiation strategy. Log-rolling has been shown to be a very effective strategy for reaching efficient results, in analytical research (Mumpower 1991), as well as in empirical studies (Froman and Cohen 1970; Milter et al. 1996). We therefore formulate the following hypotheses:

H2: (a) The existence, and (b) the more frequent use of concessions in a negotiation reduces the probability that a negotiation dyad reaches a Pareto-optimal agreement while the existence/more frequent use of trade-offs, insistence, and demands increases the probability that a negotiation dyad reaches a Pareto-optimal agreement.

H3: (a) The existence, and (b) the more frequent use of concessions in a negotiation reduces the utility of the agreement for the negotiator who uses concessions while

the existence/more frequent use of trade-offs, insistence, and demands increases the utility of the agreement for the negotiator who uses them.

In single-issue negotiations, concessions are the only type of bargaining steps which move the negotiation towards a compromise. In multi-issue negotiations, trade-off steps can also improve the situation of both parties. Since insistence is a step in which no move takes place at all, we expect it to increase negotiation time. The same holds for demands, which are a move away from compromise when the two sides have opposing preferences. Therefore we formulate:

H4: (a) The existence, and (b) the more frequent use of concessions and trade-offs in a negotiation shortens its duration, while the existence/more frequent use of insistence and demands prolongs negotiations.

4 Method and Measurement

Our study is based on the ex-post analysis of negotiation records collected during experiments with the Negotiation Support System (NSS) Inspire (Kersten and Noronha 1999). While the ex-post analysis of existing data reduces the control over independent variables, this problem is at least partially compensated by the size of the database available. Furthermore, in our specific hypotheses, the independent variables reflect the behavior of negotiators, which cannot be directly controlled in an experiment, except when one side of the negotiation is directly played by the experimenter. Thus we consider an ex-post analysis of data as a suitable way to test our hypotheses.

The experiments analyzed in this study were carried out in the years 1996–2004. Inspire is an Internet-based experimental NSS, which was developed at Carleton University to conduct studies in electronic negotiations, and as a teaching tool (Kersten and Noronha 1999; Köszegi and Kersten 2003). Negotiation experiments using Inspire follow a structured pattern. In the *preparation phase*, the case is presented to subjects. Case descriptions in Inspire explicitly state all issues to be negotiated and the direction of improvement of each issue for the role the subject is playing. For each issue, the case also defines a set of discrete values.

The system then elicits the multi-attribute utility functions of the subjects using a modified conjoint analysis method (Kersten and Noronha 1999). Although the case description states the direction of improvement for each issue, the system does not enforce the utility function to correspond to the case description. After completing the utility elicitation, a pre-negotiation questionnaire is administered to the subjects, in which demographic data and the perceived difficulty of the utility elicitation process are recorded.

The second phase is the actual *negotiation phase*. All communication between the two negotiators takes place anonymously via the system, there is no direct contact between subjects, neither physically nor via e-mail. To hide their identity, all users are required to select a user name, under which they communicate with their opponents. While subjects are not prevented from disclosing their true identities, this information cannot be verified by their counterparts.

During the negotiations, the subjects can exchange structured offers, which specify a value for each issue, as well as free-text messages, which can accompany offers or be sent independently. All offers are time-stamped and recorded in a database, from where they were retrieved for our analysis. Offers are automatically evaluated using the negotiator's utility function, and the utility value of each package is displayed to the user. Throughout the negotiation, the system maintains a history log, which can be displayed upon request by the user, as well as a graphical representation of the utilities of offers made by both sides in terms of the utility function of the negotiator to whom the graph is shown. Users can change their utility functions by performing another utility elicitation at any time during negotiations.

Negotiations last for up to 3 weeks, but can be terminated by the parties at any time. When the negotiators reach an agreement, the system enters the *post-settlement phase*. Here the system checks whether the compromise is Pareto-optimal, and if it is not, it proposes several alternatives dominating the current compromise, and negotiations can continue. Finally, a post-negotiation questionnaire is administered to the users, in which their experiences with the system and attitudes towards future use of NSS are recorded.

Inspire is freely available on the Internet and anybody interested in trying out the system may sign up for a negotiation. But by far the largest group of users are students, who participate in Inspire negotiations as part of a course requirement. Typically, negotiations are set up between student groups from different universities in courses on international negotiations, decision analysis, information systems, or similar subjects. Students earn credit towards their course requirements by participating in the experiments. The credits are not tied to the negotiation outcomes, and instructors are not informed about the negotiation results.

In all negotiation experiments analyzed for this study, an identical case, the "Cypress-Itex" negotiation, was used. The "Cypress-Itex" case describes a bilateral buyer–seller negotiation for bicycle parts. Parties have to agree on four issues: price, delivery time, payment terms, and conditions for the return of defective parts. In each attribute the parties have to choose from discrete values to compose an offer. The five possible values for price, four for delivery time and three for the remaining two attributes generate a total of $5 * 4 * 3 * 3 = 180$ packages which the parties can offer during the negotiation.

Our classification of bargaining steps is based on an ordinal ranking of the discrete values in each issue. This ranking could be derived directly from the case description, which states the direction of improvement for each issue and each side. However, an empirical analysis of the utility functions elicited from negotiators has shown that actual preferences sometimes contradict the case description (Vetschera 2006). For the empirical analysis, we therefore ranked issue values according to the actual utilities elicited from negotiators.

The fact that a negotiation has reached an agreement, as well as the compromise, is recorded in the Inspire database, and can be used for our analysis. To check whether the compromise is Pareto-optimal, we calculated the utility values of all 180 possible alternatives using the utility functions of both parties and identified dominating alternatives, i.e. alternatives which have at least the same utility for both negotiators and a strictly higher utility for at least one negotiator. If no dominating alternatives exist,

Table 2 Absolute and relative use of bargaining steps

	Buyer		Seller		Total	
	Absolute	Relative (%)	Absolute	Relative (%)	Absolute	Relative (%)
Concession	2,083	65.07	2,045	64.23	4,128	64.65
Trade-off	674	21.06	748	23.49	1,422	22.27
Insistence	330	10.31	321	10.08	651	10.20
Demand	114	3.56	70	2.20	184	2.88
Total	3,201	100.00	3, 184	100.00	6,385	100.00

the compromise is Pareto-optimal. As we already explained in Sect. 3, the duration of negotiations is measured by the number of offers exchanged rather than calendar time.

5 Results

In the period from 1996 to 2004, in total 2,880 negotiation experiments based on the "Cypress-Itex" case have been conducted using Inspire. Out of these 2,880 negotiations, 1,087 (37.74%) fulfilled the basic requirements for this study: (i) The utility elicitation was performed by both subjects, and (ii) each party submitted at least two offers, this condition is required for the determination of bargaining steps.

Of these 1,087 negotiations, 813 (74.79%) reached an agreement and of these 813 agreements, 401 were Pareto-optimal (49.32%).

Table 2 presents the absolute and relative use of the four bargaining steps concession, trade-off, insistence, and demand for the whole data set. Nearly two thirds of the bargaining steps used by the negotiators were concessions, followed by trade-off, insistence, and demand. This result is similar to the data obtained by Gimpel (2007),who found about 55% of concessions, and correspondingly somewhat higher frequencies than our data for the other types, in negotiations with an automated agent.

We used χ^2 tests to analyze whether the use of the four types of bargaining steps significantly differs between roles. According to these tests, sellers use trade-offs more often ($\chi^2 = 5.33$, $p < 0.05$) than buyers, and demands ($\chi^2 = 10.11$, $p < 0.01$) less often. For concessions and insistence, the differences are not significant.

For the remainder of this section, relative frequencies of the types were calculated within each negotiation rather than pooled across all negotiations. Considering the distribution of step types at the aggregate level of all negotiations would lead to an overweighting of those types which are more frequently used in long negotiations, since these contribute higher absolute numbers of each type. As it is quite likely that the length of negotiations is related to the outcome dimensions we are studying (e.g. negotiations often break up at an early stage, therefore negotiations leading to an agreement are on average longer), this would lead to a distortion of our results.

As the relative frequencies of the use of bargaining steps always sum up to one (and thus are linearly dependent) we analyzed the influence of bargaining steps separately

Table 3 The use of bargaining steps and the probability of reaching an agreement

Bargaining step			Agreement reached: Yes	Agreement reached: No	Total	χ^2
Concession	Used	*N*	812	264	1,076	
		%	75.46	24.54	100.00	
	Not used	*N*	1	10	11	25.44
		%	9.09	90.91	100.00	$p = 0.0010$[a]
	Total		813	274	1,087	
Trade-off	Used	*N*	529	140	669	
		%	79.07	20.93	100.00	
	Not used	*N*	284	134	418	16.32
		%	67.94	32.06	100.00	$p < 0.0001$
	Total		813	274	1,087	
Insistence	Used	*N*	270	134	404	
		%	66.83	33.17	100.00	
	Not used	*N*	543	140	683	20.95
		%	79.50	20.50	100.00	$p < 0.0001$
	Total		813	274	1,087	
Demand	Used	*N*	117	47	164	
		%	71.34	28.66	100.00	
	Not used	*N*	696	227	923	1.01
		%	75.41	24.59	100.00	$p = 0.3139$
	Total		813	274	1,087	

$df = 1$, $N = 1{,}087$, with continuity correction

[a] p-value simulated by Monte Carlo simulation with 1,000 replicates due to small sample size

using univariate statistical methods. The linear dependency problem cannot be avoided by using absolute frequencies of the different bargaining steps, as this would confound the effects of bargaining steps and the duration of negotiations.

To test the influence of the use of bargaining steps on the probability to reach an agreement (H1a) and on the probability to reach a Pareto-optimal agreement (H2a), we use χ^2-tests. Since only 11 out of 1,087 negotiations contained no concessions, and only one of these 11 negotiations reached an agreement, we followed the approach by Patefield (1981) and used simulation techniques to approximate the actual distribution rather than the standard χ^2 to perform the test for this step type. The results of these tests are summarized in Tables 3 and 4.

Negotiations in which trade-offs are used have a significantly higher probability of reaching an agreement (79%) compared to negotiations in which no trade-offs are used (68%). Concerning concessions, the difference is even greater (75 vs. 9%), although this result must be interpreted with caution due to the small number of negotiations in which no concessions were used. For insistence, the converse is true: 67% of the negotiations in which insistence was used led to an agreement, without insistence the

Table 4 The use of bargaining steps and the probability of reaching an Pareto-efficient agreement

Bargaining step			Pareto-efficient			
			Yes	No	Total	χ^2
Concession	Used	*N*	401	411	812	
		%	49.38	50.62	100.00	
	Not used	*N*	0	1	1	0.97
		%	0.00	100.00	100.00	$p = 1.0000$[a]
	Total		401	412	813	
Trade-off	Used	*N*	271	258	529	
		%	51.23	48.77	100.00	
	Not used	*N*	130	154	284	1.99
		%	45.77	54.23	100.00	$p = 0.1587$
	Total		401	412	813	
Insistence	Used	*N*	119	151	270	
		%	44.07	55.93	100.00	
	Not used	*N*	282	261	543	4.15
		%	51.93	48.07	100.00	$p = 0.0417$
	Total		401	412	813	
Demand	Used	*N*	44	73	117	
		%	37.61	62.39	100.00	
	Not used	*N*	357	339	696	6.97
		%	51.29	48.71	100.00	$p = 0.0083$
	Total		401	412	813	

$df = 1$, $N = 813$, with continuity correction

[a] p-value simulated by Monte Carlo simulation with 1,000 replicates due to small sample size

fraction is 80%. For these three step types, the differences are significant at $p \leq 0.001$. No significant difference was found for demands.

To test H2a, only the 813 negotiations which reached an agreement can be analyzed. We compared the probability that the agreement is efficient in negotiations which contain or do not contain the different types of bargaining steps. The results of the χ^2-tests are summarized in Table 4.

Only one negotiation reached an (inefficient) agreement without using concessions, which renders the difference in concessions insignificant. Concerning the other types, Table 4 indicates that negotiations in which trade-offs are used are more likely to reach a Pareto-optimal agreement (though this effect was not significant). When insistence or demands are used, probability of an efficient agreement is significantly lower ($p < 0.05$ and $p < 0.01$, respectively). These results contradict hypothesis H2a regarding insistence and demand, as we expected that the existence of insistence and demand in a negotiation would increase the probability of reaching an efficient solution.

Table 5 Average relative frequency of bargaining steps in negotiations with vs. without agreement

	Average relative frequency in negotiations		
	With agreement ($N = 813$)	Without agreement ($N = 274$)	
Concession	69.61% (21.76%)	63.19% (26.75%)	$W = 127{,}666$ $p = 0.0003$
Trade-off	20.43% (19.52%)	16.81% (20.05%)	$W = 124{,}400$ $p = 0.0028$
Insistence	7.41% (12.55%)	16.51% (21.25%)	$W = 86,411$ $p < 0.0001$
Demand	2.55% (7.10%)	3.49% (9.44%)	$W = 108060.5$ $p = 0.2355$

Table 6 Average relative frequency of bargaining steps in negotiations with Pareto-efficient vs. inefficient agreements

	Average relative frequency in negotiations with		
	Pareto-efficient agreement ($N = 401$)	Not Pareto-efficient agreement ($N = 412$)	
Concession	70.15% (21.56%)	69.08% (21.96%)	$W = 84,357$ $p = 0.5986$
Trade-off	22.11% (20.38%)	18.79% (18.51%)	$W = 89645.5$ $p = 0.0315$
Insistence	5.97% (10.88%)	8.82% (13.85%)	$W = 75162.5$ $p = 0.0080$
Demand	1.78% (5.40%)	3.31% (8.38%)	$W = 76923.5$ $p = 0.0054$

To test the relationships of agreement (H1b) and Pareto-optimality (H2b) to the frequency of use of bargaining steps, we use nonparametric Wilcoxon rank sum tests of the equality of means, as the frequencies are not normally distributed. To test hypothesis H1b, we compared the average relative frequency of the different bargaining steps in negotiations that reached an agreement to those that did not (Table 5). Similarly, Table 6 compares negotiations that reached an efficient versus inefficient agreement.

The relative frequency of concessions and trade-offs is significantly higher ($p < 0.001$ and $p < 0.01$, respectively) the relative frequency of insistence significantly lower ($p < 0.001$) in negotiations that reached an agreement. We can therefore accept hypothesis H1b with respect to these three bargaining steps. In accordance with our hypothesis, the relative frequency of demands is lower in negotiations that reached an

agreement than in negotiations that ended without agreement, however, this difference is not significant.

The relative frequency of concessions does not differ significantly between negotiations in which the agreement was efficient and where it was not. However, the relative frequency of trade-offs is significantly higher ($p < 0.05$) and the relative frequencies of insistence and demand are significantly lower ($p < 0.01$) in negotiations that reached an efficient agreement. This result confirms our hypothesis H2b with respect to trade-offs, for insistence and demand the results contradict our expectations.

Since the individual utilities are negatively skewed, we also used the nonparametric Wilcoxon rank sum test to test the influence of the existence of bargaining steps in a negotiation process on the negotiator's individual utility (H3a). We compared the average individual utility of agreements where the negotiator used a particular bargaining step with the average individual utility of agreements of negotiators who did not use this bargaining step. This analysis can only be done for the 1,626 negotiators (two negotiators in each of 813 negotiations) who achieved an agreement (Table 7).

The average individual utility of negotiators who use insistence or demand is significantly higher ($p = 0.006$ for insistence, $p = 0.007$ for demand) than the average utility of agreements to negotiators who do not use these types, which confirms our hypothesis H3a. However, in both cases the significant relation holds for only one role: the effect of insistence is significant only for buyers, that of demands only for sellers. For the use of concessions and trade-offs, the results are not significant.

To test the influence of the existence of bargaining steps in a negotiation process on the duration of negotiation (H4a) we also used nonparametric Wilcoxon rank sum test of the equality of means since the duration of negotiations is positively skewed. We compared the average duration of the negotiation process where the negotiators used a particular bargaining step with the average duration when the negotiators did not use this bargaining step (Table 8).

For all types of bargaining steps, negotiations in which a particular step type is used take significantly longer than negotiations in which the type is not used. In interpreting these results, one has to be particularly careful with respect to causality. Our results do not indicate that using a particular step type will necessarily prolong negotiations. Causality can also be interpreted in the other direction: longer negotiations provide more room for experimentation and thus lead to the occurrence of different types of bargaining steps.

To test hypothesis H3b, we computed the correlation between the relative frequency of usage of a particular bargaining step and the individual utility of the negotiator using it in the agreement (Table 9). Similarly, correlation coefficients between the relative frequency of different bargaining steps in a negotiation and the duration of the negotiation process were computed to test H4b (Table 10).

For both roles, the relative frequency of using concessions is negatively correlated to the individual utility of a negotiator, and the frequencies of using demand are positively correlated (all $p < 0.01$). For sellers, there is also a significant positive correlation between the use of insistence and utilities. For buyers, the effect of insistence is also positive, but not significant and the coefficient is very small. This result corresponds to our expectations formulated in hypothesis H3b. The correlation coefficients indicate that the correlations of the frequency of usage of bargaining steps and the utility

Table 7 Average individual utility depending on the use of bargaining steps

		Buyer			Seller			Both		
		With step	Without step		With step	Without step		With step	Without step	
Concession	Utility	67.08	68.94	$W = 10803$	67.65	72.17	$W = 14045$	67.36	70.90	$W = 49435$
		(16.71)	(13.60)	$p = 0.8785$	(18.40)	(18.62)	$p = 0.0939$	(17.56)	(16.79)	$p = 0.1359$
	N	785	28		770	43		1,555	71	
Trade-off	Utility	66.90	67.34	$W = 79943.5$	67.99	67.80	$W = 81714$	67.47	67.56	$W = 324009$
		(16.20)	(16.94)	$p = 0.6513$	(17.20)	(19.49)	$p = 0.8303$	(16.72)	(18.24)	$p = 0.6589$
	N	385	455		387	426		745	881	
Insistence	Utility	70.19	66.36	$W = 62123.5$	69.32	67.56	$W = 52458.5$	69.78	66.97	$W = 228676$
		(16.69)	(16.51)	$p = 0.0025$	(17.98)	(18.52)	$p = 0.3413$	(17.29)	(17.56)	$p = 0.0058$
	N	167	464		151	662		318	1,308	
Demand	Utility	69.99	66.87	$W = 29964$	74.02	67.49	$W = 22959.5$	71.62	67.18	$W = 105942$
		(17.06)	(16.55)	$p = 0.1226$	(15.72)	(18.52)	$p = 0.0157$	(16.59)	(17.58)	$p = 0.0070$
	N	73	740		50	763		123	1,503	

Table 8 Average duration of negotiation depending on the use of bargaining steps

		Average duration of negotiations		
		With Bargaining step	Without Bargaining step	
Concession	Duration	5.91 (2.77)	2.64 (0.81)	$W = 10734.5$
	N	1076	11	$p < 0.0001$
Trade-off	Duration	6.76 (2.85)	4.45 (1.93)	$W = 213{,}216$
	N	669	418	$p < 0.0001$
Insistence	Duration	6.97 (3.16)	5.23 (2.29)	$W = 185{,}985$
	N	404	683	$p < 0.0001$
Demand	Duration	7.16 (2.99)	5.65 (2.68)	$W = 100{,}097$
	N	164	923	$p < 0.0001$

Table 9 Correlation of the relative frequency of the use of bargaining steps and the individual utility of the outcome

	Buyer		Seller		Both	
	Utility		Utility		Utility	
Concession	−0.10	$t = -3.00$	−0.23	$t = -6.82$	−0.18	$t = -7.24$
		$p = 0.0028$		$p < 0.0001$		$p < 0.0001$
Trade-off	0.05	$t = 1.30$	0.02	$t = 0.43$	0.03	$t = 1.20$
		$p = 0.1927$		$p = 0.6688$		$p = 0.2285$
Insistence	0.03	$t = 0.81$	0.15	$t = 4.37$	0.09	$t = 3.77$
		$p = 0.4204$		$p < 0.0001$		$p = 0.0002$
Demand	0.12	$t = 3.50$	0.27	$t = 7.91$	0.21	$t = 8.71$
		$p = 0.0005$		$p < 0.0001$		$p < 0.0001$
	$N = 813, df = 811$				$N = 1{,}626, df = 1{,}624$	

Pearson's product moment correlation, 95% confidence interval

of the outcome are considerably stronger for sellers than for buyers for concession, insistence, and demand.

To test whether the differences between roles are statistically significant we converted the correlation coefficients into normally distributed variables by Fisher's Z-transformation. One-sided tests indicate that the correlations are indeed stronger for sellers than for buyers (concession: $T = 2.66$, $p < 0.01$; insistence: $T = 2.51$, $p < 0.01$; demand: $T = 3.05$, $p < 0.01$).

The relative frequency of concessions is negatively correlated with duration, which corresponds to hypothesis H4b. However, in contrast to our expectations, there is a significant positive correlation between the use of trade-offs and the duration of negotiations, while we expected trade-offs to lead to shorter negotiations. As expected, the more frequent use of insistence increases the duration of negotiations, although this

Table 10 Correlation of the relative frequency of the use of bargaining steps and the duration of the negotiation

	Duration	
Concession	−0.30	$t = -10.54$
		$p < 0.0001$
Trade-off	0.30	$t = 10.21$
		$p < 0.0001$
Insistence	0.07	$t = 2.17$
		$p = 0.0301$
Demand	0.03	$t = 0.83$
		$p = 0.4082$
$N = 1{,}087, df = 1{,}085$		

Pearson's product moment correlation, 95% confidence interval

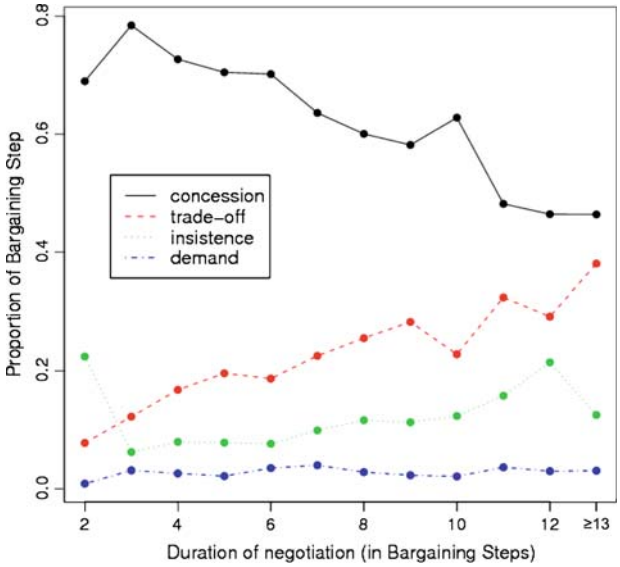

Fig. 1 Average frequency of bargaining steps and the duration of negotiations

effect is only significant at the 5% level. There is no significant impact of the use of demands on duration.

Figure 1 illustrates the relative frequency of bargaining steps for different durations of the negotiation process. This figure clearly reflects the results of the correlation analysis. In longer negotiations, the share of concessions continuously decreases, which is compensated by an increase of the share of all other types of bargaining steps. The large drop in the share of insistence for very long negotiations of more than 12 steps could be caused by the low number of observations in this category (23).

Table 11 Summary of the results of the empirical analysis

Bargaining step	Effect	Agreement (H1)	Efficiency (H2)	Individual utility (H3)	Speed (H4)
Concession	Direction	Positive	Negative	Negative	Positive
	Existence	Confirmed	Rejected: n.s.	Rejected: n.s.	Rejected: opp.
	Frequency	Confirmed	Rejected: n.s.	Confirmed	Confirmed
Trade-off	Direction	Positive	Positive	Positive	Positive
	Existence	Confirmed	Rejected: n.s.	Rejected: n.s.	Rejected: opp.
	Frequency	Confirmed	Confirmed	Rejected: n.s.	Rejected: opp.
Insistence	Direction	Negative	Positive	Positive	Negative
	Existence	Confirmed	Rejected: opp.	Confirmed	Confirmed
	Frequency	Confirmed	Rejected: opp.	Confirmed	Confirmed
Demand	Direction	Negative	Positive	Positive	Negative
	Existence	Rejected: n.s.	Rejected: opp.	Confirmed	Confirmed
	Frequency	Rejected: n.s.	Rejected: opp.	Confirmed	Rejected: n.s.
Method	Existence	χ^2	χ^2	Wilcoxon	Wilcoxon
	Frequency	Wilcoxon	Wilcoxon	Correlation	Correlation

6 Discussion

Table 11 summarizes the results of our analysis by displaying the relationships between the four types of bargaining steps and the four outcome dimensions which we studied in this paper. Although we used a fairly large sample, testing the hypotheses concerning the existence of concessions was difficult in several cases since the database contained only few instances of negotiations in which no concessions were made at all. Concessions are such a common phenomenon in negotiations that it is almost impossible to study negotiations which do not contain concessions. Therefore, results relating to the existence of concessions should be interpreted very cautiously.

Concerning the frequency of concessions, most of our hypotheses are confirmed: negotiations exhibiting more concessions are more likely to end in an agreement, which is achieved faster, but provides lower utility to the conceding negotiator. The only exception is the supposedly negative influence on efficiency, which could not be confirmed. The fact that we did not find empirical evidence of negative consequences of concessions even more underlines the importance of concessions for successful negotiations.

The positive effects which the negotiation literature typically associates with trade-off bargaining steps are only partially confirmed by our results. While negotiations containing trade-off offers more often lead to an agreement, and the agreement is more likely to be efficient, a positive relationship to individual utilities of the negotiator who performs such steps could not be confirmed. Thus it seems that the gain in efficiency from trade-off steps benefits the opponent more than the negotiator who makes these

steps. Contrary to our expectation, the duration of negotiations is longer, rather than shorter, when trade-offs are used.

"Hard" bargaining tactics as insistence and demand are, as expected, related to a higher individual utility of the negotiator who uses them. But in particular insistence turned out to be a quite risky strategy. Negotiations in which insistence is used are more likely to end in an impasse. Furthermore, the expected positive impact of insistence on efficiency could not be confirmed in our data. To the contrary, negotiations in which hard tactics are used generate fewer efficient agreements and take longer.

Our results have consequences for both the theory and the practice of negotiations. From a theoretical point of view, the negative relationship between "hard" tactics like insistence and demands and efficiency is quite surprising. According to the widely used "Dual Concern" model of negotiations (Carnevale and Pruitt 1992), a high concern for one's own outcome is necessary to achieve efficient negotiation outcomes. Our results indicate that hard tactics do not have this effect. This is not necessarily a contradiction to the "Dual Concern" model, but at least indicates that these tactics are not an adequate way to enact the concern for one's outcome.

Another surprising result, which lacks a theoretical explanation, is the difference between insistence and demands in their impact on reaching an agreement. While it is intuitively clear that insistence is likely to lead to a stalemate in negotiations, to our knowledge there is no theoretical model which would explain why increasing demands do not have this effect.

The typology of bargaining steps which we have developed in this paper can serve as a tool for negotiators in practice. Our results not only indicate the impact of different types of bargaining strategies on various outcome dimensions. They can also help negotiators to classify tactics of their counterparts, and make predictions of the outcome of negotiations based on this information.

While our study is based on a large data set of negotiations, it still has several limitations. As an exploratory ex-post analysis of an existing dataset, the sample is not as balanced as would be needed to test some hypotheses. This limitation in particular concerns our hypothesis 1. Although one could question whether it makes sense at all to study "negotiations" in which no concessions are made, such experiments could help to gain further insights into the role and importance of concessions in negotiation processes. Future studies in the form of controlled laboratory experiments could, for example, use confidants of the experimenters on one side of the negotiations, who on purpose use or avoid certain types of offers to generate a balanced design for statistical analysis. In this way, controlled empirical studies could be performed to further test our hypotheses.

In this paper we analyzed the impact of the usage and frequency of bargaining steps on outcome measures. Our definition and classification of bargaining steps was based on the offers sent by negotiators. But offers are only one (although probably the most important) kind of information which is exchanged during negotiations. Future research should therefore integrate our classification of bargaining steps with an analysis of the messages which accompany offers, and the other types of communication they contain. This integration (Tutzauer 1992), in particular a combination of our analysis with content analyses already performed for electronic negotiations (Srnka and Koeszegi 2007; Pesendorfer and Koeszegi 2006) could lead to further insight into

the complex, multi-level exchange of information that takes place during electronic negotiations.

While the bargaining steps introduced in this paper offer a dynamic perspective of negotiation processes, this aspect still can be strengthened. One possibility is to integrate our analysis with phase models of bargaining (Weingart and Olekalns 2004; Adair and Brett 2005). Content-based research has already shown that different types of communication acts are used during different phases of electronic negotiations (Pesendorfer et al. 2006). It is therefore likely that the use of different types of bargaining steps also differs across the phases of negotiations.

Such an analysis would integrate the "macro-dynamics" of phase models with the "micro-dynamics" of step types. Focusing at the micro level, future studies could analyze interactions between subsequent bargaining steps, both of the same negotiator, and between the two parties. In particular, reciprocity of negotiator behavior could be reflected in individual steps. Reciprocity would for example predict that a concession is more likely to be answered by a reciprocal concession from the opponent than a demand.

Apart from this use in empirical research, our classification scheme for bargaining steps could also be used for other purposes. In active NSS (Kersten and Noronha 1999), such a classification scheme could be used to automatically detect bargaining strategies of negotiators, and provide corresponding advice to other parties or to mediators. In an even more distant perspective, software-based autonomous negotiation agents could use such a typology, and empirical results about the impact of different types of bargaining steps, to plan and implement a negotiation strategy on behalf of their users.

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