"NEGOTIATION SUPPORT: THE EFFECTS OF COMPUTER INTERVENTION AND CONFLICT LEVEL ON BARGAINING OUTCOME"

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Conflict Resolution: The Effect of Computer Intervention and Conflict Level on Bargaining Outcome

ABSTRACT:

Past empirical research in the area of group decision support systems (GDSS) has focused on group decision making **under cooperation.** There is however an emerging effort to investigate the **non-cooperative** situations, where negotiation between conflicting parties is needed in order to reach agreement.

This paper reports on a study that examined the impact of computer support during negotiation, in situations of both high and low conflict. Specifically, the research question addressed was: Do computer suggestions positively affect the outcome of face-to-face negotiations and the attitudes of negotiators, especially in low-conflict situations, when compared to dyads that have no computer-based support? Investigation of such questions helps determine whether computers assist negotiators in reaching improved settlements, and if so, under what circumstances.

KEY WORDS AND EXPRESSIONS:

Negotiation; Conflict Resolution; Analytical Mediation; Third-Party Intervention; Group Decision Support Systems; Computer-Assisted Negotiation.

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1.0 INTRODUCTION

Negotiation is a naturally occurring phenomenon, used at individual, organizational, and international levels to solve opinion differences. It may range from agreeing on a vacation plan by family members, to discussing a salary increase by an employee, yet to limiting nuclear arms by the superpowers. Regardless of the problem domain, effective resolution of conflicts has the potential to improve personal welfare, corporate performance, as well as global relations.

There are barriers to effective resolution, however. People engaged in multi-issue negotiations often find it difficult to evaluate objectively various alternative resolutions according to each alternative's utility. One problem is the complexity of the evaluation process, which involves assigning utilities to each issue and then using an aggregation function to combine them into a total utility for the contract. Even if both sides can specify their preferences, the cognitive difficulty of finding a Pareto-optimal agreement between them remains. (An agreement is not Pareto-optimal if some other alternative exists which <u>both</u> sides would prefer.)

Behavioral, as well as cognitive, issues can impair objectivity in people's evaluation procedures. It has been found that the need to "save face" plays an important role in conflict situations [Hiltrop and Rubin, 1981; Johnson and Tullar, 1972; Pruitt and Johnson, 1970]. Even when a proposed contract is preferable to no contract, negotiators may not reach agreement if they feel they would be giving in [Brown, 1970, 1977]. Additionally, people reach poorer agreement (if agreement is reached at all) when they discuss

and try to settle each issue individually, one at a time, rather than approach the problem in an integrative manner where they consider the multiple issues as a package and work with trade-offs among the issues [Erickson, et al., 1974].

Given such obstacles to the achievement of "optimal" settlements, researchers in the field of group decision support systems (GDSS) are beginning to consider the conflict resolution area a fertile one for investigation. Recent research efforts in the field of negotiation try to exploit two major new developments. The first consists of building information systems tools, referred to as "negotiation support systems" (NSS), that can assist in the negotiation task. This research trend is witnessed by the work of Fraser and Hipel [1986]; Jarke, Jelassi, and Shakun [1987]; Kersten [1985]; and Srikanth and Jarke [1987]. The second development focuses on the potential for computer support of multi-attribute negotiations. Much of the work here is based upon the ideas of Walton and McKersie [1965] and Raiffa [1982] who emphasize the use of a systematic approach to negotiation based on an analysis of the process. The latter consists of defining what each side wants (determining their utility functions) and calculating a theoretically "optimal" solution to suggest to the parties. This type of approach focuses on optimizing the outcomes for both parties and achieving a win-win solution rather than on specific strategies, tactics, and maneuvers which will allow one side to "beat" the other (i.e., the win-lose solution).

The developments mentioned above were triggered by advances in computer and information technology which provide more efficient

capabilities for using negotiation algorithms suggested by researchers in management science and operations research. There is now a **need for assessing the behavioral implications** of using such technologies prior to and during negotiations. Specifically, it is important to determine whether or not computer support **should** be used as an integral part of the process and if so, what type/level of support is useful and under what circumstances. The study reported here is a first step in addressing this issue.

This study attempts to assess the effects of presenting negotiators with optimal solutions during face-to-face negotiations. Cognitive and social psychology theory would predict that negotiators without benefit of this information would be unable to reach such outcomes for the reasons given above. Calculation and presentation of these optimal solutions by the computer should enable negotiators to reach higher joint outcomes, especially in situations where more give-and-take is possible.

Section 2 of this paper reviews prior research work in the areas of analytical mediation and computer-assisted negotiations. The purpose and rationale of this study within the context of this type of mediation is described. Relevant empirical research on third-party intervention in general is also reviewed briefly. Section 3 describes the empirical study performed to assess the impact of computers on negotiation outcome(s). It starts by stating the research question under investigation and the hypotheses that were tested. It then discusses the research methodology used to conduct the study. In this context, first the subjects are described followed by the task, research setting, and experimental

procedures. Next the set of variables (manipulated, measured, and controlled) is provided. The results of the study are then presented. Section 4 is a discussion of these results; while Section 5 outlines future research directions in the field of computer-assisted negotiations. Some concluding remarks are given in Section 6.

2.0 BACKGROUND AND RATIONALE

2.1 Analytical Mediation

Recently the Decision Techtronics Group (DTG) of the State University of New York at Albany proposed the use of computer-assisted conflict resolution techniques, or "analytical mediation" [Mumpower, et al., 1986]. The system is based on one proposed earlier by another decision conferencing group, Decision and Designs, Inc. [Barclay and Peterson, 1976]. It uses an integrative, "joint problem solving" approach which has been suggested by a number of researchers in the negotiation area (for example, Walton and McKersie [1965], Ulvila [1979], and Raiffa [1982]).

The underlying goal of the analytical mediation methodology is to give each party more on those issues which are more important to it. For example, if a buyer is more concerned about delivery date than price and the seller holds the opposite view, they should both be more satisfied if an earlier date and higher price are agreed upon than if they "split the difference". The first step in the application of the methodology is to define the issues and their ranges. Second, importance weightings are elicited from each side, allowing the construction of utility curves. The role of the

mediator in a negotiation is essential to encourage each side to report his true importance weights and utilities [Barclay and Peterson, 1976]. The third step is to compute one or more optimal solutions, i.e., those which maximize the utility for both sides. The final step is to present the proposal(s) to disputants for deliberation.

A comprehensive research program on negotiation support is needed to determine how computer-based tools can help and under what circumstances they would have a positive effect. The study described here examined the use of computer assistance during the fourth, or face-to-face, stage of negotiation. The computer was used to suggest to bargainers theoretically "optimal" solutions for their particular situation.

2.2 Research on Third-Party Intervention

The analytical approach deals with how third parties can assist negotiators in resolving their conflict. One assumption that seems to underlie this approach to negotiation is that people are logical, that is, they approach the task in a rational manner from a joint problem solving perspective. Researchers in social psychology have found that negotiators do not always perform in such a manner.

One consistent finding has been that bargainers perceive concession making as a sign of weakness (see, for example, Brown, 1970; Hiltrop and Rubin, 1981; Podell and Knapp, 1969; and Pruitt and Johnson, 1970). Bargainers resist making concessions when their "need to save face" is high. Such need is affected by factors that include accountability to constituents, a tough stance by their opponent (slow concession rate or high opening position), and

objective self awareness (such as when they are being watched or filmed). In such cases a mediator's proposal of an agreement can facilitate the inter-negotiator bargaining and outcomes because it saves face for the negotiators. That is, it allows negotiators to rationalize their concession making. They can tell themselves they are not being weak, they are merely going along with good advice from a knowledgeable third party.

A second line of research has investigated the effects of anticipated intervention from third parties of varying power (no intervention, to making just a suggestion, to imposing a contract on the parties). Here it was found that parties like to resolve conflict on their own, and to the extent they can do so they will [Bigoness, 1976; Hiltrop and Rubin, 1982; Johnson and Pruitt, 1972; Johnson and Tullar, 1972; Rubin, 1980]. In low conflict or when the need to save face was low, the more controlling the third party was, the more actively the disputants tried to settle matters on their own. When conflict was more intense, bargainers preferred active (powerful) third-party intervention. The desire to solve the conflict on their own was overshadowed by their need to save face, so they held their position until the intervenor took over.

The dependent measures used in these "face saving" studies were generally concession rates and number of agreements. Another measure of bargaining effectiveness was how good the final solution was in terms of total utility (generally, the sum of both sides' utility points). Studies examining this variable have found improvements in joint score when negotiators approached the task in a holistic manner [Erickson et al., 1974], when possible solutions

were suggested as opposed to asking subjects to "paraphrase what the other was saying" [Bartunek et al., 1975], and when aspiration levels were sufficiently high [Neal and Bazerman, 1985]. (In all cases the task was structured such that joint gains were possible.)

The present study differs from previous ones in this area in that it examined both high and low-level conflict (distributive and integrative situations) in one study. Unlike the two previous studies which manipulated this variable (Erickson, et al. [1974] and Hiltrop and Rubin [1982]), third-party intervention and level of conflict were manipulated, and joint gains were measured. Further strengths of this study compared to many previous ones in this area are that it employed actual, rather than anticipated intervention; used a multi-issue task; and allowed face-to-face negotiation, as opposed to written communications among participants. It is hoped that the results from the hypotheses tested in this study will contribute to both practice and theoretical development in the area of negotiation. Of particular interest is its relevance to the analytical mediation process, where computers are necessary to calculate the optimal solutions to be presented to the negotiators.

3.0 COMPUTER-SUPPORTED NEGOTIATIONS: AN EMPIRICAL STUDY

3.1 Research Question and Hypotheses

As stated above, this study focused on the impact of computer suggestions during face-to-face negotiations. Thus, one treatment consisted of the presence or absence of computer suggestions. It is also important to determine under what conditions such support is effective. The single most important determinant of the effectiveness of intervention techniques in bargaining may be the

intensity of the disputants' conflict of interest [Hiltrop and Rubin, 1982]. Therefore, the other treatment in this study is level of conflict: either high or low (see Figure 1.) Hence, the major question of interest can be stated as follows:

Will computer suggestions positively affect the outcome of face-to-face negotiations and the attitudes of negotiators, especially in low-conflict situations, when compared to groups that have no suggestions?

		Negotiation Support	
		Computer Suggestions	No Suggestions
Level of Conflict	High Conflict		
	Low Conflict		

FIGURE 1: RESEARCH DESIGN

Obviously, one study cannot give this question a definitive answer which necessarily holds over all negotiation contexts and all sizes of conflicts. However, it can give evidence to the notion that computer techniques can be beneficial for negotiations.

Joint Utility of Outcome

Hypothesis 1.1: In the low-conflict situation, agreements reached by dyads with computer support will have greater utility than agreements reached by dyads without computer support.

It is believed that negotiators produce solutions using a simple compromise strategy which does not maximize joint profit [Barclay and Peterson, 1976]. This is partly due to the tendency to stop bargaining when a satisfactory, rather than optimal, solution is reached. This has been demonstrated by Bartunek, et al.'s

findings [1975] and supported by Neale and Bazerman [1985]. Secondly, humans are simply not able to process all of the hundreds of possible solutions even if they did know each other's utility function (which they do not) [Mumpower, et al., 1986]. Therefore, it was predicted that computer suggestions will proffer higher outcomes to negotiators than will the points which they may have been considering [Wall, 1981]. Additionally, the computer displayed an entire contract, thus forcing disputants to consider a whole package at once. Erickson, et al. [1974] demonstrated that such a holistic approach, rather than considering each issue individually, led to higher joint scores in low-conflict conditions. For all these reasons, it was expected that computer-supported dyads would reach an agreement with higher utility than non-computer-supported dyads.

Hypothesis 1.2: In the high-conflict situation, there will be no difference between the utility of agreements reached by dyads with computer support and the utility of those reached by dyads without computer support.

If an integrative solution is available, it seems likely that computer suggestions will assist disputants in finding it. However, if there is little possible integration, other than "splitting the difference", the computer may not be particularly effective. This prediction, which is tested in this research, has been stated by Raiffa [1982] and Mumpower, et al. [1986] and also supported by the results of Erickson, et al.'s work [1974].

Number of Deadlocks

Hypothesis 2: In the high-conflict situation more deadlocks will occur between pairs without computer support than between pairs with computer support.

Bargainers in the high-conflict scenario were in a zero-sum situation. Because there were no jointly beneficial trade-offs, both sides were expected to be slow to concede and thus would toughen their bargainer positions. Without the aid of computer suggestions, it was expected that many dyads would deadlock. When computer support was present, however, the negotiators would be more likely to make concessions. They would be able to rationalize their concession making by telling themselves they were not being weak, but rather intelligent to follow the advice of a third party.

All dyads were expected to reach agreement in the low-conflict conditions because there were so many jointly beneficial trade-offs and viable contracts available. Therefore, there was no hypothesis concerning the "number of deadlocks" for the low-conflict situation.

Time to Reach an Agreement

Hypothesis 3.1: In low-conflict situations, the time it takes bargainers with computer support to reach an agreement will be greater than the time taken by bargainers without computer support.

It was expected that in the low-conflict situation, the display of suggestions would lead to a greater bargaining time. This is because the suggestions would open new options for the bargainers to consider. Their aspiration level should be raised when they are presented with contracts whose utilities are higher than they thought they could achieve. The ensuing exploration of possible solutions would take time (although it is expected that in the end one of the suggestions will be chosen).

Hypothesis 3.2: In high-conflict situations, the time it takes bargainers with computer support to reach an agreement will be less than the time taken by bargainers without computer support.

Presentation of suggestions in the high-conflict condition was expected to lead to a faster resolution time. The suggestions probably would not be much different from the contracts the buyer and seller are considering, so the bargainers' aspiration levels would not be raised. Thus, they would either accept one of these solutions or quit with whatever they were considering at the time. The search through the solution space for an acceptable contract would not be expanded.

Post-Bargaining Attitudes

Research Question 1: How will negotiators' attitudes be affected by the computer support and/or level of conflict treatments?

After the bargaining session, participants were asked questions in order to measure their satisfaction, their perception of their opponent, and some indication of what subjects felt the atmosphere or climate of the negotiation was like. Two-tailed tests were done on factor scores because the attitude survey was exploratory in nature.

3.2 Research Methodology

3.2.1 Subjects

One hundred and twelve subjects, recruited from upper level undergraduate classes at the Indiana University School of Business, participated in the experiment. Two subjects, who apparently did not understand the objective, settled on contracts that were below their alternative contract (explained below). These subjects and their opponents were excluded from the analysis, resulting in a total of 108 subjects. Participation was voluntary; those who took

part received extra credit in the class from which they were recruited. Participants were also eligible for small cash awards which were based on their performance.

3.2.2 Task, Research Setting, and Procedures

The task for this study involved playing the role of a buyer or a seller who were negotiating four issues of a three-year purchase agreement. The product being purchased was a turbocharger engine part; the issues were price, quantity, time of first delivery, and warranty period. The buyer/seller task was chosen on the basis that subjects would be better able to relate to this business scenario than, for example, a corporate merger or labor/management dispute. The turbocharger was used because students were expected to have little experience with this item, therefore no preconceived notions or biases about the terms (price, quantity, etc.) they were to negotiate. The case was written for this study and was pre-tested in two pilot studies. Of the 78 students participating in the pilot studies, not one had questions about the case and all understood the instructions of the task.

Two students from different classes would arrive at the experimental room at their specified time and be assigned the role of buyer or seller by the flip of a coin. They read a case which gave them some identical background information about the companies they supposedly were representing. They were also given a page of confidential information and point sheets which varied by the level-of-conflict condition. The points corresponded to the text of the case, for example, issues described as "very important" were assigned higher point values. Also given in the case material was

an "alternative contract", i. e., a purchase or sale offer from another company. This gave subjects a minimum point level to achieve in the negotiation. The point sheet depicted in Figure 2 is the one for the buyer in the low-conflict situation.

FIGURE 2

POINT SHEETS

ROBERTS

ISSUES FOR BARGAINING (BUYER/LOW CONFLICT)

Possible terms for the three-year contract

==========

1. Quantity (minimum number of units Roberts must buy each year of the contract)

Roberts							Simo
	5,000	5,500	6,000	6,500	7,000	7,500	8,000
SCORE:	40	33	27	20	13	7	0

==========

2. Warranty Period (duration of the turbocharger warranty period in years)

Roberts				Simo
	4 years	3 years	2 years	1 year
SCORE:	16	10	5	0

==========

3. Price (cost per unit Roberts will pay Simo)

Roberts							Simo
	$200	$204	$208	$212	$216	$220	$224
SCORE:	16	13	11	8	5	3	0

==========

4. Delivery (time first shipment of turbochargers will be sent)

Roberts				Simo
	5 months (January)	6 months (February)	7 months (March)	8 months (April)
SCORE:	29	19	10	0

==========

The score on your alternative contract is 44

After reading this material, the subjects went into the bargaining room and sat across a table from each other. A micro-computer was located at the end of this table (see the spatial layout shown in Figure 3). Subjects read the case and instructions, then bargained face-to-face for 25 minutes, or until agreement was reached. In the computer-supported conditions, approximately midway into the session (i.e., after 12 minutes from the start), the computer presented three suggestions simultaneously and displayed them throughout the remainder of the bargaining session.

In all conditions the computer displayed a five-minute warning at 20 minutes into the session and at 25 minutes presented a "STOP BARGAINING NOW" message. This allowed the computer to act as timer and also prevented the non-computer-supported subjects from questioning the presence of the computer. At the close of bargaining, subjects signed a "final agreement form", then completed a post-bargaining questionnaire.

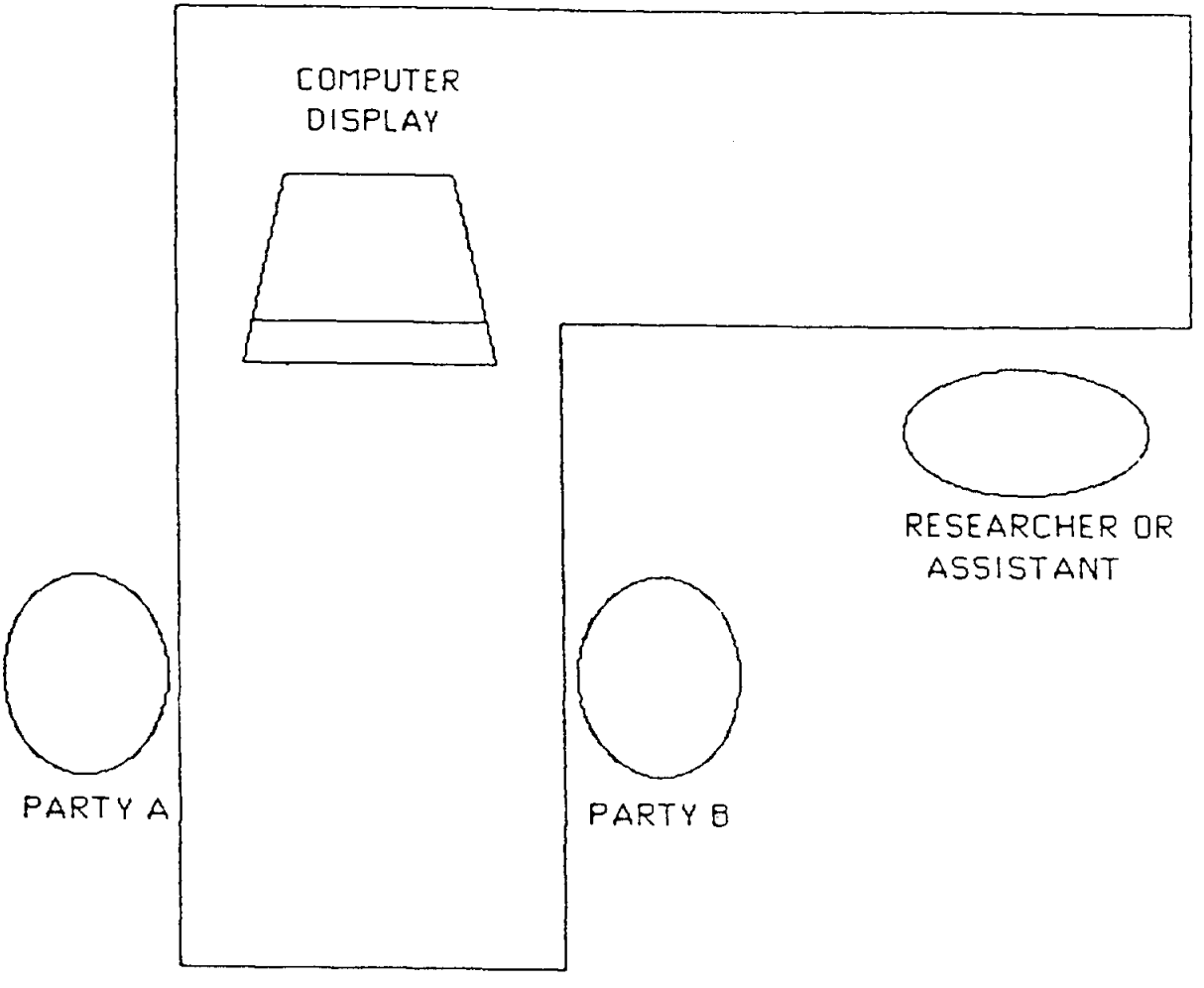

FIGURE 3

SPATIAL LAYOUT - BARGAINING ROOM

3.2.3 Variables

Independent Variables

Figure 4 below shows the variables used in this study and their relationships. The two independent variables were computer support and level of conflict. The computer support treatment was the display of three suggested contracts approximately halfway (12 minutes) into the negotiation session. The suggestions were the Nash solution [Nash, 1950] and the two closest contracts to it (i.e., the three contracts that maximized the product of the two negotiators' total utility less the utility of their alternative contracts.)

Level of conflict was high or low. In the high-level conflict, issues for both buyer and seller were weighted similarly (i.e., assigned approximately equal points). This resulted in a distributive bargaining situation resembling a zero-sum game where one party's gains were almost equal to the other one's losses. When conflict was low, the assigned weights for the issues were different, which allowed for the potential for mutually beneficial trade-offs.

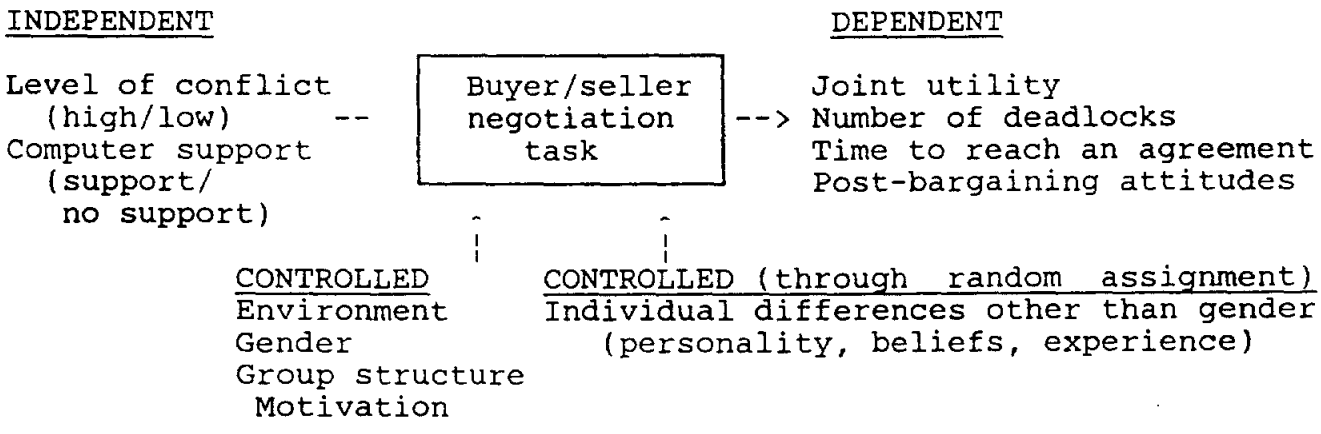

FIGURE 4: VARIABLE ENVIRONMENT

Dependent Variables

The main variable of interest was the joint utility of the final contract. This was measured by adding buyer and seller points on the final agreement. While the Nash solution is based on the product, the scores here were summed because this is intuitively easier to understand and is frequently used in studies of this type. (To assure consistency with the Nash solution, the product of buyer/seller scores were also analyzed.)

"Number of deadlocks" refers to the number of dyads who did not reach agreement. "Time to reach agreement" was measured from the time the face-to-face bargaining started until agreement or the 25 minute time limit was reached, whichever occurred first. A post-bargaining questionnaire was used to assess participants' attitudes.

Controlled Variables

Individual differences were controlled through random assignment of subjects to the role of buyer or seller, of subjects to pairs, and pairs to experimental conditions. To control for gender effects, dyads were male-male and female-female. Proportions of each gender type assigned to conditions were approximately the same. In an attempt to keep motivation high and constant, monetary incentives were offered for the top bargainers.

Group structure (number per side, zero history, unrestricted verbal communication) was the same, with the exception of the presence or absence of the computer acting as a "third party". Properties of the environment, with the exception of computer display present/absent, were identical.

4.0 RESULTS AND DISCUSSION

In this section, the results obtained in this study are discussed. They are presented in the following order : 1) utility of outcome, 2) time to reach agreement, and 3) attitudes and behavior descriptions. A summary of these results is provided at the end of the section.

4.1 Utility of Outcome

For the dependent variable "joint score", the high- and low-conflict conditions were analyzed separately using the Permutation test [Siegel and Castellan, 1988]. ANOVA was inappropriate for this variable because by definition the score populations in the high- and low-conflict conditions did not have the same variances or ranges.

The results of the permutation test indicate that in the low-conflict situations, dyads with computer support did achieve settlements with significantly greater joint utility than those without support ($p < .01$). In the high-conflict conditions, there was no significant difference between joint scores of dyads with computer support and those without. The means for the joint score variable are illustrated in Figure 5. (Analysis of the product of scores also resulted in a significant difference ($p < .01$) between low-conflict groups and no significant difference in high-conflict groups.)

In the low-conflict situations, where "win-win" arrangements were possible, the NSS did result in significantly higher joint outcomes. To further examine why this happened, the individual scores of bargainers were analyzed. The means of the lower scores

for each dyad were compared and the means of the higher scores were compared across conditions. Both comparisons resulted in significant differences.

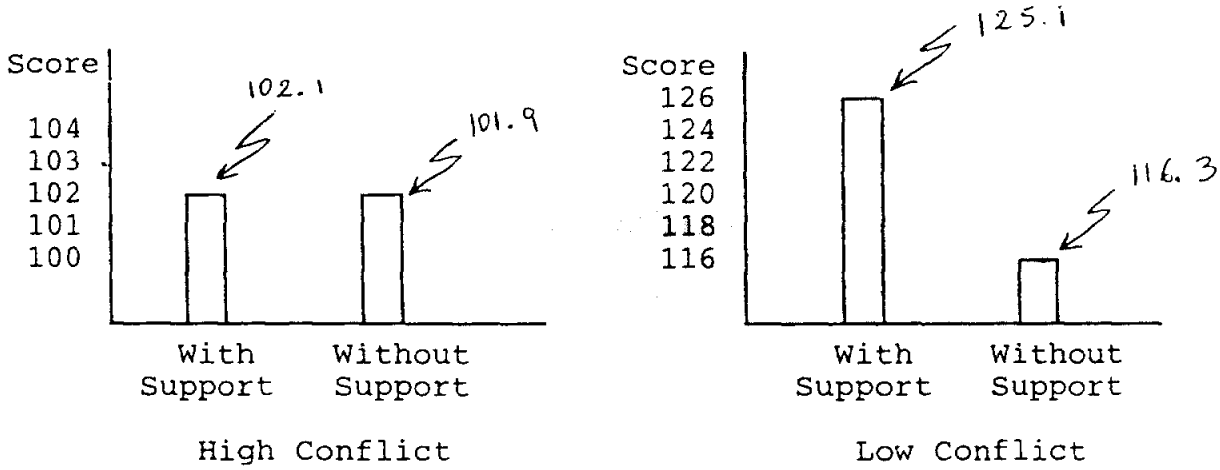

FIGURE 5: MEANS FOR THE JOINT SCORE VARIABLE

That is, not only was there a tendency for the lower score to be increased by the computer suggestions but the higher scores were raised as well. Thus, both parties generally improved their positions when the computer suggestions were available.

Discussion

It is evident that the subjects often split the issues down the middle. When this arrangement provided both sides with a settlement higher than their respective alternative contracts, they stopped bargaining. That is, the negotiating subjects displayed "satisficing" rather than "optimizing" behavior. When an integrative solution was available, as in the low-conflict situation, it is not surprising that the computer suggestion assisted disputants in finding it. However, in the high-conflict conditions, when there was little possible integration other than "splitting the difference", there was no evidence that the computer improved the outcome utility. This finding is consistent with

speculations made by Raiffa [1982] and Mumpower, et al. [1986] concerning analytical negotiation in zero-sum situations.

Further Analysis: Subjects Did Not Accept Suggestions

In order to gain more insight into what was happening, dyad scores were broken down into three groups. Depicted in Figure 6 are the number of dyads within which: 1) members agreed upon one of the suggested contracts, 2) one member achieved a score greater than the scores on contracts suggested by the computer, and 3) members did not agree on a suggested contract and did not score higher than the scores on contracts suggested by the computer. In this last group the computer suggestions would have given one or both members greater utility without putting either in a worse position. No statistical analyses were performed; the purpose was merely to examine how many people could have improved their positions by simply accepting one of the computer suggestions.

In the low-conflict conditions, very few people would have scored more poorly had they accepted one of the computer suggestions. Actually, only four out of the 60 people (30 dyads) would have been worse off (see Figure 6). This data supports the conclusion stated above that computer suggestions helped negotiators reach agreements with higher utility. Notice that 6 out of 15 dyads with computer support reached this type of agreement while only one 1 out of 15 without support reached it. The question is why six dyads settled for less than Pareto-optimal contracts even when they were offered three better agreements. (The same phenomenon was observed in the high-conflict situations, and is discussed below.)

COMPARISON OF DYAD SCORES TO
COMPUTER SUGGESTIONS

Condition	No.of Dyads	Both scores equalled one of the suggestions	One score greater than any suggestion	Both less or one score same as a suggestion, while partner's was less than that suggestion
LOW CONFLICT				
With computer support	15	6	3	6
Without computer support	15	1	1	13
HIGH CONFLICT				
With computer support	11	1	4	6
Without computer support	12	0	4	8

FIGURE 6: NUMBER OF DYADS PER TYPE OF AGREEMENT

In the high-conflict situation where computer support was present, members of all but one pair tried to "out-bargain" their partners and did not accept the computer suggestions. Of these 20 people (10 dyads), four scored higher than the suggestions would have permitted and 16 (the partners of these 4 people plus the 12 subjects who did not reach Pareto-optimal agreements) did not. This pattern was similar in the high-conflict/no computer support condition. As in the low-conflict situation, many subjects who were offered suggestions did not end up accepting them even when it would have been more profitable to do so. There are several possible explanations for this behavior. First, it could be due to differences between the utility (points) assigned by the researchers to the issues and subjects' utility functions which were internalized after they read the case. In other words, subjects created and used their own individual point systems based on the case text.

Similarly, their utilities may have been influenced by certain biases. For example, in several instances subjects playing the role of seller dismissed immediately the idea of accepting the lowest price, even though this was part of the Nash solution and would have given them more points in total than they were considering. They simply felt that price was unacceptable, regardless of the trade-off the buyer was willing to make. This could be because in real situations bargainers often overstate initial demands, particularly on important issues. Assuming that bargainers initially demand more than they expect, it makes sense for the other side to be reluctant to give them all of what they ask on any one issue. This helps

explain the general tendency of splitting issues down the middle (which is exactly why analysis should be useful and lead to higher joint gains in situations where joint benefits are possible).

Third, bargainers could have discounted the suggestions due to: 1) overconfidence, or 2) lack of understanding. In one pilot study subjects were given the choice of requesting suggestions or not. Procedures were changed substantially after this first pilot study and the data were not used; however, some insight can be gained from some of the comments made by participants. Several comments indicate a degree of overconfidence on the part of the bargainer. One pair of women did not use the computer because they did not want to "blow their competitive edge". (Actually, one of these females was not overconfident. She did get a higher score than the computer would have suggested, and was glad she had not used it. The other wished she had.) One woman said she did not use the computer because it would "show her opponent when she (the opponent) was being outbargained" (both women could have improved their scores). One pair of males said they "felt they could do better themselves" (both could have improved their scores).

Other comments show a lack of training or understanding, or perhaps some degree of intimidation by the computer. One pair of males stated they were "too busy negotiating and trying to reason" to use the computer (this dyad did not reach agreement). Another pair said they "didn't believe in that random number stuff"; and yet a third said "computers are for the future; we are nuts and bolts" (both could have improved their scores). One male dyad did not ask for the suggestions, and after the session, when asked why they had

not requested these, they said "yeah, we were kind of curious about that -- can we plug it in now?" It is apparent that they felt intimidated by the system.

The overall conclusions drawn from the test of the joint score variable are that bargainers do tend to split issues down the middle and often miss opportunities for joint gains. That is, they follow satisficing rather than optimizing strategies. Suggestion of optimal solutions does help subjects reach agreements with higher utility. There is some degree of irrationality in their decision process, however, as optimal agreements are often not accepted even when presented to negotiators. It was determined that this could be because of: 1) different utility structures, 2) biases against giving the opponent all of what he/she asked for on any one issue, or 3) discounting of the suggestions due to overconfidence and/or lack of understanding.

4.2 Number of Deadlocks

Results

There were only two high-conflict dyads who failed to reach agreement. Thus, the number of deadlocks which occurred in the high-conflict/no-computer condition was no different than the number that occurred in the high-conflict/computer-supported condition ($p = .26$).

Discussion

One obvious explanation is that it was generally easy to reach agreement on this task. Many previous studies that dealt with face-saving situations involved subjects bargaining against a programmed adversary who inevitably led the pair to a deadlock. At that point

suggestions would be made, then post-intervention concession rates measured. Usually suggestions did lead to larger subject concessions and eventual agreement. Unlike these experiments, the task in the present study included an "alternative contract", i.e., an offer from another company that they would take if they did not reach agreement.

A second explanation was drawn from observing subjects. They exhibited behaviors which indicated relief and pleasure with any agreement reached. The most frequent behavior was to get the attention of the researcher and announce with a pleased voice that agreement had been reached, and ask what they were to do next. There were costs associated with deadlocking, such as being perceived as uncooperative and/or a poor bargainer, and perhaps the embarrassment of not being able to complete the task as requested (there is always a risk of demand characteristics in experiments). Apparently, people made a great effort not to deadlock. This was the case whether or not the computer suggestions were present.

4.3 Time to Reach Agreement

Results

The time taken to reach agreement was analyzed using ANOVA. The two pairs who did not reach agreement within the allowed time were excluded from this analysis, as it was not known how long, if ever, it would have taken them to reach agreement.

For those reaching a contract, there was a main effect for computer support. Those receiving suggestions took significantly longer to reach a settlement than those without (average minutes for those with support = 18.8; without support = 13.5; $p < .01$; see

Figure 7). There was no main effect for conflict and no significant interaction effect. Two-way analyses of variance were done to determine whether this main effect held over both high- and low-conflict. The difference in time was significant in the low-conflict scenario ($p < .001$), while the effect of computer support on time was not significant when the conflict was high.

Discussion

It can be seen from Figure 7 that, as expected, low-conflict groups with support took longer than those without support. It had been predicted that dyads in high-conflict would take less time when they received computer support. This hypothesis was not supported; no difference in settlement time was found in high conflict.

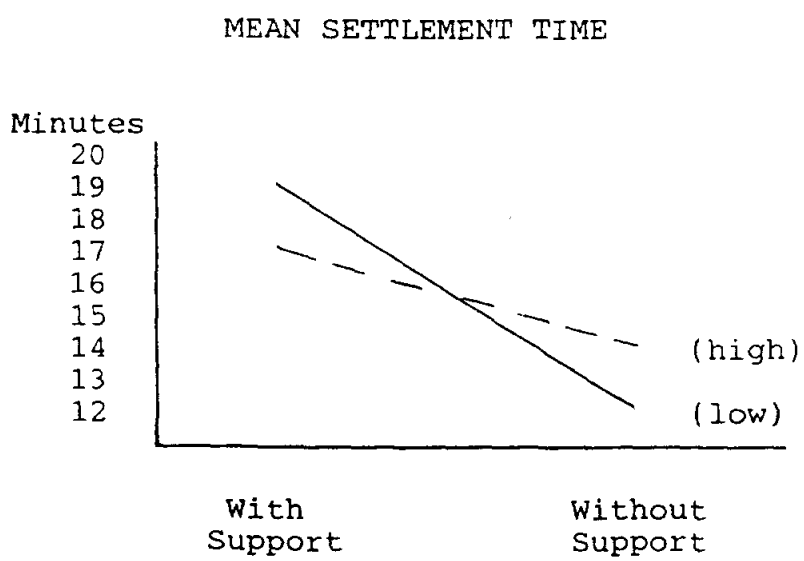

FIGURE 7: MEAN TIME TO REACH AGREEMENT

In this study it is believed that the computer created higher point expectations (aspiration levels) in low-conflict conditions and led to a more thorough exploration of alternatives by the participants. In order to rule out the possibility that the increase in time was due to the anticipation of something happening in 12 minutes (subjects were told that suggestions would be displayed after 12 minutes of bargaining), 10 extra dyads were run in "pause" conditions (five dyads in high-conflict and five in low-conflict situations). In these conditions, subjects were told they would be expected to briefly stop bargaining after 12 minutes. The computer sounded a beep and displayed a "PLEASE STOP BARGAINING NOW" message after 12 minutes. Then, 20 seconds later, another beep was sounded and a "YOU MAY RESUME BARGAINING NOW" message was displayed. The results of these pause conditions were almost identical to those of the non-computer-supported conditions, so no further use was made of the data. Ruling out the alternative explanation of the anticipation, however, does strengthen the argument that it was the added information that caused an increase in time to reach agreement for computer-supported dyads.

The fact that solution time was no different in high-conflict situations could be due to offsetting effects. First, the computer helped bargainers by permitting them to accept one of the suggestions with less fear of reaching a poor agreement and looking foolish or weak. This would have led to quicker resolutions. Additionally, it may have encouraged bargainers to explore new options, as it appeared to do in the low-conflict scenario. This would have caused an increase in settlement time. Overall, the

decrease in time caused by the face-saving effect of the suggestions could have been offset by an increased desire to explore options, leading to a "no difference" conclusion.

4.4 Attitudes and Behavior Descriptions

The post-bargaining measures yielded some results which shed additional light on negotiation dynamics; they also raised some interesting questions. Using factor analysis, the fourteen-item post-bargaining questionnaire (Figure 8) was condensed into four factors: positive climate, negative climate, satisfaction, and perception of other. Reliability of the factors were measured with Cronbach's alphas; the respective alphas were .85, .77, .77, and .17. For the first three factors, ANOVA was used on factor scores to determine if any differences among conditions existed. The two questions comprising the fourth were analyzed individually.

Strongly Agree						Strongly Disagree
1	2	3	4	5	6	7

1. I think my bargaining partner earned more points than I did.

2. I think the outcome of the negotiation was satisfactory for my company.

3. It was very difficult to reach an agreement.

4. I am satisfied with my own performance as a negotiator.

5. I think the other negotiator did a good job for his or her company in the negotiation.

6. I am satisfied with the number of points I earned.

7. During the negotiation, for the most part the other negotiator was inflexible.

8. During the negotiation, for the most part I was inflexible.

9. At times during the negotiation, the other negotiator seemed suspicious of my statements.

10. During the negotiation, at times I felt suspicious about the other negotiator's statements.

11. For the most part, the other negotiator was considerate during the negotiation.

12. For the most part, I was considerate during the negotiation.

13. During the negotiation, the other negotiator was generally a cooperative bargainer.

14. During the negotiation, I was generally a cooperative bargainer.

FIGURE 8: POST-BARGAINING QUESTIONNAIRE

"Positive climate" included questions 11-14. This dealt with subjects' perceptions about the consideration and cooperativeness level of the negotiation. There were no significant main effects, but the interaction between conflict and support approached significance ($p = .08$). Those subjects in high conflict felt the climate to be more favorable when the computer suggestions were present. In low conflict the opposite was perceived. For these subjects, those without computer support felt the atmosphere of the negotiation was more positive.

The second factor was "negative climate", or perceived inflexibility, suspiciousness, and difficulty in reaching agreement (questions three, and seven through ten). The results here are consistent with those of the "positive climate" factor, except the effects of computer support and level of conflict on negative climate are stronger. There was a significant interaction effect here ($p < .005$), and individual analyses showed that the same pattern of results held for each of the five questions. In high-conflict conditions, subjects' negative perceptions were less when the suggestions were presented. The opposite attitude was found in the low-conflict situation. Here the computer-supported dyads perceived a more negative climate in terms of suspiciousness, inflexibility, and difficulty in reaching agreement than non-computer-supported dyads did. The conclusion to be drawn may be that high utilities, such as those achieved in the low-conflict/computer-supported condition, can only be achieved when participants are more inflexible and cautious. But this cannot be determined without further research in the area.

Questions two, four, and six comprised the "satisfaction" factor. There was a main effect for satisfaction. Those subjects in the low- conflict conditions had a significantly higher degree of satisfaction than those in the high-conflict situations ($p = .03$). The individual questions were analyzed and although the same pattern existed for questions two, four, and six, it was found that the latter one, concerning how satisfied subjects were with the points they earned, had the greatest difference among conditions ($p < .01$). Thus, not surprisingly, the higher point scores of subjects in the low-conflict conditions lead to a higher level of satisfaction.

Because the reliability of the fourth factor was so low (alpha = .17), questions one and five were analyzed separately. There were no differences among conditions for the two questions in this factor.

Computer Questions

Subjects who received suggestions were asked four additional questions. These were not included in the factor analysis discussed above, but analyzed separately. To summarize subject responses (see Figure 9), bargainers: 1) agreed that the suggestions had been reasonable, 2) agreed somewhat that they would be willing to use such a system in the future, 3) felt the computer did not influence their decision much, and 4) disagreed slightly that the computer suggestions were partial to their opponent. These feelings were consistent whether subjects were in high or low conflict, with the exception of the sixteenth question. Here those subjects in low conflict said they would be more willing to use such a system in future negotiations than those in high conflict. This is not

surprising, as the computer offered more valuable information to those in low conflict.

A positive point about these responses is that even with no training or understanding, the subjects are not negatively disposed toward the system. That is, they did not seem to find it annoying or obtrusive or partial. On the other hand, they certainly did not recognize the value of the suggestions offered. They tended not to accept the solutions even when both parties could have improved their positions. This result makes apparent the importance of training/understanding of the system.

MEAN RESPONSES TO COMPUTER QUESTIONS
("1" was strongly agree; "7" was strongly disagree)

Question	Conflict Low	Conflict High	Overall
15. I thought the computer suggestions were unreasonable.	5.0	4.7	4.8
16. I would be willing to use a computer system like this in future negotiations.	3.1*	3.9*	3.4
17. The computer did not influence our decision very much.	3.9	3.3	3.7
18. In general, the computer suggestions appeared to favor the other party.	4.7	4.7	4.7

FIGURE 9: COMPUTER QUESTION RESULTS

* Difference between conditions approached significance, $p = .061$

4.5 Summary of Results

Figure 8 provides a summary of the results obtained in this study. The findings are presented in four categories: 1) utility of outcome, 2) number of deadlocks 3) time to reach agreement, and 4) attitudes and behavior descriptions.

The overall conclusion from this experiment is that computer support, as defined in terms of calculating and presenting optimal contracts for consideration, did affect bargainer outcomes and attitudes. Benefits were present in both high- and low-conflict situations. The computer suggestions helped low-conflict dyads reach agreements with higher joint utility, although there were associated costs in that it took longer time to reach agreement and led to more negative perceptions about the climate of the negotiation. In high-conflict situations, the computer suggestions led to more positive post-bargaining attitudes. It is possible that suggestions would lead to fewer deadlocks in high-conflict situations, although the results of this study (where almost everyone reached agreement) could not support this belief.

Joint Utility

High conflict:	Computer	No computer	ns
Mean score:	102.1	101.9	
Low conflict:	Computer >	No computer	$p < .01$
Mean score:	125.1	116.3	

Number of Deadlocks

High conflict:	Computer	No computer	ns
# of Deadlocks:	2	0	

Time to Reach Agreement

High conflict:	Computer	No computer	ns
Mean minutes:	17.7	14.7	
Low conflict	Computer >	No computer	$p < .0001$
Mean minutes:	19.6	12.7	

Attitudes and Behavior Descriptions

1. Positive Climate: Interaction almost significant, $p = .08$.

High conflict: With computer MORE positive than no computer.
Low conflict: With computer LESS positive than no computer.

2. Negative Climate: Interaction effect significant, $p < .01$.

High conflict: With computer LESS negative than no computer.
Low conflict: With computer MORE negative than no computer.

3. Satisfaction: Significant main effect for conflict.

Low conflict MORE satisfied than high conflict, $p = .03$.

4. Perception of other negotiator: no differences.

TABLE 15: SUMMARY OF RESULTS

5.0 FUTURE RESEARCH DIRECTIONS

The NSS used in this experiment was a simple system which merely offered suggestions to negotiators. Several assumptions were made, such as the number of parties (two), number of people per side (one), number of issues (four), discrete rather than continuous values per issue, and stable and measurable utility functions. Results of the present study indicate that NSS can provide benefits to their users.

Building on the work reported on in this paper, an important future research agenda may consist of the following phases:

1) Design a more sophisticated NSS than the one used in this study. The new system should assist in **all** stages of the negotiation process; that is, in (a) defining the bargaining issues and setting the participants' initial positions, (b) eliciting the disputants' preferences, (c) computing the optimal agreement, and (d) presenting it to the negotiating parties.

2) Implement the NSS designed in Phase 1, or a prototype version of it. Here it is expected that the researcher will encounter technical problems dealing with data sharing, model management, confidentiality enforcement (private vs. public information display), and communication handling between negotiators' workstations (or terminals).

3) Empirically test the system built in Phase 2 in a more complex bargaining environment than the one involved in this study. Specifically, the NSS should be used in a negotiation situation that is **multi-party** (more than two negotiating sides, each of which may contain several members), **multi-issue** (more than four items, which

may take on continuous as well as discrete values), and **dynamic** (in terms of changing preference/utility functions). Such empirical testing should involve decision makers and negotiators from the "real-world" (rather than business school students). It is the authors' belief that each step of the research agenda suggested above will provide additional insights to better understand both the technical and behavioral difficulties in building and using NSS. Moreover, it will serve as a basis for assessing the potential of computer-assisted negotiations in enhancing individual or organizational bargaining and conflict resolution abilities.

6.0 CONCLUDING REMARKS

The study described in this article addressed the issue of third-party (computer) intervention in negotiations. The question of interest was whether computer suggestions improved negotiation outcomes and disputants' attitudes in high- and low-conflict situations. As stated earlier, one study cannot give this question a definitive answer which holds over all bargaining contexts. However, this project gave evidence to help support the notion that **computer intervention in the form of "optimal" suggestions to negotiators can be beneficial.**

In terms of NSS potential, the raised low-conflict joint score result is important, but perhaps more important is the fact that so few individuals would have been hurt by accepting one of the suggested agreements. It could have been the case that many dyads had one member who scored above the Nash solution. If this had happened, it would make sense for people in real-world negotiation situations to refuse the use of an NSS. One of the bargainers might

instead hope to be one of those that would do better than the suggested settlement point. In both high- and low-conflict conditions, however, very few people scored more than the points offered in the suggestions. In other words, very few people would have been put in a worse position by accepting the Nash solution or one close to it.

Overall, the NSS was shown to be of value. In low conflict the bargainers worked harder and achieved more points because their aspiration levels were raised. Their attitudes were more negative, but perhaps this higher degree of inflexibility and suspiciousness were necessary in order to squeeze out the available joint gains. In high conflict, the NSS did not help achieve joint gains, but it offered the benefit of lessening negative perceptions. Those who received the suggestions felt both they and their partner had been somewhat more flexible, cooperative, considerate, and less suspicious. Thus, regardless of conflict level, the computer suggestions resulted in some benefit to the negotiators. And, as mentioned above, very few participants would have had their positions worsened had they ended up with a computer suggestion rather than their own settlement point.

Obviously, additional work is needed in order to generalize such findings and to investigate the technical issues in NSS, as well as the behavioral factors, e.g., the behavioral weaknesses and cognitive limitations often displayed by negotiators. The research agenda suggested in the previous section is directed toward our understanding of these factors, and hopefully answering some of the related questions.

Whether the application scope of NSS is personal or institutional, the critical challenge concerns our ability, as researchers, to provide effective computer support that can improve the quality of conflict resolution and bargaining outcomes. The emergence of analytical approaches to negotiation coupled with recent advances in information technology are creating opportunities for meeting this challenge.

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