Decision Support Systems 53 (2012) 161–174

Contents lists available at SciVerse ScienceDirect

Decision Support Systems

journal homepage: www.elsevier.com/locate/dss

Shall we dance? — The effect of information presentations on negotiation processes and outcomes

Johannes Gettinger [a,*], Sabine T. Koeszegi [a], Mareike Schoop [b]

[a] Vienna University of Technology, Institute of Management Science, Theresianumgasse 27, 1040 Vienna, Austria
[b] University of Hohenheim, Information Systems I, 70593 Stuttgart, Germany

ARTICLE INFO

Article history:
Received 2 July 2009
Received in revised form 16 August 2011
Accepted 1 January 2012
Available online 17 January 2012

Keywords:
Electronic negotiation support
Graphical decision support
Information presentation
Communication process
Empirical study
Human–computer interaction

ABSTRACT

The way information is presented influences human decision making and is consequently highly relevant to electronically supported negotiations. The present study analyzes in a controlled laboratory experiment how information presentation in three alternative formats (table, history graph and dance graph) influences the negotiators' behavior and negotiation outcomes. The results show that graphical information presentation supports integrative behavior and the use of non-compensatory strategies. Furthermore, information about the opponents' preferences increases the quality of outcomes but decreases post-negotiation satisfaction of negotiators. The implications for system designers are discussed.

1. Introduction

Managers spend up to one fifth of their working time with conflict resolution and negotiation [15,63]. They increasingly negotiate via electronic media such as e-mail, e-meeting and e-negotiation systems [73]. Electronic negotiations are not mere translations of traditional negotiations onto electronic media, but rather they provide additional value by supporting the decision making and/or communication process [62,74]. Electronic negotiation support (eNS) is realized through information and communication technology and can range from a simple message exchange to a complex support system. A negotiation support system (NSS) comprises one or more of the following functionalities: facilitation of communication, decision/negotiation analysis support, process organization and structuring, and access to information, negotiation knowledge, experts, mediators or facilitators [26]. In this context, the representation of information (textual, graphical, and auditory) is important for human–computer interactions. Due to technical advances in the last decades, users can often rapidly and effectively choose from various formats of computer generated reports. We know from empirical evidence that the way information is presented strongly influences human perceptions, preferences and decision making (e.g. [5,76]). Thus, the presentation of information is of essential importance for decision makers [70,77].

Current technological advances allow decision makers to access information more easily by using wireless networks, data warehouses and similar tools [42,52]. The vast amount of information is not necessarily linked to more accurate and efficient decisions, but rather sometimes to "information overload" for a decision maker (e.g. [41,72]). Scientific interest also focuses on handling large amounts of information and on overcoming mental resource limitations and cognitive biases (e.g. [23,46]). These developments have led to the advancement of stylized decision aids that "represent the problem in a stylized way that capitalizes on some special human cognitive processing ability" [86, p. 46]. Traditional stylized decision aids are tables and graphs in the form of lines, scatter plots, bar charts, and animations [45]. These display formats have been used successfully to extend human processing abilities in decision making [34,78,79]. Nevertheless, the potential of stylized decision aids has not yet fully been explored in eNS research. Thus far, scholars have focused on the improvement of tool-functionalities which aid bargainers in the negotiation process (e.g. [11,37,53]). In that sense, graphical support implemented in a system would be used to improve process and outcome (e.g. [7,12,82]). In electronic negotiation systems, information to be represented in a graphical manner would include message threads, preferences and utility values [62].

Although information representation is relevant, it has received little attention in negotiation research. Typically, information in e-negotiation systems is presented in text or tabular format. Except for the suggested utilization of the "negotiation dance graph" [56], to date only a "history graph" has been proposed and implemented [27,63]. A history graph exhibits the history of offers and counteroffers over

* Corresponding author. Tel.: +43 1 58801 33072; fax: +43 1 58801 33092.
E-mail address: Johannes.Gettinger@tuwien.ac.at (J. Gettinger).

0167-9236/$ – see front matter © 2012 Elsevier B.V. All rights reserved.
doi:10.1016/j.dss.2012.01.001

time of both negotiators based on preferences of the supported user only. In contrast, the negotiation dance graph represents all offers and counteroffers in the utility of both negotiators, while time is only implicitly considered, and it provides users with information about the actual preferences of their counterparts.

The present study aims to analyze how information presentation in these alternative formats (table, history graph and dance graph) influences the negotiators' behavior and negotiation outcomes. The paper reports on a 2006 controlled laboratory experiment. Students from three universities in Europe and the Middle East negotiated a contract in a scenario with multiple issues in the tourism industry. Using the NSS Negoisst [62,63], subjects were divided into three treatment groups using the three different representation aids on the negotiation process: a table, a negotiation history graph or a negotiation dance graph.

The paper is structured as follows: a discussion of the cognitive fit and related theories serving as the theoretical background of this study; an introduction of different types of information representation in a NSS; a discussion of the hypotheses comparing the effect of the three different information representation aids on negotiation processes and outcomes, based on previous empirical findings; a presentation of the Negoisst system and description of the experimental setting; and a presentation and discussion of the results and limitations of our study and future research threads.

2. Theoretical background

The paradigm of cognitive fit suggests that effective and efficient problem solving is obtained when all tools or aids used in the problem solving process correspond to the requirements of the task [78–80]. Problem solving is seen as an outcome of the relationship between problem presentation and the problem solving task. Cognitive processes act on the information presentation and the problem-solving task to provide a mental representation of the situation. The latter is the way the problem is represented in human working memory. When the types of information in the problem presentation match those in the task, the problem solver formulates a mental representation that is based on the same type of information. In contrast, a mismatch between the problem presentation and the task leads to a mental representation based only on the problem representation. The decision maker must then mentally transform the task into a suitable form, exerting additional cognitive efforts in order to solve a particular type of problem. Similarly, if a mental representation is formulated according to the task alone, the decision maker has to transform the data of the problem presentation into an appropriate form for the task solution. In both cases, additional cognitive capacities are required for auxiliary mental steps, which typically lead to poor results for the decision maker. The cognitive fit theory encourages the use of problem representations consistent with task requirements in order to improve the decision making process for those using decision aids.

Complementing the cognitive fit theory, Paivio [48–50] proposes the dual coding theory. This suggests that human working memory encodes, organizes, stores and retrieves imagery and verbal information in two different ways. When retrieving, processing and reproducing information, cognitive activities are mediated by two independent yet interconnected cognitive subsystems in the human mind: An imagery system (specialized in the representation and processing of nonverbal objects in a sequential manner) and a verbal system (specialized in handling linguistic propositions using a parallel processing system). Both methods are functionally interconnected at the referential levels, so that an activity in one system can cause an activity in the other system. The visual argument approach asserts that graphical displays make less demands on human cognitive resources [34,59]. According to this theory, graphs enable users to extract information without engaging in deep processing by providing guidance, constraints and facilitations in cognitive processes.

The cognitive fit theory and its complementary models (dual coding theory, visual argument approach and conjoint retention hypothesis) have received significant attention in empirical research. Several studies confirm the basic assumptions of the cognitive fit theory and propose further extensions. Speier and Morris [71] provide a study associating literature on graphical support and cognitive fit theory. They investigate the characteristics of query interfaces and show that visual interfaces provide a holistic perspective of the presented data. Along with Smelcer and Carmel [68], they extend the view of comparative advantages of graphical display formats by showing that the performance difference in terms of time and accuracy increases even with task complexity. The relationship between the level of information processing and environmental complexity has the shape of an inverted "U" [65], demonstrating that graphical aids allow users to gather more information prior to reaching the critical point of information overload. Free cognitive resources can be used elsewhere. A more recent Speier study [70] illustrates that subjects supported with graphs perform as well as subjects supported with tables, when facing complex symbolic tasks involving decision accuracy. Furthermore, they outperform the latter when facing spatial tasks. Graphs help subjects find solutions faster regardless of task complexity in spatial tasks, while subjects supported with tables are only equally efficient in complex symbolic tasks. Concerning the characteristics of spatial language, Hubona et al. [21] provide support for the cognitive fit theory in terms of decision accuracy but not in terms of time. Recently, Khatri et al. [28] extended the perspective of cognitive fit for external problem presentations and internal task representations. They find subjects to perform more accurately but not faster when both presentation formats match. The fit of both presentations facilitates an understanding of the presented information.

Other studies suggest a trade-off between the benefits of minimizing errors and the cognitive effort or time needed in a particular task environment [14]. When facing complex situations, decision makers use cognitive simplification strategies [15,61] and pursue a strategy of swapping effort in terms of time invested in the problem solution for accuracy [24]. The graphical organization of information influences the equation of this cost–benefit tradeoff by allowing the user to pursue an adequate strategy more easily than others. Jarvenpaa [22] introduces the term "incongruence" to describe a situation in which the processing required for a decision strategy and the process encouraged by the graphical tool are in conflict. Thus, the cost–benefit principle assumes that this incongruence results in additional costs for the user, increased effort or time or higher likelihood of mistakes. Dilla and Steibart [13] confirm that additional mental calculations increase the potential of making mistakes.

3. Types of information representation in eNS

In general, NSS have incorporated the following types of information representation for quantitative data: (1) solely text-based systems, (2) numerical systems offering analytical decision support with utility functions and preference values, (3) systems offering stylized decision aids in the form of tables, and (4) systems offering graphical display of the negotiation history.

While text-based systems constitute a minimum requirement, all other representation forms are more sophisticated. One idea to support decision makers is to quantify all available data and to implement it into numerical systems, which have already been shown to provide better support than simple textual messages. Numerical systems require well-structured inputs in a predefined format [19], show impacts of variables on results [7] and provide assessment scores [36]. However, numerical systems do not support decision makers in handling dynamic processes [7]. In negotiations, the history of exchanged offers, the concessions of the negotiation parties over time, their possible change of preferences and similar dynamic processes contain essential

Date	Title	Sender	Evaluation
Apr 10 12:50:47 AM	start of our collaboration Question	Bingo Tours	100.00
Apr 13 12:24:29 AM	RE: start of our collaboration Clarification	Playa Hotel	16.52
Apr 16 3:30:38 PM	offer Offer	Bingo Tours	96.52
Apr 18 8:46:46 AM	RE: offer Counteroffer	Playa Hotel	18.35
Apr 19 9:53:49 AM	RE: RE: offer Counteroffer	Bingo Tours	86.85
Apr 21 12:09:20 AM	RE: RE: RE: offer Counteroffer	Playa Hotel	16.35
Apr 22 9:40:40 AM	RE: RE: RE: RE: offer Counteroffer	Bingo Tours	52.91
Apr 23 9:50:47 AM	RE: RE: RE: RE: RE: offer Counteroffer	Playa Hotel	33.21
Apr 24 7:14:42 AM	RE: RE: RE: RE: RE: RE: offer Counteroffer	Bingo Tours	52.91
Apr 24 4:54:22 PM	RE: RE: RE: RE: RE: RE: RE: offer Counteroffer	Playa Hotel	52.91

Fig. 1. Tabular Support for electronic negotiations.

information for negotiators [62,81]. A more stylized information representation is essential.

Tables represent information that is symbolic in nature. They present data in separable formats, which introduce single point values more accurately than other representation aids [12,31,67]. Results from various studies indicate that tables should be used to present information when decision makers are required to recall specific amounts, handle values accurately (e.g. [5,12,45]) or compare data [44]. Therefore, in conflict situations with high sensitivity to small deviations from the optimum, tabular reports can provide exact values that are more resistant to distortion in comparison with other forms of information representation [4,5]. Tables provide little integrative information. Any links between the single values displayed must be made by the decision makers since tables neither provide support for integrating the effects of a number of variables in one period of time, as schematic faces do, nor for showing the effects of one variable over more periods of time, as graphs do [67,79]. The general assumption is that symbolic representation facilitates extracting and acting on discrete data values, and analytical processes provide the most appropriate access for decision makers to data presented in tables [78–80].

As graphs can be displayed in various formats, they often differ considerably in terms of their abstraction or arbitrariness. No unique terminology has been used for characterization of graphs. They are described as being "imaginastic," which means that they convey continuous information, while tables are seen as "verbal" in nature, i.e. they convey discrete information [78,79]. Graphs have visuospatial properties meaning they stress information on data relationship rather than on linguistic intelligence [4,5]. Graphs facilitate the acquisition of information by focusing on single units of information and their characteristics. They also allow for the grouping of information [35] and the establishment of associations among the values of each information package (or variable) across time periods without addressing the elements separately or analytically (e.g. [4,78,79]). Graphical display formats have a sequential structure reflecting an overview of the presented information. Many perceptual inferences, including perceiving and drawing inferences, are automatically supported at low cognitive costs [8,34]. Graphs facilitate the comprehension of large amounts of quantitative information [44,67]. Empirical research has reported that subjects provided with graphical formats are more effective in trend, pattern and time sequence data detection, (e.g. [12,68,77]) and in task execution in terms of processing time (e.g. [31,32,44]).

Concerning the level of complexity, tables outperform graphs regarding time and decision accuracy in simple decision making settings [45,58]. At a low level of complexity, graphs are perceived to be more difficult to read than tabular displays [12]. An increase in task complexity is better mediated by spatial rather than linear information displays [68]. Studies suggest that graphical decision aids are more efficient and lead to better performance when subjects face a higher cognitive load [45,58,70]. Graphs have been found to be more appropriate for the presentation of large amounts of information [12], because users have to invest less effort in order to "get the message" shown in graphical displays [5,6,40]. Users sometimes prefer graphs to tables due to their appealing format; they enjoy exercises and experience a higher level of satisfaction [40,43,77]. Still, subjects do not always prefer the most appropriate presentation format for the relevant task [20,32].

The most common and straightforward way to provide users of NSS with information about multi-issue offers is to present the utility values [27]. This involves analyses of the current offer and all prior offers made in the negotiation. Offers are evaluated and compared to the negotiator's aspirations, reservation level or to the BATNA (Best Alternative To Negotiated Agreement) over several periods of time, while all social interactions are processed simultaneously [1,66].

The most common way to present a negotiator's utility is via tables. Tables contain negotiators' utility in numerical form (see Fig. 1) and allow for an easy interpretation of the presented information.[1]

One way to visualize the negotiation process graphically is the history graph (see Fig. 2), which has already been implemented in NSS [63,64,82]. In the history graph, the factor "time" is represented on the horizontal axis and negotiators' "utility" is on the vertical axis. All offers are labeled on the ordinate according to the score associated with an offer. Even though offers of both parties are displayed, the calculation of the utility values is based only on the preferences of the focal user. Therefore, the history graph shows the distance between the offers submitted and received based on the focal users' value function. The history graph is designed to enable users to assess

[1] Figs. 1, 2 and 3 are based on a generic negotiation example using the same case as in the present study. They present the same information differing only in their implemented presentation formats.

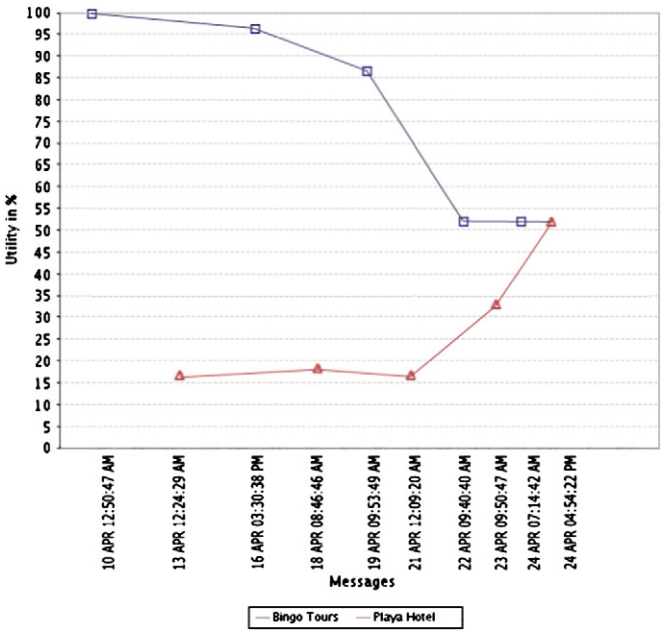

Fig. 2. The history graph.

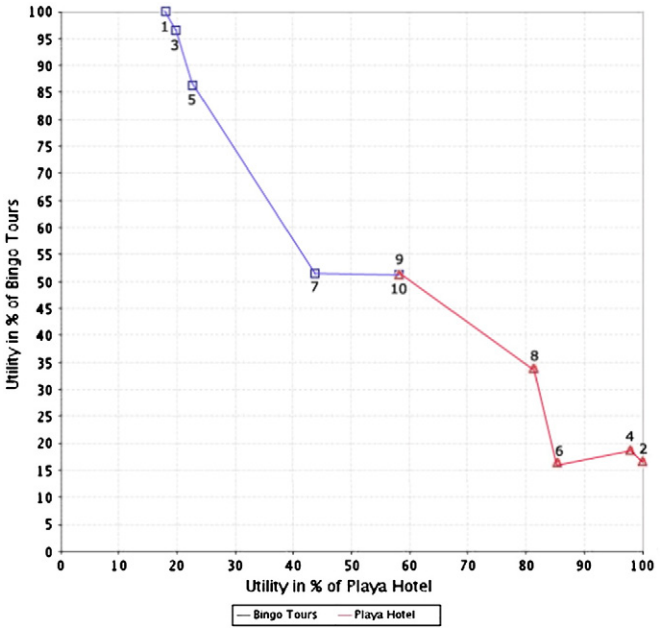

Fig. 3. The negotiation dance graph.

how far they are from reaching an agreement. For example, company A and company B negotiate over a contract including several issues and refer to the history graph. When company A formulates an offer, the utility rating of the offer and consequently its graphical presentation is based on the preferences of company A. When company B analyzes the offer received from company A, company B is provided with a rating and a graphical display of the offer according to the ratings of company B. This implies that each transmitted offer is rated according to the focal user only, while the preferences of the counterpart are not taken into account in the rating of offers or in the graphical displays.

Alternatively, literature proposes the use of the negotiation dance graph [56]. In contrast to the history graph, the negotiation dance graph rates and visualizes each exchanged offer according to the real preferences of both negotiators, i.e. the history of offers is presented in the joint utility space (see Fig. 3). The negotiation dance graph presents preference information about the counterpart to the negotiators, thus providing significantly more information than the negotiation history graph. Operatively, each offer is rated on the ordinate according to the preferences of the focal negotiator, while on the horizontal axis the offer is rated according to the preferences of the counterpart. While in a single attribute negotiation, preference information can directly be inferred from the dance graph, this information is much more difficult to read in a multi-attribute negotiation. Nevertheless, by comparing several offers made by the negotiation partner, the negotiators can identify the counterpart's major trade-offs between attributes. Within an integrative negotiation approach, the knowledge of the counterpart's true preferences facilitates Pareto-improving negotiation moves and consequently efficient agreements [56]. Within a distributive negotiation setting, however, it bears the danger of being exploited by opportunistic and competitive negotiators. In the negotiation dance, the factor "time" is considered to be more implicit as all offers are numbered in chronological order and linked by spatial lines. The main difference between the history graph and the negotiation dance graph is that in the history graph calculations are made only on the basis of the focal user's preferences, whereas in the negotiation dance each rating is a function of utilities of both users.

The leading research question of this study is whether the three alternative information presentation formats cause different processes and/or outcomes. Consequently we have to ask whether (1) the presentation of information in different *formats* (table vs. graph) and (2) the *information level* (own utility vs. own and counterpart utility) affect the negotiation process and/or outcome (see also Table 1). To do so, a sophisticated NSS is required offering all of the functionalities.

3.1. The Negoisst system

To answer the research questions, an electronic negotiation support system is required that supports business negotiations, rich communication support and various forms of decision support. Negoisst is a web-based NSS offering sophisticated support and formal document management [62,63]. Therefore, the experiments were conducted using Negoisst (see Fig. 4 for a screenshot of the system). Users negotiate via an electronic message exchange. The content of the messages is written in natural language (shown to the left of Fig. 4). In order to avoid misunderstandings and to prevent re-negotiations due to contractual ambiguities, Negoisst offers semantic and pragmatic enrichment. Semantic enrichment links free text to the negotiation agenda (shown to the right of Fig. 4). Pragmatic enrichment supports explicit intentions, because message types are indicated by the author (see Fig. 4). Negoisst also provides decision support. Negotiators specify their preferences on attributes to be negotiated and the system then computes a utility function. Each offer is rated, and both negotiators

Table 1
Experiment design.

Design		Information level	
		Own utility	Own and counterpart utility
Format of presentation	Table	"Table group" 19 dyads	Not implemented and tested
	Graphs	"History graph group" 22 dyads	"Negotiation dance group" 19 dyads

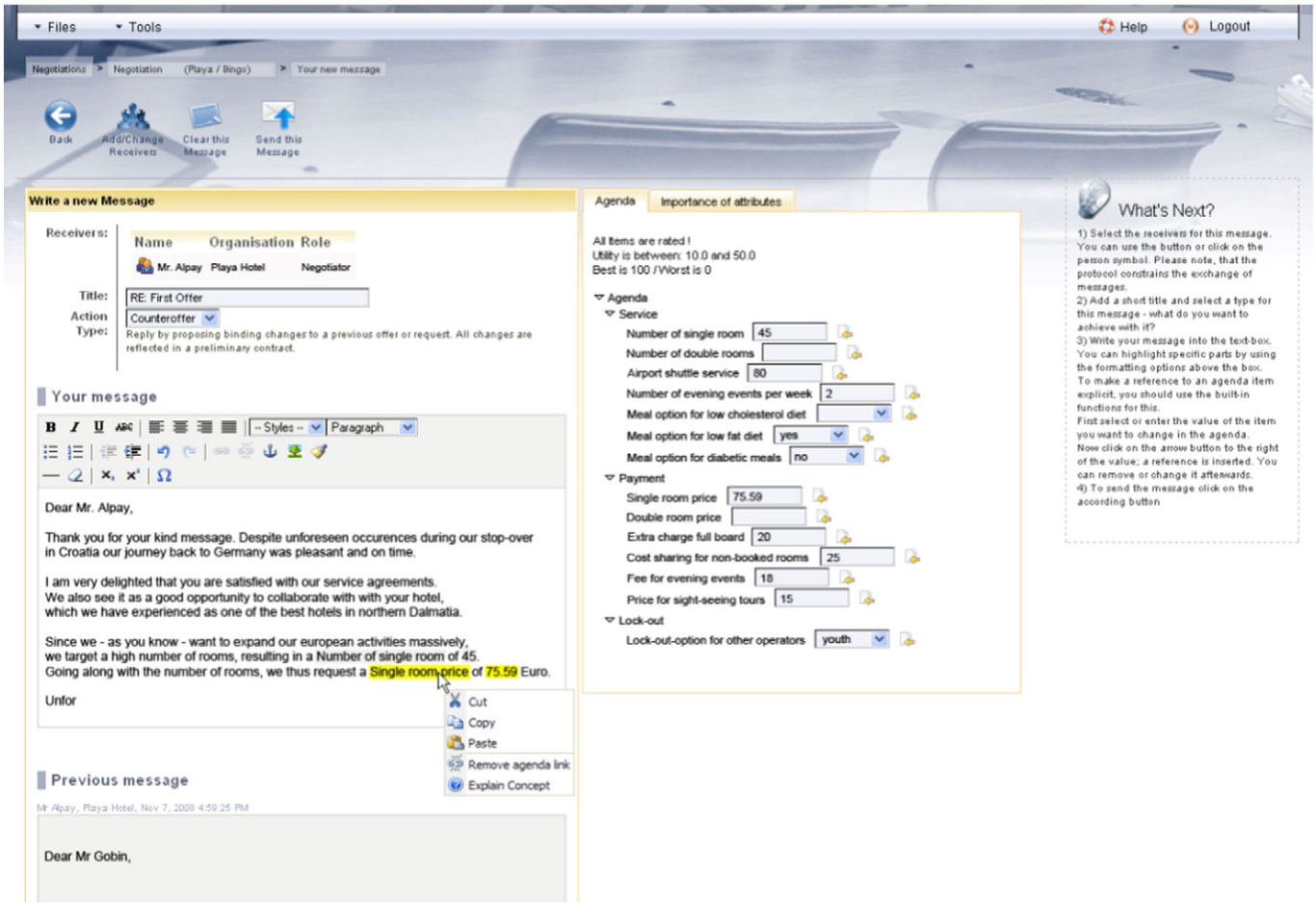

Fig. 4. The system interface of Negoisst.

can see in a glance how well they have already achieved their goals. If a negotiator writes a message offering a certain package, then the system will calculate the utility immediately. The negotiator can check the utility value before sending the message. Negoisst automatically deduces a contract version from each message sent, as well as a message thread representing the reasons for the decisions taken. Users are able to check the contract versions as well as all exchanged messages at any time during the negotiations.

For the purpose of this study, three different settings of varying information presentation have been implemented. Subjects assigned to the first setting, also referred to as the "table group", were provided with a numerical display of utility values positioned next to the according offer. When reviewing the ongoing negotiations, decision makers could see changes in utility ratings in tabular form. Subjects in the second setting were provided with the history graph in the negotiation history. In order to avoid ambiguity in graphical display, a short explanation of how to interpret calculated utilities is given to the users in textual form next to the history graph. In the third setting, subjects were provided with the negotiation dance graph, and a short written description of its characteristics to avoid misinterpretation.

4. Hypotheses

In this section, we suggest six hypotheses. Hypotheses 1–3 refer to expected differences between presentation formats, and hypotheses 4–6 refer to expected differences between information levels.

Swaab et al. [75] propose that negotiators provided with graphical decision aids develop a better understanding of the negotiation problem. Through the display of the utilities of previous offers and counteroffers during the negotiation, negotiators can more easily identify tendencies and trends, conflicting issues and topics less exposed to conflict. Since negotiators refer to salient information [61], we assume that negotiators with graph support will be more focused on the task at hand, with knowledge of the entire process and the ability to discuss issues in terms of utility values. Furthermore, negotiators supported with graphs should be better able to create a shared cognition of the conflict situation and consequently facilitate communication about needs and interests rather than positions (e.g. [43,61,75]). Additionally, graphs could also enhance the process of idea generation [7]. Altogether, we assume:

H 1(a). Negotiators supported with the history graph exchange more priority information (i.e. information about interests and needs) than those with tabular support.

Graphs offer a visualization of the relationship between negotiators in terms of distance/closeness of offers and counteroffers and movements toward or away from each other. Therefore, the relational aspects are more salient to negotiators and will more often be addressed in discussions. The cognitive fit theory suggests that graphs reduce cognitive load. This should free resources for social relationship building. We, therefore, hypothesize:

H 1(b). Negotiators supported with the history graph show more social/relational communication than those with tabular support.

Social interaction is closely related to the issue of fairness. It is assumed that there are several reasons why people act in a fair manner [9]. Apart from altruistic motives, people behave justly hoping for

reciprocity from the other party or to avoid being punished for unfair behavior (e.g. [54,87]). The dynamic representation of behavior in the history graph makes both concessions and resistance to concede visible for negotiation partners. We assume that this will evoke more discussions about fairness:

H 1(c). Negotiators provided with a history graph will discuss fairness more often than those with tabular support.

In any conflict situation, both parties have to converge in order to reach an agreement, i.e. at least one has to make a concession. Concessions seem to be crucial, especially when parties are trapped in a deadlock, or when conflict spirals occur and the situation escalates [29,55]. People often view bargaining situations negatively and perceive concessions as losses. Negotiators supported with the history graph can easily assess the effects of concessionary steps since they are displayed dynamically. We, therefore, hypothesize:

H 1(d). Negotiators provided with a history graph make more concessions than those with tabular support.

Negotiators often base their decisions on heuristic strategies or on oversimplifying rules, which allow them to generate leverage effects within the decision accuracy-benefit trade-offs [24]. This behavior reduces cognitive effort and negative effect [18]. Negotiators trust their own judgments to be correct. However, if conflicts become more difficult, the result is often overconfidence (e.g. [23,46]) and less concessionary behavior from the involved parties [2]. To convince or persuade the counterpart of a biased opinion, they use hard tactics (threats, intimidation and demanding commitments) [69]. When negotiators are provided with the negotiation history graph, the risk to succumb to overconfidence is reduced. As discussed above, negotiators can more easily analyze previous concession behavior and infer how much effort is required to reach an agreement. We hypothesize:

H 1(e). Negotiators provided with the history graph use fewer hard tactics than those with tabular support.

In summary, negotiators provided with the history graph are expected to share priority information and stress social relationships and fairness. They will use fewer hard tactics and make more concessions. In negotiation theory, this behavior is classified as “integrative negotiation behavior” [84,85] and has been shown to have a positive effect on agreement. We hypothesize:

H 2. Negotiators provided with the history graph are more likely to reach an agreement than those with tabular support.

Whether an agreement is reached or not is an indicator of the effectiveness of negotiations but not of the quality of negotiation outcomes. In the negotiation theory, three further indicators are often used to measure the quality of negotiation outcomes: joint outcome (as an indicator for efficiency), contract balance (as an indicator for fairness), and negotiator satisfaction with agreement (as a holistic assessment) [16,33,57]. Empirical evidence proves that negotiators pursuing an integrative negotiation strategy produce higher joint outcomes (e.g. [10,83,85]). Furthermore, there exists a trade-off between time/effort and decision quality or accuracy [22,24]. The development of value-creating offers, e.g. through logrolling, requires significantly more cognitive effort. This can be more easily achieved when negotiators are supported with the history graph. Therefore, we assume:

H 3(a). Negotiators provided with the history graph reach higher joint outcomes compared to those with tabular support.

Again, the importance of fairness will be stressed more among negotiators with history graph support. We, therefore, expect more balanced agreements in this group and hypothesize:

H 3(b). Negotiators provided with the history graph reach more balanced (equal) agreements (measured in utilities) than those with tabular support.

When negotiations have closed and parties leave the virtual bargaining table, they feel like either winners or losers [38]. Their mood and feelings depend on various factors. The process by which agreement was reached must be considered. The provision of the history graph will lead to integrative negotiation behavior resulting in a better bargaining climate [25]. According to the hypotheses stated above, we expect higher joint and more balanced outcomes to have a positive impact on the level of satisfaction (e.g. [17,37,77]). All of these factors contribute to the following hypothesis:

H 3(c). Negotiators provided with the negotiation history graph show a higher post-settlement satisfaction compared to those provided with tabular support.

In addition to the differences between tabular vs. graphical information presentation, we aim to analyze the effect of the provision of additional information in distinct graphs. The following hypotheses concern the change of information in the settings. In contrast to the history graph, the negotiation dance graph provides information about the counterparts' utility.

We expect that this additional information will change negotiation behavior in several ways. By providing utility information about both negotiators, dyads should be better able to assess whether their negotiation partner behaves fairly. Negotiators provided with this type of graph can easily see if real concessions are being made. Decision makers aware of this fact should consequently ask their opponent for fair treatment and stress the importance of fairness more often [47]. Therefore, we expect:

H 4(a). Negotiators provided with a negotiation dance graph will focus more on fairness compared to negotiators provided with a history graph.

In contrast to the history graph, the negotiation dance graph allows negotiators to identify mutually beneficial offers and counteroffers more easily, because bargaining steps are exhibited in the joint utility space. Furthermore, the visualization of offer-ratings according to the preferences of both negotiators provides a certain extent of control to both negotiation partners and, therefore, might actually act as a barrier against deceiving the partner. We expect to see more concession making, e.g. in the form of logrolling or Pareto-movements, and we assume:

H 4(b). Subjects provided with a negotiation dance graph make more concessions compared to those provided with a history graph.

At the same time, additional information about the utility of the counterpart and its representation in the utility space more explicitly demonstrates the differences in positions resulting in an increased awareness of conflict and/or unfair behavior. The higher level of control may actually induce negotiators to use more hard and soft tactics for substantiating their own position while counterbalancing unfair or competitive behavior. We, therefore, hypothesize:

H 4(c). Negotiators provided with a negotiation dance graph use more hard tactics than those provided with the history graph.

In summary, we expect more discussion about fairness and concession behavior when subjects are provided with utility information

of the counterpart. At the same time we expect more hard tactics. The assumption is that the positive and negative effects on negotiation behavior will counterbalance each other with regard to the number of agreements, and we hypothesize:

H 5. There are no differences in the number of agreements between history graph and negotiation dance graph groups.

Although we do not expect differences in the number of agreements between the two groups, we expect the quality of agreements to differ significantly. The visualization of changes in utilities due to modifications in single issues in the negotiation dance graph helps negotiators to identify Pareto movements and efficient alternatives [56]. Therefore, we hypothesize:

H 6(a). Negotiators provided with a negotiation dance graph reach higher joint outcomes than those provided with the history graph.

We assume that the visibility of differences in utilities during the negotiation process makes it more difficult to demand "the bigger share of the cake" [60]. There is an expectation of more balanced agreements when negotiators have information about utilities of both negotiation partners, and we hypothesize:

H 6(b). Negotiators provided with a negotiation dance graph reach balanced agreements more often than negotiators provided with the history graph.

Consequently, we expect negotiators who reach higher joint outcomes and more balanced agreements will be more content (e.g. [17,37,77]), and we hypothesize:

H 6(c). Negotiators provided with the negotiation dance graph will be more satisfied with the agreement compared to negotiators provided with the history graph.

5. Method

To test the hypotheses we conducted a controlled laboratory experiment. An electronic bilateral multi-issue negotiation in the tourism industry was conducted using Negoisst in which we varied the type of information representation between the three treatment groups (table, history graph, negotiation dance graph).

5.1. Simulation case

The simulation case used for this analysis describes negotiations between a European tour operator (Bingo Tours) and a Croatian Hotel (Playa Hotel). Bingo Tours is a growing company interested in adding Playa Hotel to its list of business partners. 14 issues need to be discussed. The case was designed to constitute a mixed-motive bargaining situation, including integrative and distributive issues. Users were provided with private preference information, including the importance of all issues and their reservation levels. Negotiators were told that profitable long-term partnerships with their counterparts were possible and desirable, although there was no specification of what a good deal should look like. No information was provided as to whether other potential business partners would be interested in either the tour operator or the hotel, so that subjects would assume that there was no other potential partner (i.e. no alternatives).

120 undergraduate and graduate students of business administration and information systems of the Universities of Vienna (Austria), Hohenheim (Germany) and Tel-Aviv (Israel) participated in this study (see Table 2). The sample consists of 24 Austrian students, 75 German students, and 17 Israeli students. 56 participants are female and 64 participants are male with an average age of 22.7 years. By pairing subjects from different universities into dyads, the possible distortion due to personal contact was minimized. Roles and treatment were assigned randomly (see flowchart of experimental process in Appendix A). Students were not rewarded financially for participation but received credits for courses at their university, independent of the quality of their outcome. All participants received the same two-hour preparation training. They had to fill in a pre-negotiation questionnaire giving user-specific information and expectations.[2] Participants conducted the negotiations (which had to be completed within 2 weeks) using Negoisst. Once the negotiation was terminated, subjects answered a post-negotiation questionnaire.

Table 2
Subjects.

	Austria	Germany	Israel	Male	Female	Total
"Table group"	4	26	8	22	16	38
"History graph group"	15	25	4	21	23	44
"Negotiation dance group"	6	26	6	21	17	38
Total	25	77	18	64	56	120

5.2. Content analysis

We applied content analysis to the 60 negotiation transcripts following the five stage model suggested by Srnka and Koeszegi [73]. Each negotiation transcript was unitized by two coders. At the end of unitization, two quality checks were performed. When assessing inter-coder reliability of unitization, we reached a Guetzkow's U = 0.17% and the textual conformance of unitization of 91.36% of all coded units. Both results can be considered very satisfying [30,73,84]. Differing unitizations were eliminated through discussion. In total, the 60 negotiation transcripts were divided into 10,161 codable units. For categorization, a category scheme was developed including 64 subcategories summarized in nine main categories (see Appendix A). Each negotiation transcript was coded by two coders. The inter-coder reliability, Cohen's κ, reached 0.94 which can be considered an excellent result [39]. Again, discrepancies between coders were discussed, and all differences were eliminated.

6. Results

As mentioned, the 60 negotiation transcripts, containing 740 messages, included 10,161 communication units.

Considering the presented category scheme, categories including concessions, the exchange of priority information and social emphasis are all part of an integrative bargaining style. Categories of normative statements, tactics, negative responses, positional information and positional offers are elements of distributive bargaining behavior. Only about one fourth of the total communication was used for cooperative approaches, while half of the efforts represented competitive bargaining behavior. The rest of the communication units, almost one fourth, were needed to coordinate the bargaining process. Fig. 5 shows the distribution of communication units in the main categories.

On average, subjects in all three groups used the same number of communication units (table M = 86.39, negotiation history graph M = 84.61, negotiation dance graph M = 83.03). The proportion of communication units for individual subjects in the three groups differed significantly. Table 3 lists the means and standard deviations of the relative frequencies of main and subcategories of each individual negotiator used to test the hypotheses. Our analysis of the communication patterns, i.e. hypotheses H 1(a–e) and H 4(a–c), is based on comparisons of these relative frequencies in the three different groups. For hypotheses concerning the agreement rate, the joint

[2] Due to page constraints the questionnaire is not included, but can be requested from the authors.

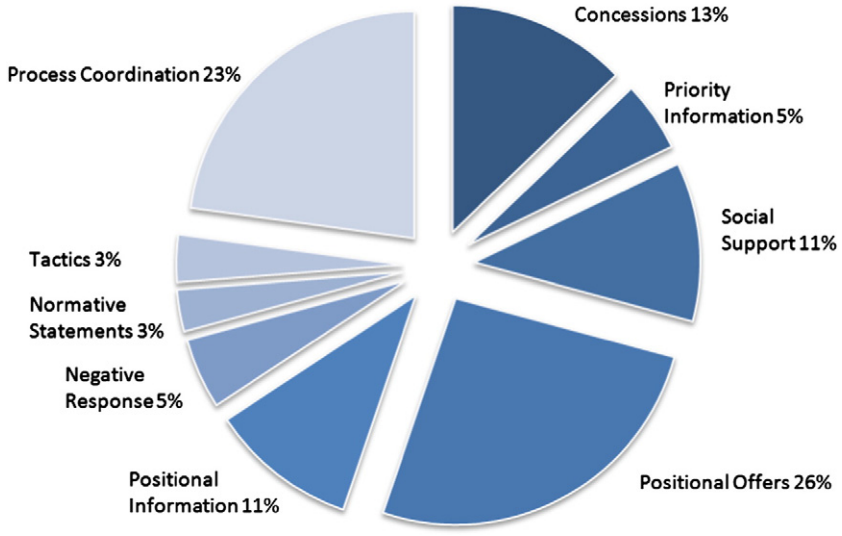

Fig. 5. Distribution of communication units.

utility, and the contract balance, i.e. hypotheses H 2, H 3(a–b), H 5, and H 6(a–b), we referred to the data stored by the system Negoisst in the negotiations. Hypotheses H 3(c) and H 6(c) are based on the answers provided by the subjects after the negotiations. For these comparisons, we used Kruskal–Wallis and Mann–Whitney tests, since data was not distributed normally.

In hypothesis H 1(a), we expect negotiators provided with a history graph to exchange more information concerning the task at hand than those provided with tables. Thus, we look at the main category "ask or give priority information" including the subcategories "request priority information," "request product information," "give priority information," "reveal personal information," and "clarifications." The three

Table 3
Relative frequencies of main and subcategories.

Main and subcategories (relative frequencies and standard deviations)	Table N = 38		History graph N = 44		Negotiation dance graph N = 38		Total
	Mean	SD	Mean	SD	Mean	SD	
Make concession	13.40%	0.051	11.70%	0.062	13.40%	0.067	12.83%
Concessions (other than lockout option)	9.00%	0.045	8.00%	0.060	9.10%	0.059	8.70%
Concession lockout option	0.30%	0.005	0.40%	0.006	0.91%	0.009	0.54%
Cond. concesions (other than lockout option)	1.30%	0.017	1.20%	0.021	1.40%	0.022	1.30%
Cond. concession lockout option	0.30%	0.006	0.10%	0.003	0.06%	0.003	0.15%
Acceptance	2.40%	0.024	1.90%	0.023	1.78%	0.018	2.03%
Multi issue offer	0.10%	0.005	0.10%	0.004	0.10%	0.005	0.10%
Ask or give priority information	4.72%	0.037	5.06%	0.036	5.25%	0.039	5.01%
Request priority information	1.49%	0.025	1.26%	0.017	1.24%	0.016	1.33%
Request product information	0.04%	0.003	0.19%	0.006	0.31%	0.008	0.18%
Give priority information	1.33%	0.015	1.67%	0.018	1.72%	0.021	1.57%
Reveal personal information	0.45%	0.007	0.95%	0.011	0.37%	0.021	0.59%
Clarification	1.41%	0.022	1.00%	0.010	1.62%	0.018	1.34%
Show social support	10.04%	0.052	12.49%	0.057	11.48%	0.045	11.34%
Show concern or express understanding	1.77%	0.014	1.91%	0.022	1.86%	0.020	1.85%
Show positive emotion (incl. thanking and humor)	5.04%	0.033	5.38%	0.034	5.95%	0.032	5.46%
Express apology or regret	1.08%	0.012	1.07%	0.016	0.83%	0.013	0.99%
Refer to trust and relationship	0.88%	0.012	1.80%	0.018	1.19%	0.014	1.29%
Express hope	1.12%	0.015	1.88%	0.016	1.34%	0.016	1.45%
Make off-task comments (extra role)	0.15%	0.005	0.41%	0.010	0.30%	0.005	0.29%
Make positional offers	24.93%	0.076	25.97%	0.077	27.25%	0.086	26.05%
Give positional information	11.97%	0.057	9.93%	0.037	9.73%	0.057	10.54%
State facts about product/service/company	4.30%	0.031	4.05%	0.029	3.38%	0.026	3.91%
Self-supporting statements	1.48%	0.013	1.26%	0.012	1.22%	0.013	1.32%
Persuasive statements	6.18%	0.038	4.62%	0.026	5.14%	0.038	5.31%
Show negative response	5.91%	0.028	4.92%	0.037	4.32%	0.033	5.05%
Reject proposals, offers or suggestions	3.43%	0.020	3.49%	0.033	2.72%	0.023	3.21%
Set conditions (not related to concrete issue)	0.98%	0.009	0.64%	0.010	0.40%	0.008	0.67%
Show negative emotions or sarcasm	1.50%	0.018	0.78%	0.013	1.21%	0.017	1.16%
Substantiate position	2.73%	0.021	3.20%	0.023	2.98%	0.030	2.97%
Stress similarities and common ground	0.61%	0.009	0.21%	0.004	0.49%	0.008	0.44%
Request understanding/accommodation	0.78%	0.009	1.13%	0.014	1.65%	0.017	1.19%
Refer to fairness	1.34%	0.014	1.85%	0.015	0.84%	0.015	1.34%
Use tactics	4.00%	0.024	2.36%	0.023	3.75%	0.026	3.37%
Soft tactics	1.60%	0.016	1.00%	0.012	1.70%	0.018	1.43%
Hard tactics	2.40%	0.017	1.40%	0.021	2.00%	0.018	1.93%
Process coordination	22.37%	0.067	24.38%	0.064	21.83%	0.057	22.86%
Total	100%		100%		100%		100%

former subcategories represent the exchange of information about the characteristics of issues at hand and the decision maker's preferences. The subcategory "reveal personal information" focuses on personal information of subjects and those having an impact on at least one decision maker. Comments to clarify prior statements were considered as an effort to decrease the likelihood of misunderstandings and to emphasize task relevant aspects. Analyses show no differences in the communication about the task due to the type of information presentation ($p = .284$ $U = 774.5$). Thus, hypothesis H 1(a) is not supported.[3]

In hypothesis H 1(b), we predict that negotiators provided with a history graph are more concerned with social aspects of the negotiation process than those provided with tables. In order to measure "social orientation," we examine the main category "show social support." This category includes subcategories that express empathic communication, positive emotion or reference to general social or personal elements of negotiations, i.e. "show concern or express understanding," "show positive emotion," "express apology or regret," "refer to trust and relationship," "express hope," and "make off-task comments." Our results illustrate that negotiators provided with the history graph put significantly more emphasis on these social aspects than those provided with tabular support ($p = .015$ $U = 600.5$). Moreover, negotiators provided with the history graph display significantly fewer negative emotions and sarcastic remarks (see subcategory "show negative emotion or sarcasm") than those with tabular support ($p = .014$ $U = 613$). Therefore, hypothesis H 1(b) is supported by our data.

According to hypothesis H 1(c), we expect subjects provided with the history graph to discuss the issue of fairness more often than subjects provided with a table. To test this hypothesis, we examine the subcategory "refer to fairness." As expected, we find that negotiators provided with a history graph put more emphasis on discussing fairness issues than negotiators provided with a table ($p = .048$ $U = 658.5$). Therefore, hypothesis H 1(c) is supported.

In H 1(d), we hypothesize that negotiators provided with a history graph make more concessions than those provided with a table. When comparing the median values of the main category "make concession," it is obvious that users supported with tables assent more often. We tested this hypothesis in the opposite direction and find weak support ($p = .060$ $U = 669.0$). However, we have also examined the issues for which negotiators are prepared to make concessions. We look at how these concessions are framed, i.e. as an unconditional concession (e.g. "I am willing to offer a lower price") or as a conditional concession (e.g. "I am only offering a lower price when you increase the number of rooms"). We observe an interesting difference which partly supports our original hypothesis; when examining the most important and conflicting issue of the negotiation case (the lock-out option), we find that users provided with the history graph more often make unconditional concessions ($p = .067$ $U = 706.5$), while users provided with tables make significantly more conditional concessions ($p = .049$ $U = 719.0$).

With regard to hypothesis H 1(e), the analysis of the main category "use tactics" shows that, supporting our hypothesis, subjects of the table group use significantly more tactics than subjects of the history graph group ($p < .001$ $U = 481.0$). Our analysis reveals that negotiators supported by tables use significantly more hard tactics ($p = .001$, $U = 516.5$) and slightly more soft tactics ($p = .057$ $U = 673.0$).

In hypothesis H 2 we predict that negotiators provided with the history graph are more likely to reach an agreement than negotiators provided with tables. To test this hypothesis we compare the agreement rate in the table and the history graph group and find only weak support for our hypotheses. Negotiators provided with the history graph reach an agreement more often than negotiators provided with tables ($p = .080$ $\chi^2 = 2.730$).

To test hypothesis H 3(a), we calculate the joint utility, i.e. the sum of the utility of both negotiators within one dyad. The results do not support our hypothesis. In contrast, the results show that subjects provided with a history graph reach outcomes with significantly lower joint utility than subjects provided with tables ($p = .015$ $U = 252.0$).

Fairness, another indicator for the quality of agreements, is measured in this study through the contract balance, i.e. the difference between the utility reached by each negotiator within one dyad. Contrary to our prediction in hypothesis H 3(b), the agreements of users provided with the history graph are significantly less fair compared to agreements reached by negotiators provided with tables ($p = .002$ $U = 204.0$). Data from the post-negotiation questionnaire show that subjects provided with the history graph perceived their partners as well as themselves to be more satisfied with the negotiation outcome than subjects provided with tables ($p = .047$ $U = 281.5$), thus supporting hypothesis H 3(c).

The following results for hypotheses H 4–6 were obtained from tests between the two groups supported with graphs but provided with different levels of information. In hypothesis H 4(a), we assume that negotiators provided with the negotiation dance graph discuss fairness more often than negotiators provided with the history graph. However, contrary to prediction, negotiators provided with the history graph put significantly more emphasis on discussing fairness than negotiators provided with the negotiation dance graph ($p < .001$ $U = 459.5$).

In hypothesis H 4(b) we predict that negotiators provided with a negotiation dance graph make more concessions compared to those provided with a history graph. We do not find a difference in overall concession behavior. However, similarly to the results for H 1(b), when looking at the most important and conflicting issue (lock out option), we find that users provided with the negotiation dance graph make more unconditional concessions ($p = .009$ $U = 599.0$). Therefore, hypothesis H 4(b) is partially supported. We find that negotiators provided with the negotiation dance graph use hard tactics significantly more often than negotiators provided with the history graph ($p = .013$ $U = 603.5$). Moreover, negotiators of the dance graph group also use significantly more soft tactics than negotiators of the history graph group ($p = .044$ $U = 660.0$). Thus, hypothesis H 4(c) is confirmed.

According to hypothesis H 5, we expect to find no difference in the number of agreements between the history graph and the negotiation dance graph groups. The data supports this hypothesis and reveals no difference between these two groups in terms of the agreement rate ($p = .595$ $\chi^2 = 0.438$).

When comparing the quality of agreements, we find that negotiators provided with the negotiation dance graph reach significantly higher joint outcomes than negotiators provided with the history graph ($p = .019$ $U = 308.0$). Therefore, hypothesis H 6(a) is supported by our data. Similarly, subjects of the negotiation dance graph group reach more balanced agreements than subjects of the history graph group ($p < .001$ $U = 220.0$), thus supporting hypothesis H 6(b). In H 6(c), we hypothesize that negotiators provided with the negotiation dance graph are more satisfied with the agreement compared to negotiators provided with the history graph. However, contrary to our prediction, we find that users of the history graph show significantly higher post-negotiation satisfaction than users of the negotiation dance graph ($p = .025$ $U = 265.0$).

7. Discussion

These results summarized in Table 4 clearly show that the presentation of information affects negotiation processes. Our data reveals overall that negotiators who have graphical support show more integrative negotiation behavior compared to negotiators who have access to the same information presented in tables. When negotiators are provided with a graphical representation of the negotiation history, they show more social support, express fewer negative emotions and talk more about fairness. They use fewer hard and soft tactics and are more often prepared to concede unconditionally when it comes to highly conflicting issues. As a consequence, this more integrative behavior has

[3] We also tested the data for differences in the distribution of communication units with regard to nationality of subjects but found no significant differences.

Table 4
Summary of results.

Treatment	Dependent	Hypothesis	Results
Type of information presentation (tables vs. history graph)	Negotiation process	H 1(a)	[a]No difference in the exchange of priority information
		H 1(b)	Graphical support leads to more social support and less negative emotions
		H 1(c)	Graphical support leads to more discussions about fairness
		H 1(d)	Graphical support leads to slightly more unconditional and less conditional concessions in the most important and conflicting issue
		H 1(e)	Graphical support leads to less use of hard and soft tactics
	No. agreements	H 2	Graphical support leads to slightly more agreements
	Quality of outcome	H 3(a)	[b]Graphical support leads to lower joint utility
		H 3(b)	[b]Graphical support leads to more unbalanced agreements
		H 3(c)	Graphical support leads to a higher post-negotiation satisfaction
Information level (history graph vs. negotiation dance graph)	Negotiation process	H 4(a)	[b]More information leads to less discussions about fairness
		H 4(b)	More information leads to more unconditional concessions in the most important and most conflicting issue
		H 4(c)	More information leads to an increased use of hard and soft tactics
	No. agreements	H 5	More information has no impact on the number of agreements
	Quality of outcome	H 6(a)	More information leads to a higher joint utility
		H 6(b)	More information leads to more balanced agreements
		H 6(c)	[b]More information leads to a lower post-negotiation satisfaction

[a] Hypothesis not confirmed.
[b] Contrary to prediction.

positive effects on negotiation outcomes: the history graph facilitates reaching an agreement. Negotiators are also significantly more satisfied with the outcome when they have access to a graphical representation of the negotiation history.

Contrary to our prediction is the finding that the quality of negotiation outcomes, in terms of contract balance (fairness) and joint utility (efficiency) is lower when negotiators are provided with the history graph compared to those provided with tables. The results indicate that negotiators provided with the history graph followed a non-compensatory strategy. Usually, non-compensatory strategies are used when decision makers face a vast amount of information and balance a strategy's accuracy against its cognitive effort [3,24].

When comparing the effects of different information levels provided by the two graphs, we find that negotiation behavior becomes tougher. If negotiators are provided with the utilities of their opponent, then the visualization of offer-ratings according to the preferences of both negotiators makes it impossible to outwit the counterpart. The high level of control of both negotiation partners may actually act as a barrier to deceive the partner. Therefore, negotiators use more hard and soft tactics to substantiate their own position. At the same time, the negotiation dance graph may act as an ex-post monitoring system. When users make a concession, they can easily see whether their counterparts reciprocate, and the dance graph reduces the risk of being exploited. We observe that negotiators provided with the negotiation dance graph offer more unconditional concessions. The effect of these differences in behavior is visible in the quality of outcomes: in contrast to the history graph, the negotiation dance graph facilitates efficient and fair agreements. Nevertheless, it does not make negotiators more satisfied. On the contrary, their holistic assessment of the negotiation outcome is significantly lower compared to the negotiators who have no access to utility values of their opponent. This can be explained by the tougher negotiation process visible through the increased use of hard tactics and by the fact that negotiators compare their individual outcome with the opponent's outcome. Even a small difference in utilities might lead to the feeling of being a loser instead of a winner (e.g. [17,37,77]).

In summary, there is no clear recommendation as to which graph support should be implemented in negotiation systems. While the history graph facilitates integrative negotiation behavior and increases the probability of agreements, it leads to less balanced and efficient agreements. The negotiation dance graph, on the other hand, facilitates efficient and fair agreements but at the same time, negotiators are less satisfied with their achievements.

In general, these results also suggest that the implementation of stylized decision aids needs to be analyzed in terms of their indirect impact on qualitative/normative aspects of negotiation processes and outcomes. While decision makers can often be supported in their search for a correct solution (e.g. recognizing trends within data by overcoming limited cognitive resources), this is not possible for negotiation problems which inherently contain perceived or real conflicting interests of the participants. In such a situation, there is no "correct" or "right" solution for the decision problem, and any support for the decision maker has to follow other criteria of optimization. For system designers two important factors of consideration are: identification of criteria which are relevant for effective negotiation support (e.g. fairness, economic efficiency, effectiveness etc.); identification of support aids (graphical or non-graphical) which have an effect on process and outcome.

Our study delivers interesting insights, but it faces some limitations. The student sample limits the generalizability of our findings. However, the use of students as subjects has become very common in negotiation research and they can be seen as a sample of future managers dealing with NSS in their upcoming careers. As subjects were not influenced by the outcomes of negotiations, perhaps they were less motivated than if they had been in real negotiations involving superiors. Furthermore, the data used in this study was retrieved from one single case, which might restrict the generalization of our results. Additionally, it is not known how differences in individual cognitive constraints or cognitive load have influenced results. Moreover, subjects did not use their native language, and different English skills might have had an impact on the discussions. Another limitation of this study is that we do not know how much the subjects referred to their information presentation tools as decision support.

Several factors that could affect negotiation process/outcomes were not investigated in this paper. First, several studies show that the level of conflict in simulation cases influences results significantly [11,53]. Conflict could be induced by varying the discussion issues and creating more integrative/conflicting bargaining settings. Users' performance could be observed by changing only external factors (in this case the bargaining situation in which negotiations are embedded). Variance in the number of issues involved in a case could also affect the end result. Another avenue of future research is the effect of additional information provided to users. The present study shows that the amount of information provided to negotiators leads to either more cooperative or more competitive behavior. Future studies should investigate the impact of different types of information implemented in different information displays. Considering the process of information gathering, future investigations also need to examine the effect of dynamic decision aids at different

stages of decision making. A particular focus should be placed on the stages in which information is acquired and in which the information is evaluated. The issue of time duration of the experiment must be taken into account [51]. The effects of additional support provided by graphical aids are often seen as a trade-off between the benefits of minimizing errors and the cognitive effort or time needed in a particular task environment [22]. In the present study, there was an imposed time deadline for all users, thus the variable time was kept constant and all impacts could be considered only with regard to proxies for the quality of decisions. Raiffa [56] argues that a negotiation resembles a dance of negotiation partners. We have demonstrated with this study that there is no straight answer to the question "Shall we dance?" Rather the results suggest that the answer depends on the partners' aims (efficiency vs. fairness) quantitative vs. qualitative outcomes (utility vs. satisfaction), to dance or to skip the dance.

Acknowledgment

This research was partly supported by the Austrian Science Fund P-21062-G14. We also want to thank the anonymous reviewers of the paper for their extensive feedback and support to improve the quality of the paper.

Appendix A

A.1. The category scheme

	Main categories	Definition	Sub categories	Detailed description	Examples
Create value	1 Make concession	Substantive negotiation behavior that constitutes a concession or an agreement of parts of an offer or agreement to an offer package.	1 Concession no. of single/double room	Make or offer a concession (compared to own previous offer)	
			2 Concession price of single/double room		
			3 Concession add. services (meals, entertainm.)		
			4 Concession lockout option		
			5 Concession cost sharing		
			6 Concession airport service		
			7 Cond. concession no. of single/ double room	Offer a conditional concession (logrolling: if - **then**)	
			8 Cond. concession price of single/ double room		
			9 Cond. concession add. services (meals, …)		
			10 Cond. concession lockout option		
			11 cond. concession cost sharing		
			12 Cond. concession airport service		
			13 Acceptance		
			14 Multi issue offer		
	2 Ask or give priority information	Statements requiring or providing information about needs or interests	1 Request priority information		May I know what your expectations are about that?
			2 Request product information		How many rooms do you have?
			3 Give priority information (attribute related preferences)		The price of the rooms is most important for me.
			4 Reveal personal information (other than attribute related)		I had a very tough meeting today and now I am tired
			5 Clarification		If you look at your last offer, you can see that
	3 Show social support	Statements that constitute emphatic communication or show positive emotions.	1 Show concern or express understanding (empathic com.)		I understand your argument.
			2 Show positive emotion (incl. thanking and humor)		It is a great pleasure for me too.
			3 Express apology or regret		I am very sorry about that.
			4 Refer to trust and relationship		For me a good relationship is very important.
			5 Express hope		We hope that you understand our position.
			6 Make off-task comments (extra role)		Can I have your email?
Claim value	4 Positional offer	Substantive negotiation behavior that constitute positional bargaining and value claiming.	1 Positional offer no. of single/ double room	Make initial offer or repeat a previous offer/position (also **if** - then)	
			2 Positional offer price of single/ double room		
			3 Positional offer add. services (meals, etc.)		

(*continued on next page*)

Appendix A1 (*continued*)

	Main categories	Definition	Sub categories	Detailed description	Examples
			4 Positional offer lockout option		
			5 Positional offer cost sharing		
			6 Positional offer airport service		
			7 Bottomline offer no. of single/ double room	Offer a concession by using a bottomline or threat	
			8 Bottomline offer price of single/ double room		
			9 Bottomline offer add. services (meal, …)		
			10 Bottomline offer lockout option		
			11 Bottomline offer cost sharing		
			12 Bottomline offer airport service		
			13 Request concession no. single/ double room	Request concession from the counterpart	
			14 Request concession price single/ double room		
			15 Request concession add. services (meal, …)		
			16 Request concession lockout option		
			17 Request concession cost sharing		
			18 Request concession airport service		
	5 Give positional information	Facts or statements intended to persuade	1 State facts about product/service/company		Our rooms have air-conditioning.
			2 Self-supporting statements		We have the best rooms in the City.
			3 Persuasive statements		Okay, I really like you and I make you a very special offer.
	6 Show negative response	Rejecting offers or showing negative emotions	1 Reject proposals, offers or suggestions		We cannot lower the price.
			2 Set conditions (not related to concrete issue)		If you accept all this …
			3 Show negative emotions or sarcasm		… but I have to say, that I'm really angry! … You cannot be serious!
	7 Use tactics and contention	Communication that is intended to influence the other party	1 Make commitments		This is my very last offer.
			2 Exert pressure		You have to decide until tonight.
			3 Make promises		In the next contract, we can offer you a better price.
			4 Suggest sequential issue negotiation		We should discuss the price first.
			5 Refer alternative suppliers/buyers		We have a better offer of a different supplier!
			6 Use authority related tactics		My boss will be very unhappy.
	8 Substantiate position	Normative statements to substantiate own position	1 Stress similarities and common ground (normative)		Our guests are also your guests and therefore …
			2 Request understanding/accommodation (normative)		Please understand that we cannot go below this price.
			3 Refer to fairness (normative)		This is a fair offer.
Process	9 Process variables	Communication related to the negotiation process or specific for text-based, computer-mediated, asynchronous communication	1 Time related or process oriented		I cannot access Internet over the weekend.
			2 System issues		Do you understand how this system works?
			3 Impersonal address, closing or signature		Yours sincerely, Playa Beach Resort
			4 Personalized address, closing or signature		I wish you a very nice evening and all the best, Playa Beach Resort.
			5 Text structuring		my offer:, etc.
			6 Redundant units and anomalies		

A.2 The steps of the experiment

References

[1] W.L. Adair, J.M. Brett, The negotiation dance: time, culture, and behavioral sequences in negotiation, Organization Science 16 (1) (2005) 33–51.
[2] M. Bazerman, M. Neale, Improving negotiation effectiveness under final offer arbitration: the role of selection and training, Journal of Applied Psychology 67 (5) (1982) 543–548.
[3] L.R. Beach, T.R. Mitchell, A contingency model for the selection of decision strategies, Academy of Management 3 (3) (1978) 439–449.
[4] V. Beattie, M. Jones, Measurement distortion of graphs in corporate reports: an experimental study, Accounting Auditing and Accountability Journal 15 (4) (2002) 546–564.
[5] I. Benbasat, A. Dexter, An experimental evaluation of graphical and color-enhanced information presentation, Management Science 31 (11) (1985) 1348–1364.
[6] I. Benbasat, R. Schroeder, An experimental investigation of some MIS design variables, MIS Quarterly 1 (1) (1977) 37–49.
[7] G. Beroggi, An experimental investigation of virtual negotiations with dynamic plots, Group Decision and Negotiation 9 (5) (2000) 415–429.
[8] J. Bierstaker, R. Brody, Presentation format, relevant experience and task performance, Managerial Auditing Journal 16 (3) (2001) 124–128.
[9] N. Buchan, R. Croson, E. Johnson, When do fair beliefs influence bargaining behavior? Experimental bargaining in Japan and the United States, Journal of Consumer Policy 31 (1) (2004) 181–190.
[10] C. De Dreu, L. Weingart, S. Kwon, Influence of social motives on integrative negotiation: a meta-analytic review and test of two theories, Journal of Personality and Social Psychology 78 (5) (2000) 889–905.
[11] M.M. Delaney, A. Foroughi, W.C. Perkins, An empirical study of the efficacy of a computerized negotiation support system (NSS), Decision Support Systems 20 (3) (1997) 185–197.
[12] G. Dickson, G. DeSanctis, D.J. McBride, Understanding the effectiveness of computer graphics for decision support: a cumulative experimental approach, Communications of the ACM 29 (1) (1986) 40–47.
[13] W. Dilla, P.J. Steinbart, Using information display characteristics to provide decision guidance in a choice task under conditions of strict uncertainty, Journal of Information Systems 19 (2) (2005) 29–55.
[14] W. Dilla, D. Stone, Representations as decision aids: the asymmetric effect of words and numbers on auditors' inherent risk judgement, Decision Sciences 28 (2) (1997) 709–743.
[15] A. Foroughi, Minimizing negotiation process losses with computerized negotiation support systems, Journal of Applied Business Research 14 (4) (1998) 15–26.
[16] A. Foroughi, W. Perkins, L. Jessup, A comparison of audio-conferencing and computer conferencing in a dispersed negotiation setting: efficiency matters! Journal of Organizational and End User Computing 17 (3) (2005) 1–26.
[17] A. Foroughi, W.C. Perkins, M.T. Jelassi, An empirical study of an interactive, session-oriented computerized negotiation support system (NSS), Group Decision and Negotiation 4 (6) (1995) 485–512.
[18] E. Garbarino, J. Edell, Cognitive effort, affect, and choice, Journal of Consumer Research 24 (2) (1997) 147–158.
[19] N.G. Hall, A cognitively based taxonomy of fuzzy decision support systems, First International Joint Conference of the North American Fuzzy Information Processing Society Biannual Conference, San Antonio, USA, 1994, pp. 157–158.
[20] Z. Huang, H. Chen, F. Guo, J.J. Xu, S. Wu, W.-H. Chen, Expertise visualization: an implementation and study based on cognitive fit theory, Decision Support Systems 42 (3) (2006) 1539–1557.
[21] G. Hubona, S. Everett, E. Marsh, K. Wauchope, Mental representations of spatial language, International Journal of Human Computer Studies 48 (6) (1998) 705–728.
[22] S. Jarvenpaa, The effect of task demand and graphical format on information processing strategies, Management Science 35 (3) (1989) 285–303.
[23] C. Joensson, Cognitive theory, in: V. Kremenyuk (Ed.), International Negotiation — Analysis, Approaches, Issues, Jossey-Bass, San Francisco, 2002, pp. 270–287.
[24] E. Johnson, J. Payne, Effort and accuracy in choice, Management Science 31 (4) (1985) 395–414.
[25] S.S. Kahai, R.B. Cooper, The effect of computer-mediated communication on agreement and acceptance, Journal of Management Information Systems 16 (1) (1999) 165–188.
[26] G.E. Kersten, E-negotiation systems: interaction of people and technologies to resolve conflicts, UNESCAP Third Annual Forum on Online Dispute Resolution, 2004.
[27] G.E. Kersten, S.J. Noronha, Negotiations via the world wide web: a cross-cultural study of decision making, Group Decision and Negotiation 8 (3) (1999) 251–279.
[28] V. Khatri, I. Vessey, S. Ram, V. Ramesh, Cognitive fit between conceptual schemas and internal problem presentations: the case of geospatio-temporal conceptual schema comprehension, IEEE Transactions on Professional Communication 49 (2) (2006) 109–127.
[29] S.S. Komorito, Concession-making and conflict resolution, Journal of Conflict Resolution 17 (4) (1973) 745–763.
[30] K. Krippendorf, On the reliability of unitizing continuous data, Sociological Methodology 25 (1995) 47–76.
[31] M. Lalomia, M. Coovert, A comparison of tabular and graphical displays in four problem-solving domains, SIGCHI Bulletin 19 (2) (1987) 49–54.
[32] M. Lalomia, M. Coovert, E. Salas, Problem solving performance and display preference for information displays depicting numerical functions, SIGCHI Bulletin 20 (2) (1988) 47–51.
[33] P.V. Lange, The pursuit of joint outcome and equality in outcomes: an integrative model of social value orientation, Journal of Personality and Social Psychology 77 (2) (1999) 337–349.
[34] J. Larkin, H. Simon, Why a diagram is (sometimes) worth ten thousand words, Cognitive Science 11 (1) (1987) 65–100.
[35] S. Lewandowsky, I. Spence, Discriminating strata in scatterplots, Journal of the American Statistical Association 84 (407) (1989) 682–688.
[36] M. Liberatore, A. Stylianou, Expert support systems for new product development decision making: a modeling framework and applications, Management Science 41 (8) (1995) 1296–1316.
[37] J. Lim, Y.P. Yang, Enhancing negotiators' performance with computer support for pre-negotiation preparation and negotiation: an experimental investigation an East Asian context, Journal of Global Management 15 (1) (2007) 18–42.
[38] L.-H. Lim, I. Benbasat, A theoretical perspective of negotiation support systems, Journal of Management Information Systems 9 (3) (1992–93) 27–44.
[39] M. Lombard, J. Snyder-Duch, C.C. Bracken, Content analysis in mass communication: assessment and reporting of intercoder reliability, Human Communication Research 28 (4) (2002) 587–604.
[40] H. Lucas, An experimental investigation of the use of computer-based graphics in decision making, Management Science 27 (7) (1981) 757–768.
[41] H. Lucas, N. Nielson, The impact of the mode of information presentation on learning and performance, Management Science 26 (10) (1980) 982–993.
[42] N. Lurie, C. Mason, Visual representation: implications for decision making, Journal of Marketing 71 (1) (2007) 160–177.
[43] A. Massey, W. Wallace, Understanding and facilitating group problem structuring and formulation: mental representations, interaction, and representation aids, Decision Support Systems 17 (4) (1996) 253–274.
[44] J. Meyer, D. Shinar, D. Leiser, Multiple factors that determine performance with tables and graphs, Human Factors 39 (2) (1997) 268–286.
[45] A. Montazemi, S. Wang, The effects of modes of information presentation on decision-making: a review and meta-analysis, Journal of Management Information Systems 5 (9) (1988–1989) 101–127.
[46] M. Neale, M. Bazerman, The effects of framing and negotiator overconfidence on bargaining behaviors and outcomes, The Academy of Management Journal 28 (1) (1985) 34–49.
[47] J. Oetzel, S. Ting-Toomey, Face concerns in interpersonal conflict: a cross-cultural empirical test of the face negotiation theory, Communication Research 30 (6) (2003) 599–624.
[48] A. Paivio, Imagery and Verbal Processing, Holt, Rinehart and Winston, Inc., New York, NY, 1971.
[49] A. Paivio, Images in Mind: The Evolution of a Theory, Harvester Wheatsheaf, New York, NY, 1991.
[50] A. Paivio, Dual coding theory: retrospect and current status, Canadian Journal of Psychology 45 (3) (1991) 255–287.
[51] S. Paul, D.L. Nazareth, Input information complexity, perceived time pressure, and information processing in GSS-based work groups: an experimental investigation using a decision schema to alleviate information overload conditions, Decision Support Systems 49 (1) (2010) 31–40.
[52] Y. Peng, Y. Zhang, Y. Yuang, S. Li, An incident information management framework based on data integration, data mining, and multi-criteria decision making, Decision Support Systems 51 (2) (2011) 316–327.
[53] W.C. Perkins, J.C. Hershauer, A. Foroughi, M.M. Delaney, Can a negotiation support system help a purchasing manager? International Journal of Purchasing and Materials Management 32 (2) (1996) 37–45.
[54] M. Pillutla, J.K. Murnighan, Being fair or appearing fair: strategic behavior in ultimatum bargaining, The Academy of Management Journal 38 (5) (1995) 1408–1426.
[55] L.L. Putnam, T.S. Jones, Reciprocity in negotiations: an analysis of bargaining interaction, Communication Monographs 49 (3) (1982) 171–191.
[56] H. Raiffa, The Art and Science of Negotiation, Harvard University Press, Cambridge, MA, 1982.
[57] A. Rangaswamy, G.R. Shell, Using computers to realize joint gains in negotiations: towards an "Electronic bargaining table", Management Science 43 (8) (1997) 1147–1163.
[58] W. Remus, A study of graphical and tabular displays and their interaction with environmental complexity, Management Science 33 (9) (1987) 1200–1204.
[59] D. Robinson, K. Kiewra, Visual argument: graphic organizers are superior to outlines in improving learning from text, Journal of Education and Psychology 87 (3) (1995) 455–467.
[60] A. Roth, J.K. Murnighan, The role of information in bargaining: an experimental study, Econometrica 50 (5) (1982) 1123–1142.
[61] J.E. Russo, P. Schoemacker, Managing overconfidence, Sloan Management Review 33 (2) (1992) 7–17.
[62] M. Schoop, Support of complex electronic negotiation, in: D.M. Kilgour, C. Eden (Eds.), Handbook of Group Decision and Negotiation, Springer, 2010, pp. 409–423.
[63] M. Schoop, A. Jertila, T. List, Negoisst: a negotiation support system for electronic business-to-business negotiations in e-commerce, Data and Knowledge Engineering 47 (3) (2003) 371–401.
[64] M. Schoop, S. Koeszegi, F. Koehne, K. Ostertag, D. Staskiewicz, Process visualisation in electronic negotiations: an experimental exploration, Group Decision and Negotiation Conference, 2007, pp. 128–130.
[65] H. Schroder, M. Driver, S. Streufert, Human Information Processing, Holt, Rinehart and Winston, New York, 1967.
[66] J.K. Sebenius, Negotiation analysis: a characterization and review, Management Science 38 (1) (1992) 18–38.
[67] P. Shah, J. Hoeffner, Review of graph comprehension research: implications for instruction, Educational Psychology Review 14 (1) (2002) 47–69.
[68] J. Smelcer, E. Carmel, The effectiveness of different representations for managerial problem solving: comparing tables and maps, Decision Sciences 28 (2) (1997) 391–420.

[69] B. Spector, Negotiation as a psychological process, The Journal of Conflict Resolution 21 (4) (1977) 607–618.
[70] C. Speier, The influence of information presentation formats on complex task decision-making performance, International Journal of Human Computer Studies 64 (11) (2006) 1115–1131.
[71] C. Speier, M. Morris, The influence of query interface design on decision-making performance, MIS Quarterly 27 (3) (2003) 397–423.
[72] C. Speier, J. Valacich, I. Vessey, The influence of task interruption on individual decision making: an information overload perspective, Decision Sciences 30 (2) (1999) 337–360.
[73] K.J. Srnka, S.T. Koeszegi, From words to numbers — how to transform rich qualitative data into meaningful quantitative results: guidelines and exemplary study, Schmalenbach's Business Review 59 (1) (2007) 29–57.
[74] M. Stroebel, C. Weinhardt, The Montreal taxonomy for electronic negotiations, Group Decision and Negotiation 12 (2) (2003) 143–164.
[75] R. Swaab, T. Postmes, P. Neijens, Negotiation support systems: communication and information as antecedents of negotiation settlement, International Negotiation 6 (1) (2004) 59–78.
[76] N. Tractinsky, J. Meyer, Chartjunk or goldgraph? Effects of presentation objectives and content desirability on information presentation, MIS Quarterly 23 (3) (1999) 397–420.
[77] N. Umanath, R. Scamell, An experimental evaluation of the impact of data display format on recall performance, Communications of the ACM 31 (5) (1988) 562–570.
[78] N. Umanath, I. Vessey, Multiattribute data presentation and human judgement: a cognitive fit perspective, Decision Sciences 25 (5–6) (1994) 795–824.
[79] I. Vessey, Cognitive fit: a theory-based analysis of the graphs versus tables literature, Decision Sciences 22 (2) (1991) 219–240.
[80] I. Vessey, D. Galletta, Cognitive fit: an empirical study of information acquisition, Information Systems Research 2 (1) (1991) 63–84.
[81] R. Vetschera, Preference structures and negotiator behavior in electronic negotiations, Decision Support Systems 44 (1) (2007) 135–146.
[82] M. Weber, G. Kersten, M. Hine, Visualization in e-negotiations: an inspire ENS graph is worth 334 words, on average, Electronic Markets 16 (3) (2006) 186–200.
[83] L.R. Weingart, E.B. Hyder, M.J. Prietula, Knowledge matters: the effect of tactical descriptions on negotiation behavior and outcome, Journal of Personality and Social Psychology 70 (6) (1996) 1205–1217.
[84] L.R. Weingart, M. Olekalns, P.L. Smith, Quantitative coding of negotiation behavior, International Negotiation 9 (3) (2004) 441–455.
[85] L.R. Weingart, L.L. Thompson, M.H. Bazerman, J.S. Carroll, Tactical behavior and negotiation outcomes, International Journal of Conflict Management 1 (1) (1990) 7–31.
[86] W. Zachary, A cognitively based functional taxonomy of decision support techniques, Human–Computer Interaction 2 (1) (1986) 25–63.
[87] R. Zwick, X.-P. Chen, What price fairness? A bargaining study, Management Science 45 (6) (1999) 804–823.

Johannes Gettinger is a research assistant at the Vienna University of Technology, Austria. He holds a master's degree in International Business Administration from his studies at the University of Vienna and the University of Bologna. His research focus is on conflict resolution, in particular electronically supported decision-making and negotiation, decision as well as negotiation support systems, and the role of information in decision-making and negotiation.

Sabine T. Koeszegi is Full Professor at the Institute of Management Science at the Vienna University of Technology. In 2000 she received her PhD in Economics and Social Sciences at the University of Vienna and had several international visiting positions including the National Sun Yat-sen University in Taiwan, the Max-Planck-Institute for the Study of Societies in Cologne, and the University of Ottawa. Her current research focus is electronic negotiation support including intercultural and emotional aspects as well as the management of conflict and diversity in organizations.

Mareike Schoop is Full Professor of Information Systems at the University of Hohenheim and a Visiting Professor at the Vienna University of Technology. She received her PhD in Computer Science from the University of Manchester, UK, and her Habilitation from Aachen University of Technology. Her research areas include negotiation support systems, organizational communication, interorganizational systems, and web usage mining.