AN EMPIRICAL EVALUATION OF AN AGENT-SUPPORTED ELECTRONIC NEGOTIATION SYSTEM

Zhen Feng

A Thesis
In
The John Molson School of Business

Presented in Partial Fulfilment of the Requirements
for the Degree of Master of Science in Administration (MIS) at
Concordia University
Montreal, Quebec, Canada

February 2005

Your file Votre référence
ISBN: 0-494-04473-X
Our file Notre référence
ISBN: 0-494-04473-X

ABSTRACT

An Empirical Evaluation of
an Agent-Supported Electronic Negotiation System

Zhen Feng

Agent technologies promise to have positive impact on conducting electronic negotiations. In particular, agents can help the negotiating parties to express their preferences and desired negotiation strategies, assist in generating promising offers, evaluate incoming offers and "watch over the shoulder" of the user to ensure that he or she makes offers in accordance with the objectives/preferences specified.

The focus of this work is on empirical investigation of the value of agent support to the negotiators in conducting electronic negotiations. To this end, an agent-enhanced e-negotiation system "eAgora" has been used. In this system, an intelligent agent is used in an advisory mode to inform the negotiating parties about different aspects of on-going negotiations. The experiments have been conducted involving subjects with and without agent support for simple and complex negotiation tasks. The results suggest that, agent-supported negotiations have a positive impact in terms of user satisfaction with the negotiation process and outcome, perceived usefulness and ease of use of the system, confidence in the negotiation outcome, and negotiation outcome.

Acknowledgments

I would like to take this opportunity to thank Dr. Vahidov for the encouragement and expertise provided in my thesis effort. My gratitude also extends to Dr. Kersten and Dr. Laframboise whose guidance and feedback helped me in improving the quality of this work. I feel honored to have them on my thesis committee.

I would also like to thank Eva Chen for providing a prototype e-negotiation system that enabled me to work on my thesis. My special thanks go to my friends, Frank, Linda and Steven for the support to my project. And, finally to Catherine, my wife, whose constant encouragement and support provided me with confidence to complete this work.

Table of Contents

LIST OF FIGURES

LIST OF TABLES

1. Introduction

The emergence of the Internet and the World Wide Web as a medium of communication and trade has the potential to revolutionize many aspects of business and create opportunities previously nonexistent in physical markets. It allows, for instance, creation of new goods and services (information and digital goods) and new business models within virtual marketplaces (e.g. eBay, Amazon.com). Moreover, electronic commerce has the capacity to benefit both the buyers and sellers, through the introduction of digital intermediaries entrusted with the coordination of interactions between the respective parties (Chircu and Kauffman, 2001).

Search sites such as Yahoo or Altavista enable users to conduct keyword searches of extensive databases. Shopbots and intelligent agents that automatically gather information from multiple online vendors with regard to prices and various product attributes, also facilitate the otherwise time-consuming and strenuous shopping process (Greenwald and Kephart, 1999).

The employment of emerging technologies within the digital economy enables customers to conduct transactions on their own terms, which in turn endows them with a sense of empowerment (MacDonald and Tobin, 1998). Intelligent agent, a software program that runs automatically, continuously, and proactively in a computer environment, has the potential to drastically transform consumer behaviors, as shoppers become increasingly selective, better informed and more assertive. The end result of all these developments is

the emergence of a better informed buyer community. According to Maes, Guttman, et al. (1999), agent technologies can be applied to each stage of the consumer's buying behavior model. In particular, agents can represent their users in the negotiation stage in order to assist their users in making sound decisions. ASPIRE, a web-based support negotiation system proposed by Kersten and Lo (2003), employed a software agent, which offered support to negotiating parties. Vahidov and Elrod (1999) proposed use of critiquing agents within the framework of active decision support. A similar concept was also applied in developing eAgora (Chen, Kersten, et al., 2004), an agent-supported negotiation system.

Although the above technologies (electronic auctions, shopbots, e-negotiation systems, etc.) proliferate, many potential users may fail to use them despite the numerous potential advantages they offer. This could be partially due to security and privacy concerns related to payment mechanisms, inherent within electronic commerce (Crowston and MacInnes, 2000). However, this could possibly be related to the unawareness of either the existence of the technology or the benefits that these tools can provide.

This thesis will evaluate the effectiveness of the agent-supported negotiation system-eAgora. It includes the following sections: 1) literature review, including negotiations and negotiation analysis; negotiation support systems; intelligent agents; agent-based automated systems and agent supported negotiation systems; 2) research methodology, including predefined user acceptance variables and their definitions, proposed model and

hypotheses; 3) results consisting of experimental design and data analysis, and 4) conclusions and discussions.

2. Literature Review

This section serves to provide some of the current research that has been published on the negotiations, negotiation systems, and intelligent agents. The fundamentals of the following research highlight early evolution of the various negotiation support systems (NSS) and the integration of intelligent agents into the electronic negotiation process.

2.1. Negotiation and Negotiation Analysis

2.1.1. Definitions of Negotiation

The Wiser Negotiation (1998) defined negotiation as persuading activity for the opposite sides when they disagree with each other. It is a process of bargaining and does not necessarily lead to final agreement.

Other researches (Lewicki, Saunders, et al., 1997; Raiffa, 1998; Thompson, 1998) further defined negotiation as a decision making process by which the involved parties communicate ideas and exchange offers in order to minimize the initial difference in preferences.

Beam and Segev (1998) also defined negotiation in the electronic commerce environment as the process by which two or more parties multilaterally bargain resources for mutual intended gain, using the tools and techniques of electronic commerce. According to Beam and Segev, negotiation using email is not considered as negotiation in e-commerce,

however the electronic negotiation between two software agents with the result presented to their users (principals) is.

2.1.2. Negotiation Analysis

As a matter of fact, negotiation is a main activity of our lives. Even though negotiation has been a main element in commerce, negotiation has been studied extensively in many other fields such as psychology, sociology, anthropology and the economy (Chen, Kersten, et al., 2004). Bazerman et al. (2000) and Raiffa, Richardson, et al. (2003) presented negotiation that mainly covers the negotiation phases, processes and critical factors, whereas Young (1991) stressed the importance of planning and preparation before negotiations. Young also pointed that in order to determine whether a settlement proposal is good or bad or whether litigation really is the client's best alternative to a negotiated agreement, determination of an expected value of the outcome is needed. This expected value may serve as a proxy for utility index (Thompson, 1998) in partially evaluating gains or losses during negotiation.

Several types of negotiation have been proposed by Chen, Kersten, et al. (2004), based on the characteristics of negotiations (Table 1)

Characteristics	*Descriptions*	*References*
Issues	Negotiation focuses on single issue (for example, price only) or multi-issue	(Bui et al. 2001)
Number of parties involved	Bi-lateral or multi-lateral	(Thompson, 1998)
Approaches of negotiation	Competitive or cooperative	(Strobel, 1999)
Technology	Web-based NSS, agent-supported system, etc	(Kersten, 2002; Chen, Kersten, et al., 2004)

Table 1: Types of negotiation *(Adopted from Chen, Kersten, et al., 2004)*

Strobel (1999) in his study further differentiated negotiations from auctions by arguing that negotiation bargaining focuses on multi-issues and is bilateral, while auctioning focuses on a single-issue and is multilateral. The traditional "win-loss" situation has been gradually replaced by "win-win" in business negotiation, which has led to cooperative negotiation becoming the preferable mode for commerce activities. This implies that, in e-commerce both the sellers and buyers would be better off if they can agree upon mutually beneficial deals. This potential for "win-win" outcomes within the electronic marketplace (eBay, Kasbah, Tete-a-Tete) can provide buyers and sellers with a new approach to conducting business transactions.

2.2. Negotiation Support Systems

The availability of electronic commerce systems on the Internet further increases the demand for negotiation support in the context of deal making. Auction systems have been a focus of research in e-commerce and e-markets for years (Kumar and Feldman, 1998). E-market systems (e.g. eBay, YahooAuction, and AmasonAuction) that enable buyers and sellers to make transactions have been widely used and earned awareness from the wide community of users. Other systems such as Kasbah and Tete-a-Tete, provide individual buyers and sellers with a more advanced negotiation capabilities. They allow users to use software agents to negotiate on their behalf (Guttman, Moukas, et al., 1998; Maes, Guttman, et al., 1999). Nevertheless, while popular, these online auction systems are limited in that they permit negotiation only along a single dimension, most typically, the price (Beam, Segev, et al., 1999).

Real life negotiations often involve joint search for an agreement on multiple issues of products and services. For example, some merchants do not want their potential buyers to evaluate their products based on price only. They are in fact offering a whole package of products and/or services that may involve many other issues, in addition to price. For instance, auto dealers negotiate such issues as price, warranty policy, delivery date; real estate agents negotiate with buyers on the selling price, delivery date, additional work and arrangements, etc. As the e-markets, e-commerce systems and the products and services offered become more sophisticated, both users and buyers could need support in

evaluating the variety of options while having to cope with the information overload, in order to make decisions effectively and efficiently.

Furthermore, human negotiators (especially novices) could make mistakes or ignore important elements in all stages of their negotiations from time to time (Fig. 1). Potential errors that could cause substantial negative results may be avoided with the emerging of negotiation support technologies (Chen, Kersten, et al., 2004).

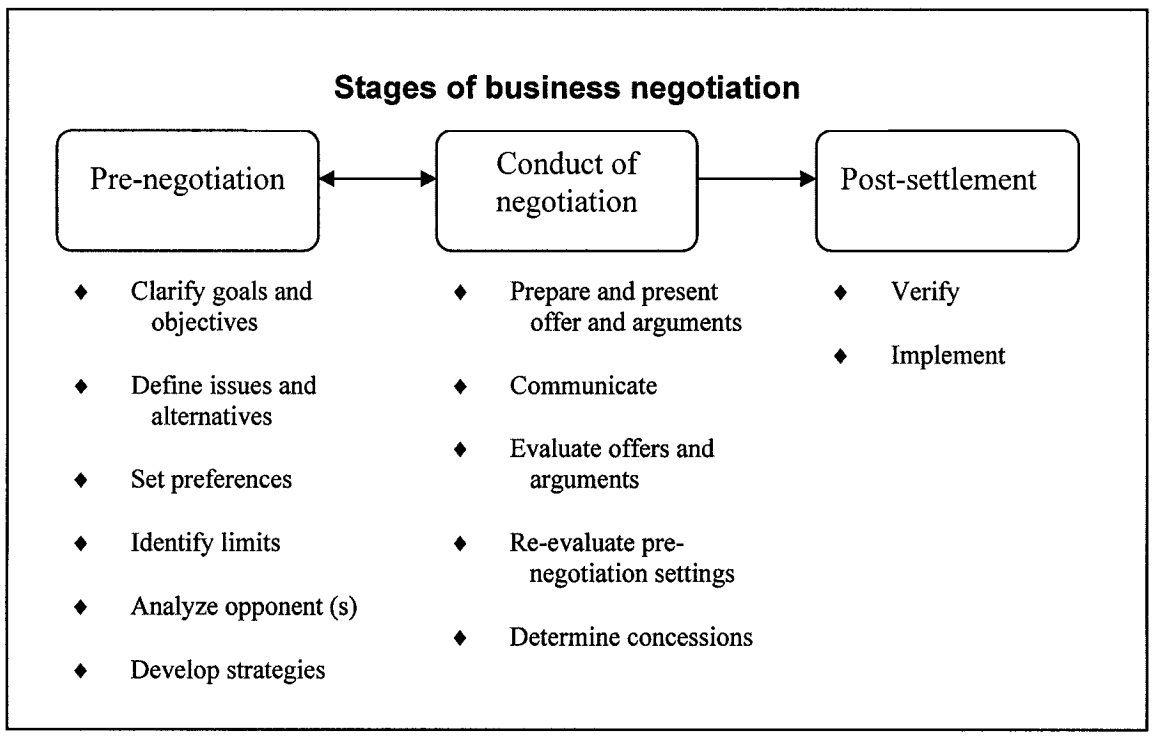


Figure 1: Tasks in business negotiation stages *(Adopted from Chen, Kersten, et al., 2004)*

A number of researchers (Kersten et al. 2000; Schoop and Quix, 2001) further concluded in their studies that the negotiation system could be accepted as an effective mechanism in preparing and conducting negotiations. INSPIRE system was initially developed and proved successful as a Web-based NSS to negotiators, by supporting the three stages of business negotiations (Kersten and Noronha, 1999). The system has analytical capabilities of extracting and modelling users' preferences, evaluating offers in terms of those preferences and automatically entering into the post-settlement phase to generate potentially attractive agreement, if it suspected that the compromise between the user and his/her opponent might not have been the optimal one (Kersten et al, 2000).

2.3. Intelligent Agents

2.3.1. Agents and their applications

Intelligent agents are a promising area of research that has emerged recently (Franklin and Graesser, 1996; Maes, 1995; Nwana and Ndumu, 1998).

Intelligent agents could be described based on the most important features that have been mentioned by Wooldridge and Jennings (1995). They stated that any computer software that possesses properties of autonomy, reactivity, proactiveness, and social ability can be regarded as an "agent". These features enable agents to be used in a variety of applications, ranging from small individual systems such as proactive email and news filtering to large industrial critical systems such as process control, manufacturing and traffic control systems (Maes, 1994; Jennings and Wooldridge, 1995).

2.3.2. Types of agents

The following provides an overview of different types of agents as represented by various researchers.

Based on the functionalities and architectural attributes, Schubert, Zarnekow, et al. (1998) in their study categorized software agents into information, co-operation and transaction agents.

> *Information agents* obtain information from the Internet by applying filtering, in accordance with the generated preference structure of their users. Example applications include email filtering (Maes, 1994), meeting scheduling (Nwana, Lee, et al. 1997) and news groups article collecting (Casasola and Gauch, 1995). These agents are sometimes called personal agents (Lai and Yang, 1998; Lashkari, Metral, et al. 1994)
>
> *Co-operation agents* synchronize, share and communicate users' preferences. (Jennings, 1995)
>
> *Transaction agents* are used to perform negotiation and settlement phases of electronic commerce (Schmid and Lindemann, 1998)

Collections of agents that need to interact with other agents to carry out tasks on behalf of their users in a coordinated fashion are described as multi-agent systems (MAS). These may work in a variety of situations including competition, collaboration, or coordination

in order to pursue their objectives in the interests of their users (Nwana, Lee, et al., 1997). The MAS free or partially free their users from involving themselves in routine activities. Sycara et al. (1997) studied information agents especially in a World Wide Web environment by focusing on the behaviors of information agents, such as advertising, message polling, information monitoring, query answering, etc.

Living in an information age, we are fed with rich and diversified information in our daily lives. This information is generated from a variety of data that is often not structured or organized (raw data). However, even if these data are processed and turned into useful information, human beings find it difficult to digest such huge volumes. Hence, there is a need for effective tools to help human decision makers filter this information in order to effectively and efficiently support decision processes.

2.3.3. Agents and e-commerce

One of the most promising applications of agent technology is the role that agents could play in electronic commerce. Agents can act as mediators in e-commerce (Maes, Guttman, et al., 1999). For example in Kasbah, users create their own agents, assign them tasks and let them negotiate with their opponents' agents. By doing so, the most important phases of the business transaction, information search and negotiation, are automated.

This task delegation was also addressed by Jennings and Wooldridge (1997). They further emphasized that agents could perform broad types of behaviors in terms of task

sophistication, the highest level being the ability of the agent to volunteer information or services to its users without being asked.

Vahidov and Elrod (1999) found that critiquing is an important activity that could be delegated to agents. In eAgora e-negotiation system (Chen, Kersten, et al., 2004), agents not only generate proposals but also provide critiques to users' negotiation exchanges. This function of agent support alerts users to remain on track, with their objectives and preferences.

Nevertheless, Chavez, Dreilinger, et al. (1997) argued that the role of agents should be limited to mediators in electronic commerce, meaning that in other stages of the consumer's buying model, agent involvement may cause user's frustration, and thus would inhibit user's acceptance of agents, whereas Kersten and Lo (2003) proposed in a recent study that agents could provide assistance to users in their negotiation activities.

2.4. Agent-based Automated Negotiation

Figure 2 schematically represents the place of agents within the electronic negotiation environment. Agent technologies have been previously applied in Web-based Negotiation Support System and Automated Negotiation.

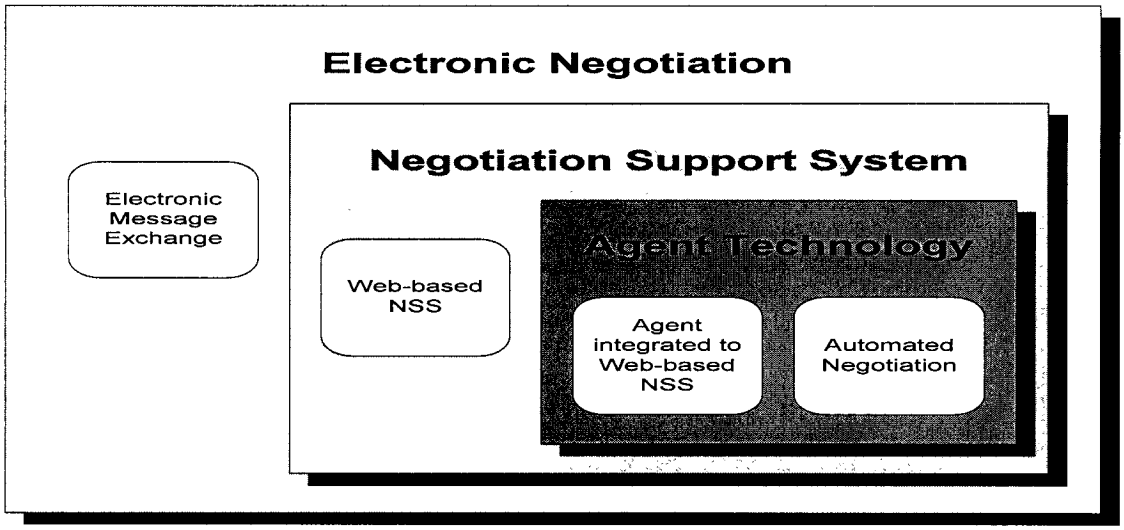


Figure 2: Electronic negotiation technologies (*Adopted from Chen, Kersten, et al., 2004)*

Automated negotiation, by definition, means that the negotiation process is conducted autonomously. This automation was made possible by employing agent technology with little or no human interaction in the process. The multi agent system (MAS) discussed in the previous section frees its users form involving themselves in the negotiation, i.e. the agents interact with each other, to complete the transactions. Some researchers on MAS such as Jennings and Wooldridge (1998) argued that MAS is ideal in combining intelligent agent technology with e-negotiations. The agents' roles as mediators

	Persona Logic	Firefly	Bargain Finder	Jango	Kasbah	Auction Bot	Tete-a-Tete
1. Need Identification	Only a few primitive event-alerting tools (e.g., Amazon.com's "Eyes" program) help anticipate consumers' needs and provide paths into the subsequent CBB stages. However, systems like Firefly can alert a consumer with product recommendations when consumers with similar interests purchase specific products.						
2. Product Brokering	X	X		X			X
3. Merchant Brokering			X	X	X		X
4. Negotiation					X	X	X
5. Purchase and Delivery	Post-purchase evaluation usually includes feedback about two distinct elements of the shopping process: product brokering and merchant brokering. Traditionally, customer remarks are accessible (and used) by either the marketing staff of manufacturers or the customer satisfaction staff of merchants. However, agent-based distributed trust and reputation mechanisms (like Kasbah's Better Business Bureau) enable customers to share and combine their experiences and use merchant and product reputations as additional aspects of brokering and negotiation.						
6. Product Service & Eval.							

Figure 3. Roles and Examples of Agents as Mediators in Electronic Commerce *(Adopted from Guttman, Moukas, et al., 1998)*

in e-commerce were studied, based on the Consumer Buying Behavior Model, i.e. in the three important stages of a user's buying behavior 1) product brokering 2) merchant brokering 3) negotiation (Guttman, Moukas, et al., 1998). They argued that the agent-based system would be best applied in the digital world, as opposed to in the traditional marketplace, where a greater physical presence is typically required, such as an auction house. Kasbah and Tete-a-Tete are the two most notable examples to emerge in MAS during e-negotiation (Fig.3). Guttman, Moukas, et al., (1998) also anticipated that, as software agent technologies were becoming more mature, they would be capable of better understanding and managing ambiguous content, personalized preferences, complex goals, changing environments and disconnected parties.

Guilfoyle (1995) predicted in his paper, that "in 10 years time most new IT development will be affected, and many consumer products will contain embedded agent-based

systems". In addition to the Kasbah marketplace mentioned earlier, Tsvetovat, Gini, et al., (1997) have developed MAGMA, an agent-based virtual market (the currently called B2B agent-based marketplace) designed to enable simulations of actual markets. Though slightly different, both systems yield positive feedback from participants who joined the negotiations.

2.5. *Agent-supported Negotiation Systems*

Early research, on negotiation support, can be traced back to the end of the 1980s (Kersten, 1987; Jelassi and Foroughi, 1989). These systems included analytical tools as well as communication channels to facilitate negotiations. Use of agents in e-negotiation systems had initially focused on automating negotiations. However, for most business negotiations, total automation may not be feasible or adequate. Thus for many business negotiations agents could provide informative support, rather than automation (Chen, Kersten, et al., 2004).

Successful implementations of web-based negotiation support systems appeared by the late 1990s when INSPIRE, a web-based support negotiation system was developed (Kersten and Noronha, 1999). INSPIRE provides a platform with analytical tools to enable e-negotiations, however, it by itself does not involve an agent. ASPIRE, the agent-augmented version of INSPIRE proposed by Kersten and Lo (2003) combines analytical support tools with software agents to provide advice to negotiators. However, rather than implemented for business purpose, this system was mainly used for educational purposes, and as a research prototype with rather limited capabilities. Thus,

there was a need to further develop functionality of ASPIRE to achieve a better fit with in the requirements of business environments.

eAgora

eAgora, an e-marketplace developed by Eva Chen as part of her M.Sc. thesis (2003), implemented using the Fusebox development methodology, provides a high level of modularity and flexibility, thereby enabling users to negotiate with or without agent support. It allows negotiating parties to employ an agent as an advisor in the process of negotiation. Prior to negotiation, users provide their preferences and assign weights to the negotiated issues. When performing online negotiations, users keep receiving proposals generated by agents to assist offer making. When users receive incoming offers, the agent evaluates the offers and provides critical comments to the users, for example, "You should accept this offer because the utility you obtained is as high as, or higher than you expected", or "You should reject this offer because you get negative utility" (Eva Chen, 2003). These comments are based upon the preferences and weights of the negotiated issues. Furthermore, the agent also generates a number of promising proposals, based on the users' negotiation strategy and opponent's counter-offer, enabling the users to consider these proposals prior to submitting an offer. These proposals contain a combination of issues that maximize users' utilities subject to concession levels calculated according to users' strategies (Fig. 5). With these proposal alternatives, the negotiating parties will save time and effort in making offers, especially while executing complex negotiation tasks involving many issues.

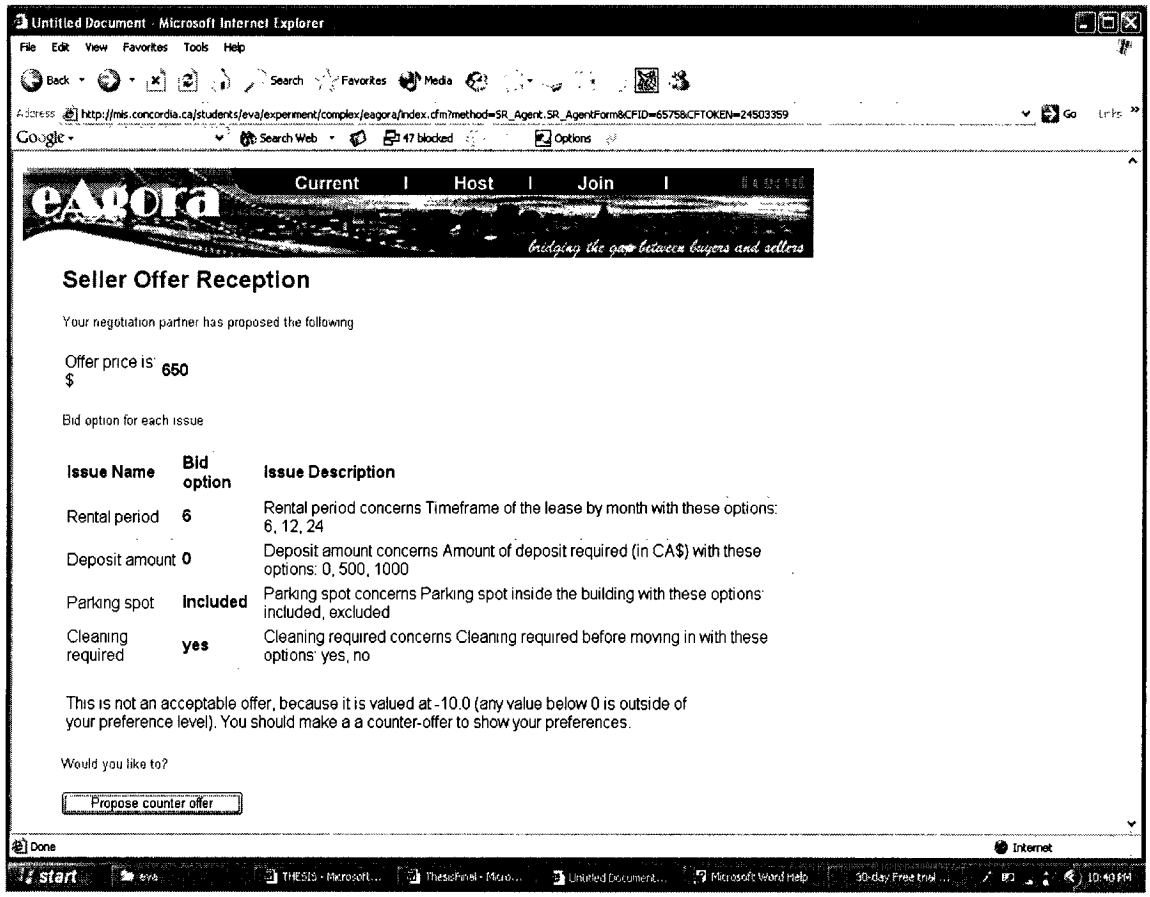


Figure 4. Comment provided by agent (screenshot)

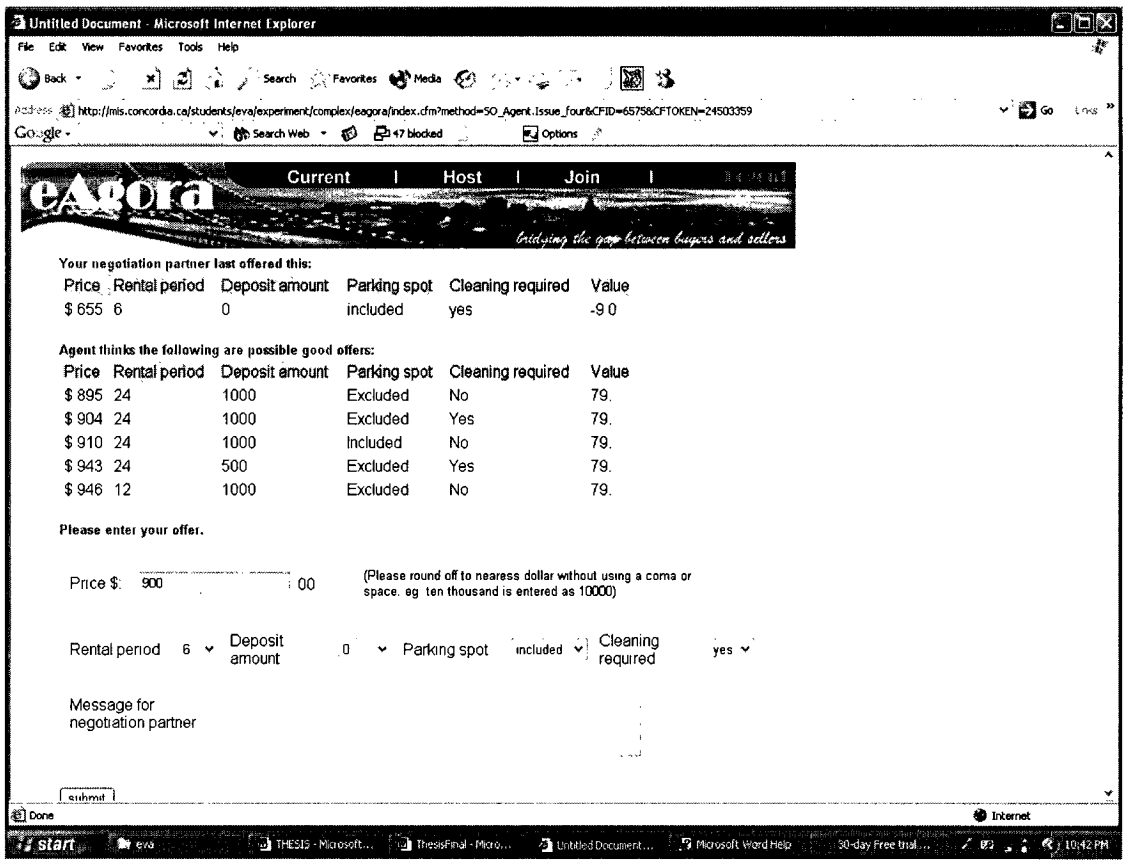


Figure 5. Proposals generated by agent (screenshot)

The previously done pilot test of eAgora indicated that the participants were in favor of employing eAgora to buy or sell products over the Web (Chen, Kersten, et al., 2004). In addition, they also responded that the agents provided useful advice and suggestions during their negotiations. Most individuals said that they would use the agent in future negotiations. Therefore, eAgora was considered useful in online multi-issue negotiation, although there was a lack of solid empirical evidence.

3. Research Methodology

3.1. Research Objectives

This research aims at investigating the effectiveness of agent-supported e-negotiations. The agent-enhanced system used in this study is eAgora, since it demonstrates the key capabilities of agent-supported e-negotiations. The significance of this empirical study is three-fold: 1) The work extends research on agent support in conducting negotiations. The results of the empirical evaluation of the system will help developers to validate and potentially improve the design of agent-supported negotiation systems; 2) Users' participation is critical to any system development. If the results prove to be positive, users' comments and feedback on the system will further attract more practitioners to integrate agent technology into e-negotiation support system in a broader context. 3) The empirical evaluation of eAgora will provide a foundation for academician(s) who wish to compare different applications of agent supported negotiation systems in order to explore the advantages of these systems.

3.2. Definitions and Measures of Dependent Variables

The effectiveness of the type of e-negotiation system is the main dependent hypothetical construct to be studied. In order to examine this construct, some of its dimensions, such as perceived usefulness and ease of use, user satisfaction, user confidence were included in the study. A questionnaire consisting of some background questions as well as

perceived measures of system effectiveness was provided to the participants who worked in different scenarios of online negotiations. In addition, information concerning the outcome of negotiation was recorded by the system for each participant in the study.

Much past behavioural work has been done in order to investigate the dependent variables in information systems research. The most prominent examples include IS success model (DeLone and McLean, 1992); technology acceptance model (Davis, 1989); and task-technology fit model (Goodhue and Thompson, 1995). In these works the information system (or its characteristics) appears on the antecedent side of the models and the relationships among relevant constructs are studied. While the focus of the current work is not on the structural relationships between such constructs as usefulness, ease of use, performance, etc. we do include some of the relevant constructs in order to investigate the effectiveness of agent-supported negotiations.

On the other hand, in the closely related field of decision support systems the researchers have long advocated the use of various constructs to measure the effectiveness of these systems (Aldag and Power, 1986; Sharda et al., 1988). Thus this study also uses a variety of variables as dimensions of system effectiveness.

In 1986, Snitkin and King discovered in their research that, for a personal Decision Support System, a high correlation exists between usage and perceived effectiveness. However, effectiveness could, in a broad sense, be very abstract, and also rely upon the

user's perceptions. Therefore, later researchers (Franz and Robey, 1986; Davis, 1989; Melone, 1990) focused on exploiting the measures of effectiveness.

Perceived usefulness and ease of use were thoroughly studied as measures for acceptance of information system (Franz and Robey, 1986; Davis, 1989; Branscomb and Thomas, 1984). They are indicatives of how likely the users will be to utilise the information systems.

As Belkin and Vickery (1985) pointed out, satisfaction is a concept intended to capture an overall judgment, based on user reaction to the system. User satisfaction construct was widely studied as a central role in behavioural research in Information System (Bailey, Pearson, et al., 1983; Chin, Diehl, et al., 1988; Baroudi and Orlikowski, 1988; DeLone and McLean, 1992; Seddon and Yip, 1992; Doll and Torzadeh, 1988; Mcgill and Hobbs, 2003). Development of an instrument to measure user satisfaction has allowed academicians and practitioners to evaluate the effectiveness of systems. Therefore, employing user satisfaction as a measure in evaluating IS effectiveness is well justified. In fact, the user satisfaction construct was not only used in IS research, but also in other fields, e.g. to measure the effectiveness of an organization, the evaluation of products and consumer satisfaction (Oliver 1980; Oliver and Desarbo, 1988).

User's confidence reflects the degree of a user's certainty about a product or service, i.e. to what extent that he/she believes that a system can meet his/her expectations. This construct has been traditionally used in the assessment of decision support systems

(Sharda et al., 1988). It is essential that, such systems provide the user with confidence in their outcomes. Otherwise, a system is likely to encounter overwhelming consumer resistance, and fail to gain acceptance.

The above constructs form the basis of the current study as various dimensions of the effectiveness of agent-supported e-negotiation system.

Qualitative Measures

Perceived usefulness This important construct is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989)

Typical items included in measuring the construct are:

- Quick task accomplishment
- Job performance improvement
- Job effectiveness enhancement
- Making job easy

Perceived ease of use This is defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989)

Items include:

- Easy way to perform task
- Ease of system use
- Clarity of the system instruction

User satisfaction with an information system was defined by Chin and Li (2000) as "the overall affective evaluation an end-user has regarding his or her experience related with the information system".

User satisfaction with process

Measurement: Likert scales

- Satisfied with interaction with system
- Satisfied with guidance
- Satisfied with feedback
- Satisfied with online negotiation process

User satisfaction with negotiation outcome

Measurement: Likert Scale

- Negotiation meets expectation
- Users are satisfied with outcome
- Agreement made is satisfactory

User Confidence refers to the user's degree of certainty that his/her negotiation outcome met the expectation. Thus, it is plausible to assume that the more confidence the user has about a system, the more potentiality that the user will use the system in the future.

Measurement: Likert Scale

- Certainty with outcome

Quantitative Measure

Negotiation outcome This is a quantitative measure that can be directly captured following the negotiation. It is calculated using the weighted combination of the overall attractiveness of the agreement based on the preferences stated by the user prior to negotiations. The effectiveness of a system is partially measured by this computer-recorded performance. The higher the utility is, the better the negotiation outcome.

The perceived usefulness and ease of use will be operationally defined using an instrument developed by Davis (1989) with some modifications tailored to the experiment. Measures of user satisfaction also proved to be reliable, using a variety of instruments from previous studies (DeLone and McLean, 1992; Seddon and Yip, 1992, etc.). A seven-point Likert scale, in which 1 represents very unlikely ("strongly disagree") and 7 represents very likely ("strongly agree") is used to measure the users' degree of satisfaction, usefulness and ease of use as well as other constructs.

Based on the above stated conceptual definitions, we generated 16 candidate items adopted from previous studies, such as Davis (1989) (refer to the part of variables definition above) for the dependent variables. These items were formulated into 16 questions (see Appendix B). The subsequent analysis of the results using factor analysis indicated that four of these questions did not show a clear pattern of loadings. Thus, we have refined our model by removing 4 questions that caused the ambiguity, and leaving 12 questions, which were used as measures for the dependent variables. It has to be

pointed out that some items were not chosen in measuring my variables of interest, firstly because many previous works were testing relationships between constructs while my study focuses on showing the benefits of agent support; and secondly, since most of time was devoted to conducting the time and effort consuming experimental tasks, this necessitated devising a relatively compact questionnaire

The participants for this experiment were presented with this questionnaire, following their online negotiations to measure their satisfaction with negotiation process, the outcome, and their comments on how useful and easy to use the system was according to their experiences.

3.3. Treatment Variables

In this study, we developed three treatment variables, which are: the type of e-negotiation support system, task complexity and the user's role.

Type of the e-negotiation system means the negotiation conducted is either with or without agent support.

Task complexity indicates the task that users work on is either a simple case (few issues) or complex one (many issues).

User's role indicates user, working on the case, is acting either as a buyer or a seller.

Since the purpose of this research is to investigate the effectiveness of the agent-supported negotiation system eAgora, and in so doing, eventually promote its use in practice, an empirical testing is conducted to analyse the specific differences in the performance of the Agent-supported Negotiation System (ANS) vs. the Traditional Negotiation System (TNS) in both simple and complex task contexts.

3.4. Research Model

Todd and Benbasat (1999) developed a model for investigating the effectiveness of decision support tools. Task complexity was examined by Jain and Solomon (1999) in their experiments, and proved it had an effect on the negotiation support system. The model used in this research is a modified version of the Todd and Benbasat's model i.e. it takes into consideration the added elements of the task complexity, the user's role (buyer or seller), while involving the constructs discussed above as dimensions of the hypothetical variable, effectiveness. All the measures of perceived usefulness and ease of use had been tested in Davis research (1989) and showed high content validity.

The major expectation in this work is that agent support in negotiations will lead to improved effectiveness. Moreover, it is anticipated that this effectiveness will be significantly higher when performing complex negotiations vs. simple negotiations (This expectation is summarized as in Table 2). We also anticipate that the role of the negotiator (buyer vs. seller) will not have a significant effect on the effectiveness of negotiations.

Experimental Task

In this model, the type of e-negotiation system basically includes the system with or without agent support. The participants had been assigned an experimental task of negotiating the rental of a condo, and user names have been assigned to them on a random basis. Parts of participants were assigned a simple case that involved "condo-subletting" transaction and based only on issues of monthly rent and parking spot (see Appendix C). A complex task (the same case expanded with more issues) involved multiple issues, including: monthly rent, rental period, deposit amount, parking spot and cleaning required. Thus, more cognitive effort is required when performing complex task vs. simple task.

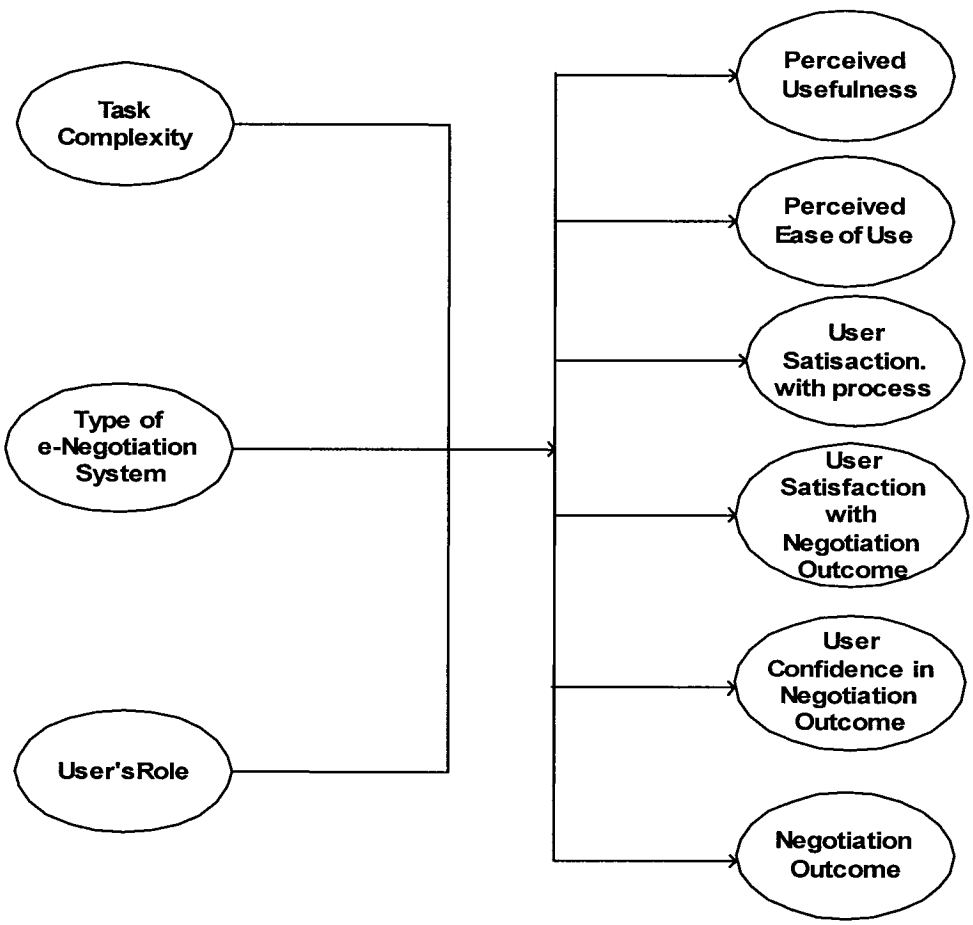


Figure 6: Research Model

Task / Effect / Type of e-negotiation system	Simple	Complex
Agent supported e-negotiation system (ANS)	LESS	MORE
Non-Agent supported e-negotiation system (TNS)	MORE	LESS

Table 2: Negotiation scenario

The anticipated effect of type of system and task complexity on effectiveness is illustrated in Table 2 and could be summarized as follows:

- In performing simple task, users feel little effect of agent support in evaluating the effectiveness of the system.
- In performing complex task, users respond more positively to agent support in evaluating the effectiveness of the system.

3.5. Hypotheses

In the real world, in addition to price, commercial transactions take into account many quantitative and qualitative parameters, i.e. product quality, delivery, guarantee, reputation, return policy and after sales service. In such a complicated negotiation environment, users are less expected to exercise correct judgment in the negotiation process, in the absence of any decision-making assistance.

As stated in the literature review section, an abundance of information may on one hand, provide users with numerous choice advantages, but on the other hand, lead to information overload. Therefore, the employment of agent technologies is expected to positively affect users' decision making.

In this research, the general hypothesis is that the user using ANS performs better than the user using TNS, especially in performing high complexity negotiation tasks. The following hypotheses are formulated based on a research on designing of Agent-based Decision Support Systems (DSS) for enhancing the effectiveness of the traditional DSS (Vahidov and Fazlollahi, 2004). The corresponding statistical hypotheses will be tested using eAgora, a newly developed web-based agent-enhanced negotiation system (Chen, Kersten, et al., 2004).

User satisfaction had been discussed in many previous studies (DeLone and McLean, 1992; Seddon and Yip, 1992; Doll and Torzadeh, 1988; Mcgill and Hobbs, 2003), and all the conclusions indicated that, user satisfaction had a significant influence on user's intended use of IS. This is one of the most important measures in evaluating the effectiveness of the information system. Consequently, our first four hypotheses are:

H1a. ***Using ANS will lead to higher user satisfaction with process than using TNS.***

H1b. ***Using ANS will lead to higher user satisfaction with process than using TNS when performing complex tasks as opposed to performing simple tasks.***

H2a. ***Using ANS will lead to more satisfying outcome than using TNS.***

H2b. ***Using ANS will lead to more satisfying outcome than using TNS when performing complex tasks as opposed to performing simple task.***

Consumers (users) who are more conscious of the different qualities and attributes of a product, as well as being more confident in their judgment of how well this product will satisfy their needs will be more likely to purchase the product. User confidence is also a very important factor in decision making. This was revealed particularly in a number of marketing research projects published by Laroche, Kim, et al. in 1996 and Laroche and Sadokierski in 1994. Based on these theories, we propose the following two hypotheses:

H3a. ***ANS users will have higher confidence level in negotiation outcome than TNS users.***

H3b. ***ANS users will have higher confidence level in negotiation outcome than TNS users when performing complex tasks as opposed to performing simple tasks (in negotiating single issue).***

It is well documented that the usefulness and ease of use of information systems have positive influences on the technology acceptance by both organizations and individuals (Davis, 1989; Doll and Torzadeh. 1988; Delone and McLean 1992; Mcgill and Hobbs, 2003; Franz and Robey, 1986). Our next hypotheses, therefore, involve these factors:

H4a. ***ANS users will find the system more useful than TNS users***

H4b. ***ANS users will find the system more useful than TNS users when performing complex task than when performing simple task.***

Since ANS has more capabilities in addition to the ones of TNS, we hope to show that it does not require significantly higher effort operating than TNS.

H5a. ***An ANS user will find the system no more difficult to use than TNS user.***

H5b. ***An ANS user will find the system no more difficult to use than TNS user when performing complex task than simple task.***

User's role was recorded in the computers as either a buyer or a seller. The agent system, be it on the buyers' side or the sellers' side, is assumed to have no influence in measuring the effectiveness of the system, In other words, the effectiveness of a system will not be dependent upon who uses the system.

H6a. ANS users will perform better than TNS users

H6b. ANS users will perform better than TNS users when working on complex tasks vs. simple tasks.

H7. User's role (buyer or seller) has no influence on effectiveness of the system.

4. Results

4.1. Experiment Design

4.1.1. Subjects

The experiment involved 104 purely student subjects. The subjects were chosen from the Montreal area, mainly from the graduate and undergraduate student populations at Concordia (88) and Mcgill (16) universities. The age of the subjects ranged from 21 to 30 years. The majority of subjects were studying commerce, while only 2 were from the arts program. This was not because of our intention to recruit mainly commerce students, but the recruiting itself was mainly done in the GM Building of Concordia, where the faculty of commerce departments is located. The analysis revealed that 45 % of the participants spent more than 20 hours a week on the Internet, with 56 having online purchasing experience, and 39 participants having online auction system experience.

4.1.2. Task

A lab experiment was conducted to study the effectiveness of the web-based negotiation system (eAgora), with and without agent support, in order to evaluate its potential benefits in conducting business negotiations. Two similar fictitious cases served as the basis for negotiation tasks: one involving few issues and the other with many issues.

We divided the subjects into the following groups to work on:

- Simple case with agent support
- Simple case with no agent support
- Complex case with agent support and
- Complex case with no agent support

All groups consisted of both buyers and sellers. This enabled the investigator to test if user's role would have an impact on the effectiveness of the system.

Each group consisted of 26 individuals (total of 104 participants) who were divided into 13 pairs. One participant in a pair served as a buyer and the other as a seller to participate in a negotiation. The subjects working without agent support were considered as the control group.

4.1.3. Experimental procedures

One week prior to the experiment, a recruiting ad (see Appendix A) was posted in the university campus and labs, and was also circulated in classes. This advertisement explained the purpose of the experiment, requirements of the volunteers and the reward for their participation. The advertisement also stressed that the negotiation process was not technically demanding, and any volunteer with basic Internet experience would be able to participate in the experiments.

Prior to the negotiations, the purpose of the project was presented and explained to the participants. A 10-15 minutes demonstration of eAgora served to introduce all the features and functionalities of the website (eAgora) and teach the subjects the negotiation process and how to use the website. Subsequently, one of the two fictitious cases (see Appendix D) was assigned to the participants with their login name and password included. The case details (including issues, options, and preferences) were entered into the system in advance and associated with the user accounts. The participants were then directed into two different labs, one for the buyers, and the other for the sellers. The researcher also provided an overview of the cases in order to enable the participants to better understand the cases.

The negotiation was proceeding as follows: One user from a group hosted a new negotiation by initiating the first offer. The other user then joined this negotiation. The negotiation was essentially bi-lateral; i.e. no third party could ever join in the negotiation. The active participants started exchanging offers and messages with specified product

issues and options predefined, while a monitor remained by their side to observe any problems and answer any technical questions about using eAgora. The subjects were requested to fill out the questionnaires online (see Appendix E), following their experiences with eAgora. The data generated from these questions were later analyzed statistically in order to evaluate the effectiveness of eAgora with and without agent support of Web-based negotiations.

For the subjects who negotiated with agent support, their agents were pre-assigned the users' preference values for each issue and option, the price range and negotiation strategy. Based on these pre-negotiation settings, the agent evaluated each counter-offer received and suggested possible offers to propose to the opponent. It also provided critique of user offers and counter-offers.

Unlike the real world negotiation, where parties may not be online simultaneously and thus, may not be replying to the counterpart immediately, these subjects were asked to reply to their opponents immediately after they received the offers. This simulation of negotiations represented approximately a two-week cycle in the real life negotiations. Thus, even if the length of each pair's negotiation depended on the number of exchange of offers, each negotiation was restricted to 60 minutes.

To encourage the participants to achieve the best result from their negotiations, and take the task seriously, we set up four bonus prizes to reward the best buyers and best sellers of the two cases. We evaluated their performance based the computer-recorded utility

value, and $50 was awarded to each of the four winners. Another reason of the bonus prize was to increase the response rate by reducing the number of subject withdrawals.

As this experiment consumed the time of the participants (participation was voluntary and the subjects were free to withdraw if they wanted to), each participant received a $10 reward at the site, in appreciation for their participation after they had completed their experimental tasks.

4.2. Data Collection and Analysis

4.2.1. Data collection

Data for this study was collected after an experiment, which attracted 104 volunteers. Following their negotiating experiences while using the system, the participants were asked to answer a questionnaire online based on the case that they worked on. The aim was to acquire their perceived impressions to help assess the effectiveness of the agent-supported e-negotiation system.

The questionnaire was divided into two parts; the first part was used for collecting background information on the participants, while the second part focused on the questions about the system. These questions represented the measures for such variables as user's perceived usefulness and ease of use, user's satisfaction with the negotiation process and outcome, and user's confidence with negotiation outcome.

The average time spent on each negotiation, including the demonstration, was around 45 – 60 minutes. Of the 104 participants, 82 participants answered the questionnaires completely and properly, yielding a response rate of 79% (Because of interruption caused by power outage, and some minor technical problems, some participants were unable to complete the questionnaires). In this experiment, 50 out of 82 negotiators reached agreements on the issues.

4.2.2. Data analysis

Validity

In order to find the adequate measures to evaluate the system effectiveness, we have initially included 16 questions (see Appendix B) in our research, aimed at measuring perceived usefulness (USE), ease of use (EAS), user satisfaction with process (SATP), user satisfaction with outcome (SATO) and user confidence with outcome (CON). Out of these sixteen, four questions were dropped as they did not show the consistent pattern of loadings across the key factors extracted. Consequently, we have US1, US2, EA1, EA2, SP1, SP2, SP3, SO1, SO2, SO3, CN1, CN2, that represent 12 questions (see Appendix C) to measure the five dependent variables.

The pattern of correlation between the items is shown in Table 3. We expect to see higher correlations between the items that relate to the same construct (convergent validity) and lower correlations between inter-construct items (discriminant validity).

To further explore validity of the measures, we conducted an exploratory factor analysis (i.e., assuming we don't know which items relate to which factors), and subsequently a confirmatory factor analysis (i.e. assuming that we already know which items relate to which constructs and seeking to validate the measurement model). The exploratory factor analysis has revealed that the loadings (see Table 4) overall show support for convergent and discriminant validity.

US1 and US2 higher for factor 3

EA1 and EA2 higher for factor 2

SP1, SP2 and SP3 higher for factor 4

SO1, SO2 and SO3 higher for factor 1 and

CN1 and CN2 higher for factor 5

We can see from this validity tests that, despite of the existence of correlation among the 12 measures as discussed in the correlation analyses next, and in particular the most closely correlated dimensions of perceived usefulness with satisfaction with process and user confidence, the general discriminant validity has been demonstrated. We can see that the participants of the experiment do distinguish among these dimensions in their responses on the questionnaire and, presumably in their thinking.

To further support the validity of our measurements, we used LISREL to conduct confirmatory factor analysis (CFA). Note, that no structural relationships were hypothesized, but strictly the measurement model that justifies the use of LISREL. In

essence, the software was employed because of its capability to perform confirmatory analysis. Table 5 exhibits the covariance between the 12 measures.

		US1	US2	EA1	EA2	SP1	SP2	SP3	SO1	SO2	SO3	CN1	CN2
Cor-relation	US1	**1.000**	**.797**	.431	.345	.518	.511	.550	.567	.525	.477	.609	.610
	US2	**.797**	**1.000**	.549	.480	.644	.618	.631	.533	.543	.522	.583	.651
	EA1	.431	.549	**1.000**	**.702**	.616	.661	.572	.407	.394	.357	.382	.522
	EA2	.345	.480	**.702**	**1.000**	.615	.710	.588	.331	.400	.467	.508	.602
	SP1	.518	.644	.616	.615	**1.000**	**.761**	**.720**	.516	.536	.483	.459	.625
	SP2	.511	.618	.661	.710	**.761**	**1.000**	**.775**	.517	.539	.532	.549	.597
	SP3	.550	.631	.572	.588	**.720**	**.775**	**1.000**	.582	.584	.476	.540	.621
	SO1	.567	.533	.407	.331	.516	.517	.582	**1.000**	**.889**	**.659**	.612	.609
	SO2	.525	.543	.394	.400	.536	.539	.584	**.889**	**1.000**	**.750**	.622	.628
	SO3	.477	.522	.357	.467	.483	.532	.476	**.659**	**.750**	**1.000**	.481	.624
	CN1	.609	.583	.382	.508	.459	.549	.540	.612	.622	.481	**1.000**	**.757**
	CN2	.610	.651	.522	.602	.625	.597	.621	.609	.628	.624	**.757**	**1.000**

Table 3: Correlation Matrix

	Component				
	1	2	3	4	5
US1	.260	.110	**.844**	.207	.280
US2	.253	.311	**.788**	.278	.194
EA1	.135	**.767**	.286	.303	.032
EA2	.149	**.853**	.052	.224	.318
SP1	.254	.473	.313	**.639**	.092
SP2	.254	.559	.216	**.615**	.202
SP3	.261	.322	.258	**.752**	.246
SO1	**.781**	.022	.235	.376	.273
SO2	**.839**	.109	.182	.315	.272
SO3	**.832**	.362	.223	.003	.113
CN1	.303	.179	.287	.202	**.833**
CN2	.390	.409	.341	.177	**.608**

Table 4: Rotated Component Matrix (*Exploratory Factor Analysis)*

	US1	US2	EA1	EA2	SP1	SP2	SP3	SO1	SO2	SO3	CN1	CN2
US1	2.46											
US2	1.76	1.98										
EA1	1.02	1.16	2.26									
EA2	0.94	1.17	1.82	3.00								
SP1	1.27	1.41	1.44	1.66	2.43							
SP2	1.27	1.38	1.58	1.95	1.89	2.52						
SP3	1.40	1.45	1.40	1.66	1.83	2.00	2.65					
SO1	1.83	1.55	1.26	1.18	1.66	1.69	1.95	4.24				
SO2	1.53	1.42	1.10	1.29	1.55	1.59	1.76	3.40	3.45			
SO3	1.38	1.36	0.99	1.49	1.39	1.56	1.43	2.50	2.57	3.41		
CN1	1.58	1.36	0.95	1.46	1.19	1.44	1.46	2.09	1.91	1.47	2.74	
CN2	1.54	1.48	1.27	1.68	1.58	1.53	1.63	2.03	1.89	1.86	2.02	2.61

Table 5: Covariance Matrix

In Goodness of Fit Statistics analysis, we also find the overall support for our measurement model as most of the fit indices show higher degrees of fit. In particular, the Goodness of Fit Index (GFI) = 0.89, which is very close to 0.9, further support the suitability of the chosen measures for our factors, and standardized RMR (root mean square residual) is 0.043 while values lower than 0.05 are considered best.

In summary, the twelve questions used for the analysis show good fit with the factors they are intended to represent, and, therefore are appropriate in evaluating the system effectiveness.

	use	ease	satp	sato	con
use	1.00				
ease	0.60 (0.09) 6.75	1.00			
satp	0.75 (0.06) 12.11	0.86 (0.05) 17.05	1.00		
sato	0.63 (0.08) 8.13	0.49 (0.10) 4.97	0.66 (0.07) 9.23	1.00	
con	0.77 (0.06) 12.55	0.71 (0.08) 9.33	0.75 (0.06) 11.78	0.74 (0.06) 11.95	1.00

Table 6: Correlation Matrix

Goodness of Fit Statistics

Degrees of Freedom = 44
Minimum Fit Function Chi-Square = 63.68 (P = 0.028)
Normal Theory Weighted Least Squares Chi-Square = 60.42 (P = 0.051)

Estimated Non-centrality Parameter (NCP) = 16.42
90 Percent Confidence Interval for NCP = (0.0; 40.92)

Minimum Fit Function Value = 0.79
Population Discrepancy Function Value (F0) = 0.20
90 Percent Confidence Interval for F0 = (0.0; 0.51)
Root Mean Square Error of Approximation (RMSEA) = 0.068
90 Percent Confidence Interval for RMSEA = (0.0 ; 0.11)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.24

Expected Cross-Validation Index (ECVI) = 1.59
90 Percent Confidence Interval for ECVI = (1.38; 1.89)
ECVI for Saturated Model = 1.93
ECVI for Independence Model = 22.49

Chi-Square for Independence Model with 66 Degrees of Freedom = 1797.95
Independence AIC = 1821.95
Model AIC = 128.42
Saturated AIC = 156.00
Independence CAIC = 1862.83
Model CAIC = 244.25
Saturated CAIC = 421.72

Normed Fit Index (NFI) = 0.96
Non-Normed Fit Index (NNFI) = 0.98
Parsimony Normed Fit Index (PNFI) = 0.64
Comparative Fit Index (CFI) = 0.99
Incremental Fit Index (IFI) = 0.99
Relative Fit Index (RFI) = 0.95

Critical N (CN) = 88.40

Root Mean Square Residual (RMR) = 0.12
Standardized RMR = 0.043
Goodness of Fit Index (GFI) = 0.89
Adjusted Goodness of Fit Index (AGFI) = 0.80

Table 7: Goodness of fit statistics

Reliability

We used Cronbach's Alpha in testing the reliability of the items that are specifically designed for measuring the dependent variables.

The six questions for user satisfaction were tested and confirmed very reliable (0.901 and 0.906) in measuring SATP and SATO (see Table 8). This is consistent with many previous researches (DeLone and McLean, 1992; Seddon and Yip, 1992; Doll and Torzadeh, 1988; Mcgill and Hobbs, 2003) that concluded that, user satisfaction had a significant influence on user's intention to use information systems. It is for this reason that user satisfaction is considered one of the most important measures used to evaluate an information system.

The other six measures for perceived usefulness and user confidence also had a very high reliability that is close to 0.9. Ease of use has a relatively low value of 0.82, which is still higher comparing to the suggested standard threshold value of 0.7.

Thus, as measures for the dependent factors in evaluating the system effectiveness, these items can be considered the reliable measures of the constructs.

Cronbach's Alpha	N of Items
.884	2

USE (usefulness)

Cronbach's Alpha	N of Items
.820	2

EASE (ease of use)

Cronbach's Alpha	N of Items
.901	3

SATP (satisfaction with process)

Cronbach's Alpha	N of Items
.906	3

SATO satisfaction with outcome)

Cronbach's Alpha	N of Items
.861	2

CONF (user confidence)

Table 8: Reliability analysis of measures

We developed our General Linear Model to explore the differences of influence, from three independent factors, on the system effectiveness that is measured by five factors (perceived usefulness and ease of use, user satisfaction with process and negotiation outcome, and user confidence in the negotiation outcome). In other words, we studied if there are any multi-variate effects on the dependent constructs of one or combinations of two or all three independent variables. The following is our model used to study the effects caused by the presence of each factor.

Intercept+Complex+Seller+agent+Complex * Seller+Complex * agent+Seller * agent+Complex * Seller * agent

(where seller=1, buyer =0; complex=1, simple=0; with agent=1, no agnet=0)

This multivariate test result (see Table 9) clearly shows the significance level when different variables are deployed. Interpretation of Table 9 is as follows,

- When applying task complexity only (regardless of users' role and type of system), it is not significant that the users find the system very effective (P=0.699) in both simple and complex task.
- When applying users' role only (regardless of type of system and task complexity), it is not significant that sellers or buyers evaluate the system differently (P=0.795).
- When applying agent only (regardless of users' role and task complexity), it is not significant that the system was evaluated positively (P=0.512).
- When task complexity interacts with users' role, it is not significant that different users perceive the system differently (P=0.123).
- In complex task environment, agents' presence makes a significant difference in terms of system effectiveness evaluation (P=0.016).
- Agents' presence does not significantly influence users when evaluating the effectiveness of the system (P=0.950).
- In task complexity environment with agent support, it is not significant that sellers evaluated the system differently than buyers did (0.638).

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.958	264.340(a)	6.000	69.000	.000
	Wilks' Lambda	.042	264.340(a)	6.000	69.000	.000
	Hotelling's Trace	22.986	264.340(a)	6.000	69.000	.000
	Roy's Largest Root	22.986	264.340(a)	6.000	69.000	.000
Complex	Pillai's Trace	.053	.639(a)	6.000	69.000	.699
	Wilks' Lambda	.947	.639(a)	6.000	69.000	.699
	Hotelling's Trace	.056	.639(a)	6.000	69.000	.699
	Roy's Largest Root	.056	.639(a)	6.000	69.000	.699
Seller	Pillai's Trace	.043	.515(a)	6.000	69.000	.795
	Wilks' Lambda	.957	.515(a)	6.000	69.000	.795
	Hotelling's Trace	.045	.515(a)	6.000	69.000	.795
	Roy's Largest Root	.045	.515(a)	6.000	69.000	.795
agent	Pillai's Trace	.071	.884(a)	6.000	69.000	.512
	Wilks' Lambda	.929	.884(a)	6.000	69.000	.512
	Hotelling's Trace	.077	.884(a)	6.000	69.000	.512
	Roy's Largest Root	.077	.884(a)	6.000	69.000	.512
Complex * Seller	Pillai's Trace	.132	1.746(a)	6.000	69.000	.123
	Wilks' Lambda	.868	1.746(a)	6.000	69.000	.123
	Hotelling's Trace	.152	1.746(a)	6.000	69.000	.123
	Roy's Largest Root	.152	1.746(a)	6.000	69.000	.123
Complex * agent	**Pillai's Trace**	**.197**	**2.818(a)**	**6.000**	**69.000**	**.016**
	Wilks' Lambda	**.803**	**2.818(a)**	**6.000**	**69.000**	**.016**
	Hotelling's Trace	**.245**	**2.818(a)**	**6.000**	**69.000**	**.016**
	Roy's Largest Root	**.245**	**2.818(a)**	**6.000**	**69.000**	**.016**
Seller * agent	Pillai's Trace	.023	.267(a)	6.000	69.000	.950
	Wilks' Lambda	.977	.267(a)	6.000	69.000	.950
	Hotelling's Trace	.023	.267(a)	6.000	69.000	.950
	Roy's Largest Root	.023	.267(a)	6.000	69.000	.950
Complex * Seller * agent	Pillai's Trace	.059	.716(a)	6.000	69.000	.638
	Wilks' Lambda	.941	.716(a)	6.000	69.000	.638
	Hotelling's Trace	.062	.716(a)	6.000	69.000	.638
	Roy's Largest Root	.062	.716(a)	6.000	69.000	.638

Table 9: Multivariate Tests

Therefore, the above multivariate tests indicate that the user's role does not have a significant influence on perceived effectiveness measures. Also, it has no significant effect in interactions with the task complexity, agent support and/or both of these factors combined. Therefore, this supports our expectation that there will be no significant difference in perceived measures with regard to user's role. Consequently, our last hypothesis **(H7)** is confirmed.

Hypotheses Testing

Our first hypothesis (**H1a**) apredicts that users using ANS will yield higher user satisfaction with process than users using TNS, regardless of the complexity of negotiation task. However, factor scores for SATP in Table 10 did not confirm this hypothesis (p=0.3006). This result reveals that, taking into consideration of both cases (simple and complex) and users' role, it is not significant that ANS users have more satisfaction than TNS users. Nevertheless, the MEANS analysis (where the answers to the questions are simply averaged instead of being weighed as in calculating factor scores) does indicate that the ANS users are slightly more satisfied with the negotiation process.

Given the fact that ANS users working in the complex task, we found that it is very significant that ANS users gained more satisfaction with the process. Both analyses yielded a significant P value, 2.22E-05 with factor scores analysis and 7.01E-08 with MEANS. Therefore, the second hypothesis (**H1b**) "Using ANS will lead to higher user satisfaction when performing complicated tasks versus simple tasks" has been confirmed.

SATP		
	NA	*AG*
Mean	**0.058218**	**-0.05822**
Variance	1.259176	0.758876
Observations	41	41
Hypothesized Mean Difference	0	
Df	75	
t Stat	0.524827	
P(T<=t) one-tail	**0.300626**	
t Critical one-tail	1.665426	
P(T<=t) two-tail	0.601251	
t Critical two-tail	1.992103	

SATP		
	NA	*AG*
Mean	**5.162602**	**5.349593**
Variance	2.239566	2.027507
Observations	41	41
Hypothesized Mean Difference	0	
df	80	
t Stat	-0.57963	
P(T<=t) one-tail	**0.281897**	
t Critical one-tail	1.664125	
P(T<=t) two-tail	0.563794	
t Critical two-tail	1.990065	

Table 10: Factor scores and MEANS for SATP (all cases)

SATP		
	NA	*AG*
Mean	**-0.6823**	**0.027266**
Variance	0	0.36351
Observations	20	20
Hypothesized Mean Difference	0	
Df	19	
t Stat	-5.26318	
P(T<=t) one-tail	**2.22E-05**	
t Critical one-tail	1.729131	
P(T<=t) two-tail	4.43E-05	
t Critical two-tail	2.093025	

SATP		
	NA	*AG*
Mean	**3.592063**	**5.7**
Variance	0	1.355556
Observations	20	20
Hypothesized Mean Difference	0	
df	19	
t Stat	-8.09681	
P(T<=t) one-tail	**7.01E-08**	
t Critical one-tail	1.729131	
P(T<=t) two-tail	1.4E-07	
t Critical two-tail	2.093025	

Table 11: Factor scores and MEANS for SATP (complex over simple task)

We anticipated that the ANS users have more satisfaction with the outcome than the TNS users, especially when executing complex tasks. Statistical results did not support the former hypothesis (P=0.2066) (see Table 12), but provide strong evidence (P=0.0017) for the latter expectation. This could be also seen from the MEANS analysis that yielded a P value of 2.1E-05 (see Table 13). Therefore, **H2a** is not confirmed in our study. Nevertheless, **H2b** is confirmed that ANS users have more satisfaction with the negotiation outcome, when they negotiate in complex task.

SATO		
	NA	*AG*
Mean	**-0.091**	**0.091002**
Variance	1.086344	0.921679
Observations	41	41
Hypothesized Mean Difference	0	
df	79	
t Stat	-0.82241	
P(T<=t) one-tail	**0.20666**	
t Critical one-tail	1.664371	
P(T<=t) two-tail	0.413319	
t Critical two-tail	1.990452	

SATO		
	NA	*AG*
Mean	**4.235772**	**4.707317**
Variance	3.273577	2.923306
Observations	41	41
Hypothesized Mean Difference	0	
Df	80	
t Stat	-1.21291	
P(T<=t) one-tail	**0.114367**	
t Critical one-tail	1.664125	
P(T<=t) two-tail	0.228734	
t Critical two-tail	1.990065	

Table 12: Factor scores and MEANS for SATO (all cases)

SATO		
	NA	*AG*
Mean	**-0.32732**	**0.216651**
Variance	0	1.132076
Observations	20	20
Hypothesized Mean Difference	0	
df	19	
t Stat	-2.28641	
P(T<=t) one-tail	**0.016941**	
t Critical one-tail	1.729131	
P(T<=t) two-tail	0.033882	
t Critical two-tail	2.093025	

SATO		
	NA	*AG*
Mean	**2.928571**	**5.066667**
Variance	0	3.270175
Observations	20	20
Hypothesized Mean Difference	0	
df	19	
t Stat	-5.28757	
P(T<=t) one-tail	**2.1E-05**	
t Critical one-tail	1.729131	
P(T<=t) two-tail	4.2E-05	
t Critical two-tail	2.093025	

Table 13: Factor scores and MEANS for SATO (complex over simple task)

As described in Section 3.4, user confidence is a critical factor in decision-making. It is realized that consumers (users), who are more confident in their judgment of how well a product will satisfy their needs will be more likely to purchase the product (Laroche, Kim, et al., 1996). It is expected that users will evaluate a product more positively if they decide to purchase it.

From this perspective, the proposed hypotheses addresses user confidence in the negotiation outcome, namely ANS users will have higher confidence level in the negotiation outcome than TNS (**H3a**), and ANS users will have higher confidence level in negotiation outcome than TNS user when performing complex tasks versus simple tasks (**H3b**).

The results displayed in Table 14 revealed that the former proposal (**H3a**) was not strongly supported by the two analyses (P=0.216 and P=0.08) (see Table 14). However, it is easy to see that, when performing complex tasks, users with agent support have much higher confidence level than users with no agent support. The statistic P value equals 0.000153 and 2.6E-08, respectively in factor scores and MEANS (see Table 15). These values indicate that ANS users would tend to use or purchase the system when working on complex tasks, and thus find the negotiation system very effective.

CON		
	NA	*AG*
Mean	**-0.08738**	**0.087383**
Variance	1.430006	0.579341
Observations	41	41
Hypothesized Mean Difference	0	
df	68	
t Stat	-0.78945	
P(T<=t) one-tail	**0.216297**	
t Critical one-tail	1.667572	
P(T<=t) two-tail	0.432594	
t Critical two-tail	1.995468	

CON		
	NA	*AG*
Mean	**4.634146**	**5.109756**
Variance	2.787805	1.856402
Observations	41	41
Hypothesized Mean Difference	0	
df	77	
t Stat	-1.41315	
P(T<=t) one-tail	**0.080821**	
t Critical one-tail	1.664885	
P(T<=t) two-tail	0.161643	
t Critical two-tail	1.991257	

Table 14: Factor scores and MEANS for CON (all cases)

CONF		
	NA	*AG*
Mean	**-0.49838**	**0.16627**
Variance	1.87E-16	0.456021
Observations	20	20
Hypothesized Mean Difference	0	
df	19	
t Stat	-4.40162	
P(T<=t) one-tail	**0.000153**	
t Critical one-tail	1.729131	
P(T<=t) two-tail	0.000307	
t Critical two-tail	2.093025	

CONF		
	NA	*AG*
Mean	**3.232143**	**5.525**
Variance	5.98E-15	1.407237
Observations	20	20
Hypothesized Mean Difference	0	
df	19	
t Stat	-8.64387	
P(T<=t) one-tail	**2.6E-08**	
t Critical one-tail	1.729131	
P(T<=t) two-tail	5.21E-08	
t Critical two-tail	2.093025	

Table 15: Factor scores and MEANS for CON (complex over simple task)

Perceived usefulness was widely studied and used as an effective measure in the evaluation of information systems. Numerous studies concluded that, perceived usefulness has a positive influence on the technology acceptance by organizations and individuals (Davis, 1989; Doll et al. 1998; Delone and McLean 1992; Mcgill and Hobbs; Franz and Robey, 1986). For this reason, we included this factor in the experiment.

When the data was pooled across both tasks, the MEANS exhibits different values in the experiment, i.e. higher values with the presence of agent support in the negotiations. The P value equaling 0.064 is very close to significance index (see Table 16). However, the P=0.1039 in the factor scores did not prove to be significant, thereby leaving the hypothesis that "ANS users will find the system more useful than TNS users" (**H4a**) unconfirmed.

Nevertheless, when analyzed separately, Table 17 indicates an encouraging result that ANS users do find the system more useful than TNS users, when performing complex tasks versus when performing simple task (**H4b**). This result is extremely significant, since the p-value equals 4.18E-06 and 2.74E-09 for both methods (see Table 17). This is one of the most significant findings in the study.

USE		
	NA	*AG*
Mean	**-0.13969**	**0.139686**
Variance	0.996816	0.988184
Observations	41	41
Hypothesized Mean Difference	0	
Df	80	
t Stat	-1.26968	
P(T<=t) one-tail	**0.10394**	
t Critical one-tail	1.664125	
P(T<=t) two-tail	0.207879	
t Critical two-tail	1.990065	

USE		
	NA	*AG*
Mean	**4.97561**	**5.45122**
Variance	2.24939	1.660061
Observations	41	41
Hypothesized Mean Difference	0	
df	78	
t Stat	-1.54023	
P(T<=t) one-tail	**0.063776**	
t Critical one-tail	1.664625	
P(T<=t) two-tail	0.127552	
t Critical two-tail	1.990848	

Table 16: Factor scores and MEANS for USE (all cases)

USE		
	NA	*AG*
Mean	**-0.78564**	**0.412706**
Variance	0	0.788773
Observations	20	20
Hypothesized Mean Difference	0	
Df	19	
t Stat	-6.03423	
P(T<=t) one-tail	**4.18E-06**	
t Critical one-tail	1.729131	
P(T<=t) two-tail	8.35E-06	
t Critical two-tail	2.093025	

USE		
	NA	*AG*
Mean	**3.533333**	**5.875**
Variance	7.48E-15	1.101974
Observations	20	20
Hypothesized Mean Difference	0	
df	19	
t Stat	-9.97595	
P(T<=t) one-tail	**2.74E-09**	
t Critical one-tail	1.729131	
P(T<=t) two-tail	5.47E-09	
t Critical two-tail	2.093025	

Table 17: Factor scores and MEANS for USE (complex over simple task)

In this research, we also postulated a hypothesis in testing the ease of use of eAgora when working in both cases. It was assumed that "ANS users would find the system no more difficult than TNS users" (**H5a**). The pooled data in both cases yielded a very small mean difference. This slight difference was further proved by the testing results (Table 18) with P value equaling 0.2665 and 0.1516 for the factor scores and Means, implying that ANS users found the system no more difficult than TNS users.

When the subjects negotiated on complex task with multi issues, the result is also encouraging with P value equaling 0.00046 (Table 19). In this case ANS users found the system actually easier to use than the TNS users. While confirming our hypothesis (**H5b**), this result also supports the findings of the usability test of Chen, Kersten, et al., (2004), which concluded that the participants liked the fact that the system was easy to use.

Davis (1989) found in his study that the gain of perceived usefulness from the system is less than the ease of use. He stated that ease of use is more closely related to user's intention to use the system while arguing that no amount of ease of use can compensate for a system that does not perform a useful function. In our study, **H4b**, **H5a** and **H5b** were all tested very significant, and the gain of perceived usefulness is even more than that of the ease of use.

Negotiation outcome is evaluated based on the users' utilities gained from the negotiations. The small data size (50 out of 81 subjects made agreements) somewhat

threatens the results of hypothesis testing. It is not supported that the ANS users performed better than TNS users do in complex case (see Table 20). However, if the data was pooled across all cases, it is obvious that the ANS gained much higher value over TNS on the average (see Table 21). We would conclude that, in general, ANS performed better than TNS across two cases. So **H6a** is confirmed while **H6b** is tested not to be statistically significant, though the agent support led to improved outcome.

EAS		
	NA	*AG*
Mean	**-0.06944**	**0.069437**
Variance	1.390949	0.624166
Observations	41	41
Hypothesized Mean Difference	0	
df	70	
t Stat	-0.62642	
P(T<=t) one-tail	**0.266539**	
t Critical one-tail	1.666915	
P(T<=t) two-tail	0.533077	
t Critical two-tail	1.994435	

EAS		
	NA	*AG*
Mean	**5.47561**	**5.817073**
Variance	2.84939	1.596951
Observations	41	41
Hypothesized Mean Difference	0	
df	74	
t Stat	-1.03689	
P(T<=t) one-tail	**0.151581**	
t Critical one-tail	1.665708	
P(T<=t) two-tail	0.303161	
t Critical two-tail	1.992544	

Table 18: Factor scores and MEANS for EAS (all cases)

EAS		
	NA	*AG*
Mean	**-0.55164**	**0.110599**
Variance	4.67E-17	0.570915
Observations	20	20
Hypothesized Mean Difference	0	
df	19	
t Stat	-3.91964	
P(T<=t) one-tail	**0.00046**	
t Critical one-tail	1.729131	
P(T<=t) two-tail	0.000921	
t Critical two-tail	2.093025	

EAS		
	NA	*AG*
Mean	**4.127381**	**5.95**
Variance	1.5E-14	1.418421
Observations	20	20
Hypothesized Mean Difference	0	
df	19	
t Stat	-6.84397	
P(T<=t) one-tail	**7.84E-07**	
t Critical one-tail	1.729131	
P(T<=t) two-tail	1.57E-06	
t Critical two-tail	2.093025	

Table 19: Factor scores and MEANS for EAS (complex over simple task)

PERF

	NA	*AG*
Mean	**0.461924**	**0.4005**
Variance	2.02E-16	0.05502
Observations	12	12
Hypothesized Mean Difference	0	
df	11	
t Stat	0.907135	
P(T<=t) one-tail	**0.191889**	
t Critical one-tail	1.795884	
P(T<=t) two-tail	0.383777	
t Critical two-tail	2.200986	

Table 20: Factor scores and MEANS for negotiation outcome (complex over simple)

PERF

	NA	*AG*
Mean	0.252833	0.4005
Variance	0.085607	0.05502
Observations	12	12
Hypothesized Mean Difference	0	
df	21	
t Stat	-1.36408	
P(T<=t) one-tail	**0.093493**	
t Critical one-tail	1.720744	
P(T<=t) two-tail	0.186986	
t Critical two-tail	2.079614	

Table 21: Factor scores and MEANS for negotiation outcome (all cases)

5. Discussion and Conclusions

The purpose of this study was to investigate the effectiveness of the agent-supported e-negotiation system. To this end, we have deployed six dependent variables, namely perceived usefulness and ease of use, satisfaction with process, satisfaction with negotiation outcome, user confidence in negotiation, and negotiation outcome. Among these, negotiation outcome was a computer-recorded result showing the value of an agreement from the perspective of users' preferences. It has been the only quantitative measure used for evaluating effectiveness in this study.

We employed 12 questions for measuring the dependent factors (qualitative) in this study. Based on the effect of three independent variables, including user's role, type of system and task complexity, we presented 11 hypotheses of which six turned out to be significant.

In our study, **H1a, H2a, H3a, H4a, H6b** and hypotheses were not confirmed while **H1b**, **H2b**, **H3b**, **H4b, H5a, H5b,** and **H6a** were all strongly supported. Besides, our study results indicate that users' role as either a seller or buyer did not influence users' evaluation on system effectiveness. Thus, **H7** has also been confirmed. Overall, the results support our expectation that the negotiators will find an agent-based support more effective when used in the context of more complex negotiation tasks.

One of the most significant findings of this study is the relative strength of the effect of

agent technology in negotiation support system on various dimensions of effectiveness of the system. This finding could potentially contribute to the widespread application of agent technologies in conducting e-negotiations. Nevertheless, for auction systems or negotiations involving few issues the agent's involvement may not lead to increased effectiveness. Users did not find the agent's presence in such simple negotiations very helpful.

Limitations

There are some limitations that should be pointed out. Firstly, the general findings from a designed lab experiment tend to be subjective based on the self-reported evaluations. It should be emphasized that measures employed in this study, including perceived usefulness, ease of use, satisfaction with process and negotiation outcome, and user confidence in negotiation outcome, are the result of participants' subjective appraisal of their negotiation experience, and may not be regarded as being "objective" (although it may not be practical to attempt to define what an objective view would constitute). Secondly, the subjects who are purely students can only represent a group of users from the same domain, thus raising some questions related to the generalizability of the findings. Future work involving other user groups may help address this issue.

Moreover, due to the resource constraints in this experiment we only compared the negotiations with and without agent support. Negotiations over simple and complex tasks involving agents on both sides were not part of the experiments.

Future Research Implications

Agent technologies show great promise to have positive impact on conducting electronic negotiations. In particular, agents can help the negotiating parties to express their preferences and desired negotiation strategies, assist in generating promising offers, evaluate incoming offers and "watch over the shoulder" of the users to ensure that he or she makes offers in accordance with the objectives/preferences specified.

As discussed in Section 2.3, intelligent agents have emerged as a promising area of research. Existing systems such as Aspire and eAgora are all agent-enhanced to facilitate negotiation process. The technology behind these systems varies from one to another. This may, to a certain extent, affect the users' attitude and comments in terms of the aspects studied in this research.

In future research, it would be interesting to conduct comparison study of similar systems to detect their pros and cons. Comparison studies should also include human characteristics as an independent variable, i.e. such attributes as culture, education, job, etc. In this perspective, other designers could then refer to the results in order to devise more powerful systems to better serve of the negotiators and promote "win-win" scenarios in today's competitive market. Since one of the contributions of this research is the finding that user's role has no significant influence on user's attitudes towards systems, future researchers may not need to include this variable in their study and focus on other important variables instead.

Moreover, other types of agents, such as information agents can also be employed in electronic negotiations, since information search is one of the key elements of a consumer' buying behavior. In order to properly prepare for negotiations, the search of relevant information is critical as it would lead to finding out possible alternatives to the negotiated agreements. The further research on using different types of agents in negotiations could improve use of agent technologies promise in electronic negotiation support.

Finally, one of the lessons we have learned from the study that we would like to share with other researchers who plan to conduct similar experiments is that researchers must well plan and prepare for the experiment paying much of attention to such aspects as recruiting subjects (registering them beforehand is more efficient than just waiting for them to walking in), and preparing two separate labs, preferably located close to each other with a separate monitor assigned for each lab.

REFERENCES

Aldag, R.J., Power D.J. (1986) "An Empirical Assessment of Computer-Assisted Decision Analysis." Decision Sciences, Vol.17, No.4, pp.572-588.

Bailey, J., E. Pearson, et al., (1983). "Development of a Tool for Measuring and Analyzing Computer User Satisfaction." Management Science May Linthicum: Vol.29, Iss. 5; pg. 530, 16 pgs

Baroudi, J. J. and W. J. Orlikowski (1988). "A Short-form Measure of User Information Satisfaction." Journal of Management Information Systems, Vol. 4, No. 4, Spring, pp.44-59

Bazerman, M.H., et al. (2000). "Negotiation." Annual Review of Psychology, 51: 279-314.

Beam, C. and A. Segev (1998). "Automated Negotiations: A Survey and the State of Art." Berkeley, CA, Haas School of Business.

Beam, C., A. Segev, et al. (1999). "On Negotiations and Deal Making in Electronic Markets." Information Systems Frontiers; Oct; 1, 3; ABI/INFORM Global, pg. 241.

Belkin, N.J. and A. Vickery (1985). "Interaction in information systems: a review of research from document retrieval to knowledge-based system." London: the British Library.

Branscomb, L.M. and J.C. Thomas (1984). "Ease of Use: A System Design Challenge." IBM Systems Journal (23), pp.224-235

Bui, T., J. et al. (2001). "A Multi-Attribute Negotiation Support System with Market Signaling for Electronic Markets." Group Decision and Negotiation. Dordrecht: Nov Vol. 10, Iss. 6; pg. 515.

Casasola, E and S.Gauch (1995) "Intelligent Information Agents for the World Wide" Web, Information and Telecommunication Technology Center, Technical Report: ITTCFY97-11100-1.

Chavez, A., D. Dreilinger, et al. (1997). "A Real-life Experience in Creating an Agent Market." Application of Intelligent Agents and Multi-Agent Technology PAAM'97 (London UK).

Chen, E., G.E., Kersten and R. Vahidov (2004). "An e-marketplace for agent-supported commerce negotiations." 25th McMaster World Congress, January.

Chin, W.W. and M.K.O Lee (2000). "A proposed model and measurement instrument for the formation of IS satisfaction: The case of end-user computing satisfaction."

Proceedings of twenty first international conference of information system. Brisbane, Australia.

Chin, J.P., V.A., Diehl, et al. (1988). Development of an Instrument for Measuring User Satisfaction of the Human –Computer Interface, CHI'88 Human Factors in Computing Systems, Washington, D.C. May, ACM, New York, NY, pp.2133-218

Chircu, A. and R. Kauffman (2001). The EBay of Blank: Digital Intermediation in Electronic Commerce. http://www.misrc.umn.edu/wpaper/default.asp, downloaded on 2001-11-15.

Goodhue, D.L. and R.L. Thompson (1995). "Task-Technology Fit and Individual Performance." MIS Quarterly, 19, pp.213-226.

Crowston, K. and I. MacInnes (2000). "The Effects of Market-enabling Internet Agents on Competition and Prices." Journal of Electronic Commerce Research, 1(4).

Davis, F.D. (1989). "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology." MIS Quarterly; Sept.; 13, 2; ABI/INFORM Global pg.319

Delone, W.H. and E.R. McLean (1992). "Information Systems Success: The Quest for the Dependent Variable." Information Systems Research, Vol.3, pp.60-95.

Doll, W., J. and G. Torzadeh (1988). "The Measure of End-User Computing Satisfaction." MIS Quarterly, Vol. 12, No. 2, June, pp. 259-274

Franklin, S., A.Graesser (1996). "Is it an Agent, or just a Program? A Taxonomy for Autonomous Agents." Intelligent Agents III. Agent Theories, Architectures and Languages (ATAL'96)

Franz, C. R. and D. Robey (1986). "Organizational Context, User Involvement, and Usefulness of Information Systems." Decision Science, Vol. 17, No. 3, summer, pp. 329-356

Greenwald, A.R. and J.O. Kephart (1999). "Shopbots and Pricebots", Proceedings International Joint Conferences on Artificial Intelligence, Stockholm, Sweden, July 31-August 6, pg. 506-511.

Guilfoyle, C. (1995), "Vendors of Agent Technology", UNICOM Seminar on Intelligent Agents and their Business Applications, 8-9 November, London, 135-142.

Guttman, R., A.Moukas, et al. (1998). "Agents as Mediators in Electronic Commerce." International Journal of Electronic Markets 8(1).

Jain, B. A. and J. S. Solomon (2000). "The effect of task complexity and conflict handling styles on computer-supported negotiations." Information and Management 37(4): 161-168.

Jelassi, M.T. and A. Foroughi (1989). "Negotiation Support Systems: An Overview of Design Issues and Existing Software." Decision Support Systems: The International Journal, 5: 167-181.

Jennings, N.R. (1995). "Controlling Cooperative Problem Solving in Industrial Multi-Agent Systems using Joint Intentions." Artificial Intelligence Journal 74 (2), pp 195-240.

Jennings N. R. and M. Wooldridge (1998). "Applications of Intelligent Agent." Agent Technology: Foundation, Applications and Markets, Springer-Verlag.

Kersten, G.E. (1987). "On Two Roles Decision Support Systems Can Play in Negotiations." Information Processing and Management. Oxford: Vol. 23, Iss. 6; p. 605.

Kersten, G. E. and S. J. Noronha (1999). "Negotiations in Electronic Commerce: Methodological Misconceptions and a Resolution." http://interneg.org/interneg/research/papers/1999/02.pdf.

Kersten, G. E. and G. Lo (2001). "Negotiation Support Systems and Software agents in E-business Negotiations." 1st International Conference on Electronic Business (Hong Kong).

Kersten, G. E. (2002). "E-negotiation Engineering: Review of the Emerging Field." Working Paper.

Kersten, G.E. et al. (2000). The Effects of Culture in Anonymous negotiations. A Four Countries Experiment. INR01/00.

Kersten, G.E. and G. Lo (2003). "Aspire: An Integrated Negotiation Support System and Software Agents for E-Business Negotiation." International Journal of Internet and Enterprise Management, Vol. 1, No. 3.

Kumar, M. and S.I. Feldman (1998). Business Negotiation on the Internet. IBM Institute for Advanced Commerce: Yorktown Heights, NY.

Lai, H. and T.C. Yang (1998) "A system architecture of intelligent-guided browsing on the Web", Proceedings of the 31st Hawaii International Conference on System Sciences, Vol. IV, IEEE, Hawaii, 423-432.

Laroche, M., R. Sadokierski (1994). "Role of confidence in a multi-brand model of intentions for a high-involvement service." Journal of Business Research. New York: Jan. Vol. 29, Iss. 1; p. 1 (12 pages).

Laroche, M., C., Kim, et al. (1996). "Brand Familiarity and Confidence as Determinants of Purchase Intention: An Empirical Test in a Multiple Brand Context. " Journal of Business Research, (37:2) pg. 115-120.

Lashkari, Y., M. Metral, P. Maes (1994) "Collaborative interface agents" Proceedings of the Twelfth National Conference on Artificial Intelligence.

Lewicki, R., D. Saunders, et al. (1997). "Essentials of Negotiation." McGraw-Hill, (USA).

Maes, P. (1995) "Software agents." Communications of the ACM. Vol. 38, no.11.

Maes, P. (1994), "Agents that Reduce Work and Information Overload", Communications of the ACM **37** (7), 31-40.

Maes, P., R.H., Guttman, et al. (1999). "Agents that Buy and Sell." Communication of the ACM, 42(3): 81-91.

MacDonald, J. and J. Tobin (1998). Customer Empowerment in the Digital Economy. Blueprint to the Digital Economy: Creating Wealth in the Era of E-Business (Eds.) Tapscott, Lowy and Ticoll. McGraw Hill, New York.

McGill, T and V. Hobbs (2003). "User-Developed Applications and Information Systems Success: A Test of DeLone and McLean's Model." Information Resources Management Journal; Jan-Mar; 16, 1; 24-25.

Melone, N.P. (1990) "A Theoretical Assessment of the User-Satisfaction Construct Management Science." Linthicum: Jan. Vol. 36, Iss. 1; p. 76 (16 pages)

Nwana, H.S., L. Lee, et al. (1997). *Co-ordination in Multi-Agent Systems. In H.S. Nwana and N. Azarmi (Eds.)*, Software Agents and Soft Computing pp.43-57: Springer-Verlag

Nwana, H.S. and D.T Ndumu (1998). "A brief Introduction to software Agent Technology. In N. Jennings and M. Wooldridge (Eds.)" Agent Technology: Foundations, Applications and Markets pp.29-47: Springer Verlag.

Oliver, R. L. (1980). "The Art and Science of Negotiation." JMR, Journal of Marketing Research. Chicago: Nov 1980. Vol. 17, Iss. 4; p. 460.

Oliver, R, L. and W. S. DeSarbo (1988). "Response Determinants in Satisfaction Judgments." Journal of Consumer Research. Gainesville: Mar. Vol. 14, Iss. 4; p. 495 pg. 13

Raiffa, H. (1998). The Art and Science of Negotiation. Cambridge, Harvard University Press.

Raiffa, H., J.Richardson, et al.(2003). Negotiation Analysis. The Science and Art of Collaborative Decision Making. Cambridge: Harvard University Press.

Schimid, B.F. and M.A.Lindermann (1998). "Elements of a Reference Model for Electronic Markets." In 31st Hawaii International Conference on System Sciences (HiCSS-31).

Schoop, M., C. Quix, (2001) "Doc.Com: A framework for effective negotiation support in electronic marketplaces." Computer Networks 37, pp. 153-170.

Schubert, C., R. Zarnekow, et al. (1998). A Methodology for Classifying Intelligent Software Agents. In 6th European conference on Information systems.

Seddon, P and S. Yip (1992). "An Empirical Evaluation of User Information Satisfaction (UIS) Measures for Use with General Ledger Accounting Software." Journal of Information Systems, spring, Vol. 6 Issue 1, p75, 18p

Sharda, R., Barr, S.H, and J.C. McDonnell (1988) "Decision Support System Effectiveness: A Review and an Empirical Test." Management Science, Vol. 34, No.2, pp. 139-159.

Snitkin, S R., and W. R. King (1986) "Determinants of the Effectiveness of Personal Decision Support Systems." Information and Management. Amsterdam: Feb.Vol.10, Iss. 2; pg. 83, 7 pgs

Ströbel, M. (1999). "Effects of Electronic Markets on Negotiation Process: Evaluating Protocol Suitability." IBM, Zurich Research Laboratory (Switzerland).

Sycara, K. et al. (1997) "Designing Behaviors for Information Agents." Proceedings of the First International Conference on Autonomous Agents (Agents'97).

Thompson, L. (1998). The Mind and Heart on the Negotiator. New Jersey, Prentice Hall.

Todd, P and I. Benbasat (1999). "Evaluating the impact of DSS, cognitive effort, and incentives on strategy *selection*." Information Systems Research. Linthicum: Dec. Vol. 10, Iss. 4; p. 356.

Tsvetovat, M, M.Gini, et al. (1997). *MAGMA: An Agent-Based Virtual Market for Electronic Commerce*. Applied Artificial Intelligence 11 501-523.

Young, H.P. (1991). Negotiation Analysis. The University of Michigan Press: Ann Arbour. 1-23.

Vahidov, R. and R. Elrod (1999). "Incorporating Critique and Argumentation in DSS." Decision Support Systems, 26 (3): 249-258.

Vahidov, R. and B. Fazlollahi (2004). "Pluralistic multi-agent decision support system: a framework and an empirical test." Information and Management 41, 883 - 898

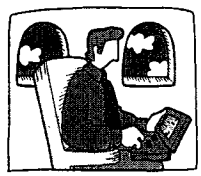
What is negotiation, The Wise Negotiator Sept.1998, Issue 1A.

Appendix A: Recruiting Ads

$10 in 30-45 min and bonus prizes

Online Negotiation! Fun to play!

SUBJECT: Online Negotiation Challenge



WHY:

- ✓ Building your negotiation skills
- ✓ Developing online negotiation experience
- ✓ Having fun and making money

WHEN and WHERE

4 sessions:	Sept.21: 10:00 a.m. and 3:00 p.m.	in GM 210
	Sept 23: 10:00 a.m. and 3:00 p.m.	in GM 210

HOW:

- ➢ Monitor demonstrates online system
- ➢ Monitor presents negotiation case
- ➢ Participant performs negotiation online
- ➢ Participant collect money

REWARD:

$10 for participation

- ❖ Bonus prize for performance, given to 2 best buyers and 2 best sellers ($50 each)

Note: ***Space is limited to 26 persons per session***

P.S. Consent form is available for you to sign before participation.

Appendix B: Sample Questionnaires

1. ***Your age is between***

☐ 15-20 years old ☐ 21-30 years old ☐ 31-40 years old ☐ 41 years old and over

2. ***How many hours a week do you spend on the Internet?***

☐ Less than 10 hours ☐ 12 hours ☐ 15 hours ☐ More than 20 hours

3. ***Do you search for products on the Internet?***

☐ Never ☐ Sometime ☐ Often ☐ Very frequently

4. ***Have you bought any thing from the Internet?***

☐ Yes ☐ No

5. ***Have you used an auction or negotiation Website?***

☐ Yes ☐ No

6. ***Did you complete a successful transaction on an auction or negotiation site?***

☐ Yes ☐ No

Questions for Usability Test

(Please put an × in the appropriate box)

Effectiveness of system

Generally speaking, I found that the system is very effective

Likely							Likely
	extremely	quite	slightly	neither	slightly	quite	extremely

Perceived Usefulness

1. Using the system in online negotiations would enable me to accomplish objectives more quickly

Unlikely							Likely
	extremely	quite	slightly	neither	slightly	quite	extremely

2. Using the system would improve my performance in online negotiations

Unlikely							Likely
	extremely	quite	slightly	neither	slightly	quite	extremely

3. Using the system would enhance my effectiveness in online negotiations

Unlikely | | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

4. Using the system would make it easier to negotiate online

Unlikely | | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

Perceived Ease of Use

1. The system offers an easy way to conduct online negotiations

Unlikely | | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

2. The system is easy to use

Unlikely | | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

3. The system provides clear instructions on the operation

Unlikely | | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

User Satisfaction with Process

1. I am satisfied with the interaction with the system

Unlikely | | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

2. I am satisfied with the guidance provided by the system

Unlikely | | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

3. I am satisfied with the feedback provided by the system

Unlikely | | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

4. I am satisfied with the online negotiation process

Unlikely | | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

User Satisfaction with Outcome

1. Negotiation results meet my expectations

Unlikely | | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

2. I am satisfied with the negotiation outcome

Unlikely | | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

3. Agreement was reached following the negotiation

☐Yes ☐o

4. Agreement made is optimal to me

Unlikely | | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

User Confidence

1. Using the system made me feel confident in conducting online negotiations

Unlikely | | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

2. By using the system, I am confident with the result of negotiations

Unlikely | | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

Future Use of the System

Assuming the system would be available in my life, I predict that I will use it on a regular basis in the future online negotiation

Unlikely | | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

Appendix C: Questions used for data analysis

Perceived Usefulness

1. Using the system in online negotiations would enable me to accomplish objectives more quickly

Unlikely | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

2. Using the system would improve my performance in online negotiations

Unlikely | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

Perceived Ease of Use

1. The system offers an easy way to conduct online negotiations

Unlikely | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

2. The system is easy to use

Unlikely | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

User Satisfaction with Process

1. I am satisfied with the interaction with the system

Unlikely | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

2. I am satisfied with the feedback provided by the system

Unlikely | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

3. I am satisfied with the online negotiation process

Unlikely | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

User Satisfaction with Outcome

1. Negotiation results meet my expectations

Unlikely | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

2. I am satisfied with the negotiation outcome

Unlikely | | | | | | | Likely

extremely quite slightly neither slightly quite extremely

3. Agreement was reached following the negotiation

☐ Yes ☐ No

User Confidence

1. Using the system made me feel confident in conducting online negotiations

Unlikely	extremely	quite	slightly	neither	slightly	quite	extremely	Likely

2. By using the system, I am confident with the result of negotiations

Unlikely	extremely	quite	slightly	neither	slightly	quite	extremely	Likely

Appendix D: Negotiation Cases (Simple)

Your username: seller
Your password: s

Owner of Condo ("Seller")

You own a one-bedroom condo (800 square feet) around Concordia University. You learned from your boss that you would be going to Ottawa from September to next May for a project with your company. You want to rent out your condo while you are away.

You have learned that many students are using eAgora, an online negotiation website to buy books, look for apartments etc. So you log onto the site and find a tenant (also known as "Buyer") who is interested in renting your condo. In renting you condo, you consider negotiating over two issues: (1) monthly rent, and (2) parking spot. The monthly rent (price) means what your tenant will pay for the condo during the contract period. This price is between $1000 and $700 according to market value. You also own a parking spot in the condo complex, but your neighbor also expressed interest in renting the spot from you. Due to these factors surrounding the issues, you assess the weights as follows.

Monthly rent represents 90% and parking spot 10% of your preferences in negotiation.

The table below is a summary of the issues.

Issues

Name	*Options*	*Weights*
Monthly rent (price)	$1000(best) to $700 (worst)	90%
Parking spot	excluded (best) included (worst)	10%

⇒ Now you commence negotiation with the student.

Your username: buyer__
Your password: s___

Potential Tenant ("Buyer")

You are a student of Concordia University, but you live very far from downtown. So you are planning to move closer to school to finish you last semester. You want a one-bedroom condo near the University. You decided to use eAgora, an online negotiation website and you found a suitable place that meets your needs.

The owner (also known as "Seller") of a condo wants to rent the place out and he wants to discuss two issues over the negotiation: (1) monthly rent (price), and (2) the possibility of an indoor parking spot. The monthly rent represents the price that you will pay for leasing the condo during the contract period. Your friend tells you that the monthly rent should be around $800 to $500 for this kind of place. The parking spot is also very important to you because you own a car and parking is extremely difficult around Concordia University. Due to these factors surrounding the issues, you assess the weights as follows.

Monthly rent represents 70% and parking spot 30% of your preference in negotiation.

The table below is a summary of the issues:

Issues

Name	*Options*	*Weights*
Monthly rent (price)	$500 (best) to $800(worst)	70%
Parking spot	included (best) excluded (worst)	30%

⇒ Now you wait for the owner to make the first offer to commence negotiation.

Your username: seller___

Negotiation Cases (complex)

Your password: s____

Owner of Condo ("Seller")

You own a one-bedroom condo (800 square feet) around Concordia University. You learned from your boss that you would be going to Ottawa for two years for a project with your company. You want to rent out your condo while you are away.

You have learned that many students are using eAgora, an online negotiation website to buy books, look for apartments etc. So you log onto the site and find a tenant (also known as "Buyer") who is interested in renting your condo. In renting you condo, you consider negotiating over **five** issues: (1) monthly rent, (2) rental period, (3) deposit amount, (4) parking spot, and (5) cleaning of the condo. The monthly rent (price) means what your tenant will pay for the condo during the contract period. This price is between $1000 and $700 according to market value. The rental period could be 2 years (the best option for you), 1 year (possible option) or 6 months (the worst option). You can also negotiate the deposit amount, which could be $0 (worst), $500, or $1,000 (best). You also own a parking spot in the condo complex, but your neighbor also expressed interest in renting the spot from you. Finally, as part of negotiating you may include cleaning of the condo by you before the tenant moves in. The relative importance of these five issues is expressed as weights as follows.

Issues

Name	*Options*	*Weight*
Monthly rent (price)	Between $1000(best) To $700 (worst)	60%
Rental period	2 years (best); 1 year (OK); 6 months (worst)	20%
Deposit amount	$1000 (best); $500 (OK); $0 (worst)	15%
Parking spot	excluded (best); included (worst)	3%
Cleaning required	No (best); Yes (worst)	2%

⇒ Now you commence negotiation with the student.

Your username: buyer___
Your password: b____

Potential Tenant ("Buyer")

You are a student of Concordia University, but you live very far from downtown. So you are planning to move closer to school to finish you last semester. You want a one-bedroom condo near the University. You decided to use eAgora, an online negotiation website and you found a suitable place that meets your needs.

The owner (also known as "Seller") of a condo wants to rent the place out and he wants to discuss **five** issues over the negotiation: (1) monthly rent, (2) rental period, (3) deposit amount, (4) parking spot, and (5) cleaning of the condo. The monthly rent represents the price that you will pay for leasing the condo during the contract period. Your friend tells you that the monthly rent should be around $800 to $500 for this kind of place. The rental period could be 1 year (the best option for you), 6 months (possible option) or 2 years (the worst option). You can also negotiate the deposit amount that could be $0 (best), $500, or $1,000 (worst). The parking spot is also very important to you because you own a car and parking is extremely difficult around Concordia University. You may also require the owner to perform cleaning of the condo as part of your negotiation. The relative importance of these five issues is expressed as weights below.

Issues

Name	*Options*	*Weight*
Monthly rent (price)	Between $500(best) To $800 (worst)	50%
Rental period	1 year (best); 6 months (OK); 2 years (worst)	15%
Deposit amount	$0 (best); $500 (OK); $1000 (worst)	10%
Parking spot	included (best); excluded (worst)	20%
Cleaning required	Yes (best); No (worst)	5%

⇒ Now you wait for the owner to make the first offer to commence negotiation

Appendix E: Screenshot of online questionnaire