Factors and Business Impacts in Human-Computer Negotiations

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A Thesis submitted to
the Department of
Supply Chain & Business Technology Management

For the Degree of
Doctor of Philosophy (Business Administration) at
John Molson School of Business
Concordia University
Montreal, Quebec, Canada

October 2022

CONCORDIA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

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Entitled: Factors and Business Impacts in Human-Computer Negotiations

and submitted in partial fulfillment of the requirements for the degree of

Doctor Of Philosophy (Supply Chain and Business Technology Management)

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Abstract

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Negotiation commonly takes place where there are competing interests. Negotiations require a substantial amount of cognitive effort and time commitment. Artificial Intelligence (AI) has recently been experiencing a dramatic rise. AI and computer agents may significantly affect how negotiations are conducted. Agents can exhibit human-like behavior and follow the preferences of the principals and predefined strategies, goals, and constraints. For example, some companies already used computer sales assistant to help customers and even negotiate the price and other features online. The purpose of this thesis is to contribute to the transformation of the negotiation process from human vs human to human vs computer, in the context of e-commerce. By investigating various factors that influence human-computer negotiations and the impact of these factors on negotiation outcomes, the current thesis can shed light on the cognitive process underneath human-computer negotiation in the context of online purchasing. The work of this thesis is organized into three major components.

As its first component, this thesis conducted a thorough search of state-of-the-art literature on human-computer negotiation and proposed a framework for future studies. Based on prior research, a list of various kinds of computer agent attributes that may influence negotiation results and the relationships between these factors and negotiation outcomes were proposed. In addition to computer agents' attributes, this essay included past literature that studied human participants' individual differences and the influence of such differences. Based on the Technology Acceptance Model (TAM), this essay investigated the development of human-computer negotiation and human participants' acceptance and perception of a computer agent. At the end of the first essay, an overall research framework is presented.

Based on the framework of essay 1, an experiment was conducted in essay 2 to investigate how various agent strategies, tactics and configurations influence the outcomes of negotiations. Specifically, essay 2 investigated the effects of negotiation tactics (concession pattern/curve), synchronous vs. asynchronous modes, and solution-search mechanisms (search between multiple issues or dive into one issue at a time) on the subjective and objective outcomes of human-computer negotiations. A 3×2×2 experiment was conducted where the subjects could negotiate the purchase of a mobile plan with computer agents acting as sellers. In this experiment, three time-based negotiation concession patterns and two solution-search mechanisms were employed in synchronous vs. asynchronous mode. On the other hand, the negotiation results were evaluated

from multiple levels. Specifically, not only the overall result at group level but also the result at individual level were included in this research. On the individual level, in addition to objective measurements, subjective measures of negotiation results, such as usefulness and intention to use, were also adopted. A model was generated and tested based on TAM and a so-called TIMES framework (Task, Individuals, Mechanism, Environment, and System).

Essay 3 investigates a construct named "implicit power" and the influence of implicit power in the context of online purchasing where humans negotiate with computer agents. Implicit power refers to perceived power gained indirectly through hints in the exchange of offers. In most of the prior research, when researchers talked about power, they meant the kind of power that can be gained directly through communication during negotiation. But there is another kind of power that is implicitly perceived by the other party through ways other than communication and influences negotiations as well. After introducing implicit power, a model was built to test the influence of implicit power of both negotiation parties: humans and computers. Specifically, a 2×4×3 experiment was conducted. Several aspects of implicit power were studied, including anchoring, agent avatar image power, and the power of human subjects' personality. In the experiment, the subjects negotiated the purchase of a laptop with computer agents acting as sellers. Two anchoring conditions and four different avatar images were used to test the influence of computer agents' implicit power. As the source of human's intrinsic power, the participant's personality (Social Value Orientation) was also tested in three different types: prosocial, individualistic, and competitive. This research proposed the concept of implicit power and studied the influence of several kinds of implicit power. The model built in this research shows a good ability to explain the variance in the dependent variable (R^2: 0.44).

Keywords: human-computer negotiation, research framework, system acceptance, implicit power, agent tactics, individual differences

Acknowledgements

Words cannot express my gratitude to my supervisor and Chair of the Department: Professor Rustam Vahidov. His invaluable advice and help carried me through the whole process of my research work. This work would not have been possible without his patience and feedback, which gave me great support and guidance. I would also like to express my deepest appreciation to Professor Raafat Saade. His passion for research inspired me and gave me many research ideas. I am deeply grateful for his detailed proofreading and editing help.

I would like to give my warmest thanks to HEC's Department Director: Professor François Bellavance, who generously provided knowledge and expertise to help me. The experimental design course he taught me is one of the most important training courses I had to go further in academic research. I am also grateful to my research committee member Suchit Ahuja for letting the project writing and defense be an enjoyable journey.

Additionally, I would also give my greatest thanks to Professor Bo Yu, who offered great help with my research ideas and methods when I undertook my research. I am also grateful to Dr. Xuhua Shen for his editing help and feedback.

Lastly, I would like to give special thanks to my parents, Jishan Yang and Li Liu, for their continuous support, understanding and encouragement during this process.

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1 Introduction

Negotiations have been a subject of extensive research in recent years. When competing interests exist between parties, negotiations have been found to be a potentially effective mechanism for the search of a joint solution. In a negotiation process, two or more parties or entities communicate over one or more issues to reach a balanced outcome. A balanced outcome between negotiators means an agreement where each party tries to achieve their most benefit (Adnan et al., 2016). In negotiations, the concept of utility is often employed to measure the level of economic outcome, profitability or desirability of a given offer (or a counteroffer).

There are three major categories of business exchange mechanisms, including fixed-price catalogues, auctions, and negotiations (Gimpel et al., 2008). Negotiations offer additional benefits, primarily due to their flexibility in identifying different pathways to achieve the highest utility for both parties. (B. W. Brooks & Rose, 2004; Sharland, 2001). However, negotiations require a substantial amount of cognitive effort and time commitment, involving psychological influences such as emotions and personality traits that need to be considered. To that effect, Artificial Intelligence (AI) technologies can facilitate the negotiation process with the promise of less subjective influence and acceptable outcomes for all negotiating parties (Patil & Gaud, 2021).

Artificial Intelligence has recently been on the dramatic rise, promising profound effects on the fast-evolving smart economy and society (Aghion et al., 2017). Computer agents, a subset of AI, may significantly affect how exchanges and mechanisms operate. Using software agents to represent human or business interests in negotiations is a promising research direction (Baarslag et al., 2017; G. J. Hofstede et al., 2019; Koley & Rao, 2018). The evolution of the AI technologies and the Internet allowed for the creation of electronic negotiation platforms suitable for integrating business strategy and operations and used when the parties are separated spatially or in time (Kersten & Noronha, 1999).

The use of software components, called computer agents (or software agents) that exhibit a human-like behavior as negotiating to represent a given party seems to be a promising way to take advantage of the benefits of this exchange mechanism while minimizing the cognitive effort and subjective influence. Agents can be instructed to behave following the preferences of the principals (humans or businesses) while adhering to defined strategies, tactics, goals, and constraints (i.e., behavior). As they are free from cognitive, emotional, and psychological influences, they will manage the negotiation process more effectively and efficiently while simultaneously obtaining more coherent and favorable outcomes.

In the current thesis, first, a thorough search of the state-of-the-art literature on human-machine negotiations was conducted, and a framework for future studies was proposed. After researching extensive literature, a list of various kinds of computer agent attributes that may influence negotiation results was proposed and the relationships between these factors and negotiation results were put forward based on past research. In addition to computer agents' features, the experiment human subject's attributes were also included in this thesis and the influence of individual differences was researched. Combined with Davis's "Technology Acceptance Model" (TAM) (Davis, 1989) and Vetschera et al.'s "Assessment Model for

Internet-based Systems" (AMIS) (Vetschera et al., 2006), current research proposed an enriched new AMIS model and a framework for future study.

This is followed by an essay that focuses on the prospects of humans negotiating with artificial computer agents in online shopping settings. It studied the influence of computer agents' attributes on negotiation results and proposed a systematic method to evaluate the negotiation outcomes. Specifically, this essay investigated the effects of synchronous vs. asynchronous modes, concession tactics (concession curve), and search mechanisms (search between different issues or dive into one issue at a time) on the subjective and objective outcomes of human-computer negotiations. Experimental studies on agent vs. human negotiations aim to investigate how various agent strategies and tactics, as well as other important settings or individual attributes, influence the outcomes of negotiations (Vahidov et al., 2014). On the other hand, the negotiation results were evaluated from multiple levels. Specifically, not only the overall result at group level but also the result at individual level were included in this research. On the individual level, in addition to objective measurements, subjective measures of negotiation results, such as usefulness and intention to use, were also adopted. Based on a so-called TIMES framework (Task, Individuals, Mechanism, Environment, and System) (Kersten et al., 2008), a model was built in current research to measure the negotiation results. This research systematically accommodates multiple layers of measurement of negotiation results into one model. It promotes a way to evaluate negotiation results from different perspectives systematically. The findings could provide valuable insights into the design of successful online businesses incorporating the elements of software agent technologies and flexible offer-making.

In the third essay, I studied implicit power and its influence on negotiations. Power is widely considered to be the most important factor in negotiations. It is commonly accepted that higher power will lead to better negotiation results. In previous research, power was considered to be gained directly through chat or natural language communications. But there is another kind of power: implicit power. It is perceived implicitly by the other party through tacit hints as opposed to a message explicitly expressed through direct communication (chat) or demonstration of such party's power. Implicit power originates from the field of social psychology and is not widely recognized in the field of negotiation. Many commonly used variables should be categorized as implicit power, such as anchor (starting point), concession tactic (toughness of an agent), and facial expression. These variables show hints about the negotiator's power that will be perceived implicitly from the exchange of offers. However, these variables were not identified as a whole to represent power. In prior studies, these variables were studied separately from power as if these variables represent other aspects of a negotiator. This led to some conflicting results from past studies (Schaerer et al., 2015). Schaerer et al. found that higher power led to lower negotiation results, which is the opposite of the commonly accepted understanding. In Schaerer et al.'s research, they separated anchor from power and studied anchor and power separately. They found that all the high-power negotiators had set a lower anchor. They believe this is because anchor had a stronger influence. But in fact, anchor is one factor of implicit power. So lower anchor decreased the negotiator's power and, as a result, decreased negotiation results. In summary, if Schaerer et al. had included anchor in power, their results could have been consistent with past literature and common sense.

After introducing implicit power, a model was built to test the influence of implicit power of both negotiation parties: humans and computers. I specifically incorporated agent's anchor, concession tactic, agent gender (in avatar image), and facial expression (in avatar image) into this model as an agent's implicit power. It can be easily understood that those features of an agent can convey some tacit hints about the agent's power, and they can change the negotiation result if other conditions are the same. In particular, an agent who sets a high starting point (high anchor) or is very hard to yield (tough tactic) can make the other party perceive this agent as powerful. In addition, as commonly accepted in past research, male agent and angry facial expression would also convey a sense of strong power. Furthermore, in the context of human-computer negotiation, both the computer agents' and human negotiators' traits should be considered when accounting for implicit power. So, human negotiators' individual differences should be introduced into the model as the implicit power of the participant. Human negotiators' individual differences root in such a person's characteristics and demographic background. This expands the research to the area of social psychology. The concept of Social Value Orientation (SVO) from social psychology was adopted. This research proposed to introduce implicit power to the negotiation field and found some proof of the existence of such a construct. The experiment results show much interaction between anchor, SVO, and agent gender. These interactions may indicate the existence of such implicit power between these variables. This research introduces an "implicit power" construct, which can solve some conflicting results from previous research.

The remainder of the thesis is organized as follows. Essay 1 reviews the state-of-the-art literature related to human-computer negotiations to develop a research agenda. It is followed by Essay 2: Human-Computer Negotiations: A Systematic Evaluation of the Effects of Timespan, Tactic, and Search Mechanism. In this essay, the influences of several factors such as concession curve, search mechanism, and timespan were studied, and both subjective and objective outcomes were tested. In the end, Essay 3 was introduced: Can a Negotiator Build a Tough Impression Without Chatting? ——Implicit Power and Its Influence on Human-Computer Negotiation. In both Essay 2 and Essay 3, research models and hypotheses are introduced, followed by a description of experimental settings and procedures, then concluding with the experiment results and discussions.

2 Essay 1: Human-Computer Negotiations: State of the Art and Research Agenda.

In this essay, an exhaustive search of state-of-the-art literature was conducted to propose a framework for future studies. The literature was organized in the following manner: First, the development of human-computer negotiation was investigated, and a list of computer agent tactics that may influence negotiation results was developed. Second, past literature that studied human participants' individual differences and the influence of such differences on negotiation results was studied. Third, extensive literature was reviewed to investigate human participants' acceptance and perception of computer agents. Fourth, I combined my research framework with the TAM and AMIS and generated an enriched new model. Finally, literature on the influence of the above factors on negotiation results was researched, and my overall research framework was presented.

2.1 Human-computer negotiation

Designing agents to negotiate with humans has been an intriguing research direction (Mell et al., 2021). It has been suggested that such agents should take into account social and reputational aspects while negotiating with humans (Mell, 2017). An overview of the applications of software agents in e-commerce was presented by Yu et al. (2015). The authors concluded that the use of software agents is becoming more important in social affairs and has a high potential for building responsive and smart e-commerce systems. Automating or semi-automating negotiations would help alleviate an effort-consuming negotiation task and the associated psychological burden on humans engaged in this interaction. It would also contribute towards maintaining the expected consistency of the negotiation's processes and outcomes, which, in turn, would promote better control by human principals in managing the exchange processes.

Research on the use of computer agents in negotiations dates back to the 90s, with results confirming that computer agents achieved better economic results than humans in some aspects (Chavez & Maes, 1996; Faratin et al., 1998; Patil & Gaud, 2021). An early work including negotiating agents in a simulated marketplace was reported by Maes, Guttman, and Moukas (1999) featured price-only negotiations among software agents regarding the sale and purchase of items. The agents deployed pre-defined tactics to exchange offers in the negotiation process. Patil and Gaud developed a negotiation technique: Minimum Profit Algorithm (Patil & Gaud, 2021). It used XG Boost regressor for intelligence to achieve a mutually acceptable agreement between the supplier and customers. Their results suggest that this system outperforms the traditional way of negotiation.

There has been past experimental work on using agents to negotiate with human counterparts. Burgoon et al. (2000) conducted an experiment to examine whether including richer and more human-like attributes in computer agents would increase their influence. Participants were randomly assigned to one of five computer or human agents and negotiated using the Desert Survival Problem (Lafferty et al., 1974). Results suggested that computer agents showed more influence than human agents, while human agents received more positive ratings with regard to communication dimensions.

In another study, an experiment was designed to compare the performance of agents vs. humans in agent-human negotiations (Bosse & Jonker, 2005). The findings suggested that agents were able to achieve more fair agreements. Huang and Lin (2007) reported using an agent imitating a salesperson that employed persuasion while negotiating product prices with customers. In Vahidov, Kersten, and Gimon (2012), agents were employed to interact in a procurement scenario with a single buyer and three sellers. Most participants were human subjects, but some seller groups included agents. In this study, conceding agents made more agreements than humans, but competing ones made no agreements. An experimental study comparing the performance of software agents with different time- and behavior-dependent tactics in negotiations with humans has been reported (Vahidov et al., 2014). The study also included a group of "human-human" negotiations as a control group. The findings suggested that most agent types outperformed humans regarding the utility achieved. Moreover, the findings clearly demonstrated that more "human-agent" agreements were achieved when compared to "human-human" negotiations.

Some researchers investigated other factors that may also influence the "human-computer" negotiation process and outcomes. In another experimental study, agents negotiated a deal with varying levels of complexity (Vahidov et al., 2017). The complexity of the negotiation task was operationalized by varying the number of issues to negotiate. It was found that task complexity had an interaction effect with agent tactics on the negotiation outcomes. The impact of photographic images embedded in agent offers has been found to significantly impact the result (Vahidov, 2018).

The use of computer agents can influence not only economic outcomes but also subjective perceptions. Shank (2013) found that the computer identity of an agent weakens a customer's emotional response and perception of product quality. Moreover, many customers showed no discernible difference in their reactions to human or computer agents. In subsequent research, Shank (2014) investigated the influence of using computers as agents on customers' perception of the "goodness" of the product's quality. The results suggested that the agent's computer identity weakened a customer's perception, which led to power impressions, while "goodness" was not influenced.

Along with the development of AI, it can become harder to tell a computer agent from a human negotiator, which leaves great potential to adopt a computer agent instead of a human negotiator. Byde, Yearworth, Chen, and Bartolini (2003) reported an experiment pairing humans with agent counterparts in negotiation settings. They designed an automated negotiation agent system and used it in their experiment. The result suggested that experiment subjects could not distinguish computer agents from human negotiators based on performance and the ability to negotiate "reasonably". Miwa and Terai (2012) found out that information or instruction about the agent (whether the agent is a human or computer) rather than the agent's actual behavior (cooperate or not) would influence the participants' choice about whether to cooperate with the agent in the Prisoner's dilemma game (Poundstone, 2011).

In recent years, more intelligent computer agents have been designed and widely used. For example, Rosenfeld et al. (2014) invented a chat-based negotiation agent named NegoChat. The advantage of this computer agent is that it can support natural language processing (NLP) and use strategies adjusted to NLP. Mell and Gratch (2016) designed a web-based human-computer

negotiation platform named IAGO. IAGO provides a front-facing graphical user interface (GUI) for the human participants and allows the agent designer to customize the agent using a specific negotiation tactic or strategy. In the first annual human-agent league of the Automated Negotiating Agents Competition, competitors from several universities submitted their designs of computer agents to IAGO. Human subjects were recruited from Amazon's Mechanical Turk (MTurk) and asked to negotiate with those aforementioned computer agents (Mell et al., 2018).

2.2 Influence of agent's attribute

Negotiation can be viewed as a distributed search through a space of potential agreements (Jennings et al., 2001), according to the perspective of agent involvement. This distributed search has three aspects: the rules governing the interaction (such as participant types, negotiation status, and protocols), the range of issues over which agreement must be reached (single issue or multiple issues), and models that define how agents move toward an agreement (such as agents' decision-making models and concession methods). The latter aspect is twofold: how an agent decides to make concessions (tactics or concession models), and how an agent manipulates the issues in multi-issue negotiations while making concessions (search mechanisms).

In addition to concession models and search mechanisms, there are many other tactics that can also be used in negotiation. For example, coercion, opening strong, and salami tactics (Saner, 2012) can be used in distributive negotiations, while logrolling is commonly used in integrative negotiations. In distributive negotiations, tactics or other methods are used to exert power or force the opponent to yield. Because distributive negotiation is a "zero-sum" transaction, the "Pie" amongst all negotiators is fixed. If one party yields in the negotiation, the other parties will gain more utility. As a result, showing power can be very useful in making the opponent yield or compromise. Furthermore, Bacharach and Lawler (1981) suggested that power is the central determining factor in negotiations. To show power to the opponent, one can use many methods, such as strong opening (anchoring), facial expression cues (such as angry facial expressions) and showing very little or no compromise.

On the other hand, tactics used for integrative negotiation aim to identify the priority of all the issues for each party and, thus, the solution to enlarge both parties' benefits. In other words, the negotiator's interests usually are not in completely opposite positions, which means that an issue that is important for one party may not be equality important to the other. This provides an opportunity for both parties to reach a win-win outcome by compromising on their less important issues in order to gain more on their more important issues.

In a real-world negotiation, there is a limit to the space for logrolling, so both integrative tactics and distributive tactics should be used in negotiation.

2.2.1 Concession curve (tactic)

Concession-making tactics describe how agents decide on concessions during negotiations. Three families of tactics have been identified and studied by Faratin et al. (1998), including behavior-dependent, time-dependent, and resource-dependent. These types of tactics represent

how agents react as they interact with their human counterparts. In behavior-dependent tactics, agents react to their opponent's offer-making by composing offers based on pre-determined behaviors (for example, imitation of the opponent's behavior, namely Tit-For-Tat). Time-dependent tactics make concessions based on the time elapsed during the negotiation, following a certain behavioral pattern. These can be represented using curves showing drops in issue utility values over time. Minor concessions in the beginning usually indicate a competitive behavior, while giving up a large amount of utility from the start is indicative of a conceding behavior. Resource-dependent tactics are models guided by the availability of resources remaining during negotiations. This kind of tactic makes offers based on the estimated amount of a certain resource. To this end, it is similar to the time-dependent tactics, except that the domain of the function used is the quantity of a resource other than time.

Early use of time-depending tactics was reported by Chavez, Dreilinger, Guttman, and Maes (1997). They employed three types of concession-making curves: "anxious", "cool-headed", and "greedy". The "anxious" agent would quickly lower its price and was more likely to make a deal, with a linear decay and the same concession throughout the whole negotiation process. A "cool-headed" agent was between "anxious" and "greedy" agents (decay in an inverse-quadratic shape curve). A "greedy" agent would make very small concessions at the beginning, trying to gain more utility, and large concessions when it was close to the end (decay in an inverse-cubic shape curve). The experiment found that the greedy agent obtained more utility only for mugs; for other trading goods, the results were non-intuitive. Lopes et al. (2001) classified tactics into five categories based on the amount of concession made: stalemate, tough, moderate, soft, and compromise. These tactics can express the initial attitude of the agents.

During the later use of time-dependent tactics, various researchers have found ways to describe or define time-dependent curves. For example, to ensure that agents' tactics can adequately represent their owners' strategies and preferences, Luo, Jennings, and Shadbolt (2006) devised a novel default-then-adjust acquisition technique. They conducted an experiment over an accommodation-renting scenario. The result indicated that tactics were efficient in acquiring the participants' strategies and preferences. In addition, functions were used to describe the curves of tactics. For instance, Lee and Chang (2008) adopted three types of time-dependent tactics: Boulware, Linear, and Conceder Tactics, which were also used by Wang and Chou (2003), using the formula proposed by Faratin et al. (1998). Lee and Chang compared these tactics with three behavior-dependent tactics: Relative, Average, and Random Absolute Tit-For-Tat Tactics. However, in their experiment, all negotiations were simulated between computer programs and no human participants were included. In another research, Carbonneau and Vahidov (2014) proposed a model in which utility can be specified by a curve with only one changeable parameter that reflects the degree of competitiveness (or toughness) of the negotiator. With the change of that parameter, an agent can be set to be competitive (make small concessions at the beginning and large concessions at the end), conceding (make large concessions at the beginning and small concessions at the end), or cool-headed (make the same amount of concessions all the time). This method greatly reduced the complexity of an agent's tactic configuration.

2.2.2 Multi-issue negotiation (search mechanism)

Another important consideration is whether the agent's tendency to exploit a single issue at a time or try manipulating multiple issues in the negotiation process would lead to better results. As mentioned earlier, there are usually multiple search methods to manipulate issue options for achieving the same overall drop in utility. Adopted from the general field of Artificial Intelligence, depth-first methods tend to make concessions on a single issue (exploiting opportunities within one issue at a time). At the same time, breadth-first search mechanisms try out manipulations with different issues at each step to move toward an agreement.

Negotiations involving multiple issues in the search method allow for richer options in searching for mutually beneficial agreements. Rangaswamy and Shell (1997) proposed that negotiations over multiple issues allowed discrepancies between the preferences of different negotiators' issues. This discrepancy is a key element in searching for mutually beneficial solutions. Some other studies researched the effect of search mechanisms (negotiate one issue at a time or make multi-issue offers). These studies found that negotiators making multi-issue offers outperformed those negotiating one issue at a time (Mannix et al., 1989; Yukl et al., 1976).

On the other hand, Naquin (2003) studied the relationship between the number of issues and the satisfaction level of negotiators. They found that an increase in the number of issues added to the potential for integrative outcomes but at the same time worsened the negotiator's satisfaction with the result. Because the negotiators expected better outcomes when there were more issues under negotiation, the results did not turn out as good as the negotiator's expectation, leading to more dissatisfaction. In this case, more issues in a negotiation do not necessarily lead to better results. An adequate number of issues will leave the participant more satisfied.

Search mechanisms also influence joint outcomes. Yao et al. conducted three experiments and found that frequent use of multi-issue offers increased joint gains, and the interaction between trust (low or high) and multi-issue offers had an impact on joint outcomes (Yao et al., 2021). However, other studies report inconsistent relationships between the use of multi-issue offers (instead of single-issue offers or depth-first search mechanism) and joint gains. For example, the relationship was negative in Weingart et al. (1990), positive in Liu and Wilson (2011), and not significant in Cai et al. (2000).

2.2.3 Time pressure (timespan)

Besides the computer agent tactics mentioned earlier, another important aspect of conducting online "human-to-agent" negotiations is the effects of synchronous versus asynchronous negotiation sessions, representing the mode of interactivity. In other words, whether the fact that negotiations are conducted in a synchronous session or are extended over time as a series of offer retrieval/submission episodes may have an impact on key outcomes.

In synchronous mode, it is expected that a participant would be more engaged, while in asynchronous mode, when the processing time is long enough, one may be interrupted and distracted. This interruption does not necessarily lead to worse results. Min, LaTour, and Jones (1995) studied the influence of negotiation time on the outcomes (price). It was found that

among student subjects, longer negotiation time meant better deals. Nonetheless, when the timespan for the negotiation procedure is long enough, a problem emerges that the participants can be interrupted during the negotiation and potentially reduce the level of engagement and attention to the negotiation process and details. This problem could be significant and may result in errors (McFarlane & Latorella, 2002). Some researchers have studied the effect of various kinds of interruption and the relationship between them (McFarlane, 2002). Another study comparing synchronous and asynchronous electronic negotiations concluded that synchronous negotiations follow a phase model similar to Sequential Stage Models (as opposed to episodic models), while asynchronous negotiations did not show this similarity trait (Pesendorfer & Koeszegi, 2006).

The issue of time in negotiations can be translated into the pressure of time elapsing and deadlines imposed on the negotiation processes. Paurobally et al. (2003) conducted an experiment to study the offer exchange under time constraint in the context of mobile electronic commerce. They designed an agent that could give offers depending on the amount of time left. Adair and Brett (2005) proposed a model that tested how the behavior sequence varied across the time spent. Nevertheless, another study by Moore (2004) looked at how negotiators treated deadlines. It was found that when given the choice of revealing time deadlines for negotiations, negotiators chose not to do so because they thought this would be detrimental to their own outcomes. However, the study found that revealing deadlines could lead to more speedy concessions from the other party, generating better outcomes for the negotiator. Mosterd and Rutte (2000) focused on the effects of time pressure and accountability on the competitiveness of interaction and outcome. Their study found that when negotiators negotiated only for themselves, time pressure made them less competitive, and a greater proportion of negotiations led to an agreement. When negotiators negotiated on behalf of "constituents", however, the opposite was found. Time pressure resulted in more competitive behavior and a lower proportion of agreements.

De Dreu (2003) conducted two studies to investigate the influence of time pressure and the "closing of mind" in negotiation. The author found that the effect of time pressure was due to the need for cognitive closure, namely "the closing of mind", under which people seek closure of the process and engage in shallow rather than thorough processing of information. The author found that the pressure of limited time reduced the participants' motivation to process the information thoroughly. The human participant would rely more on cognitive heuristics and achieve a less integrative agreement. In an empirical study, Stuhlmacher and Champagne (2000) also found that participants under higher time pressure made fewer offers in average and conducted more and larger concessions that were consistent with negotiator preferences. In a meta-analysis of extant research on time pressures, Stuhlmacher et al. (1998) found that high time pressure increased the likelihood of concessions and cooperative behavior across studies.

Chi et al. (2013) also investigated time in relation to other variables, such as customer satisfaction and profitability. They discovered an interaction effect, where time enhanced customers' experience of service quality. Another study by Okhuysen et al. (2003) found that negotiated agreements were more efficient (i.e., less contentious) when there was more time available until the agreements had to be implemented.

2.2.4 Power

As one of the basic concepts in social science (Russell, 1938), power exists widely in our daily life, from the smallest negotiating talk between parents and children to negotiations between two nations. Power is defined by Magee and Galinsky (2008) as "asymmetric control over valued resources in a social relationship" (related definitions can be found in Blau, 1964; Fiske, 2010).

In 1959, social psychologists John French and Bertram Raven identified five bases of power: reward, coercive, expert, legitimate, and referent power (French et al., 1959). Later, researchers started to realize the dynamic and subjective nature of power and identify social and personal power (J. R. Overbeck & Park, 2001; Van Dijke & Poppe, 2006). Social power involves control over resources that others value, while personal power involves control over one's own access to resources and therefore involves a lack of dependence on others.

In the social science field, Galinsky et al. conducted a review of power, covering the past, present and future of power (Galinsky et al., 2015). The authors summarized four ways to manipulate or measure power: structural, experiential, conceptual, and physical. In conceptual manipulation, Galinsky et al. proposed a visual priming method that could prime power through visual imagery. In a previous study, Galinsky et al. (2003) investigated how cognitive representations of concepts could be made psychologically salient and could consequently affect behaviors, often outside of conscious awareness. The visual priming proposed by Galinsky can be likened to one aspect of referent power in French and Raven's five bases of power (French et al., 1959). This visual priming can give a visual cue suggesting the subject's background, charm or social status. Torelli et al. (2012) demonstrated that the concept of power could be successfully activated by showing participants' photos.

In addition to the situational factors of power mentioned above, Galinsky et al. also proposed some moderators of power, such as individual differences or culture. One of the individual differences that is associated with power is trait dominance, which is defined as "the tendency to behave in assertive, forceful, and self-assured ways" (C. Anderson & Kilduff, 2009). This definition is consistent with the personal power as opposed to social power, which was identified by Overbeck and Park (2001). This definition is also consistent with the dimensions of social value orientation: a topic I will turn to in the 2.3.1 Social motives section.

The effect of power on negotiation has been studied extensively in numerous studies (C. Anderson & Thompson, 2004; P. H. Kim et al., 2005; Wolfe & Mcginn, 2005). Power-dependence theory (Emerson, 1962) is refined for negotiation research based on the social exchange theory: a negotiator with comparatively higher power can claim more resources in negotiation results. For example, one article indicated that high-power individuals used power for their own needs (Galinsky et al., 2003). In another article, the authors found that when two parties were perceived with equal power, the distribution of result utility got affected, leading to more integrative results (Wolfe & Mcginn, 2005). Anderson and Thompson (2004) found that positive actions from more powerful parties would lead to more integrative results than those from less powerful parties, while joint outcomes were not influenced.

In the social science and social psychology areas, two kinds of power have been identified: explicit power and implicit power. Some power cues are explicit, obvious and salient, while others are implicit, subtle and harder to detect. Caza et al. (2011) investigated the two kinds of power in an organizational background. They found that implicit and explicit power cues have different effects on people, and the way power is conveyed and expressed can influence important outcomes in organizations.

Although explicit power plays a great role in society, implicit power can influence subjects' behavior even without their consciousness. Implicit power can be demonstrated using various measures, and nonverbal behavior is one kind of implicit power. While nonverbal behavior has been studied among human subjects, few articles have examined its use in computer agents. Krämer (2008) conducted a few experiments and investigated the use of nonverbal behavior in avatars or agents. Since most nonverbal behaviors cannot be controlled consciously by human subjects, they believe that the only method of studying nonverbal behavior is by using virtual agents or avatars that can be systematically controlled (Bente et al., 2001; Blascovich et al., 2002). Their results revealed a significant effect of the increased head movement of a virtual agent on observers' impressions.

In the literature from the negotiation field, power rarely was studied from implicit/explicit perspectives. However, recently, Overbeck and Wareham conducted research and investigated nonverbal behavior in mixed-gender negotiations (J. Overbeck & Wareham, 2020). They believe some nonverbal dynamics related to power have the potential to explain gender differences in negotiation processes and outcomes. The authors reviewed past theoretical and empirical literature and found that several gender differences in nonverbal behavior could be directly correlated with power differences in nonverbal cues. In the end, the authors developed three properties of nonverbal cues, including mode (e.g., implicit vs explicit), intent (e.g., spontaneous vs strategic), and consequence (e.g., competitive vs cooperative).

2.2.5 Opening offer (anchoring)

In the 1970s Amos Tversky and Daniel Kahneman (1974) found that when people make judgments and decisions, they tend to rely on three heuristics: availability, representativeness, and anchoring. Anchoring as one of the cognitive biases has drawn much attention since then. There are several theoretical backups for the reason why anchoring can influence negotiation: (1) the social implications theory; (2) the insufficient adjustment theory; (3) the numeric priming theory; and (4) the information salience theory (Guthrie & Orr, 2006). Although all the theories can explain some cognitive processes behind anchoring, it is commonly admitted that the last theory provides the most compelling explanation. According to the information accessibility theory, when we are presented with an anchor, we will try to collect the information we have access to and test the accuracy of the anchor (Strack & Mussweiler, 1997). Nevertheless, subconsciously, we would look for the positive evidence and treat the anchor as if it is the true value or close to the true value.

Anchoring is usually referred to as the initial offer or opening offer. In some psychological papers, adjustment and heuristics are also used to refer to anchoring. It is based on the priming effect and sets up the starting point for following offers and counteroffers. A considerable

number of studies have researched the issue of first offers and counteroffers (Blount et al., 1996; Moran & Ritov, 2002; Whitford et al., 2013). Kristensen and Gärling (1997) found that anchor points (i.e. seller's initial offer) and reference points (reservation price) jointly influence counteroffers. When buyers perceived the initial offer as a gain rather than as a loss, they bought at a higher price, and there were fewer offers and fewer impasses. In a later article, Kristensen and Gärling (2000) noted that counteroffers were higher for a high rather than low anchor point (seller's initial offer) but also higher for a high reference point when the anchor point was perceived as a gain compared to a low reference point when the anchor point was perceived as a loss. Schaerer et al. noted that anchor and final negotiated values are highly correlated (Galinsky & Mussweiler, 2001; Schaerer et al., 2015).

Specifically, researchers have found that negotiators tend to be inappropriately affected by anchors in negotiation (Kahneman, 1992; Ritov, 1996; Thompson, 1995; Whyte & Sebenius, 1997). It is found that anchoring persists even when negotiators are aware of its effects (Chapman & Johnson, 2002). In other words, when a participant is aware that the other party is using an anchoring tactic to affect the negotiation, this participant still cannot eliminate the anchoring's influence from the other party.

Guthrie and Orr (2006) found out from a meta-analysis that the negotiator will be less influenced by the anchoring effect when given rich information than in an environment with limited information. Also, an experienced negotiator will be less influenced by anchoring. This result is also supported by several other articles (Bateman, 1980; Brodt, 1994). This means there is an interaction effect between anchoring and information richness as well as between anchoring and negotiator experience. According to Guthrie and Orr's classification (2006), the negotiator is in a moderate information environment if they are offered the BATNA (Best Alternative To Negotiation Agreement) (R. Fisher et al., 2011). Otherwise, they are in a low-information environment.

2.2.6 Avatar image

In order to enrich Web site interfaces and enhance consumers' shopping experiences, an easy and low-cost way is to use an avatar as a profile image for online shopping agents. Qiu and Benbasat (2005) have found that 3D avatars enhance consumers' feelings of telepresence (feeing present using a communication medium). Numerous research papers have discussed the application of anthropomorphic agents and their interactions with human beings. In the study of Aldiri et al. (2008), the authors studied the use of images for sales agents, and they found that using images can increase the customer's initial trust towards e-commerce.

2.2.6.1 Avatar image: agent gender

The negotiator's gender and its influence have drawn many researchers' attention for decades (Chen & Chen, 2012; Halpem & McLean, 1996; Kray et al., 2001, 2002). Abundant research findings have shown that women's performance in mixed-gender negotiations often falls below those of men, especially in negotiations on monetary tasks (Bowles et al., 2005; Stevens et al., 1993; Walters et al., 1998). In a meta-analysis of extant research dealing with gender differences

in negotiation outcomes, Stuhlmacher and Walters (1999) found that across studies, men negotiated significantly better than women. However, the differences in outcomes between men and women were small.

Research points to behavioral differences between female and male negotiators before, during, and after the negotiation. Before the negotiation, women set lower goals and expectations than their male counterparts (Kray et al., 2001; Major & Konar, 1984). During the negotiation, women react in a more emotional manner (Stuhlmacher & Walters, 1999). They tend to consider what happens as part of a long-time relationship, whereas men usually take each negotiation episode as a separate, unconnected event (Greenhalgh & Gilkey, 1993). Consequently, women often show more interest in interpersonal relationships at the bargaining table (Kray & Gelfand, 2009). In other words, they end up significantly more on the cooperative side than their male counterparts, who are instead more likely to endorse a more competitive method (Walters et al., 1998). Men also often receive better offers in negotiation (Ayres & Siegelman, 1995) and, thus, as a consequence of an anchoring effect, obtain better results at the end of the discussion. At the end of a negotiation episode, women report less satisfaction with their overall performance than men do (Watson & Hoffman, 1996). They acknowledge feeling less powerful during the bargaining process (Kray et al., 2001) and report greater dislike of the whole process (Babcock et al., 2006; Small et al., 2007), as well as lower self-efficacy (Stevens et al., 1993).

Plenty of articles are trying to explain the origin of the gender difference in negotiation behavior. Watson (1994) proposed in a review article four explanations for the origin of gender differences in negotiating behavior: gender-role socialization, situational power, gender and power combined, and Expectation States Theory (Berger et al., 1977). These four explanations explain the gender differences from the following perspectives: 1) behavioral expectations, 2) power in a given situation regardless of gender, 3) the combination of behavioral expectations and situational power, and 4) Expectation States Theory. Expectation states theory proposes that the effects of power and gender combine with each other but differently under different circumstances. For example, being a male negotiator will enhance his power when facing a female but has no effect when facing another male.

Social Role Theory (Eagly, 1987; Eagly & Karau, 2002) proposes that distributive negotiating presents a disadvantage for women. According to social role theory, social roles—such as gender roles—carry expectations regarding the appropriate behavior of occupants of those social roles. Gender roles contain expectations of how men and women should behave. When one behaves in a way that is not consistent with stereotypic expectations, one is likely to be negatively evaluated in terms of the gender role, the role of negotiator, or both (Eagly & Diekman, 2005; Eagly & Karau, 2002), which is called Role Congruity Theory. This effect has been demonstrated specifically in negotiation (Watson, 1994). According to social role theory (Eagly, 1987), the stereotype held by western society is that women should behave in a manner that reflects concern for others and selflessness; this role is characterized as *communal* (Bakan, 1966). By contrast, the stereotype of men in western society is that of displaying competitiveness, self-assertion, and a desire for achievement, which Bakan characterizes as *agentic*. Accordingly, they claim that because negotiation performance rewards aggressive and competitive behaviors that are congruent with an agentic stereotype and punishes passive and accommodating behaviors associated with a communal stereotype, female gender stereotypes

should accordingly place female negotiators at a disadvantage (Kray & Thompson, 2004; Miles, 2010).

One meta-analysis (Shan et al., 2019) found an interaction effect between gender and culture. The authors used a few variables to represent cultural values: individualism, assertiveness, in-group collectivism, and harmony. They found that these variables moderate, strengthen, or weaken the effect of gender on negotiation performance.

However, to my knowledge, most research is about the human participant's gender. Few articles studied the influence of computer agents' gender and its influence. Amanatullah and Morris (2010) conducted an experiment where humans negotiated with computers and studied gender's influence on negotiation behavior. However, their research is about the influence of human participants' gender. The authors only included one gender for computer agents, so the computer counterparts are the same gender for all the human participants. Johnson et al. (2021) investigated the gender difference with an intelligent agent. However, they did the same as in previous articles, using a male agent for all the cases.

2.2.6.2 Avatar image: facial expression (visual cues)

Since Carnevale and Isen (1986) first brought scholarly attention to the importance of emotions in negotiation, researchers started to realize that emotion played an inevitable part in negotiation. After that, a variety of feelings are examined in a negotiation context. For example, Fisher et al. (1990) showed that the very activity of negotiating caused feelings of anger to increase in individuals. A couple of studies also examined the effect on a more general level. Kumar (1997) discusses the origins and consequences of emotional affect in negotiations. He argues that positive and negative affect may have positive and negative effects on negotiation outcomes. Similarly, Kopelman et al. (2006) found that negotiators made more extreme demands when faced with a negotiator displaying negative emotions while displaying positive emotions was more likely to result in the other party making concessions. Barry and Oliver (1996) review the sizeable literature on "affect" and discuss how "affect" influences the decision to negotiate, selection of opponent, formulation of expectations and offers, tactics, outcomes, and proclivity to comply with agreed terms. Van Kleef's review took in a considerable amount of literature that included findings on all emotions within the context of negotiation (G. Van Kleef, 2010). He reviews the literature that shows that expressing disappointment makes one's partner feel more satisfied and that expressing guilt builds positive relationships but does not elicit concessions. Fassina and Whyte (2014) investigated the use of strategic "flinch" (the display of verbal or physical shock as a reaction to the other party´s opening offer) only to find that the participant of this tactic claimed more value compared to the control group, but the target of the flinch perceived the relationship less positively compared to the participants in the control group.

Among all the emotional expressions, anger is the most researched (G. Van Kleef, 2010). Allred et al. (1997) examined how anger and happiness affected negotiations. Van Kleef, De Dreu, & Manstead (2004a) found that negotiators reduced their demands more rapidly after receiving expressions of anger from their counterparts than they did after neutral or happy expressions. Denson and Fabiansson (2011) reviewed a variety of articles and discussed the advantages and disadvantages of expressing anger during a negotiation. Yuasa and Mukawa

(2007) conducted an experiment and found that facial expressions (happy, angry, and cool) significantly influence the receiver's impressions and decision-making.

Along with the increase in research, many researchers have found conflicting results. In some studies, the expression of negative emotion can result in negative outcomes (Kopelman et al., 2006), while in some other cases, the expression of negative emotion can bring about positive negotiation performance (G. A. Van Kleef et al., 2004a). Researchers argued that the Emotions as Social Information (EASI) theory could be the underlying reason (G. A. Van Kleef et al., 2004b). The EASI theory states that emotions convey useful information about people's feelings, intentions, and orientation toward others. The key propositions from the EASI theory specify the two psychological mechanisms through which individuals can be influenced by the emotional expressions of the other: affective reactions and what they call inferential processes. It is theorized that affective reactions are more likely to produce effects that are symmetrical with the emotion expressed, i.e., adverse effects on performance due to negative emotion and positive effects on performance due to positive emotion. By contrast, the inferential process mechanism is likely to produce asymmetrical effects, i.e., positive effects on performance due to negative emotion and negative effects on performance due to positive emotion (Lindebaum & Jordan, 2014; van Kleef, 2014)

Van Kleef and Côté (2018) concluded that there is no simple answer to the questions of which emotions are helpful to express in conflict and negotiation nor when they have a positive or negative impact on negotiation outcomes. Some moderators could contribute to the main effects of anger on negotiation outcomes, such as power, the perceiver's information processing ability, the perceiver's motivation, and social-contextual factors such as culture. Power is the most extensively investigated factor. Studies have shown that emotional expressions will have a more significant effect on low-power counterparts than on high-power counterparts (Sinaceur & Tiedens, 2006; E. Van Dijk et al., 2008; G. A. Van Kleef & Côté, 2007). Low-power negotiators may feel more pressure to concede to the demands of a counterpart expressing negative emotions. In contrast, counterparts in a high-power condition will be less inclined to concede to the demands of an angry negotiator.

In Sharma et al.'s (2020) meta-analysis, emotional expressions influence the outcome of negotiation through three mediators: inferences of limits, inferences of toughness, and reciprocal or complementary emotional reactions from the counterparts.

2.3 Influence of individual differences

Individual differences are the different responses generated by an individual toward specific events or circumstances in a way that is different from other people regularly. Rubin & Brown (1975) documented extensive literature on individual differences in negotiation, and concluded that individual differences typically do not explain much variance in negotiator behavior (Thompson, 1998), just as they fail to account for much variance in other behaviors (Ross & Nisbett, 1991).

In the 1990s, many authors reached the conclusion that simple individual differences offer limited potential for predicting negotiation outcomes (Bazerman & Carroll, 1987; Morris et al., 1999; Pruitt & Carnevale, 1993). However, a meta-analysis by Sharma et al. (2013) found this irrelevance consensus stemmed from one early narrative review based on limited data. The authors found that numerous personality traits demonstrated predictive validity over multiple outcome measures, and they concluded that the irrelevance consensus was misguided.

Although it may be hard to predict negotiation results from personality, a variety of factors relating to a negotiator's personality have been investigated by researchers, and it is quite clear that personality impacts negotiation behavior. These studies focus on confidence (Galasso, 2010; Lim, 1997), open-mindedness (Z. Ma & Jaeger, 2005), cognitive ability (Barry & Friedman, 1998; Schei et al., 2006), emotional intelligence (Der Foo et al., 2004; K. Kim et al., 2014; Mueller & Curhan, 2006; Ogilvie & Carsky, 2002) and nervousness (A. W. Brooks & Schweitzer, 2011).

2.3.1 Social motives

In social psychology, social value orientation is a person's preference about how to allocate resources (e.g., money) between the self and another person. There are two theories underlying the generation of social value orientation: Cooperation Theory and Dual Concern Theory. Cooperation Theory argues that negotiators have different social motives (Deutsch, 1973). In the case of a competitive motive, negotiators try to maximize their own outcomes, with no (or negative) regard for the outcomes obtained by their opposing negotiator. In contrast, negotiators with a prosocial motive try to maximize both their own and others' outcomes. Thus, social motives refer to preferences for outcomes to self and others, such that prosocial, egoistic, and competitive negotiators differ in attaching a positive, zero, or negative weight to other's outcomes, respectively (C. K. W. De Dreu & Boles, 1998; Van Lange, 1999). Social motives may be rooted in individual differences in social value orientations (Van Lange et al., 1997) or in the situation. These social value orientations are presumed to be learned over time as people interact with others and are exposed to the benefits and disadvantages of cooperative and competitive behavior.

Building on the seminal work of Blake and Mouton (1964), Pruitt and Rubin (Pruitt & Rubin, 1986) proposed their Dual Concern Theory. It postulates two kinds of concern, other-concern and self-concern, each ranging in strength from weak to strong. Other-concern is closely related to the concept of social motive discussed earlier, with egoistic negotiators having weak other-concern and prosocial negotiators having strong other-concern. Self-concern is closely related to "toughness" and resistance to yielding. The concept of resistance to yielding refers to the negotiator's intransigence in concession-making.

There is some research about individuals' negotiation results and social motives (other-concern). In an experiment, Kern et al. (2005) observed that cooperative negotiators use integrative strategies more than individualistic negotiators and also get better individual outcomes. Craver (2003), though, argues that the most effective negotiators may be those that employ a hybrid competitive problem-solving approach, incorporating traits from both classifications.

Several pieces of evidence support the assumption that social motives (other-concern) and resistance to yielding (self-concern) vary independently (Butler, 1994; Van Lange, 1999). However, both of them influence negotiation results in terms of contentious/problem-solving behavior (negotiation behavior) and joint outcome (C. K. W. De Dreu et al., 2000). De Dreu et al. (2000) found that resistance to yielding (self-concern) is a moderator of the effect of social motives (other-concern) on negotiation behavior and joint outcome. This well explained the conflict results from some previous papers: De Dreu et al. (1998) manipulated social motives using monetary incentives and found that when dyads had little coercive power, prosocial negotiators engaged in more problem-solving and less contentious behavior and achieved higher joint outcomes than egoistic negotiators. However, Weingart et al. (1996) failed to find differences in integrative negotiation as a function of social motives, and O'Connor and Carnevale (1997) found that negotiators with an egoistic motive achieved higher joint outcomes than negotiators with a prosocial motive. Sequeira and Marsella (2018) also found that the personality traits of social value orientation (social motives) influence human negotiation behavior directly.

Social value orientation is found as a moderator under many circumstances. Ramirez-Marin et al. (2021) found that time pressure (stress) has a positive influence on integrative offers and joint outcomes. SVO moderates the effect of stress on joint negotiation outcomes, such that, under stress, prosocials fare better than proselfs. Jeuken et al. (2015) found that in negotiation, the motive to engage in indirect aggression (gossip about the counterpart to influence the result) toward their counterpart is moderated by social value orientation and power. Mischkowski & Glöckner (2016) found that the relation between short decision time and cooperative behavior is moderated by social value orientation. Such a relationship is positive for prosocials but not significant for proselfs. Van Kleef and Van Lange (2008) found that individual differences in social value orientation moderate responses to others' expressions of disappointment in negotiation. Specifically, Proselfs conceded more to a disappointed opponent than to a neutral or angry one, whereas prosocials were unaffected by the other's emotion.

Change of SVO

Many articles have found that an adult's social value orientation is stable and will not change even after years (Bekkers, 2004b). However, even in the long term, while a person's personality is stable, it still can fluctuate after some stimuli.

Social values are commonly considered stable dispositions with which individuals enter a choice situation (Hulbert et al., 2001; Ligthart, 1995; Perugini & Gallucci, 2001; F. Van Dijk et al., 2002). Extensive research regarding SVO suggests that this social preference is temporally stable and cannot be affected by situations (Kuhlman et al., 1986; Li et al., 2013; Van Lange et al., 1997). SVO is a stable personality trait that reflects how people evaluate interdependent outcomes for themselves and others and plays an important role in the process of decision-making, especially outcome evaluation (Messick & McClintock, 1968).

However, research on the stability of social value orientations has produced different results (Bekkers, 2004a). Over a period of nineteen months, the stability of the threefold social value orientation typology in a computerized survey among a national sample of the Dutch population

was only .19 (Bekkers, 2004a). This result is further refined and supported by Bekkers (2004b) by correcting for measurement errors. These low estimates indicate that social value orientations are not stable personality characteristics. Social value orientations appear to be less stable than other characteristics and should be understood as cooperative intentions that may change from one situation to the next (Bekkers, 2004b).

Even though SVOs have been originally conceptualized as temporally stable distribution preferences, some studies have shown that their expression may easily be affected by situational factors. Griesinger and Livingston (1973) found that directly instructing participants to behave cooperatively, individualistically, or competitively could influence a person's preferences for own-other payoff combinations. De Dreu and McCusker (1997) showed that framing of outcomes in terms of gains and losses affected cooperation behaviors such that prosocials cooperated more, but individualists cooperated less in a loss than in a gain frame. In addition, the classification of subjects in types of social value orientations is sensitive to priming effects (Bekkers, 2004b; Hertel & Fiedler, 1998; Utz et al., 1999).

Consumer engagement is a key factor that drives online interaction in general (Voorveld et al., 2009) and specifically the interactions in online shopping contexts (Han & Kim, 2017). Levy and Gvili (2020) predicted that a shopper's propensity to negotiate price is positively associated with engagement in the transaction, and the authors testified it with an experiment.

In past research, authors found that personality traits can influence engagement directly or through a moderating effect. Qureshi et al. produced a significant model with personality. The result shows that this model accounted for a reasonable amount of variance in engagement with learning (Qureshi et al., 2016). Akhtar et al. (2015) found that personality traits, together with other factors, are predictors of engagement in work. Tisu et al. (2020) propose a model of personality traits, namely, proactive personality, core self-evaluation, and psychological capital, which can directly predict work engagement. O'Neill et al. (2014) identified a few personality and character traits as predictors of engagement during distributed work. Meanwhile, some other researchers found that personality moderates factors' effect on work engagement (Liao et al., 2013) or online recommendations engagement (Rook et al., 2020). Nevertheless, most of the personalities being studied are Big Five personality traits. Little research investigated the relationship between SVO and engagement.

Although many articles studied personality's influence on engagement, few articles have studied engagement's influence on the stability of personality traits. Since engagement has a very close relationship with personality traits, I believe engagement can influence the stability of personality. Also, it is possible to assume that a person's individual differences will influence the change of the individual differences themselves (Figure 1). Specifically, the fluctuation of a person's SVO could be different depending on the person's SVO type: prosocial, individualistic, or competitive.

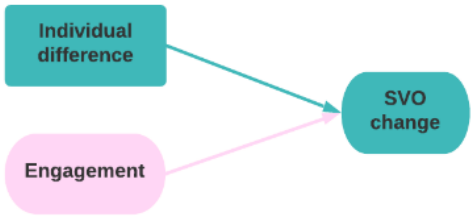

Figure 1 Change of SVO

2.3.2 Conflict handling model

The conceptual construct for handling interpersonal incompatibilities was originally developed by Blake and Mouton (1964). Blake and Mouton proposed that people share two prime motivations for interpersonal conflict: the desire to realize one's own goals (concern for production) versus the desire to meet interpersonal relationships (concern for people). The mixture of the two concerns ends in the introduction of five discrete strategies: smoothing, problem-solving, compromising, withdrawing, and forcing (Blake & Mouton, 1964).

Later, Thomas and Kilmann developed a conflict model and classified people's conflict behavior into five categories: avoiding, accommodating, compromising, competing, and collaborating (Kilmann & Thomas, 1975) (Figure 2). Rahim (1983) developed a similar model with categories: avoiding, obliging, compromising, dominating and integrating (Figure 3).

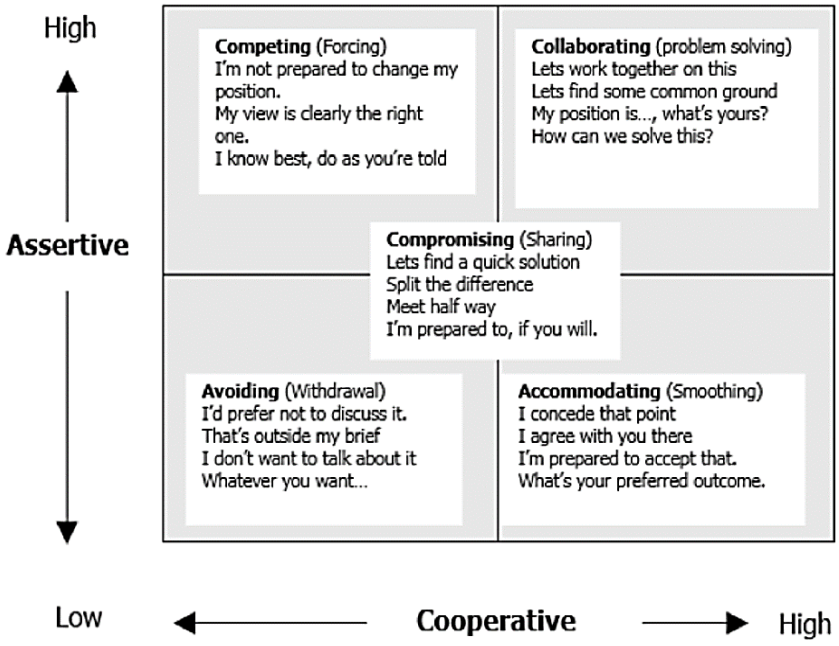

Figure 2 Thomas Kilmann conflict model

Note. Reprinted from "Interpersonal conflict-handling behavior as reflections of Jungian personality dimensions", by Kilmann, R. H., & Thomas, K. W., 1975, *Psychological Reports, 37*(3), p. 971–980.

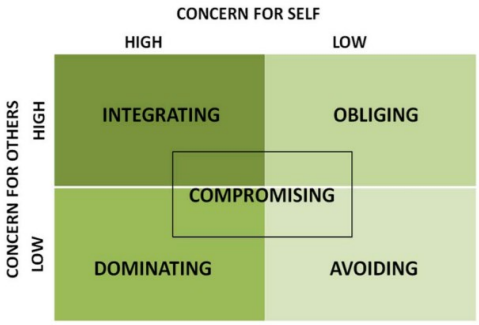

Figure 3 Rahim conflict model

Note. Reprinted from "A measure of styles of handling interpersonal conflict", by Rahim, M. A., 1983, *Academy of Management Journal, 26*(2), p. 368–376.

Some researchers figured out the relationship between individual differences and the conflict-handling model. Tehrani & Yamini (2020) studied in detail that person with each of the five personality dimensions (openness to experience, conscientiousness, extraversion, agreeableness, neuroticism) would adopt which conflict handling methods from Thomas Kilmann Conflict Model. Also, Gbadamosi et al. (2014) researched that people from different age groups or with different gender would use a different conflict-handling method.

Although the TKI has been supported by recent research and is widely recognized, surprisingly, little empirical research compares the effect of the five styles on outcomes in Internet-based negotiations (Zaremba & Kersten, 2006). Zaremba and Kersten (2006) conducted research and found that none of the five dimensions of TKI has any influence on negotiation results (economic results). Also, Ma (2007) conducted an experiment and investigated how Chinese people approach conflicts and how this affects their negotiation behaviors during a business negotiation. He found that there is no significant statistical influence from the five dimensions of TKI. However, he noted some mean differences of result individual profit in five TKI dimension groups. He found that Chinese people prefer "compromising" the best, then "avoiding".

2.4 Negotiation system acceptance

In the information system usage field, Davis's technology acceptance model (TAM) (Davis, 1989) and technology acceptance model 2 (TAM 2) (Venkatesh & Davis, 2000) are shown in Figure 4 and 5. These two models have gained significant recognition and been widely applied to a diverse set of information systems by a wide range of participants. The foundations of TAM and TAM2 are mainly based on two theories in social psychology: the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1977) and the Theory of Planned Behavior (TPB) (Ajzen, 1991), both of which have proven successful in predicting and explaining behavior across a wide variety of domains.

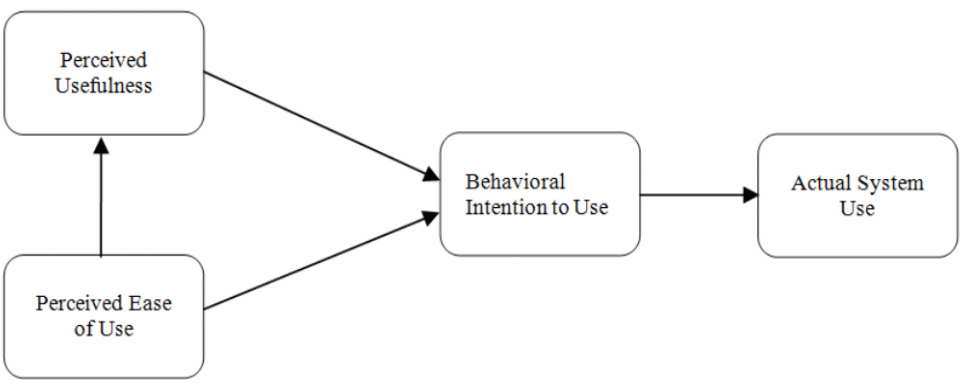

Figure 4 Technology Acceptance Model

Note. Reprinted from "Perceived usefulness, perceived ease of use, and user acceptance of information technology", by Davis, F. D., 1989, *MIS Quarterly,* p. 319–340.

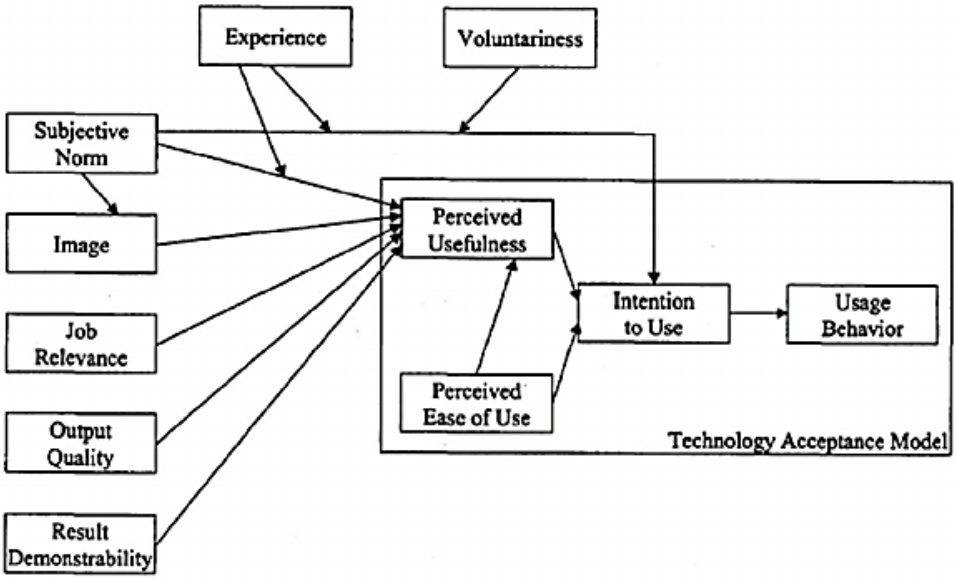

Figure 5 Technology Acceptance Model 2

Note. Reprinted from "A theoretical extension of the technology acceptance model: Four longitudinal field studies", by Venkatesh, V., & Davis, F. D., 2000, *Management Science, 46*(2), p. 186–204.

Along with the development of the TAM and TAM2, Venkatesh et al. (2003) provide the Unified Theory of the Acceptance and Use of Technology (UTAUT), which includes a broad range of antecedents to intention, as well as moderators. Similar to TAM, this model is also based fundamentally on intention to use, which leads to use. However, in UTAUT, not only "perceived usefulness" and "ease of use" are antecedents of intention, but four general factors: performance expectancy, effort expectancy, social influence and facilitating conditions, are also considered to be predictors of "intention to use", along with four moderating factors: voluntariness of use, experience, age and gender (Figure 6).

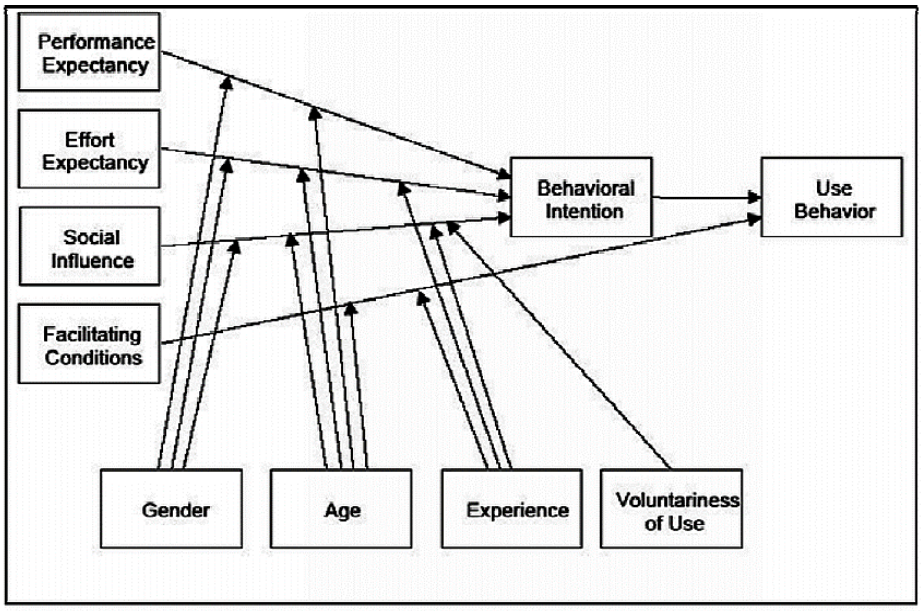

Figure 6 UTAUT model

Note. Reprinted from "User acceptance of information technology: Toward a unified view", by Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D., 2003, *MIS Quarterly*, p. 425–478.

Vetschera et al. (2006) propose a model that relates the characteristics of the participants, the system, and the results emanating from system usage to the perceptions of the systems and processes. This model, called "Assessment Model for Internet-based Systems" (AMIS), is depicted in Figure 7. The original purpose of the AMIS model was to assess the behavioral value of the electronic negotiation system: Inspire. AMIS is essentially built on the TAM model as its underlying theory. Using structural equation modelling, Etezadi-Amoli et al. (2006) and Kersten et al. (2008) provide alternative models: TIMES model (Task, Individuals, Mechanism, Environment, and System) for negotiation systems, which may be considered variations of AMIS essentially.

From all those previous models, one can find that the factors that can influence the variable "intention to use" are crucial to an information technology system. Influencing factors to "intention to use" include "ease of use", "usefulness", and "result" (in AMIS). The "ease of use" and "usefulness" can be abstracted into "effort expectancy" and "performance expectancy" as in the UTAUT model. I adopted these variables in the enriched AMIS system (Figure 8). The "result" variable from the AMIS model can take "satisfaction" (Figure 8) as one kind of result, and it will influence the "intention to use" behavior and "performance expectancy". In the AMIS model, the "characteristics" has an effect on "usefulness" ("performance expectancy" in Figure 8), "ease of use" (effort expectancy in Figure 8) and result. The characteristics include the characteristics of the system and participants. In current case, the characteristics of the system will be the system agent's attributes, such as search mechanism; the characteristics of the participants should be the participant's personality attributes, such as the participant's Thomas Kilmann conflict handling type or Social Value Orientation type.

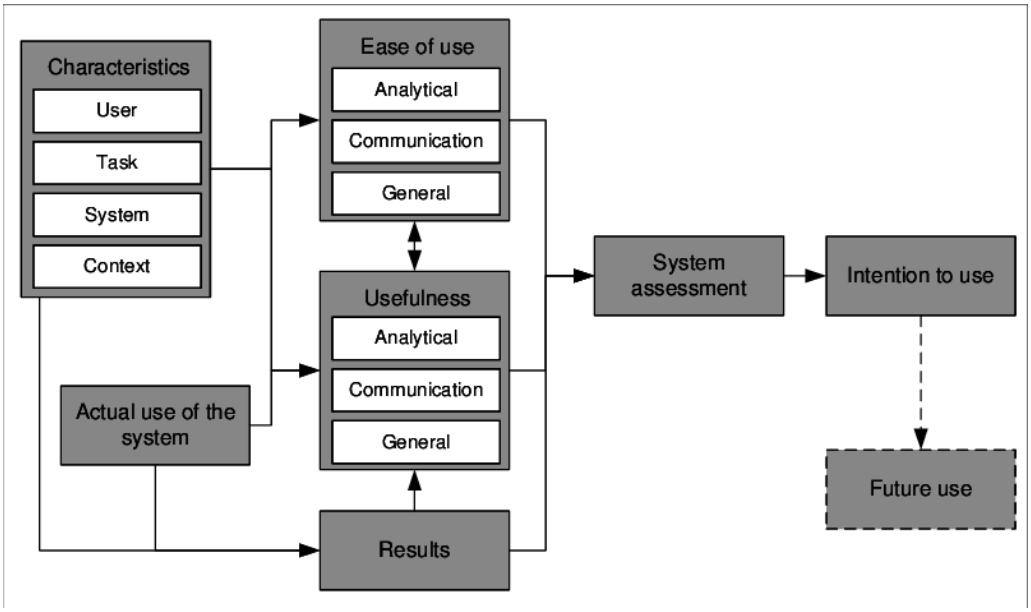

Figure 7 AMIS model

Note. Reprinted from "User assessment of E-negotiation support systems: A confirmatory study", by Etezadi, J., Kersten, G., Chen, E., & Vetschera, R., 2006, *InterNeg Research Papers, 2*(06).

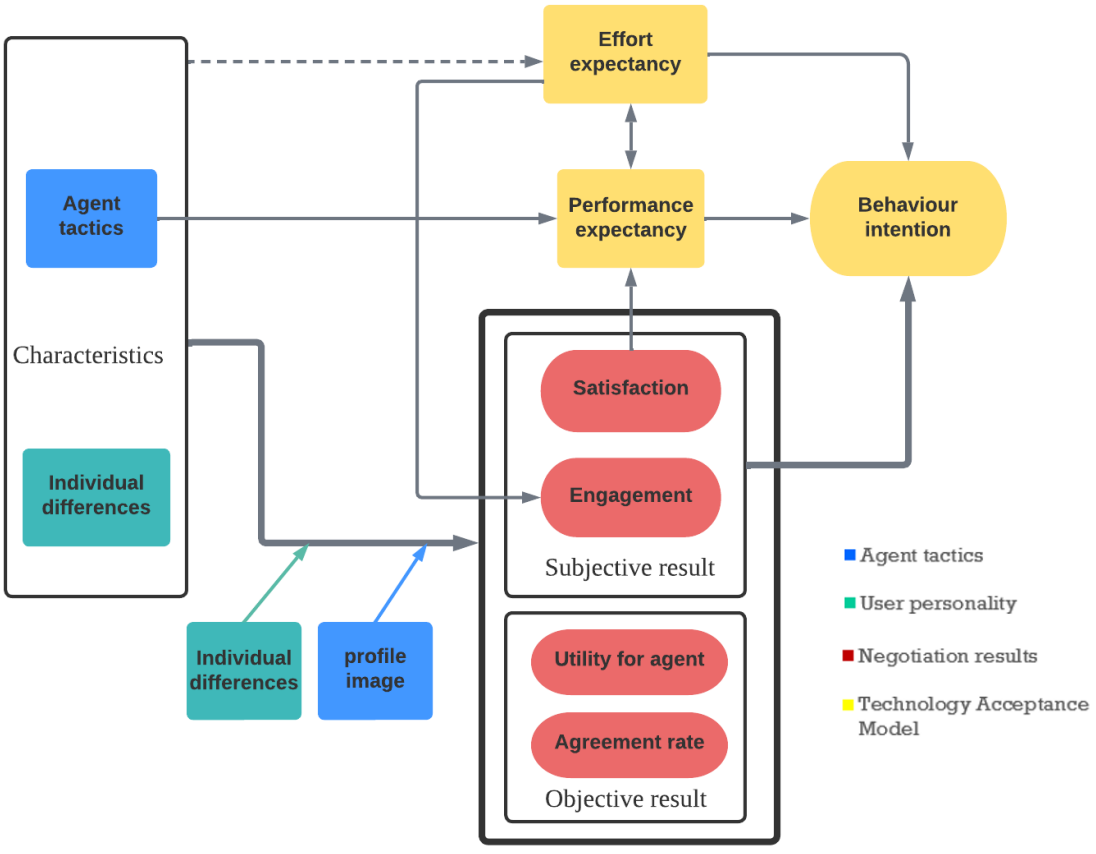

Figure 8 Enriched AMIS model

There has been some past research about the participant's acceptance of computer agents in negotiations. Chang (2010) investigated the employment of intelligent agents in a web-based auction. The result suggested that customers and website operators thought the software agent was useful and efficient. In the second phase, the authors found that consumers' familiarity with the agent functionality was positively associated with perceived ease of use, perceived usefulness, perceived playfulness, and intention to use the tool. In Rathnam (2005)'s paper, the author researched the effects of the search strategy of software agents and consumers' product class knowledge in the context of consumers seeking to purchase cars on the Internet. The result suggested that subjects with high product class knowledge had more positive affective reactions (denoted by satisfaction, the propensity to purchase, and confidence in the decision) toward agents/applications that used the weighted-average-method and elimination-by-aspects strategies as compared to the profile-building strategy.

2.5 Measurement of negotiation result

The outcomes of negotiation are often reflected by objective measures such as the number of agreements (or agreement rate) and achieved utility (claimed value) of the agreement by both parties. Additionally, subjective measures, such as satisfaction with the outcome and the process, as well as constructs related to perceived usefulness and intention to use, are widely included in various studies.

2.5.1 Objective outcomes

2.5.1.1 Claimed value (individual utility)

Economic outcomes are the most commonly studied performance measures in laboratory studies (Thompson, 1990). Individual economic value, also called value claimed (Lax & Sebenius, 1987), is the payoff that an individual negotiator receives, regardless of the distributive or integrative setting of the task. In negotiations, the concept of utility is often employed to measure the level of economic outcome, profitability or desirability of a given offer (or a counteroffer). Having its source in the field of Economics, where it indicates the degree of satisfaction with a product or service, utility has been employed in agent-based negotiations to quantify the goodness of an offer to a given party (Yu et al., 2015). The overall concession made by an agent can be described as a drop in utility between two subsequent offers. Note that, generally, for a multi-issue case (i.e., negotiations involving multiple issues, e.g., price, warranty, etc.), such a concession can be implemented by different combinations of concessions on individual issues.

Past literature has investigated a wide range of factors influencing utility. Vetschera et al. reviewed past literature from substantive, communication, and emotional dimensions (Vetschera et al., 2021). Among all these factors, the most researched factor is the concession curve of the negotiator (C.-F. Lee & Chang, 2008; Vahidov et al., 2017). It is easy to understand that a competitive negotiator would be reluctant to yield and tend to secure a higher utility. Some negotiators could use a compromising tactic to reach a fast agreement if the utility is within their limit (reservation point).

Besides compromising and competitive concession curves, search mechanism is another computer strategy that can be used to influence negotiation results (Rangaswamy & Shell, 1997; Yao et al., 2021). Specifically, for a given drop in concession, the agent can keep conceding on the same issue as in the previous offer or concede on other issues. The overall drop in utility is the same for both cases, but the latter is trying to explore more options and reach a mutual benefit result. This will impact negotiation results (Liu & Wilson, 2011). Computer agents that try to manipulate multiple issues instead of exploiting a single issue at a time may give the counterparty a useful impression and lead to better results. Adopted from the general field of Artificial Intelligence, depth-first methods tend to make concessions on a single issue (exploiting opportunities within one issue), while breadth-first search mechanisms try out manipulations with different issues at each step to move towards an agreement. Rangaswamy and Shell (1997) proposed that negotiations over multiple issues allowed discrepancy between the preferences of different issues to negotiators, while this discrepancy is a key element in searching for mutually beneficial solutions.

Time pressure can influence the negotiation result too. The issue of time in negotiations can be interpreted as the pressure of time elapsing and deadlines in negotiations. Min, LaTour, and Jones (1995) studied the influence of negotiation time, among other factors, on the outcomes (economic value). They found that for student subjects, longer negotiation time meant better deals. In a meta-analysis of extant research on time pressures, Stuhlmacher et al. (1998) found that across studies, high time pressure increased the likelihood of concessions and cooperative behavior. In an empirical study, Stuhlmacher and Champagne (2000) found that participants under higher time pressure averaged fewer offers. They also found that higher time pressure resulted in more and larger concessions. So, it is safe to assume that a negotiation under high time pressure can result in more claimed value for the opposing party. Nonetheless, when the timespan for the negotiation procedure is long enough, a problem emerges that the negotiator can be interrupted by other tasks during the negotiation. This problem could be important and result in different conclusions (McFarlane & Latorella, 2002).

Besides the means mentioned above, power could be used to influence negotiation results. For example, coercion, opening strong, and salami tactics (Saner, 2012) can be used to increase the negotiators' power and give the opposing party a hard-to-yield impression. Because distributive negotiation is a "zero-sum" transaction, the "Pie" amongst all negotiators is fixed. If one party yielded in the negotiation, the other parties would gain more utility. As a result, showing power can be very useful to make the opponent yield or compromise and get more utility. Also, Bacharach and Lawler (1981) suggested that power is the central determining factor in negotiations. In order to show the opponents power, one can use strong opening (anchoring), facial expression cues (such as angry facial expressions), showing very little or no compromise (competitive concession strategy), and other means.

In terms of emotion expression, Kumar (1997) discusses the origins and consequences of "affect" in negotiations. He argues that positive and negative affect may have positive and negative effects on negotiation outcomes. Similarly, Kopelman et al. (2006) found that negotiators made more extreme demands when faced with a negotiator displaying negative emotions while displaying positive emotions was more likely to result in the opposing party making concessions. Van Kleef, De Dreu, & Manstead (2004a) found that negotiators reduced

their demands more rapidly after receiving expressions of anger from their counterparts than they did after neutral or happy expressions.

Studies have also shown that emotional expressions can be a moderator of the effect of power on negotiation results. Specifically, it will have a more significant effect on low-power counterparts than on high-power counterparts (Sinaceur & Tiedens, 2006; E. Van Dijk et al., 2008; G. A. Van Kleef & Côté, 2007). Low-power negotiators may feel more pressure to concede to the demands of a counterpart expressing negative emotions, whereas counterparts in a high-power condition will be less inclined to concede to the demands of an angry negotiator.

Also, gender would make a difference in negotiation. Women often show more interest in interpersonal relationships at the bargaining table (Kray & Gelfand, 2009). In other words, they end up significantly more on the cooperative side than their male counterparts, who are instead more likely to use a more competitive perspective (Walters et al., 1998). Men also often receive better offers in negotiation (Ayres & Siegelman, 1995) and, thus, as a consequence of an anchoring effect, obtain better results at the end of the discussion. Because of this gender difference, a female computer agent (with a female picture as its avatar image) may receive worse offers or be in disadvantage in negotiation.

Besides the computer agent's strategies, the influence of a negotiator's personality should also be considered. Based on Duo Concern Theory, Thomas Kilmann Conflict Model and Social Value Orientation can be used to explain the variance in result utility. The two concerns of Duo Concern Theory influence negotiation results in terms of contentious/problem-solving behavior (negotiation behavior) and joint outcome (C. K. W. De Dreu et al., 2000). Also, De Dreu et al. (2000) found that resistance to yielding (self-concern) is a moderator of the effect of social motives (other-concern) on negotiation behavior and joint outcome. O'Connor and Carnevale (1997) found that negotiators with an egoistic motive achieved higher joint outcomes than negotiators with a prosocial motive. Sequeira and Marsella (2018) also found that personality traits of social value orientation (social motives) directly influence human negotiation behavior.

Social value orientation is found to have moderating effect in many situations. Ramirez-Marin et al. (2021) found that SVO moderates time pressure's (stress) positive influence on integrative offers and joint outcomes. Specifically, under stress, prosocials get better results than proselfs. Mischkowski & Glöckner (2016) found that the relation between short decision time and cooperative behavior is moderated by social value orientation. Such a relationship is positive for prosocials but not significant for proselfs. Van Kleef and Van Lange (2008) found individual differences (social value orientation) moderate responses to others' expressions of disappointment in negotiation. Specifically, Proselfs conceded more to a disappointed opponent than to a neutral or angry one, whereas prosocials were unaffected by the other's emotion.

From all the analyses above, a model was generated to analyze the influencing factors and the computer agents' result utility (Figure 9).

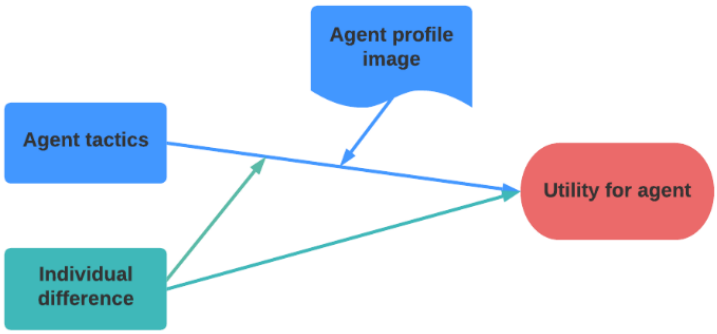

Figure 9 Influencing factor of utility claimed by the agent

2.5.1.2 Agreement rate

The agreement rate is a critical indicator of the negotiators' cooperative behavior on dyadic level. While the claimed value is an important measure of the outcome, it cannot be used if an agreement is not reached. The utility alone cannot evaluate the negotiation results comprehensively. If the negotiation did not reach an agreement, utility value would not be realized, and the overall economic value could not be satisfying.

Anchoring and the concession curve are factors that can reflect the computer agent's power (or perceived power to the negotiator). These factors will influence the result of the agreement rate. Namely, a powerful agent will make the counterparty feel hard to get benefits and leave the counterparty unsatisfied. As a result, the agreement rate would be lower for powerful agents. In particular, agents that use competitive tactics or set high anchors may get low agreement rates.

Search mechanisms could also affect the agreement rate. Depth-first search may quickly lead to an agreement on one of the issues, which then can be used as an anchor for finalizing the deal, while breadth-first will explore various issues probing the negotiation space and inducing the counterpart to make moves on the issues they are inclined to concede on. Nonetheless, there has been little past work on the effect of the search method. Ma, Ronald, Arentze, and Timmermans (2013) defined a search mechanism for computer agents but did not compare the performance of different search methods. Search mechanism can reflect the "smartness" or "flexibility" of an agent. Hence, one can assume that human subjects would be more satisfied with a "more flexible" agent and reach a higher agreement rate.

For time pressure, Mosterd and Rutte (2000) focused on the effects of time pressure and accountability on the competitiveness of interaction and outcome. Their study found that when negotiators negotiated for themselves, time pressure made them less competitive, and a greater proportion of negotiations led to an agreement.

2.5.1.3 Joint outcome (joint utility)

Integrative negotiation tasks incorporate multiple issues that the parties must agree upon, with greater opportunity to create value beyond simply reaching an agreement. The parties'

interests over a given issue may be opposed or even completely compatible. This can lead to a more integrative result, with both parties compromising on less important issues and gaining on prior issues.

However, for computer-agent negotiation, there is some difference. For example, in most of the studies by Van Kleef and his colleagues (E. Van Dijk et al., 2008; G. Van Kleef, 2010; 2004a, 2004b; van Kleef, 2014; G. A. Van Kleef & Côté, 2007, 2018), joint gains are not examined. This likely reflects the nature of their computer-simulated research design. Because one human subject responded to a computer-simulated other, partners could not meaningfully reach agreements nor create joint gains. This is the same as the experiment's settings. Although much research focused on the joint outcome, I specifically focused on the agent's utility because the online purchase agent is usually used by companies that want to sell products online. This kind of company would want to know what kind of result they should expect if they apply a particular kind of agent.

2.5.2 Subjective outcomes

While economic outcome variables have been of primary interest in negotiation studies, growing interest over time has focused on psychological performance measures (Bendersky & McGinn, 2010). Large and active research literature has focused on various psychological performance measures. Integrating these psychological measures into a unified framework, Curhan, Elfenbein, and Xu (2006) defined subjective value as the "social, perceptual, and emotional consequences of a negotiation". Subjective measures (e.g., satisfaction with the outcome and the process) have been widely included in past studies.

2.5.2.1 Engagement

In e-negotiation, a negotiator's engagement can be interpreted as how much the negotiator is attracted by the negotiation process. The underlying reason for being attracted could be the negotiator's individual differences and the expected efforts.

A person's individual difference includes many factors, such as gender and cultural difference. Cultural difference is usually represented by individualism-collectivism (G. Hofstede, 2001). Individualism-collectivism can also be shown in a person's social value orientation. A few researchers have indicated that the individualism-collectivism factor may affect consumers' tendency to engage in price negotiation (D. Y. Lee, 2000; Nyer & Gopinath, 2002). The literature on individualism-collectivism suggests that collectivists tend to engage in competitive relationships with out-group individuals (Triandis, 1990). Research suggests that collectivist people tend to have less trust in out-group others (Huff & Kelley, 2005; Watkins & Liu, 1996) and that their trust radius is usually narrower than individualists (Van Hoorn, 2015). Marketing research shows that the overall lower trust collectivists assign to out-group sellers further hurts their perception of product price fairness (Bolton et al., 2010). Therefore, collectivists are more likely to engage in price negotiation than individualists as they are more sensitive to price fairness. Since individualism-collectivism has a significant impact on engagement, SVO, with

individualist as one of its three dimensions, should also have an important influence on engagement.

When an individual expects the negotiation to cost much effort, it is natural to conclude that such a person will engage more in the negotiation. If a task is too easy, a person will not take it seriously or spend much time on it. So, it is safe to say effort expectancy would influence the negotiator's engagement.

As a result, a model is as in Figure 10.

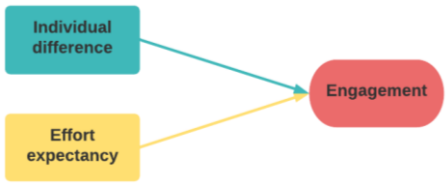

Figure 10 Influencing factors of engagement

2.5.2.2 Satisfaction

Participant satisfaction is considered one of the most important measures of information system's success. Based on the Disconfirmation Theory (Oliver, 1980, 1981), consumer satisfaction is defined as the perceived discrepancy between prior expectations/norms and the actual performance of the product/service as perceived after its consumption.

Conlon and Ross (1993) conducted a series of mediation studies, which showed that negotiators who set lower expectations are more satisfied with their outcomes. Consistently, Oliver et al. (1994) found that the difference between negotiators' expectations and outcomes is significantly correlated with negotiator satisfaction. So, a negotiator's expectancy towards the negotiation result (performance expectancy) should influence satisfaction.

In the negotiation process, the use of an anchoring tactic and a competitive tactic can be perceived by the participant as non-collaborative behavior. When the negotiation process is perceived as more collaborative, negotiators tend to avoid non-rational escalation of conflict and negative framing (Foroughi et al., 1995) and focus more on the task by solving problems. This kind of collaborative behavior is considered to influence the participant's satisfaction positively. In Wang et al.'s (2010) paper, they ran an experiment and showed that a perceived collaborative atmosphere significantly influences negotiator satisfaction.

In another paper, the authors found that at the end of a negotiation episode, women report less satisfaction with their overall performance than men do (Watson & Hoffman, 1996). They report greater dislike of the whole process (Babcock et al., 2006; Small et al., 2007) as well as lower self-efficacy (Stevens et al., 1993).

2.6 Overall research framework

In summary, the overall research framework is in Figure 11. The agent's attributes include anchoring, concession strategy (utility curve), search mechanism, time constraint, emotion expression, and agent gender. While the participant's personality includes Social Value Orientation and Thomas Kilmann Instruments, the participant's demographic background includes gender, age and culture. One can conclude that the agent's features, participant's personality and demographic background will influence the negotiation results, which can be measured using objective measurement (agreement rate, claimed utility, joint outcome) and subjective measurement (engagement and satisfaction).

On the other hand, the factors adopted from the TAM theory can also influence the subjective outcome. For example, effort expectancy will influence engagement along with individual differences. At the same time, the agents' features and satisfaction results will have an impact on the participants' perception of this system's usefulness (performance expectancy). Satisfaction, as a subjective outcome, will have a direct effect on the intention to use such system.

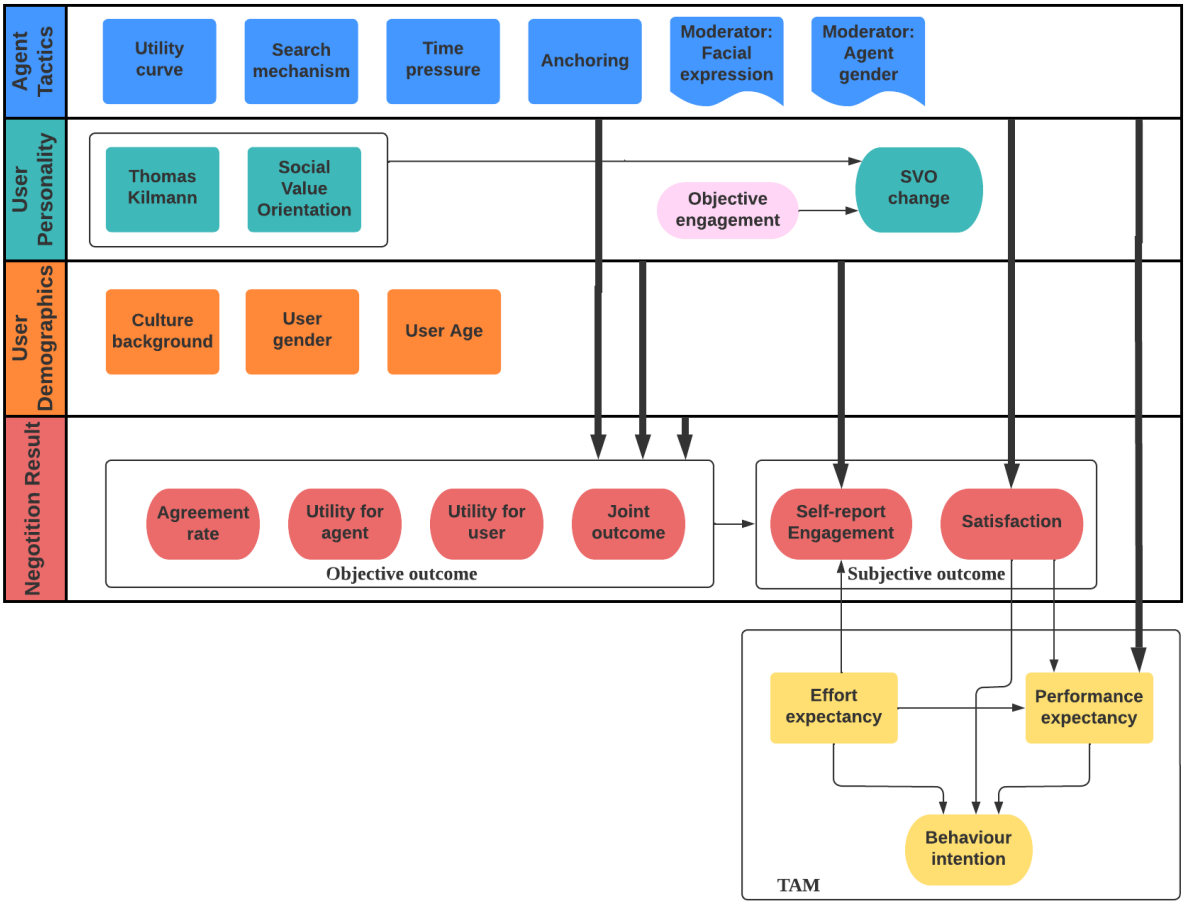

Figure 11 Overall research framework

3 Essay 2: Human-Computer Negotiations: A Systematic Evaluation of the Effects of Timespan, Tactic, and Search Mechanism

In the negotiation field, there is a wealth of research about the "human vs. human" negotiation and the features that can lead to negotiation success. However, when it comes to "human-computer" negotiations, the situation is different. Experimental studies in "agent vs. human" negotiations aim at studying how various agent strategies and tactics, as well as other important settings or individual attributes, affact the outcomes of negotiations (Vahidov et al., 2014). Based on this research, the current essay contributes to the body of literature by investigating the impact of timespan, search mechanisms, and concession tactics on negotiations while testing these factors' influence on both subjective and objective negotiation measures, at both the group and individual levels.

Experimental studies in agent vs. human negotiations aim to investigate how various agent strategies and tactics, as well as other important settings, influence the outcomes of negotiations (Vahidov et al., 2014). The outcomes are often reflected by objective measures such as the number of agreements (or agreement rate), the achieved utility (e.g., desirability) of the agreement by both parties, and the interactions represented by the number of communication threads between the agent and the human. Furthermore, the study includes subjective measures, such as satisfaction with the outcome and the negotiation process. To evaluate the negotiation based on not only the current results but also the future potentials, constructs related to perceived usefulness and intention to use were adopted as part of the subjective measures.

In past literature, most research focused on the effect of negotiation concession tactics. In e-commerce settings, a major attribute of online negotiation is that an online session can be separated spatially and temporally. This raises a question: whether having synchronous vs. asynchronous negotiation mode will influence the results? Timespan refers to the time allocated for the negotiation since it starts. In asynchronous settings, negotiators can interact within a few days until they reach an agreement or terminate the process without an agreement. While in a synchronous setting, the negotiation will finish in a relatively shorter period of time (e.g., 30 minutes). Timespan represents a form of pressure that characterizes the mode of interactivity. Consequently, whether the negotiations are conducted in a synchronous mode or extended over time as a series of offer retrieval/submission episodes may impact key outcomes.

Moreover, in multi-issue negotiations, there are often many potential offers that can be made to the counterpart for the same amount of drop in utility. Different search mechanisms may be employed in generating these offers, such as resolving the issues collectively versus resolving one issue at a time. This search mechanism reflects the software agent's tendency to exploit one single issue at a time in multi-issue negotiations (depth-first) or to jointly explore a group of different issues (breadth-first) in search of an agreement. Exploiting a single issue may influence the negotiation process by guiding the human participant to concentrate on the issues at hand, one at a time, while collectively exploring a group of different issues may facilitate guiding the negotiation process towards an integrative solution. As a result, these two search mechanisms may have different impacts on the negotiation outcomes.

Furthermore, various concession tactics are implemented using concession curves, which are utility curves for computer agents to follow during negotiation. In this paper, I use "tactic" to represent "concession tactic", which is demonstrated by the concession curve (utility curve). Using different concession curves, an agent can be competitive (hard to yield) or conceding (easy to yield). From negotiation experts' experience, a competitive negotiator would get better results in "human vs. human" negotiations. The current study investigates if the same result applies to computer agents.

Based on the information provided, studying the identified issues would help improve the design of negotiation software agents. Consequently, the current study continues the stream of experimental research investigating "software agent vs. human negotiations" (Vahidov et al., 2014, 2017) by focusing on better understanding how timespan, tactics, and search mechanisms influence negotiation outcomes and proposing a systematic way of evaluating negotiation results.

This paper focuses on the prospects of human subjects negotiating with computer agents in the context of online shopping. A 2×2×3 experiment was conducted, including two timespan modes: synchronous (30 minutes) and asynchronous (24 hours and 72 hours), and two search mechanisms: breadth-first and depth-first. Three concession-making tactics by agents were also included: Conceding, Monotonous, and Competitive to account for the "toughness" of agent negotiators.

The remainder of the paper is organized as follows: first, the research model and hypotheses are proposed for testing; it is followed by the section on experimental settings, including the negotiation case and system, and the experimental procedures; in the end, the results section presents and discusses the findings obtained from the experiments. The paper finishes with conclusions, including a summary of findings, limitations, and future work prospects.

3.1 Research model and hypotheses

To comprehensively evaluate the impacts of time span, agent tactic, and search mechanism, I propose two research models depicted in Figures 12 and 13. In this thesis, all software agents are programmed to act as sellers, while human participants assume the role of buyers (customers). The terms "participants" and "buyers" are used interchangeably in this essay, and both represent the human participants/buyers. Electronic negotiation systems (ENS) are a subtype of information systems. Thus, the study at a general level can be approached by adapting conventional IS research models, such as the Technology Acceptance Model (TAM) (Davis, 1989) and IS Success model (ISS) (Delone & McLean, 2003). However, ENS differs in many ways from the generic traditional view of IS. Unlike catalogue-based websites, electronic markets incorporating auction or negotiation features do not promise a specific outcome in human-computer interaction. The outcomes depend to a great extent on the opponent (in negotiations) or other competitors (in auctions or multi-bilateral negotiations) involved in the exchange episodes. For the assessment of such electronic marketplaces, a so-called TIMES (Task, Individuals, Mechanism, Environment, and System) framework has been proposed (Kersten et al., 2008)

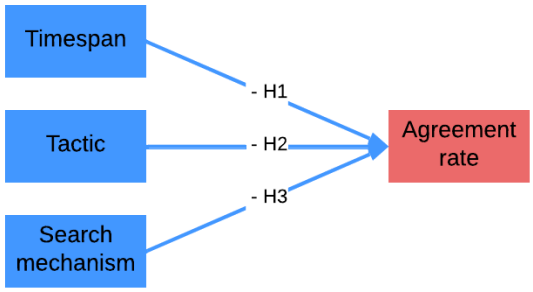

Figure 12 Influencing factors for agreement rate (group level)

Categorical variable coding:
Timespan: Synchronous: 1, Asynchronous: 2;
Tactic: Conceding: 1, Monotonous: 2, Competitive: 3;
Search mechanism: Breadth-first: 0, Depth-first: 1.

The TIMES framework looks to evaluate the impacts of electronic market systems on both objective and subjective variables. TIMES represents the characteristics that are hypothesized to have impacts on both objective outcomes (such as utility and profit) and subjective assessments (such as perceived ease of use and usefulness of the negotiation system being used). These outcomes are assumed to influence goal achievement and satisfaction, which, in turn, influence the perceived usefulness of the human-computer negotiation experience.

According to the TIMES model, task is our experimental case. Software agents are employed in the current research as individuals (albeit artificial ones) participating in an exchange. Hence, the current model includes tactics and search mechanisms as characteristics of an agent (characteristics of the individual in TIMES model). Timespan is included in the model as the characteristic of the task. Mechanism, environment, and system features are excluded from consideration since they are kept constant in the study. The model includes agreement rate and utility for both the agent and the (human) buyers as key dependent objective variables. This study includes three levels of timespan: 30 minutes (synchronous), 24 hours (asynchronous), and 72 hours (asynchronous), and two search mechanisms: breadth-first and depth-first. Three concession-making tactics by agents have been included: Conceding, Monotonous, and Competitive.

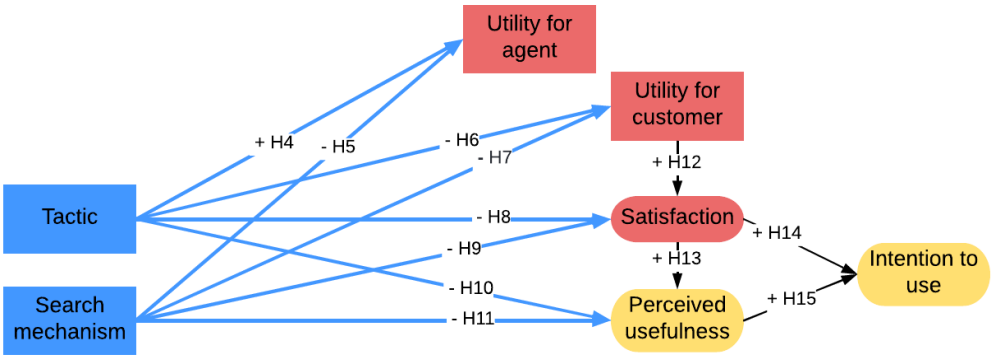

Figure 13 Research model

Categorical variable coding:
Tactic: Conceding: 1, Monotonous: 2, Competitive: 3;
Search mechanism: Breadth-first: 0, Depth-first: 1.

Objective variables play an important role in measuring tangible economic outcomes, and utility is a commonly used metric in negotiations. However, to ensure a sound evaluation system, it is also essential to include subjective assessments. In this regard, I incorporated participant satisfaction as a subjective measurement. To investigate the impacts on humans' intention to use the system in the future, "perceived usefulness" and "intention to use" have been adopted from the TAM and ISS. Perceived usefulness is the key variable influencing the intention to use according to the TAM model.

The updated IS Success model postulates that the benefits obtained from using a system influence participant satisfaction, leading to further use of the system (Delone & McLean, 2003). This model has been examined by a meta-study of 180 papers and supported at the individual level of analysis (Petter et al., 2008). Therefore, I hypothesize that utility to the participant, after their use of the system in the experiment, reflects the benefits obtained, which in turn has an impact on this participant's satisfaction. Participant satisfaction further influences their intention to use the system.

TIMES framework proposes a link between participant satisfaction and perceived usefulness. In a study investigating drivers of online travel booking behavior, a similar influence of satisfaction on perceived usefulness has also been posited (Madlberger, 2014). Therefore, I propose that participant's satisfaction in an online negotiation system will influence perceived usefulness.

To build the research model, I have separated model 1 and model 2 instead of combining them into one model. The reasons are as follows: for model 1, all the data can be included in the analysis to calculate the agreement rate, regardless of whether the cases reached agreements or not. For model 2, only the cases that reached agreements can be used because there is no uvility value if the negotiators did not reach an agreement. Therefore, the two models need to use different datasets, and model 1 needs to be separated from model 2. It is worth noting that the sequence of positing the hypotheses presented in Figures 12 and 13 follows a top-down and left-to-right approach. The variable containers in the models used a rectangle to represent the observed variable and an ellipse to represent the latent variable.

3.1.1 Timespan

There are two timespans used in this research: synchronous mode (30 minutes) and asynchronous mode (24 or 72 hours). The different lengths of timespans would have an influence on negotiation results. I assume a participant in a synchronous process will be more involved, and a more involved participant will be more likely to reach an agreement without interrupting or terminating the negotiation process. De Dreu (2003) found that under time pressure, people seek closure of the process, stop considering combinations of multiple alternatives, and engage in shallow rather than thorough processing of information. Nonetheless, when the timespan for the negotiation procedure is long, the participant can be interrupted during the negotiation leading to poor results (McFarlane & Latorella, 2002). Koeszegi, Pesendorfer, and Vetschera (2011) found that synchronous negotiation led to a more effective and competitive process because negotiators

engaged more in the debates. Meanwhile, negotiators in asynchronous mode (i.e., with a longer timespan) would have more time to reflect, cool down and control emotions. Hence, I propose hypothesis 1 as below:

H1. A synchronous negotiation will result in a higher agreement rate than an asynchronous negotiation.

3.1.2 Tactic

Utility is often employed in order to measure the level of profitability or desirability of a given offer (or a counteroffer) (Yu et al., 2015). Concession-making tactics describe how an agent goes about deciding on concessions. The concession made by an agent can be described as a drop in utility between two subsequent offers, which can be illustrated using curves that depict the decline in issue utility values over time.

According to the research of Lopes et al., different types of concession levels can influence the negotiation process (Lopes et al., 2001). Based on Faratin's research (Faratin et al., 1998), a few time-dependent tactics were adopted in previous research (C.-F. Lee & Chang, 2008; K.-J. Wang & Chou, 2003), including Boulware, Linear, and Conceder Tactics. A Conceder tactic is a strategy that the agent makes large concessions at the beginning while becoming conservative and starting to make small concessions when close to the end of the negotiation time session. A Boulware tactic is the opposite, where the agent makes small concessions at the beginning and large concessions close to the end. The Linear tactic means the agent makes the same number of concessions throughout the whole negotiation.

In this essay, I adopted similar tactics, including competitive, conceding, and monotonous tactics. In a negotiation procedure, a competitive agent makes small concessions from the beginning, thus following a "tougher" tactic and appearing less inclined to concede. Thus, I assume agents using this kind of tactic are less likely to reach an agreement with participants. As a result, a competitive agent can be expected to achieve a low agreement rate.

H2. Conceding agents will achieve a higher agreement rate than competitive ones.

For the utility of agreements achieved by the agents, I argue that agents who employ tougher tactics at the beginning of a negotiation can make it harder for the opponent to achieve their desired outcomes and lower their expectations, which can result in higher utilities for the agents themselves.

H4. Competitive agents will achieve agreements with higher agent utility than conceding ones.

Our next set of hypotheses concerns the utility of agreements achieved by participants. While the utilities of agents and buyers are not in strictly opposite positions, it can be expected that agents who adopt a more aggressive approach at the beginning will gain greater utility for themselves, resulting in a loss of utility for buyers.

H6. Conceding agents will achieve agreements with higher buyer utility than competitive ones.

3.1.3 Search mechanism

Negotiations involving multiple issues in search methods allow for a richer exchange in the search for mutually beneficial agreements. Rangaswamy and Shell (1997) proposed that negotiations over multiple issues allowed for discrepancy between the preferences of different issues to negotiators. This discrepancy is a key element in the search for mutually beneficial solutions. In other words, for a given drop in utility, there are usually multiple search methods to manipulate issue options for achieving the same overall drop.

In the current study, as elaborated above, I focused on two types of search mechanisms: depth-first and breadth-first. Depth-first methods tend to make concessions on a single issue (exploiting opportunities within one issue at a time), while breadth-first search mechanisms try out manipulations with different issues at each step to move towards an agreement. Although such search mechanisms could influence negotiation results, there has been little past work on the effect of the search method. Ma, Ronald, Arentze, and Timmermans (2013) defined a search mechanism for computer agents, but they didn't compare the performance of different search methods.

In the current study, the breadth-first search makes concessions on a different issue in each round, while the depth-first search concedes on the same issue until the target utility level is met. Therefore, one can assume that a breadth-first search mechanism would offer more flexible offers, resulting in a higher agreement rate.

H3. Agents using the "breadth-first" search mechanism will achieve a higher agreement rate than those using the "depth-first" search mechanism.

A breadth-first search mechanism is a negotiation strategy that involves manipulating different issues. An agent can make concessions on unimportant issues in exchange for the buyer's concession on important issues. The inconstancy of both parties' interests makes this manipulation possible. Thus, a breadth-first search mechanism can be expected to achieve better utility through this manipulation.

H5. Agents using the "breadth-first" search mechanism will achieve agreements with higher agent utility than those using the "depth-first" search mechanism.

H7. Agents using the "breadth-first" search mechanism will achieve agreements with higher buyer utility than those using the "depth-first" search mechanism.

3.1.4 Perceived usefulness

In the study of Rustam et al. (2013), the authors investigated the influence of the treatment on the participant's conceptual evaluation of the agent-supported negotiation system. The conceptual evaluation included perceived usefulness and satisfaction. Their results suggested that the use of an agent leads to a higher level of negotiation effectiveness. One can assume that different tactics and search strategies would have an effect on buyers' perception of the negotiation process as well. The following hypotheses concerning tactics' effect on perceived usefulness are proposed. I argue that a conceding agent who makes large concessions at the early stage will reach an agreement earlier, thus making the whole negotiation process effective and

efficient for the buyer. Consequently, the buyer will perceive the agent as useful because they reached an agreement with a satisfying utility within a relatively short time.

H10. Buyers will perceive the negotiation system more useful when interacting with softer agents than tougher ones.

In addition, a buyer is likely to perceive the breadth-first search mechanism as more useful because it offers a more flexible solution.

H11. Buyers will perceive the negotiation system as more useful when interacting with agents following the "breadth-first" search mechanism than those following "depth-first".

3.1.5 Satisfaction

The next set of hypotheses concerns the satisfaction level of buyers. According to Bui (1994), satisfaction is among the important evaluation criteria for negotiation support systems. Under the experiment circumstance, I argue that a conceding agent that makes large concessions at an early stage will reach an agreement with the buyer more easily. This will give the buyer a "pleasant" negotiation experience (possibly due to their sense of achievement of a goal), and thus they will be more satisfied with the negotiation process.

H8. Buyers will reach a higher level of satisfaction when interacting with softer agents than tough agents.

We propose that the search mechanism generating more diversified offers will make a buyer more satisfied.

H9. Buyers will reach a higher level of satisfaction when interacting with "breadth-first" agents than "depth-first" agents.

In addition, if a buyer achieved a higher level of utility for himself/herself, he/she would be more satisfied. In the experiment, the utilities for buyer and agent are not directly related, and the buyers do not know how much utility the agent got. Because of these two reasons, it is safe to assume that the agent utility won't influence the buyer's satisfaction level.

H12. Buyers who achieved a higher level of utility would have a higher level of satisfaction.

3.1.6 Relationships among subjective variables

Based on the Technology Acceptance Model (TAM) (Davis, 1989), the relationships between satisfaction, perceived usefulness and intention to use the agent-based negotiation system were derived. Because satisfaction is also an important indication of system quality (Bui, 1994), I assume that if a buyer perceives particular technology to be useful, it is more likely that they would be satisfied with the technology and would tend to use it.

H13. Buyers' satisfaction levels will positively influence the level of perceived usefulness.

H14. Buyers' satisfaction levels will positively influence buyers' intention to use the negotiation system.

H15. Perceived usefulness level will positively influence buyers' intention to use the negotiation system.

3.2 Experimental settings

3.2.1 Negotiation case and system

The case that was set up for this study involved the negotiation of a mobile plan through a responsive website. The participants were asked to negotiate with counterparts (computer agents) for the purchase of a mobile plan over several issues, namely price, regular airtime, extra airtime, text messaging, and data. Price had a continuous range, while the other issues had discrete values. Offers were composed, including all five issues. The participants needed to choose one option among all the options for each issue to compose a whole offer and the software agent went through the same process to compose a counteroffer. The participants were not informed that they were negotiating with a computer agent.

Utility was used as a scale to measure the attractiveness level of issues or the entire offers. The utility of an issue was calculated automatically based on the value assigned to each particular option associated with that issue. These option values would be specified by the participants or the experimenter (in the case of an agent) when configuring the settings. For each issue, the utility ranged from 0 to 100. The weighted average of the issue's utilities in an offer will be used to calculate the overall utility of that offer.

A software agent must be given a preference structure over the issues and options to be able to negotiate. Using these parameters, an agent can evaluate the utility of a given offer. Before the actual negotiations, a setup phase was introduced, where participants specified their preferences by assigning weights over the issues (Figure 14) and utility levels for each option of a certain issue, indicating their preferences and goals (Figure 15). Specifically, each offer had five weighted issues, and each issue had several options, each of which had a certain utility value assigned by the participant. Figure 15 shows an example of setting utility levels for the issue "regular airtime".

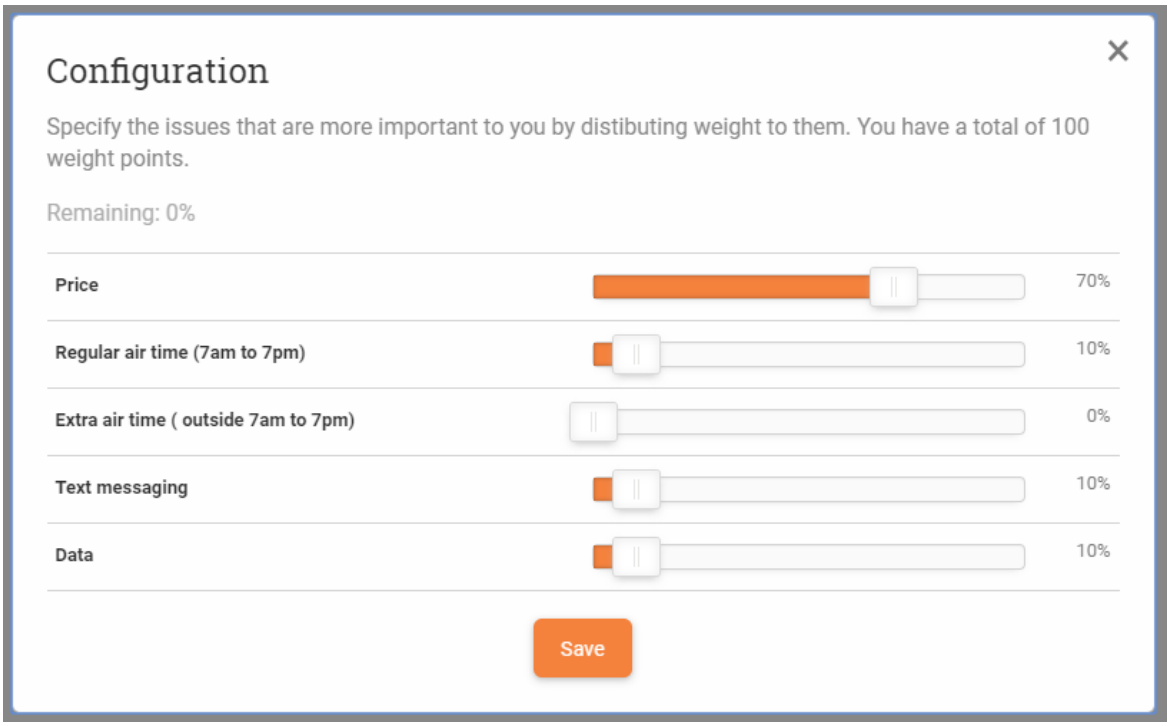

Figure 14 Setting weights for all issues

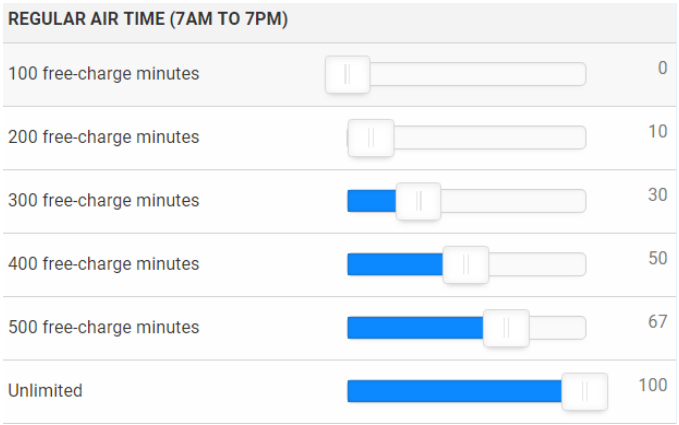

Figure 15 Setting utility values for issue "regular airtime"

The agent's preferences were set by the administrator (the experimenters). The preference structures for agents vs. buyers were not in exact opposition, i.e. the opponents were not in a fixed-pie setting (Schelling, 1958). This difference in preference structures of the negotiators opens up the possibility for the buyer and agent to search for mutually acceptable agreements in a negotiation, thus enabling "integrative" negotiation (Brinke et al., 2015).

Figure 16 shows part of the agent configuration setup. An interactive utility curve tool was provided to allow for the specification of the agent's behavior over time. The agent's tactic was set by specifying a curve that guided the agent's concession-making behavior. Three types of curves were chosen for this study, representing three time-dependent tactics (competitive, neutral, and conceding). The curves are shown in Figure 17.

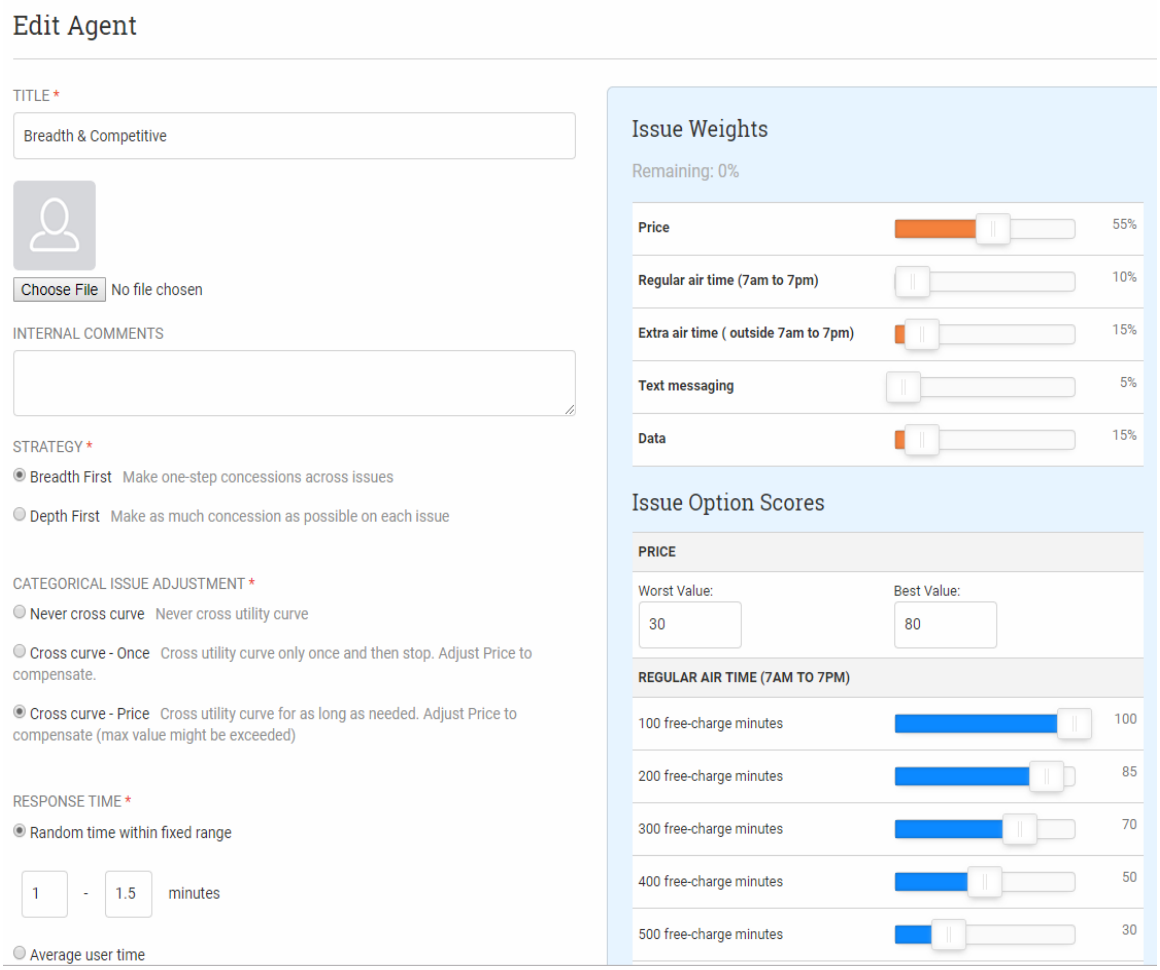

Figure 16 Experimenter's configuration page

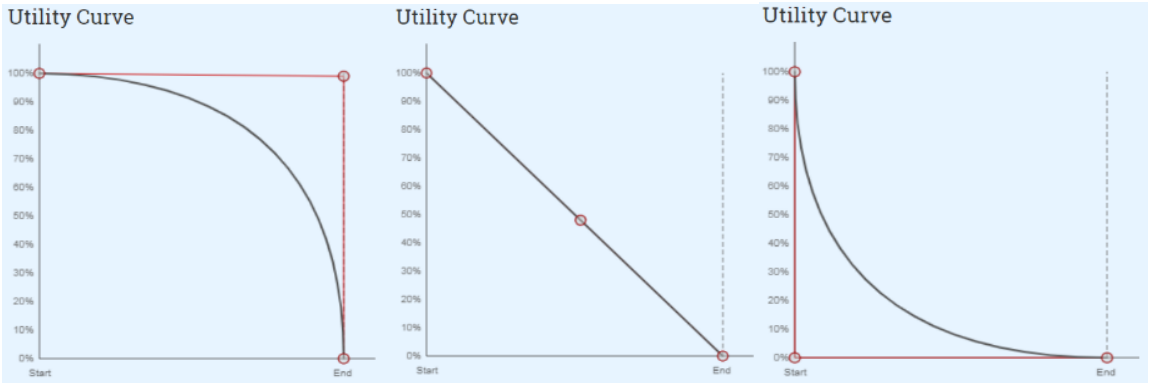

Figure 17 Competitive, monotonous, and conceding utility concession curves

The curves display the acceptable utility levels during the negotiation period. These levels defined the threshold of acceptability of the buyer's offer at a given point in time and served as a target utility when generating a counteroffer. When composing an offer, the agent modifies its previous offer by conceding on issues to meet the currently acceptable utility level. It employs one of the two search mechanisms: breadth-first or depth-first. Price adjustment was used to fine-tune the generated offer to achieve the exact utility level specified by the utility curve.

The timespan sets the limit of how long a negotiation session remains active. In other words, the timespan sets the maximum duration of the negotiation session. The participants may make an agreement during the session period or terminate negotiations without agreement (humans only). If an agreement was not achieved within a given timespan, the negotiation would end automatically without an agreement. The timespans of 30 minutes, 24 hours, and 72 hours were used in the current study. Negotiation with a 30-minute timespan was considered to be synchronous, where the offers made by the agents have a small time delay (between 60 and 90 seconds). This time delay was used to mimic human behavior so that the participants would not be able to tell that they were negotiating with a computer agent. In the synchronous mode, participants were informed that their interactions would be live and that they would need to be in front of their device (computer, mobile, iPad, etc.) to complete the negotiation. The other two timespan settings were considered to be asynchronous, enabling participants to review/make offers at various times and resume negotiation at other times within their allocated timespans.

3.2.2 Experimental procedure

The experiment involving human subjects was conducted at a North American university. In this experiment, which simulated the purchase of a mobile plan, agents played the role of sellers while the human subjects acted as buyers. The experiment consisted of three parts. The first part included a survey about the demographic information of the participants, the second part included the experimental task, and the third part featured a post-survey aimed at measuring subjective perceptions related to the participant's experiences with the negotiation process.

The study's participants were university students who were registered in an online course on the fundamentals of IT. They were invited via email to participate in a negotiation experiment, and participation was entirely voluntary. The students can participate in the experiment voluntarily and get 2% grade points as a reward for participating in the experiment. This 2% grade point reward will not compromise the voluntary nature of the experiment because the students can terminate the negotiation process at any time. Participants were randomly assigned to a negotiating agent counterpart using a specific tactic, search mechanism, and one of the three timespans. Detailed instructions were given on how to use system features.

Figure 18 displays the interface featuring an example offer exchange between a participant and a software agent. Each row illustrates an offer made by an agent (seller) or a buyer. An offer shows the options chosen for each associated issue by the agent or buyer. The right-hand side of the interface displays the total utility to guide decision-making during the negotiation process. As soon as an offer is made, a new row is entered and displayed instantly on the screen.

Figure 18 An example of offer exchange in a negotiation

In the present case, agents acting as sellers initiated the negotiation process by making the first offers to their counterparts. Buyers could then view the offer and associated details of the issues and decide to accept it, make a counteroffer, or terminate the negotiation session. If they accepted the offer, the negotiation would end with an agreement, and the utility of the agreement for both the agent and the participant would be recorded. If they terminated the negotiation, there would be no agreement and, thus, no utility achieved. If they chose to make a counteroffer, they would see a screen displaying the history of the offer exchange and the utilities for each offer. When composing a new offer, participants would be able to see the utility of their new candidate offer.

To make the agents to act more human-like (checking offers at non-deterministic time points), they were programmed to respond to their offers with a random delay. For synchronous interactions, the delays were set randomly between 1 and 1.5 minutes. For asynchronous negotiations, the delays were set between 45 and 60 minutes for the 24-hour timespan and between 150 and180 minutes for the 72-hour timespan. Agents would assess the buyers' offers in terms of their utilities and accept them only if the utility matched or exceeded the target utility values specified by the agent's tactic (as shown in the utility curves in Figure 17). Otherwise, the agents would compose new offers and continue bargaining with the buyers.

The negotiation process would continue until one of the following three actions occurred: it was terminated by the participant, a time limit was reached, or an agreement was achieved. If a human/agent pair did not reach an agreement within the given time, the negotiation would be

automatically terminated without an agreement. Agents in the study would never choose to terminate the negotiations without an agreement.

3.3 Experiment results and discussions

3.3.1 Data description

A total of 941 individuals participated in this study. They were randomly assigned to negotiate with a single agent type and a search mechanism in one of the three timespan settings. After examining the resulting dataset, it was decided to keep only those negotiation instances that included at least three offers. This is because if the number of offers in a given session was one, it meant that a participant accepted the first offer received; if it was two, it meant the participant replied to an initial offer with a counteroffer that was accepted by the agent right away. These cases do not represent real full-fledged negotiations. Thus, it was decided to discard them to have a meaningful dataset for analysis.

After filtering the data, 534 usable negotiation records were retained for analysis. These data compose Dataset 1, which is used in Model 1 to measure the influence of factors on the agreement rate. It is necessary to use all the data, regardless of whether the cases reached an agreement or not, in order to calculate the agreement rate.

The distribution of all the observations is shown in Table 1. The asynchronous group included 24 and 72 hours, and the sample size of the asynchronous group was about twice the size of other groups.

Table 1 Distribution of cases (count)

Search mechanism	**Timespan**	**Tactics**			
		Conceding	Monotonous	Competitive	Total
Breadth	Synchronous	25	42	30	97
	Asynchronous	66	51	67	184
	Total	91	93	97	281
Depth	Synchronous	24	21	28	73
	Asynchronous	49	61	70	180
	Total	73	82	98	253
Total	Synchronous	49	63	58	170
	Asynchronous	115	112	137	364
	Total	164	175	195	534

Out of the 534 negotiation instances, 400 negotiations ended with an agreement, while 134 cases ended without an agreement. For Model 2, only the cases that had reached agreements can be used to analyze the factors' influence on utility values. If negotiators didn't reach an agreement, there would be no utility value. Therefore, the 400-observation dataset was used as Dataset 2. Furthermore, among the 400 cases, only 131 observations completed the pre- and post-survey questionnaire with no missing data. Since subjective survey results were included in Model 2, only 131 cases could be kept for Dataset 2. There were 19 observations with data out of the legitimate range (e.g., having price or utility values out of the range). After deleting these data, the final Dataset 2 has 112 observations.

131 out of the 534 participants completed both the pre- and post-survey. The questionnaire had a response rate of 24.5%. The low response rate can be attributed to the fact that the system allowed the participants to complete the negotiation tasks without filling out the questionnaire. Additionally, the entire observation would be deleted as long as there was one answer missing.

Table 2 presents the descriptive statistics of the respondents' demographic data.

Table 2 Demographics data

Characteristic	*Number*	*%*
Gender		
Female	258	48.3
Male	276	51.7
Total	534	100
Age		
17-19	119	22.3
20-22	296	55.4
23-25	62	11.6
>25	57	10.7
Total	534	100

Regarding the demographic data of the respondents, the majority of participants were young (89% of them were younger than 26 years old), with slightly fewer female participants than male participants (3.4% less).

3.3.2 Experiment dataset 1: negotiation group result test

As a test measure of the group result, agreement rate was tested as a dependent variable, while the independent variables included timespan, tactic, and search mechanism. Table 3 shows the breakdown of agreement rates for each combination of timespan, tactic, and search mechanism.

Table 3 Agreement rate

Search	**Time Span**	**Tactics**							
		(a) Conceding		(b) Monotonous		(c) Competitive		(d) Tot.	Pct.
Breadth first (a)	Synchronous	23	92.0%	37	88.1%	19	63.3%	79	81.4%
	Asynchronous	59	89.4%	40	78.4%	37	55.2%	136	73.9%
	Total	82	90.1%	77	82.8%	56	57.7%	215	76.5%
Depth first (b)	Synchronous	20	83.3%	18	85.7%	19	67.9%	57	78.1%
	Asynchronous	40	81.6%	44	72.1%	44	62.9%	128	71.1%
	Total	60	82.2%	62	75.6%	63	64.3%	185	73.1%
Total (c)	Synchronous	43	87.8%	55	87.3%	38	65.5%	136	80.0%
	Asynchronous	99	86.1%	84	75.0%	81	59.1%	264	72.5%
	Total	142	86.6%	139	79.4%	119	61.0%	400	74.9%

As one can see from Table 3, 80.0% (136 counts) of synchronous negotiations and 72.5% (264 counts) of asynchronous negotiations resulted in an agreement (row c, column d). This

suggests that the human-computer interaction mode (synchronous versus asynchronous) had an impact on agreement rates. Specifically, discriminant analysis revealed that synchronous negotiations had a higher agreement rate than asynchronous negotiations at 0.1 significance level ($F = 3.452$, $p = 0.064$, *difference* = 0.068). In fact, in a synchronous process, it would seem that participants were more focused on the negotiation and less likely to terminate the process arbitrarily. Therefore, H1 was marginally supported at 0.1 significance level.

We can see from the row c and columns a, b, and c in Table 3 that tactics had a clear effect on the agreement rate, which is supported by the result of discriminant analysis ($F = 33.708$, $p = 0.000$, H2 is supported) and consistent with past studies (Vahidov et al., 2014). Specifically, the agreement rate for conceding, monotonous, and competitive tactics were 86.6% (count: 142), 79.4% (count: 139), and 61.0% (count: 119), respectively. This means that agents following conceding tactic achieved significantly higher agreement rates than those following competitive tactic ($p = 0.00$, *difference* = 0.25). Further, agents following monotonous tactic achieved significantly higher agreement rates than those following competitive tactic ($p = 0.00$, *difference* = 0.184). In general, tactics had a significant effect on the agreement rate.

Table 4 Hypotheses test results of agreement rate

Hypotheses	*p*	
H1. *A synchronous negotiation will result in a higher agreement rate than an asynchronous negotiation.*	0.064	Marginally supported
H2. *Conceding agents will achieve a higher agreement rate than competitive ones.*	0.00	Supported
H3. *Agents using the "breadth-first" search mechanism will achieve a higher agreement rate than those using the "depth-first" search mechanism.*	0.368	Not supported

The results also indicate that the search mechanism did not have a significant effect on the agreement rate. One can see from the column d and row a & b in Table 3 that 76.5% (count: 215) of breadth-first cases and 73.1% (count: 185) of depth-first cases resulted in an agreement. Although breadth-first search mechanism performed slightly better than depth-first search, the difference was not significant ($F = 0.812$, $p = 0.368$, *difference* = 0.022) according to the results of discriminant analysis. Therefore, H3 was not supported.

Table 4 summarizes the influence of all factors on the agreement rate, and Figure 19 presents the hypotheses test result model.

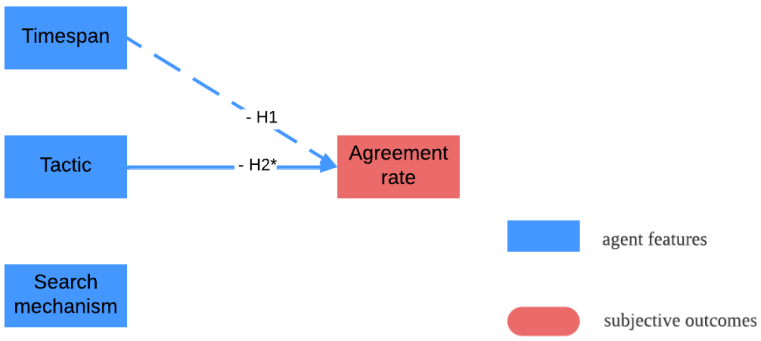

Figure 19 Hypothesis test result for agreement rate

Categorical variables coding:
*0.01<p<0.05: *, p<0.01: ***
Significant: solid line, Marginally significant: broken line
Negative relationship: -, Positive relationship: +
Timespan: Synchronous: 1, Asynchronous: 2
Tactic: Conceding: 1, Monotonous: 2, Competitive: 3
Search mechanism: Breadth-first: 0, Depth-first: 1.

3.3.3 Experiment dataset 2: structural equation modelling

The data analysis involved a three-step Structural Equation Modeling (SEM) method. First, Exploratory Factor Analysis (EFA) was used to detect latent factors and extract items from the questionnaire. Next, following the recommendations of Anderson & Gerbing (1988), a Confirmatory Factor Analysis (CFA) was conducted to establish the measurement model. The questionnaire was subsequently refined, by keeping the most relevant items. Lastly, to examine the relationships among all constructs, the proposed hypotheses were tested using SEM.

3.3.3.1 Questionnaire reliability and validity

Normality assumptions of the questionnaire items were checked (Table 5): all values of skewness and kurtosis were within -1 and +1, and all the Critical ratios (c.r.) were within the acceptable range of < 5 (Bentler, 1990).

Table 5 Refined instruments in the questionnaire and normality assumptions check results

Instruments	*skewness*	*c.r.*	*kurtosis*	*c.r.*
Perceived usefulness				
I find EXCHANGE useful to configure my mobile plan.	-0.194	-0.873	-0.872	-1.958
Using EXCHANGE would enable me to accomplish the purchase of a mobile plan more quickly.	-0.349	-1.565	-0.653	-1.466
Using EXCHANGE would increase the effective use of my time in the purchase of my mobile plan.	-0.26	-1.167	-0.82	-1.841
Using EXCHANGE would increase the quality of the purchase of my mobile plan at minimal efforts.	-0.3	-1.348	-0.738	-1.657
Using EXCHANGE would increase the quality of the purchase of my mobile plan at minimal time.	-0.317	-1.424	-0.56	-1.258
Behavioral Intention				

If made available, I intend to use systems such as EXCHANGE to negotiate for my mobile plan.	-0.373	-1.677	-0.86	-1.931
If made available, I predict that I would use EXCHANGE in the future, to negotiate for my mobile plan.	-0.299	-1.341	-0.98	-2.2
If available, I plan to use EXCHANGE to improve my mobile plan.	-0.312	-1.403	-0.991	-2.226
Satisfaction				
To what extent does the final outcome realistically reflect your objectives?	-0.355	-1.593	-0.442	-0.992
My interaction with the other party (opponent) through Exchange was positive	-0.507	-2.275	-0.18	-0.405
I am satisfied with my opponent	-0.375	-1.685	-0.482	-1.082
I enjoyed working with my opponent towards the deal	-0.561	-2.518	0.02	0.045

Table 6 shows that Cronbach's alpha values of all factors are greater than 0.9, indicating their high internal consistency. The factors' composite reliability (CR) values are all above 0.70 (Table 6), suggesting a good reliability level. In fact, the factors' CR values are above 0.9, which might suggest that some items may have been semantically redundant (Hair Jr. et al., 1998). Thus during the refinement process of CFA, similar questions rephrasing other questions have been removed, and only items that measured different aspects of the latent variables without redundancy were retained (Hair Jr et al., 2016). As a result, the internal consistency reliability of the latent factors as measured by items has been established.

Table 6 Reliability test result

Instruments	*Cronbach' alpha*	*CR*	*AVE*
Perceived usefulness	0.965	0.965	0.846
Behavioral Intention	0.973	0.973	0.924
Satisfaction	0.944	0.947	0.819

In addition, all average variance extracted (AVE) values were greater than 0.5 (Table 6), which attests to the convergent validity of the constructs. Discriminant validity was evaluated by comparing each factor's root AVE and correlation values with those of different factors. Each factor's root AVE was greater than all correlation values involving that factor. Therefore, the instrument features an adequate level of discriminant validity.

3.3.3.2 Model fit

Structural Equation Modelling was applied using AMOS to test the structural model. All factor loadings are larger than 0.80. Model-fit measures are used to assess the model's overall goodness of fit (CMIN/df, GFI, CFI, NFI, TLI, SRMR, and RMSEA). Most of the measures suggested a good model fit (Bentler, 1990; Hu & Bentler, 1998). The model yielded the following statistics: Chi-Square = 150.160, CMIN/df = 1.809, CFI = 0.963, NFI = 0.921, TLI = 0.95, SRMR = 0.0596, all suggesting a very good model fit. GFI is 0.864, which, although smaller than 0.9, still suggested a relatively good model fit. RMSEA is 0.085, which is slightly larger than 0.08 but smaller than 0.09, suggesting a relatively fair model fit.

3.3.3.3 Agreement utility for agent

Each observation in the experiment was independent of the others. The skewness and kurtosis results suggested that the input variables were approximately normally distributed. The SEM result showed that agent tactics had significant direct effects on the utilities achieved by the agents ($C.R._{tactic} = 7.7$, $p_{tactic} = 0.00$, H4 is supported). The mean utilities of agreements reached by the agents are 0.40, 0.64 and 0.80 for conceding, monotonous, and competitive agents, respectively. It is clear that competitive/tough tactics lead to higher agent utilities.

The agent-gained utility difference between two search mechanisms used in composing offers was marginal ($difference_{search\text{-}mechanism} = 0.06$, $C.R._{search\text{-}mechanism} = -1.858$, $p_{search\text{-}mechanism} = 0.063$, H5 was marginally supported). The breadth-first strategy produced slightly better results for the agents.

The test results of the hypotheses related to agreement utility for agents are shown in Table 7, suggesting that H4 is supported while H5 was marginally supported.

Table 7 Hypotheses test result of agreement utility for agent

Hypotheses	*P*	
H4. *Tougher agents will achieve agreements with higher agent utility than softer ones.*	0.00	Supported
H5. *Agents using "breadth-first" search mechanism will achieve agreements with higher agent utility than those using "depth-first" search mechanism.*	0.063	Marginally supported

3.3.3.4 Agreement utility for participant

Table 8 shows human participants' mean utilities of agreements when the negotiators reached agreements. The mean utilities are 0.65 for human participants negotiating with conceding agents and 0.43 for those negotiating with monotonous and competitive agents (row c and columns a, b, and c). The test suggested that conceding agents left significantly higher utility for buyers ($C.R._{tactic} = -4.136$, $p_{tactic} = 0.00$, H6 is supported).

Table 8 Mean utilities of agreements for buyers

	Tactics			
	(a) Conceding	(b) Monotonous	(c) Competitive	(d) Total
Breadth (a)	0.64	0.41	0.41	0.48
Depth (b)	0.67	0.50	0.46	0.55
Total (c)	0.65	0.43	0.43	0.51

The search mechanisms used in composing offers showed a moderate effect on the utilities gained by buyers ($C.R._{search\text{-}mechanism} = 1.648$, $p_{search\text{-}mechanism} = 0.099$), albeit in a different direction from what was expected. The depth-first search mechanism produced better results for the buyers than the breadth-first search (as shown in Table 8, the mean utility for the depth-first agent was 0.55, while it was 0.48 for the breadth-first agent). Thus, H7 was rejected. This result may be due to the tendency of the depth-first search mechanism to keep the buyer's focus on a specific issue. In contrast, bargaining over many issues at a time could distract buyers and reduce

their utility. Therefore, one may say the link hypothesized in H7 was detected, although with an opposite sign.

Table 9 Hypotheses test result of agreement utility for participants

Hypotheses	*p*	
H6. *Softer agents will achieve agreements with higher buyer utility than tough ones.*	0.00	Supported
H7. *Agents using "breadth-first" search mechanism will achieve agreements with higher buyer utility than those using "depth-first" search mechanism.*	0.099	Rejected (opposite direction)

3.3.3.5 Perceived usefulness

The next set of hypotheses concerns the perceived usefulness of the negotiation system. From the SEM results in Table 10, one can draw a conclusion that tactics are not significantly related to perceived usefulness (H10 was not supported). This result suggests that participants were rational in their assessment and that their conclusion about usefulness was not affected by their opponents' tactics (participants were not informed they would be interacting with computer robots).

Table 10 SEM result of perceived usefulness

Dependent variable	*Independent variable*	*Estimate*	*C.R.*	*p-value*
Perceived usefulness	Tactic	0.016	0.202	0.84
Perceived usefulness	Search mechanism	-0.178	-2.38	0.017
Perceived usefulness	Satisfaction	0.645	7.668	<0.0001

On the other hand, search mechanism was significantly related to perceived usefulness with a coefficient of -0.178. The breadth-first search mechanism was coded as 0 and depth-first as 1. As such, the breadth-first mechanism performed better in terms of perceived usefulness (H11 was supported). This result is consistent with the assumption that more diversified offers from the opponent would lead to an improved perception of the system.

In addition, the buyer's satisfaction level had a significant and positive impact on perceived usefulness, with a coefficient of 0.645. Namely, the more satisfied a buyer was, the more useful the buyer perceived the negotiation system to be (H13 was supported). The results of the hypotheses testing are listed in Table 11.

Table 11 Hypotheses test result of perceived usefulness

Hypotheses	*p*	
H10. *Buyers will perceive the negotiation system more useful when interacting with softer agents than tougher agents.*	0.84	Not supported
H11. *Buyers will perceive the negotiation system as more useful when interacting with agents following "breadth-first" search mechanism than those following "depth-first".*	0.017	Supported
H13. *Buyer's satisfaction level will have a positive influence on the level of perceived usefulness.*	0.00	Supported

3.3.3.6 Satisfaction

Dummy variables were used to encode Conceding, Monotonous, and Competitive tactics, with corresponding values of 1, 2, and 3. Therefore, higher numbers represented tougher, more competitive tactics. As the SEM results (Table 12) show that the tactics variable is negatively related to satisfaction with a coefficient of -0.184 (p=0.057), one can conclude that more competitive tactics led to diminished satisfaction from the human counterpart. Namely, a conceding agent was less aggressive and obtained higher satisfaction (H8 is moderately supported).

As shown in Table 12, the search mechanism did not significantly affect satisfaction, with a p-value of 0.911 (H9 is not supported). This result supports the speculation that the buyer subjects were rational in their assessment, and their evaluation of satisfaction with the system was not affected by the opponent's tactics or search strategy.

Table 12 SEM result of satisfaction

Dependent variable	*Independent variable*	*Estimate*	*C.R.*	*p-value*
Satisfaction	Tactic	-0.184	-1.906	0.057
Satisfaction	Search mechanism	-0.01	-0.112	0.911
Satisfaction	Utility for buyer	0.287	2.933	0.003

Regarding the influence of buyer's utility, Table 12 suggests that a buyer who achieved higher utility from the negotiation would be more satisfied with the negotiation (H12 was supported).

Table 13 Hypotheses test result of satisfaction

Hypotheses	*P*	
H8. *Buyers will reach higher level of satisfaction when interacting with softer agents than tougher agents.*	0.057	Moderately supported
H9. *Buyers will reach higher level of satisfaction when interacting with "breadth-first" agents than "depth-first" agents.*	0.911	Not supported
H12. *Buyers who achieved a higher level of utility would have a higher level of satisfaction.*	0.003	Supported

3.3.3.7 Behavioral intention

The last set of hypotheses concerns behavioral intention. Table 14 reveals that both perceived usefulness and satisfaction had a positive and significant relationship with behavioral intention (p<0.01 for both cases). Namely, if a buyer perceived the negotiation system as useful or was satisfied with it, the buyer would tend to use it in the future (H15 and H14 were supported). The test results of the hypotheses are shown in Table 15.

Table 14 SEM result of behavioral intention

Dependent variable	*Independent variable*	*Estimate*	*C.R.*	*p-value*
Behavioral intention	Perceived usefulness	0.693	9.299	<.0001
Behavioral intention	Satisfaction	0.207	2.807	0.005

Table 15 Hypotheses test result of behavioral intention

Hypotheses	*p*	
H14. *Buyer's satisfaction level will have a positive influence on buyer's intention to use the negotiation system.*	0.005	Supported
H15. *Perceived usefulness level will have a positive influence on buyer's intention to use the negotiation system.*	<.0001	Supported

3.3.3.8 Result SEM model

The summary result of hypotheses testing is presented in the model depicted in Figure 20. This figure illustrates that tactics have an impact on the utility of both agents and buyers. Search mechanisms also have a moderate effect on the utility for agents and customers. Moreover, tactics and search mechanisms influence subjective assessments. Although Hypothesis 7 was not supported for its negative influence on the result, it may moderately have a positive influence. For this reason, the plus sign in front of "H7" in the figure is depicted using a red colour.

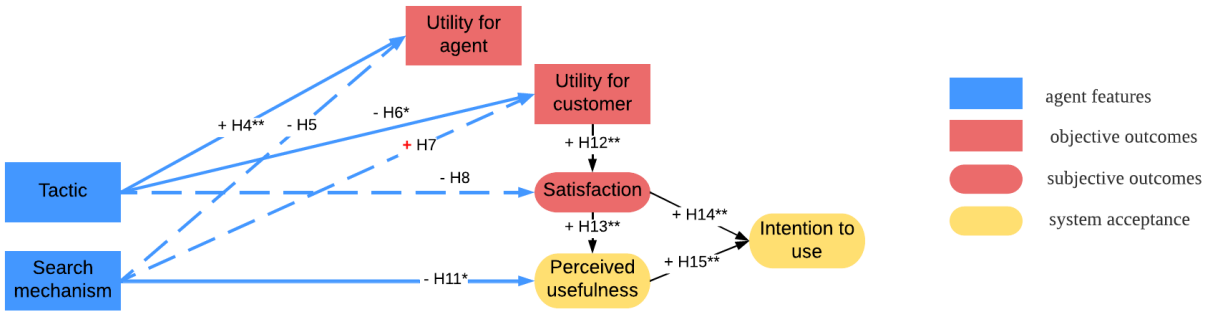

Figure 20 Research model with hypotheses test results

Categorical variable coding:
*0.01<p<0.05: *, p<0.01: ***
Significant: solid line, Marginally significant: broken line
Negative relationship: -, Positive relationship: +
Tactic: Conceding: 1, Monotonous: 2, Competitive: 3
Search mechanism: Breadth-first: 0, Depth-first: 1.

3.4 Conclusions

This paper investigated the influence of negotiation timespan, software agent negotiation tactic, and agent's search mechanism on the outcomes of "human-computer" negotiations. To this end, a 2×2×3 negotiation experiment featuring the case of mobile plan purchases was designed and conducted, including two search mechanisms, two timespans, and three tactics. The experiment included 941 participants, of which 534 negotiation records were usable for Model 1 and 112 cases for Model 2. The three concession-making tactics used by agents are Conceding, Monotonous, and Competitive, representing the "toughness" of agent negotiators. Two research models depicted in Figures 12 and 13 were proposed to study the impact of different timespan, agent tactics and search mechanisms on negotiation outcomes. The first model investigates the effects of timespan, tactic and search mechanism on agreement rate, while the second explores the influence of tactic and search mechanism on negotiation's subjective and objective outcomes. The two models present 15 hypotheses tested using discriminant analysis and structural equation

modelling, including three constructs and two hypotheses in Model 1 (Figure 19) and seven constructs and ten hypotheses in Model 2 (Figure 20).

The contribution of this research is twofold. Firstly, this research sheds light on a sound evaluation system. By utilizing a multi-level and multi-perspective approach to evaluate negotiation results, we can gain a deeper understanding of the influence of specific features. Secondly, this research investigated the influence of several factors, including timespan, tactic, and search mechanism. The results of this research can be applied to businesses that sell products online and used to guide the future adoption and design of computer agents.

As previously elaborated, past research has primarily focused on only one or a few measures for experiment results, such as utility or agreement. In Van Kleef & Côté (2018)'s review, they proposed a more systematic way and evaluated negotiation results from multi-dimensions, namely individual, dyadic, and group levels. However, Van Kleef & Côté's research did not identify different perspectives. The current research offers a multi-dimensional and multi-perspective approach to evaluate negotiation results from individual and dyadic levels, as well as subjective and objective perspectives. In addition to assessing the current results of the negotiation, this study also employs the "intention to use" as a measure to evaluate the future potential of the computer agents.

From an objective perspective, the analysis results suggest that at the dyad level, the conceding tactic significantly increased the agreement rate, while the synchronous negotiation mode marginally led to a higher agreement rate. However, the search mechanism did not influence the agreement rate. At the individual level, the results indicate that the conceding tactic led to lower agreement utility values for the agents and higher utility values for buyers. Search mechanism had a marginal effect on the utilities for both buyers and agents. The results also show that a breadth-first search mechanism leads to a lower utility for buyers and a higher utility for agents.

From a subjective point of view, the analysis results suggest that at the individual level, participants' utility had a significant influence on their satisfaction. Specifically, participants who achieved higher utility were more satisfied with the negotiation. In addition, search mechanisms and satisfaction were found to impact the perceived usefulness of the system. Lastly, as expected, perceived usefulness and satisfaction were both positively related to buyers' intention to use.

One limitation of the current work is the use of students as participants in an academic setting where the negotiation is an exercise conducted with grade points as rewards. In this case, the potential gain from the outcome of the negotiation is not monetary. Consequently, it remains to be seen how people would act in a real negotiation context involving money. In Agndal et al.'s (2017) review article, they found that 60% of empirical studies used students as their research subjects, suggesting that using students as experimental subjects is considered acceptable in academia. Furthermore, in the current research context, the research purpose is to investigate the negotiation behavior of customers when they purchase online, which is common behavior in real life nowadays, especially with younger generations. In this case, despite the use of students as research subjects of a hypothetical purchasing case, the context and setting of the experiment are quite close to the real world today. Nonetheless, this drawback was partially mitigated by setting

a threshold for the number of offers in each negotiation case. With a large number of cases, this method may help pertinent patterns emerge.

Another limitation of this study is the small sample size due to the limited number of completed questionnaires. No participants in asynchronous mode completed the survey. Hence, the test about the influence of timespan on participants' subjective perceptions about the computer agent and negotiating session cannot be completed. Further work is needed to dig into the effect of synchronism on the buyer's experience and perception.

It is important to highlight that joint outcome is a limitation in this study and probably in the research area at large. Joint outcomes are simply the addition of utility for agents and buyers together. Although much research has reported results of joint outcomes, the same case may not apply to the human-computer negotiation area. Limitations to the report on joint outcomes are also reflected in the works of many researchers, such as Van Kleef (E. Van Dijk et al., 2008; G. Van Kleef, 2010; 2004a, 2004b; van Kleef, 2014; G. A. Van Kleef & Côté, 2007, 2018). This is likely due to the nature of computer-simulated research design where one human subject responded to a computer-simulated other, making it difficult to reach meaningful agreements or create joint gains. This is the same as the experiment's settings in this research. Hence, in this research, the focus is specifically on the agent's utility because the online purchase agent is typically used by companies that want to sell products online. This type of company would want to know the expected results of applying a particular agent.

Future work can also be directed towards studying the effects of more dynamic tactics, in particular those referred to as behavior-dependent. In essence, the tactics featured in this work are pre-defined and insensitive to buyers' moves. Various forms of tit-for-tat tactics can be investigated in the future to see the effects of reciprocity. Overall, the limitations of the study present opportunities for further research.

4 Essay 3: Can a Negotiator Build a Tough Impression Without Chatting? —— Implicit Power and Its Influence on Human-Computer Negotiation

Nowadays, with the development of artificial intelligence, human-computer interaction is becoming increasingly intense and rich. In the context of e-commerce, technology has evolved from simple catalogue-like look-up websites to advanced dynamic interfaces allowing negotiation. In this regard, employing artificial software agents could help the parties achieve mutually acceptable deals.

In negotiation, power is considered the most important factor that will influence negotiation results (Pinkley et al., 1994). In most past research, power was considered to be gained directly through chat or natural language communications during negotiation. This essay proposes that there is another approach to demonstrating power. This approach involves a different kind of power that the negotiating party implicitly perceives through ways other than chat. This essay further suggests that this kind of implicit power will influence the negotiation result.

Implicit power is a kind of power that is perceived by the other party through tacit hints in negotiation as opposed to expressed through direct communication or demonstration. In past studies, some negotiator attributes (such as anchoring and concession tactic) were studied separately from power, leading to some conflicting results. For example, Schaerer et al. used "power" and "anchor" separately as two inputs to their models (Schaerer et al., 2015). They found higher power led to lower negotiation results, which was the opposite of the commonly accepted understanding. However, as proposed by the current paper, anchor is one aspect of power: implicit power, so using these factors as two independent variables may lead to unreliable results.

In this essay, I introduce implicit power into the negotiation field and incorporate the agent's anchor, concession tactic, and profile image into an agent's implicit power. Introducing implicit power in e-negotiation studies will enrich and clarify the concept of power. I then investigate the influence of the agent's implicit power on negotiation results. Meanwhile, I introduced human negotiators' individual differences into the model as human subjects' implicit power and studied the influence of such power.

Hence, the research question of this paper is: *can implicit power of both human and computer agents affect the negotiation process and its outcomes?*

This essay examines the definition and the influence of implicit power in the context of online shopping, where human buyers negotiate with computer agents acting as sellers. Specifically, an experiment was conducted to examine several aspects of implicit power, including anchoring, agent profile image power, and the power of experiment subjects' personalities. In the experiment, the participants negotiated the purchase of a laptop with computer agents acting as sellers. Two anchoring conditions and four profile images were used to test the influence of these implicit powers. As the source of intrinsic power, the participant's personality (Social Value Orientation) was also tested in three types: prosocial, individualistic, and competitive.

4.1 Research model and hypotheses

4.1.1 Negotiator power

Power has been considered one of the most important factors in negotiation (C. K. W. De Dreu & Van Kleef, 2004; Galinsky et al., 2003; Pinkley et al., 1994). It is wildly acknowledged that power can affect negotiator performance. Bacharach and Lawler (1981) suggested that power is the central determining factor in negotiations.

A considerable number of studies have researched the effect of power on negotiation and found that a negotiator with comparatively higher power can claim more resources in negotiation results (C. Anderson & Thompson, 2004; P. H. Kim et al., 2005; Wolfe & Mcginn, 2005). For example, one article indicated that the perceived power of negotiators affected the distribution of result utility (Wolfe & Mcginn, 2005). Specifically, when two parties were perceived with equal power, the parties got more integrative results. Anderson and Thompson (2004) found that positive actions from more powerful parties would lead to more integrative results than those from less powerful parties, while joint outcomes will not get influenced.

Kim et al. (2005) divided power into four categories: potential power, perceived power, power tactics, and realized power. The potential power and perceived power are negotiators' underlying and realized capacity to obtain benefits from their agreement. Perceived power is the negotiators' assessment of both parties' power. There could be a difference between real power and perceived power. This difference can be made by power tactics. Power tactics mean the "use" or "change" of power. The "use" of power can claim actual benefit for a negotiator, while the "change" of power can make the perceived power higher than real power. In one article, the authors contrasted perceived relative power with the objective individual-level measure of power (Wolfe & Mcginn, 2005). The authors found that the perceived power of negotiators affected the distribution of result utility. Specifically, when two parties were perceived as having equal power, the parties got more integrative results.

Power tactics are used to affect the power balance by enhancing the negotiator's own power or diminishing the other's power. In order to enhance the negotiator's own power, current solutions are through communication between two parties, such as using coercive threatening, rational persuasion, or expert knowledge. However, besides those solutions to show power explicitly, other factors can also implicitly influence the perceived power of one party. One can build up a strong power image implicitly using methods such as strong opening (anchoring), facial expression cues (such as angry facial expressions), using a masculine avatar image, showing very little or no compromise (concession tactic), and so forth. Many authors have already well-researched the concession curve's influence on utility for an agent (C.-F. Lee & Chang, 2008; Vahidov et al., 2014; K.-J. Wang & Chou, 2003). Based on their research, a tough tactic showed strong power and led to higher negotiation results.

To eliminate the influence of the negotiator's wording, I designed a system that only allows offer exchange without any communication, such as chat, text, or other methods. The participants cannot chat through this system, and the only way to communicate is through the exchange of offers. This way can eliminate the bias from other factors.

4.1.2 Anchoring

Anchoring is usually referred to as the initial offer, opening offer, or beginning offer. It is based on the priming effect and sets up the starting point for following offers and counteroffers.

From past research, scholars found that higher power can prompt negotiators to set a higher anchor and hence a higher result utility. For example, some researchers found that a high-power negotiator tends to use a higher level of the first offer than a low-power negotiator (Galinsky et al., 2008; Magee et al., 2007). In another article, Kristensen and Gärling (2000) noted that counteroffers were higher for a high rather than low anchor point. In other words, a high anchoring point is usually proposed by a higher-power party and will lead to a higher counteroffer for the higher-power party. As the negotiation continues, higher counteroffers usually result in a higher result for the higher-power party. This is also supported by the research of Galinsky and Mussweiler (Galinsky & Mussweiler, 2001). They found that the first offer can be used to predict the negotiation outcome (Galinsky & Mussweiler, 2001; Magee et al., 2007).

We believe anchoring and concession tactics (concession curves) should be included as aspects of implicit power. An agent's anchoring level and concession curve can influence the perceived power of an agent. Suppose an agent made an aggressive first offer and hardly made any concessions. In that case, such an agent will leave the counterpart an impression that this agent may have better alternatives and hence be perceived as a powerful negotiator. In other words, the anchor and concession curve can influence the computer agent's perceived power to the opposing party, hence the negotiation outcome. This is supported by Purtell's research. He conducted an experiment and found that negotiators' perception of their own power will result in more aggressive anchor offers and hence the final values negotiated (Purtell, 2018). This research suggested that anchor is an indicator of one party's perception of their own power. As a result, if one negotiator sets a high anchor, the opposing party would naturally think this person may have high power.

In past studies, it was commonly accepted that higher power would lead to a higher result. However, in a study by Schaerer et al., the authors found a conflicting result that "having no power can be better than having a little power" (Schaerer et al., 2015). In their study, the authors found that negotiators with no alternatives (no power) felt less powerful, but all made higher first offers, while negotiators with weak alternatives (weak power) all created low anchors. As a result, the negotiators with no alternatives reached a higher outcome than the ones with weak alternatives. The authors concluded that anchors had larger effects than feelings of power. However, as proposed in this essay, an anchor is a factor that can represent power. It is likely that negotiators with no alternatives all created higher anchors, which, in turn, made the counterparty perceive that the no-alternative negotiator may actually have some power. According to Kim et al., perceived power is the factor that will actually influence the negotiation result (P. H. Kim et al., 2005). Then the higher anchor set by no-alternative negotiators increased their perceived power to the counterparty, and those no-alternative negotiators reached a better outcome than weak-alternative negotiators.

In summary, a powerful agent that sets a higher anchor will make the counterparty feel difficult to gain utility. As a result, the agreement utility for agents who set higher anchors will be higher. So, Hypothesis 1 is as follows.

Hypothesis 1: Anchoring level will positively influence the result utility for an agent.

4.1.3 Agent "gender"

According to French and Raven's (1959) typology of power bases, "Referent Power" is a function of how attracted one party is to the other party and how much this party can influence the other party's feelings of personal acceptance, approval, and self-esteem. Referent power is also known as charismatic power. On encountering a new group of people, one may gain or give power based on observed accents, appearance or other attributes possessed by some individuals but not others. Accordingly, the settings of the agent's avatar image can be an important way of demonstrating a computer agent's power. Through the avatar image, the agent can be presented as a male or female agent with a serious or smiling facial expression. A serious male avatar image can give the other party a powerful and competitive impression. Hence, this kind of avatar image will have higher referent power. This is supported by Ragins and Sundstrom (1989)'s research. Their research revealed a consistent difference favoring men regarding resources and power.

More importantly, this kind of referent power is not a trivial factor in negotiation. In an exploratory study by Dobrijevic et al. (2011), the authors conducted a thorough study of sources of power and developed an extensive list of 16 sources of power. Among the 16 sources of power, intangible power (referent power) is among the three most important influencing powers when negotiating with peers. The other two sources of power are the need for negotiation and relationships. In the negotiation case, the exchange is between the student buyers and computer agent sellers. Since computer agents have young female and male avatar images, the negotiation can be recognized as between peers.

According to Role Congruity Theory (Eagly & Diekman, 2005; Eagly & Karau, 2002), women and men are expected to behave differently according to their gender roles, and people who behave in ways that deviate from stereotypical expectations are more likely to be negatively evaluated. This effect has been demonstrated specifically in negotiation (Watson, 1994). Women are stereotyped as being concerned for others and selfless in western society, while men are viewed as competitive, self-assertive, and achievement driven. Since negotiation performance rewards aggressive and competitive behavior, which is consistent with men's gender roles, Bakan (1966) claims that female gender stereotypes place female negotiators at a disadvantage (Kray & Thompson, 2004; Miles, 2010).

Many research findings have shown that women's performance in mixed-gender negotiations often falls below men's, especially in negotiations on monetary tasks (Bowles et al., 2005; Stevens et al., 1993; Walters et al., 1998). In a meta-analysis of extant research dealing with gender differences in negotiation outcomes, Stuhlmacher and Walters (1999) found that across studies, men negotiated significantly better than women, but the differences in outcomes between men and women were small. Over the years, scholars have conducted a host of studies to

uncover the mechanisms that may account for this gender gap. Broadly speaking, three kinds of variables have been found to account for these gender effects: individual differences between female and male negotiators, partners' differential reactions to women and men negotiators, and situational factors (Demoulin, 2014).

Many researchers have already found that gender difference stems from the individual behavioral differences between female and male negotiators before, during, and after the negotiation (Greenhalgh & Gilkey, 1993; Kray & Gelfand, 2009; Walters et al., 1998). Except for the intrinsic differences between females and males, the counterpart's differential reactions to female and male negotiators also play an important role in how negotiations evolve (Demoulin, 2014). In particular, several studies reveal that partners treat men and women differently, even when they negotiate identically. For instance, research has shown negotiators to be four times more likely to deceive a female than a male counterpart (Kray et al., 2014). In one previous research, the authors found that men often receive better offers in negotiation (Ayres & Siegelman, 1995) and, thus, as a consequence of an anchoring effect, obtain better results at the end of the negotiation. Also, in another laboratory setting, Wood and Karten (1986) provided only the name and gender of a set of group members. They found that more status and power were conferred on male than female group members. Ragins and Sundstrom (1989) found that men have greater accessibility and utility of power compared to women in organizational settings. If men are automatically accorded relatively high status and power, it will likely grant them more influence at the bargaining table.

In light of the above, it can be deduced that male agents can get a better negotiation result even using the same negotiating tactics and other factors. Not just gender differences, the computer agents also used a robot picture or no-avatar image in addition to a real-person female/male picture. Hence, whether there is any difference between "robot", "female", "male", and no-image agents can be tested.

Hypothesis 2: Agent avatar image (referent power) will have a significant influence on agents' result utility.

Kray and Thompson (2004) have thoroughly reviewed previous articles on gender and negotiations. They suggested that there should be power and gender interaction. That is, because women are presumed to place more weight on the maintenance of relationships, high-power women might be expected to use their power to promote joint outcomes to a greater extent than men would, whose focus would be on maximizing individual outcomes.

In a research article, Shank (2014) investigated the influence of using computers as agents on customers' perception of the power of the representatives. The result suggested that the agent's computer identity moderated a customer's perception, which leads to power impressions. Another study has found that gender did moderate the association between the intended opening offer (predictor variable) and the actual first offer (criterion variable) and the relationship between the intended opening offer and the actual counter-offer (Miles, 2010).

Since this study considered anchor as an indicator of power, so one can safely assume that there should be an interaction between anchor (power) and agent gender. To test gender in the current experiment, the computer agent can use a real-person female picture, a real-person male

picture, a robot picture, or no profile image. I propose that the agent's profile image (male, female, robot, or no image) can moderate the effect of anchoring (implicit power) on negotiation results. Agents with "no image" are included in the study as a control group. Using the robot image may give an impression that the opponent is solid, inflexible, and uncompromising, thus making the impression more "masculine". Thus, I propose that masculinity will increase in the order of no image, female, male, and robot. According to the research of Kray and Thompson (2004), it is safe to assume that the masculinity feature of an agent will enhance the effect of power on result utility. Specifically, the impact of power on the result will be higher for more masculine agents.

Hypothesis 3: Agent avatar image (referent power) will moderate the effect of anchoring on result utility for an agent.

4.1.4 Agent facial expression

Researchers started investigating the influence of emotion when Carnevale and Isen (1986) first brought scholarly attention to the importance of emotions in negotiation. Among all the emotional expressions, such as happiness, surprise, or disappointment, anger is the most wildly studied by researchers (G. Van Kleef, 2010). Van Kleef, De Dreu, & Manstead (2004a) observed that negotiators reduced their demands more rapidly when their counterparts expressed angry impressions than when their counterparts expressed neutral or happy impressions. Yuasa and Mukawa (2007) conducted an experiment and found that facial expressions (happy, angry, and cool) significantly influence the receiver's impressions and decision-making.

Along with the increase in studies, many researchers have found conflicting results: in some studies, the expression of negative emotion can result in negative outcomes (Kopelman et al., 2006; Kumar, 1997), while in some other cases, the expression of negative emotion can bring about positive negotiation performance (G. A. Van Kleef et al., 2004a). Van Kleef and Côté (2018) concluded that there is no simple answer about which emotions are helpful in conflict and negotiation; neither can one conclude whether these emotions have a positive or negative impact on negotiation outcomes.

In de Melo et al.'s paper (de Melo et al., 2011), the authors investigated whether computer agents' expressions of anger or happiness can generate a similar effect that was observed in human-human negotiation. The authors found that the emotional effects observed in past work between human negotiators also occur in human-computer negotiation.

In this case, no-facial expression (robot image or no image), a smiling face and an unhappy face (angry face) were used in the avatar image. Based on de Melo et al.'s work and past literature, I believe a computer agent's avatar image can reflect such an agent's implicit power and influence the result utility for this agent.

Hypothesis 4: The computer agent's facial expression will influence the result utility for an agent.

4.1.5 Individual difference

One of power's sources is personal differences (Lewicki et al., 2011). A participant's personality is one of the sources of that person's intrinsic power.

Individual differences are critical determinants of how people behave in a conflict situation. One well-understood individual difference in the context of bargaining and negotiation is Social Value Orientation. This personality trait describes relatively stable individual differences in allocating resources between the self and others. Building on the seminal work of Blake and Mouton (1964), Pruitt and Rubin (Pruitt & Rubin, 1986) proposed their Dual Concern Theory, which is the foundation of SVO. Dual Concern Theory postulates two kinds of concern, other-concern and self-concern. Egoistic negotiators have weak other-concern, while prosocial negotiators have strong other-concern. Self-concern is closely related to "toughness" and resistance to yielding. Generally speaking, the concept of resistance to yielding can also be referred to as the negotiator's intransigence in concession-making.

Evidence supports the assumption that SVO influences negotiation results (C. K. W. De Dreu et al., 2000). Sequeira and Marsella (2018) also found that personality traits of SVO influence human negotiation behavior directly. From the previous research, one can find theoretical and practical support that SVO will significantly influence the result of negotiation.

Hypothesis 5: The participant's SVO will influence the result utility for an agent. The more prosocial the participant is, the more utility the agent will gain in the end.

There is limited research on the relationship between individual differences and agent power (indicated by anchor). Previous research has focused on groups of subjects but neglected individual difference variables (Furnham & Boo, 2011). Most existing research has focused on the most widely tested Big-Five personality traits. Previous studies found that people were more susceptible to the anchoring effect when they had high conscientiousness, high agreeableness, and low extraversion level (Eroglu & Croxton, 2010), as well as high openness to experience level (McElroy & Dowd, 2007). However, in the end, Furnham and Boo concluded that researchers had failed to identify any cognitive or trait variables that had a systematic and explicable effect on anchored decisions (Furnham & Boo, 2011).

Some other research depicted the relationship between individual differences and power. From the dual-process model, there are two systems in human brain processing. System 1 is automatic, fast, effortless and often emotionally charged, while System 2 is slower, serial, effortful and more likely to be consciously controlled (Kahneman, 2003; Stanovich & West, 2000). System 1 could sometimes be overridden by System 2, resulting in individual differences in the anchoring effect (Stanovich & West, 2008).

In my opinion, an agent's implicit power (indicated by anchor) will affect negotiation results differently depending on the human counterparty's intrinsic power. For example, a powerful agent (high anchor) may not receive a good negotiation result when facing a tough/strong human counterpart but may get a much better result when negotiating with a compromising person.

Hypothesis 6: Participant's SVO can moderate the effect of anchoring on result utility for an agent.

Another commonly used measure for individual differences is Thomas Kilmann Instrument. Thomas and Kilmann (1975) developed a conflict model and classified people's conflict behavior into five categories: avoiding, accommodating, compromising, competing, and collaborating, based on the theory proposed by Blake and Mouton (1964). The five categories of TKI are formed by the participant's levels of assertiveness and cooperativeness. Based on the same theory as SVO from Blake and Mouton (1964), TKI has similar concepts as self-concern and other-concern. According to the articles investigating the influence of SVO on negotiation results, TKI should also have a significant influence on negotiation.

However, only a few articles have been published on this topic, and the current few articles reported no influence from TKI on negotiation results (Z. Ma, 2007; Zaremba & Kersten, 2006). Ma (2007) believes that the design of the questionnaire of TKI suppressed the variance of the five categories leaving them unable to represent their actual variance. In the TKI questionnaire, each question has no question body but only two answer options for participants to choose from. If any option is chosen, one of the five categories will get one more point in score. This means the answer to all the questions will locate in either dimension, depending on the chosen option. Compared to this kind of questionnaire, in regular questionnaires, each question reflects one aspect of one category, and the answer will reflect the level of such aspect. In this way, a regular questionnaire will not restrict the variability of the questions compared to TKI. Possibly, due to this reason, previous research did not get any significant influence from TKI on negotiation results.

We ran a Principal Component Analysis (PCA) with varimax rotation and found that the five categories of TKI can be grouped into three underlying principal variables: accommodating-competing, collaborating-avoiding, and compromising (Table 16). Because compromising is separated from other categories in PCA, one can assume that the compromising score can reflect its own variance without being influenced by other categories. Hence, hypothesis 7 is as follows.

Table 16 PCA result of TKI dimensions

Rotated Component Matrix[a]

	Component		
	1	2	3
competing	-.930	.028	-.243
collaborating	.044	.907	-.159
compromising	.051	.017	.996
avoiding	.276	-.708	-.270
accommodating	.817	-.138	-.158

Hypothesis 7: Participants' compromising score of TKI will influence the result utility for an agent.

The influence of tactic (concession curve) has already been studied in many previous studies (C.-F. Lee & Chang, 2008; Vahidov et al., 2014; K.-J. Wang & Chou, 2003). So, I include this relationship in the model to testify to previous studies, but I will not use large pages to explain it. From the result of previous research, agents using competitive tactics should gain more utility compared to ones using conceding tactics.

Hypothesis 8: Agents' tactic will influence the result utility for an agent.

In summary, based on the model proposed in Essay 1 (Figure 9), the research model is as in Figure 21.

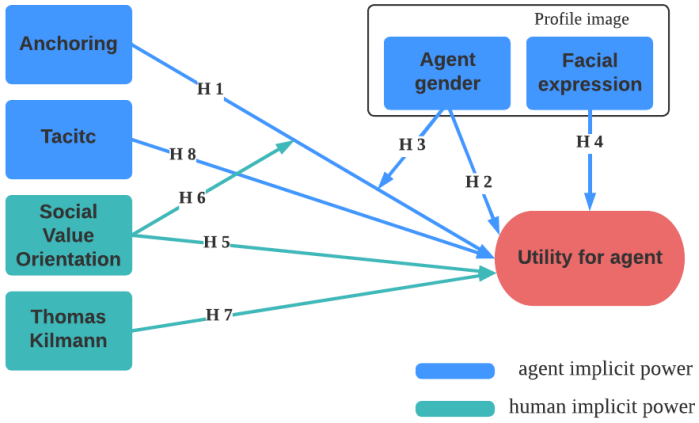

Figure 21 Research model

Categorical variable coding:
Anchor: low: 0, high: 1
Tactic: Conceding: 1, Monotonous: 2, Competitive: 3
SVO: Competitive: 0, individualistic: 1, prosocial: 2
TKI: low: 1, medium: 2, high: 3
Agent gender: non-pic: 0, female: 1, male: 2, robot: 3
Facial expression: non: 0, unhappy: 1, smile: 2.

4.2 Experimental settings

4.2.1 Negotiation case and system

The case that was set up for this study involved the negotiation of the purchase of a laptop computer through a responsive website. The participants were asked to negotiate with computer agents for the purchase of a laptop over several issues, namely price, CPU core number, CPU microprocessor type, hard drive disc storage, and RAM storage. Price had a continuous range, while the other issues had discrete values. Offers were composed, including all five issues. The participants need to choose one option value for each issue to compose an offer, and the software agent would go through the same process to compose a counteroffer. The participants were not informed that they were negotiating with a computer agent.

Utility was used as a scale to measure the attractiveness level of issues or the entire offers. The utility of an issue was calculated automatically based on the preference of participants or agents. These preferences were specified by the participants or the experimenter (in the case of agents) when configuring the settings. For each issue, the utility ranged from 0 to 100.

Before the actual negotiations, a setup phase was introduced. Participants specified their preferences by assigning weights over the issues (Figure 22) and utility levels for each option of an issue, indicating their preferences and goals (Figure 23). More specifically, in the case of this study, each offer had five weighted issues, and each issue had several options, each of which had

a certain utility value assigned by the participant. Figure 23 shows an example of setting utility levels for the “CPU: Processor type” issue.

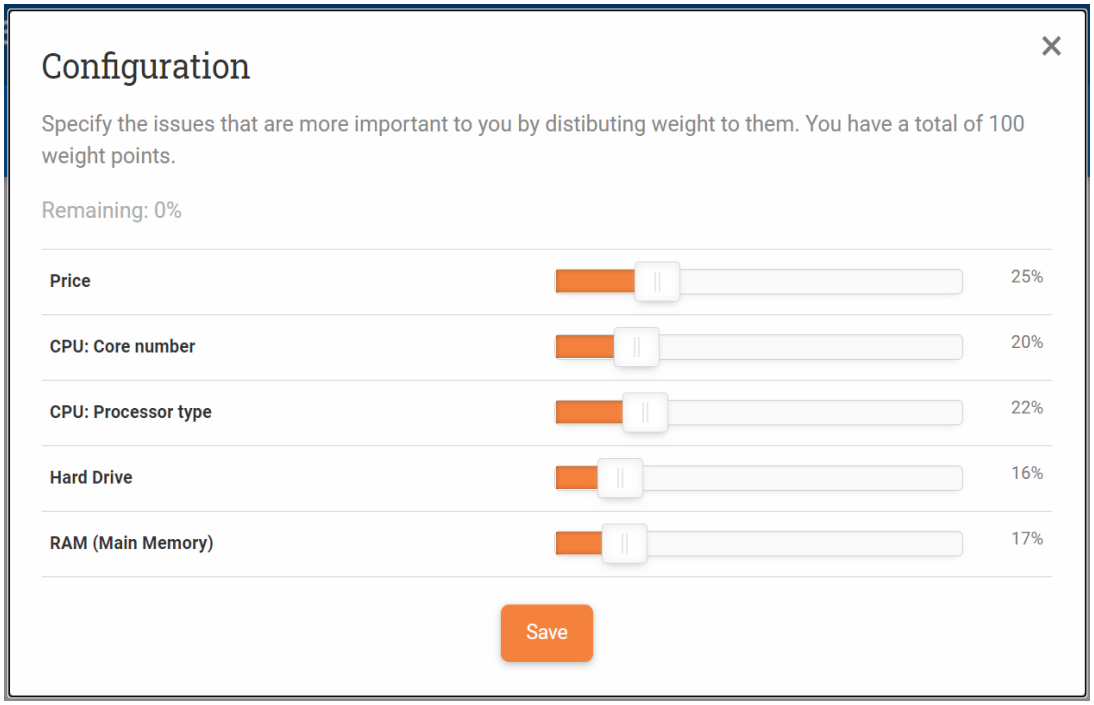

Figure 22 Setting weights for all issues

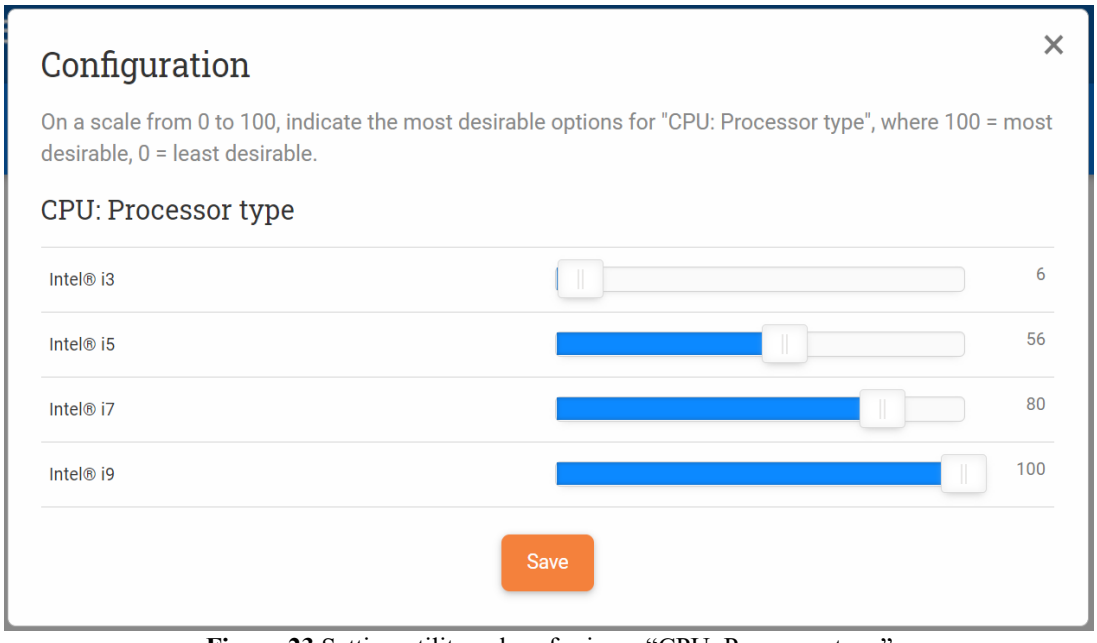

Figure 23 Setting utility values for issue “CPU: Processor type”

The agent’s preferences were set by the administrator (the experimenters). The preference structures for agents vs. participants were not necessarily in exact opposition. That means the opponents were not in a fixed-pie setting (Schelling, 1958). This difference in the negotiators’

preference structures allowed the buyer and agent to search for mutually acceptable agreements in a negotiation. This is also called "integrative" negotiation by Brinke et al. (2015).

The agent's tactic was set by specifying a curve that guided the agent's concession-making behavior. Two types of time-dependent curves were chosen for this study: competitive tactic curve and conceding tactic curve. The curves are shown in Figure 24. The curves show the acceptable utility levels throughout the negotiation period. This level defined the threshold of acceptability of the buyer's offer at a time and also served as a target utility in generating a counteroffer.

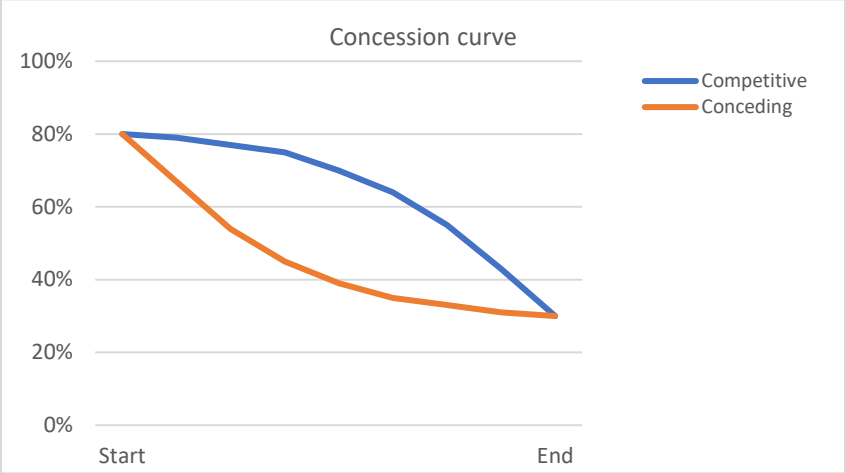

Figure 24 Competitive and conceding utility concession curves

Anchoring was manipulated in this experiment by changing the starting offer's utility value. The agents using the anchoring tactic would give a starting offer with 100% utility for an agent, compared to 80% for the agents not using anchoring manipulation. The reference points (minimum acceptable utility) for both kinds of agents were the same (30%). The agent's utility concession curve is shown in Figure 25.

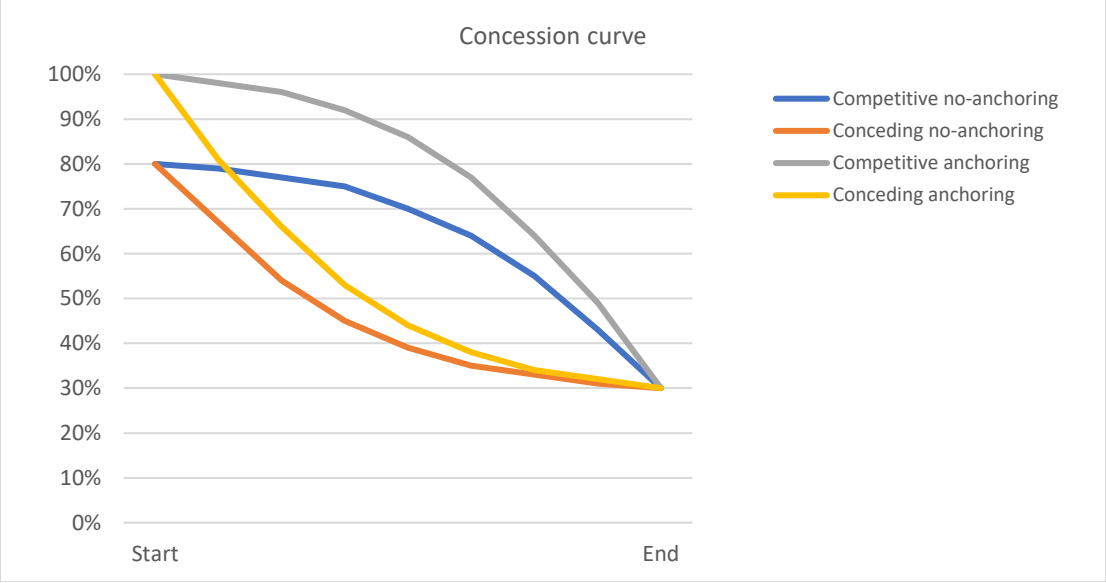

Figure 25 Concession curve with and without anchoring

An application named FaceApp was used to generate the avatar image for female and male agents based on the same picture. The app enhanced the masculine features and feminine features, respectively, for male and female images. The resulting picture is shown in Figure 26.

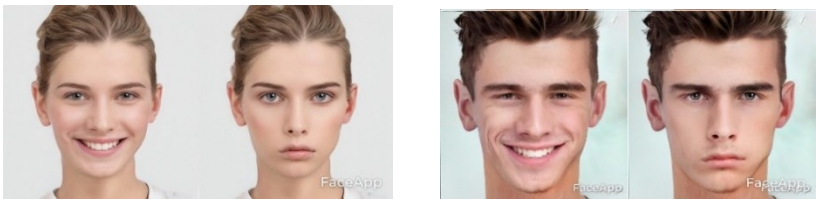

Figure 26 Female agent and male agent avatar images

We also adopted a picture representing the robot and a picture with no avatar image. The pictures are shown in Figure 27.

Figure 27 Avatar image for robot and no-picture agents

4.2.2 Experimental procedure

The experiment was conducted in a major North American university's business school. In the experiment, computer agents acted as sellers, while human participants took on the role of buyers. Participants and buyers are used interchangeably in this essay, representing the human subject buyers. The computer agents and human buyers negotiated the purchase of a laptop. The experiment consisted of two parts. The first part included a survey about the personality traits, such as the participant's SVO (Figure 28), TKI questionnaire, and demographic information of the participants. The second part included the negotiation task.

The study's participants were university students who were registered in an online course on the fundamentals of IT. They were invited via email to participate in a negotiation experiment, and participation was entirely voluntary. The students can participate in the experiment voluntarily and get 2% grade points as a reward for participating in the experiment. This 2% grade point reward will not compromise the voluntary nature of the experiment because the students can terminate the negotiation process at any time. Participants were randomly assigned to negotiating agent counterparts employing a specific tactic, an anchoring point, and one of the four different kinds of avatar images. Detailed instructions were given on how to use system features.

The interface featuring an example offer exchange between a participant and a software agent is shown in Figure 29. Each row shows an offer made by an agent (seller) or a participant student (buyer). An offer shows the option chosen for each associated issue by the agent or buyer. The total utility is shown on the right-hand side to guide the negotiator's decision-making. When an offer is made, a new row is entered and shown immediately on the screen.

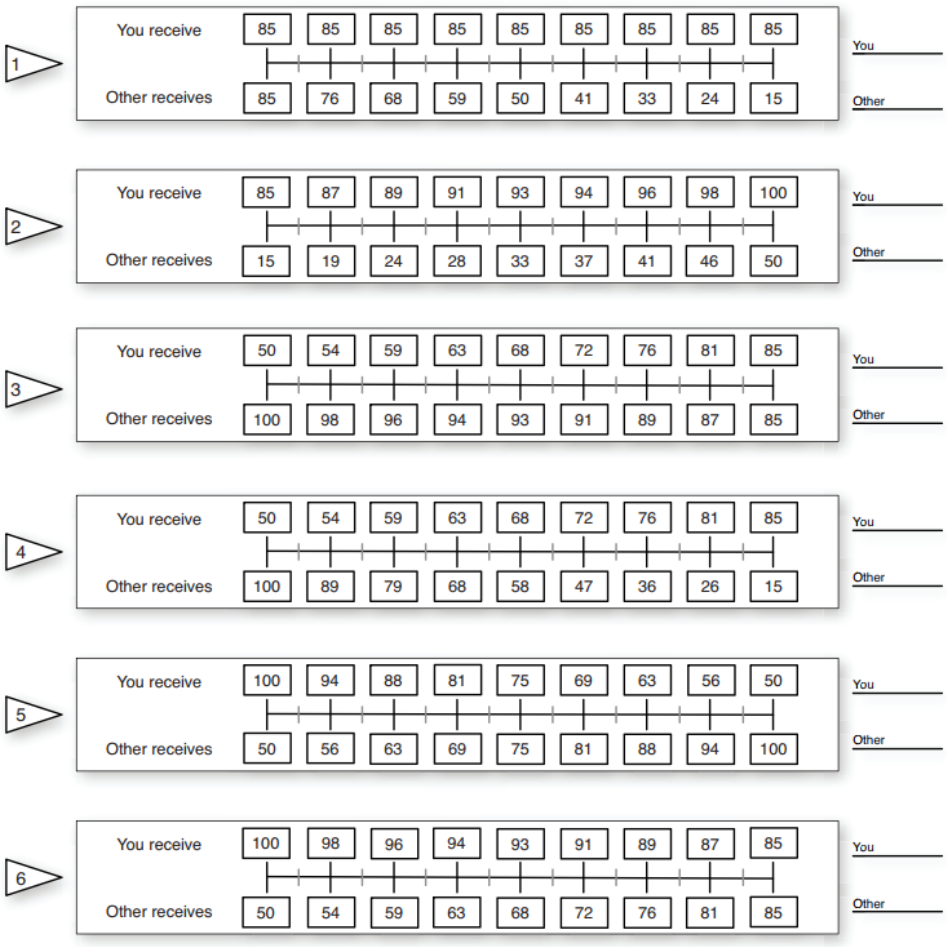

Figure 28 Social Value Orientation questionnaire

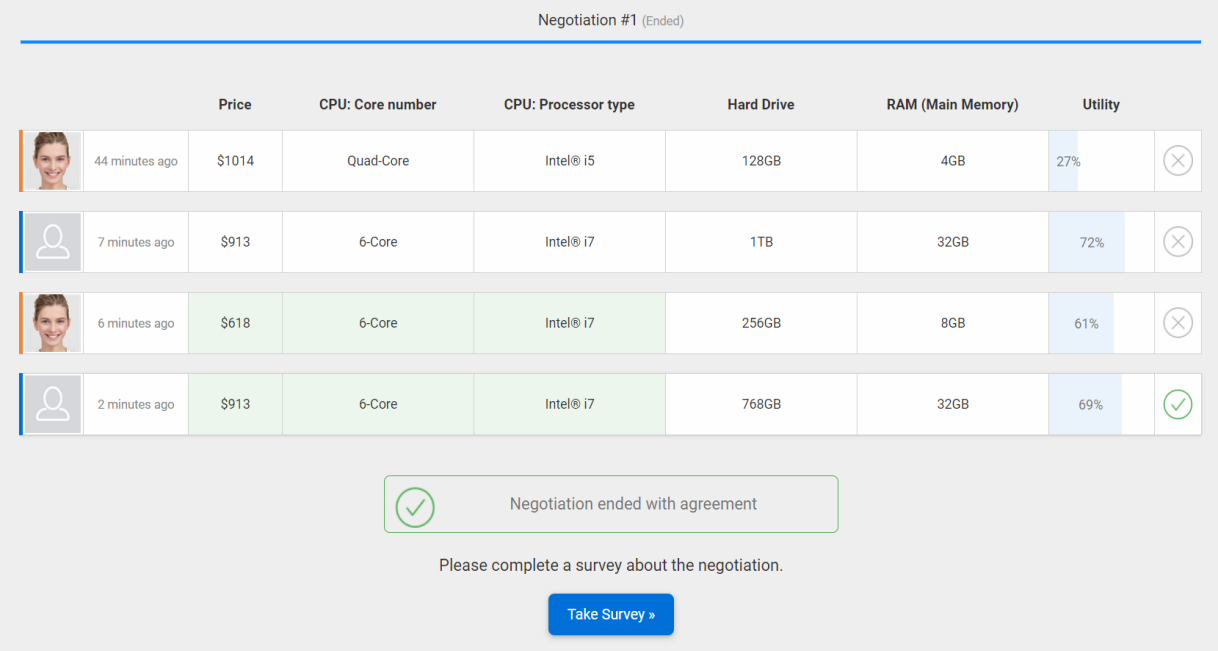

Figure 29 An example of offer exchange in a negotiation

In the present case, agents acting as sellers made the first offers to their counterparts. Buyers could then view the offer and associated details of the issues and either accept it, make a counteroffer, or terminate the negotiation session. If they accepted the offer, the negotiation would end with an agreement, and the utility for the agent and the participant would be recorded. If they terminated the negotiation, there would be no agreement and, thus, no utility achieved. If they chose to make a counteroffer, they would see a popup window with the history of the offer exchange and the utilities for each offer. When composing a new offer, participants would see the utility of their new offer.

To make agents act more human-like (checking offers at non-deterministic time points), they were set to respond to their offer with a random delay between 1 and 1.5 minutes. Agents would assess the buyers' offers regarding their utilities and accept them only if the utility matched or exceeded the target utility values as specified by the agent's tactic (utility curves in Figure 24 and Figure 25). Otherwise, they would compose new offers and continue to bargain with the buyers.

The negotiation process would continue until one of the three actions occurred: the negotiation was terminated by the participant, the time limit was reached, or an agreement was achieved. If a negotiating human-agent pair could not reach an agreement within the given time, the negotiation would be automatically terminated without agreement. Agents in the study would never choose to terminate the negotiations.

4.3 Experimental results

There were a total of 640 subjects who finished the experimental task. Participation was voluntary, and subjects could choose not to finish the whole questionnaire at no cost. If a subject left more than three questions blank, he/she was considered not taking the experiment seriously. After deleting these cases, there were 361 data records left.

Participants were undergraduate students majoring in diverse fields in business school. The average age was 22 years old, and 36.4% were younger than or equal to 20 years old. 49.6% of experiment subjects were between 20 and 25 years old. Only 14% of subjects were older than 25 years old. Among all the experiment subjects, 45.7% were males (165), and 54.3% (196) were females. Most of the experiment subjects were originally from North America (62.6%). The second largest group was from North Africa, Middle East and Central Asia (11.4%), while 7.2% of the students were from East Asia.

Analysis revealed that the observations were independent of each other. The distribution of standardized residual's P-P plot and histogram suggested that the errors were approximately normally distributed. ANOVA test results are listed in Table 17.

Table 17 ANOVA test results

Tested hypothesis	F	p	Result
H1: Anchor	F (1, 345) = 13.559	.000	Supported
H2: Agent gender	F (2, 345) = 0.913	.402	Not supported
H3: Anchor*agent gender	F (3, 345) = 5.229	.002	Supported

H4: Expression	F (1, 345) = 0.519	.472	Not supported
H5: SVO	F (2, 345) = 3.577	.029	Supported
H6: Anchor*SVO	F (2, 345) = 3.468	.032	Supported
H7: TK-Compromising	F (2, 345) = 3.286	.039	Supported
H8: Tactic	F (1, 345) = 127.9	.000	Supported

From Table 17, one can see that most of the hypotheses are supported except H2 and H4. So in the current study, neither the agent expression nor the gender in the avatar image had any significant direct effect on the negotiation result utility for agents.

For H1, the result suggested that when the agent used a higher anchor at the beginning of the negotiation, the result utility was higher as well. At the same time, agent gender moderated the effect of anchor on result utility for agent (H3). From Figure 30, one can see that for an agent using a robot picture, anchor had a more profound effect on agent's utility (F (1, 44) = 14.609, p=0.00). On the other hand, if an agent did not use any picture as an avatar image, a higher anchor did not make any difference in result utility for agent (F (1, 46) = 0.459, p=0.501). For "female", "male", and "robot" agents, higher anchor got significantly higher result utility for agent (Table 18).

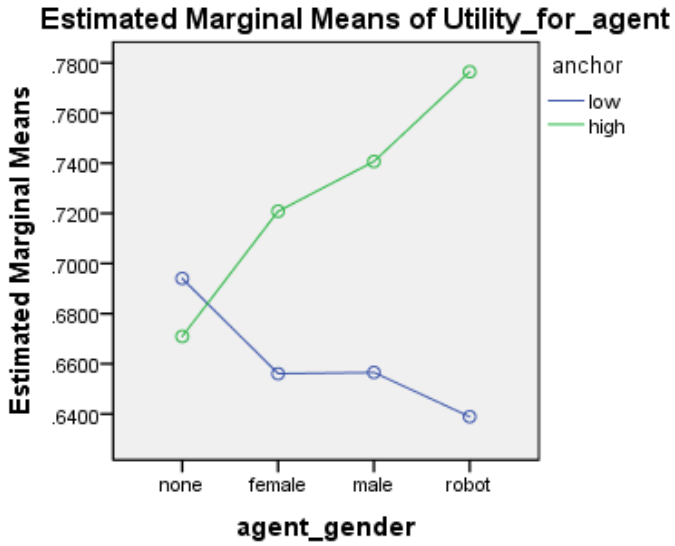

Figure 30 The interaction effect of anchor and agent gender

Table 18 Influence of anchor when agent used different avatar images

Tested	Mean dif.	S.D.	F	p
Non pic agent	0.038	0.055	*F(1, 46) = 0.459*	0.501
"Female" agent	0.063	0.024	*F(1, 131)= 6.742*	0. 01
"Male" agent	0.119	0.046	*F(1, 110)= 6.742*	0.011
"Robot" agent	0.144	0.038	*F(1, 44)= 14.609*	0.00

For H5, the analysis result suggested that the human participants' SVO showed a significant direct effect on result utility. The more prosocial a participant is, the higher utility an agent will get in the end. This result is consistent with the common understanding of SVO and negotiation results.

At the same time, as an indicator of human participants' intrinsic power, SVO moderates the effect of anchor on result utility for agent (H6). From Figure 31, one can see that, when negotiating with a prosocial or individualist type human participant, a high anchor can significantly increase the result utility for agent, while anchor did not have this kind of effect when negotiating with a competitive participant (Table 19).

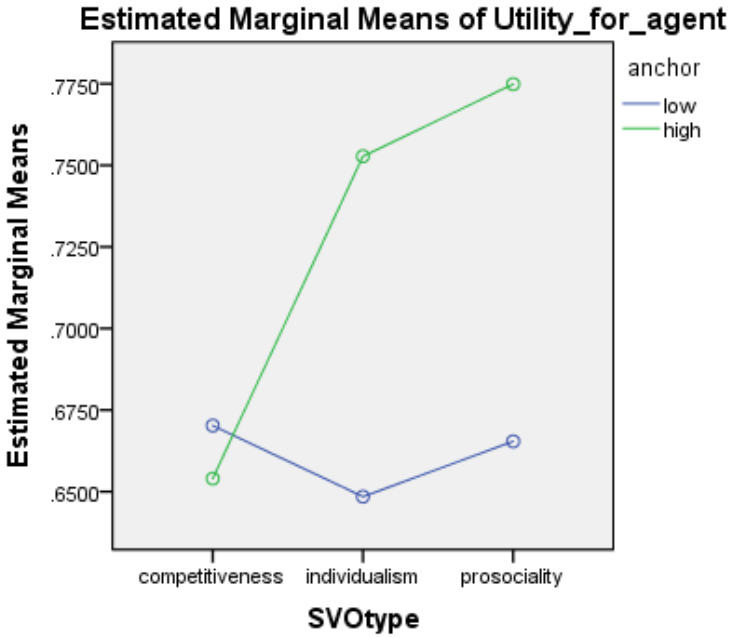

Figure 31 The interaction effect of anchor and SVO

Table 19 Influence of anchor when participant has different SVO

Tested	Mean dif.	S.D.	*F*	*p*
Competitor	0.002	0.06	*F(1, 20)= 0.001*	0.977
Individualist	0.108	0.018	*F(1, 152)= 34.479*	0.000
Prosocial	0.107	0.015	*F(1, 180)= 51.195*	0.000

From Thomas Kilmann Instrument, the "compromising" score is adopted as the measure in the experiment. The result of the analysis suggested that "compromising" had a significant effect on the result utility for agent (H7). A person who got a higher score in compromising has left the counterparty computer agent with more utility at the end of the negotiation.

4.4 Conclusion

The result research model is shown in Figure 32. From the test result, the R^2 value for the whole model is 0.44, suggesting that the current model is a fair model for predicting the result utility for an agent.

Our model suggested that both the human participant's and the computer agent's implicit power have an influence on the result utility the agent gained in the negotiation.

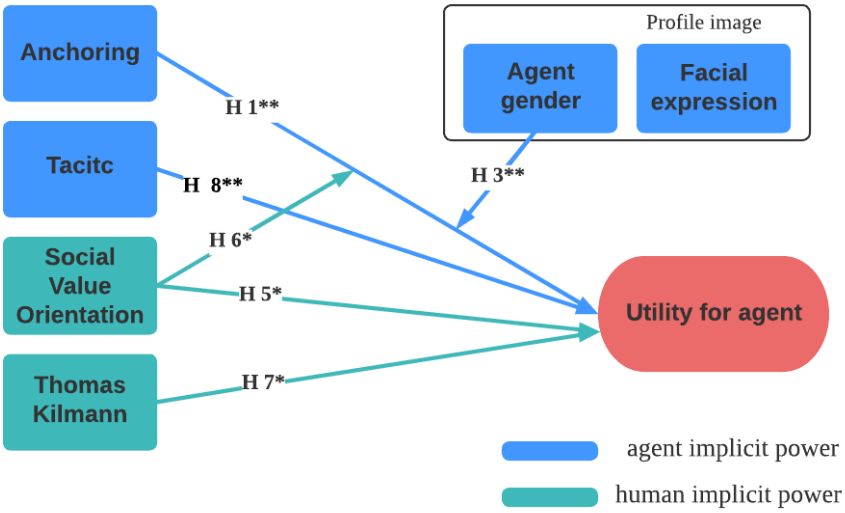

Figure 32 Result model

Categorical variable coding:
*0.01<p<0.05: *, p<0.01: ***
Anchor: low: 0, high: 1
Tactic: Conceding: 1, Monotonous: 2, Competitive: 3
SVO: Competitive: 0, individualistic: 1, prosocial: 2
TKI: low: 1, medium: 2, high: 3
Agent gender: non-pic: 0, female: 1, male: 2, robot: 3
Facial expression: non: 0, unhappy: 1, smile: 2.

For computer agents, except for explicit ways of showing their power, there are also implicit ways to make the other party perceive the agent as powerful. In this study, I investigated various ways to implicitly demonstrate power, such as using high anchors, tough tactics, or avatar pictures. The result suggested that both high anchor and tough tactic will gain more utility for an agent, while images did not show any significant direct influence on the result. Some previous research has reported moderating effects of other variables on the influence of gender (Kray & Thompson, 2004; Shank, 2014). The moderating effects may have been the reason why a statistically significant result could not be obtained. Moreover, as modern society continues to develop, people are increasingly likely to treat individuals of different genders equally. For instance, a study by Thaler et al. (2020) demonstrated that gender does not affect people's evaluations of the eeriness and attractiveness of a computer agent. However, the analysis did detect the interaction between anchor and agent gender, which suggests a significant influence from the profile image.

For a human negotiator, a participant's implicit power could be captured from such a person's personality traits. This personality has intrinsic power that can be measured using SVO or TKI. The result suggested that there is significant influence deriving from participants' individual differences, and the individual differences moderate the influence of the agent's implicit power.

The major contribution of the paper is that it brings forward the construct of implicit power in the context of e-negotiations. The proposition of this implicit power can explain and clarify

the conflicting results of past work. Based on past literature, the paper proposes several variables that should be included in implicit power. Future research can dive deeper and propose more variables to enrich the concept of implicit power.

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