

The Effect of Different Explanations of Conceder Negotiation Style on the Trust between Humans and Agents

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Abstract

Negotiations have an essential role in our lives as they help us to find mutually beneficial solutions and resolve conflicts. It leads to effective communication and collaboration between the involved parties. Negotiation among parties has high importance to have an outcome that is suitable for all. In such scenarios, negotiation agents can be used by the involved parties. Negotiation agents have explanations that indicate the behavior that the agent is going to follow in the process. This research paper focuses on trust between humans and agents regarding different explanations of the agents. In the research, the negotiation strategy conceder is used in the negotiation with an opposite and truthful explanation of itself. The results from the experiments are compared with each other using the scores of the participants which are measured through a questionnaire. By investigating the effect of different explanations, the research paper aims to answer the question "What's the effect of an agent using a truthful explanation of their conceder negotiation style versus an opposite explanation on how much humans trust the agent to negotiate for them?". The goal is to achieve a trust connection between humans and agents. The main conclusion and the hypothesis of the research are "people tend to trust less on an agent that does not do what it states in its explanation." The results of the experiment, discussion of the results, and the conclusion can be found in sections 4, 5, and 7 respectively.

1 Introduction

Negotiation is important and is done in many places in our lives. Negotiation is beneficial for dividing tasks among individuals, resolving conflicts that can be caused by the preferences of individuals, and trying to find a mutually beneficial outcome. Most of the time it is known that negotiating increases the overall outcome of all parties involved in the negotiation [Boothby et al., 2023].

In such negotiation scenarios, it could be beneficial to get help from a party that does the negotiation process on behalf of the individual. Negotiation agents could be used to negotiate in scenarios. The role of these agents is to support parties by helping with the challenges of the negotiation. They achieve this by either negotiating on behalf of the user or offering guidance. These agents have a negotiation style that could be applied to the given scenario [Jonker et al., 2012]. The negotiation style applied to the agent in this research is the conceder negotiation style. The conceder negotiation style aims to reach an agreement by favoring the opponent's preferences and giving concessions in the negotiation process [Koeman et al., 2021].

The main aspect of the negotiation agents is the trust of the human towards to agent. Humans need to trust the negotiation agent to use them in their negotiations [Baarslag et al., 2017]. The trust is affected by many factors, including the

explanations of the agents. Agents have an explanation of themselves which is known by the individual that is going to use it. In prior research related to explanations, it is stated that if an explanation is provided along with their statements, the agreement between the parties is likely to be reached more quickly [PARSONS et al., 1998]. The field of negotiation agents has been relatively under-researched, with limited research conducted about the explanations of the negotiation agents.

This research aims to examine the effect of different explanations of a negotiation strategy on the trust of the human. The hypothesis of the research is "people tend to trust less an agent that does not do what it states in its explanation". The reasoning behind the indicated hypothesis is mostly due to the agent acting dishonestly, not doing what it explains before the negotiation, even though the outcome of the negotiation favors the human. By doing experiments with two different explanations and analyzing the results of each explanation, this research aims to answer the question "What's the effect of an agent using a truthful explanation of their conceder negotiation style versus an opposite explanation on how much humans trust the agent to negotiate for them?".

The rest of the research paper is structured as follows. Section 2 covers the background of the research on trust, followed by the methodology section, Section 3, which discusses the methodology used to answer the research question. The results of two different explanations are presented in Section 4 and used to validate the hypothesis. Section 5 discusses the responsible research which covers data collection, materials, and impacts. In Section 6 evaluation of the results and limitations that are faced in the research are explained. The conclusion of the research and explorations of future research are discussed in Section 7.

2 Background

In this section, the background information of the research is discussed. The background information contains information about the trust in the negotiation agent and the explanations used in the research. The trust in the negotiation agent is discussed with relevant literature with the factors that affect trust. In the explanations part, two different explanations, the truthful and opposite, used in this research will be discussed.

2.1 Trust in the Negotiation Agent

There are many studies conducted in the field of trust and the factors that influence it next to the effect of the explanations. In research, it is stated that there are factors that influence trust, such as the complexity of the task and perceived risks [Schaefer et al., 2016]. The trust between a human and a robot is not different from the trust between humans except for the aspect of dealing with an artificial party. As defined by Wagner, the trust is "a belief, held by the trustor, that the trustee will act in a manner that mitigates the trustor's risk in a situation in which the trustor has put its outcomes at risk" [Wagner, 2009] [Gao et al., 2016]. By this definition of Wagner, the trust between humans and agents depends on whether the agent is acting toward the side of the human. It is indicated that trust development is influenced by the counterpart's propensity [Yao et al., 2017]. Even if the explanation

of the agent seems favorable to the human, the suggestion it does may reduce the trust as its propensity for the opponent is present. As seen through research, some measures of trust in human-robot interaction focus on the person's belief in the robot and whether it is capable of completing a given task [Ullman and Malle, 2017]. Meaning if the agent is capable of finishing the negotiation where the party using it has the beneficial outcome, the trust between parties can be built easier than an outcome where the agent is not capable of finishing the negotiation. In the end, the trust developed in the negotiation can lead to the long-term success of a partnership [Yao et al., 2017] between agent and human.

2.2 Explanations

Explanations have an important role in this research regarding their effect on the trust of humans in negotiation agents. The explanation used by the agent helps the human to understand how the agent is going to act and what strategy it is going to use in the negotiation process.

In the research, there are two different explanations for the agent that uses the conceder negotiation style. These explanations are namely the truthful and the opposite. The explanation of the agents is the main change that affects the trust of the human in this research. By having two different explanations for the same agent, the effect of explanations on trust between the human and agent is observed. Following subsections discuss the explanations used in this research.

The Truthful Explanation

The truthful explanation of the agent using the conceder negotiation style is stated to reveal the intentions of the agent which aims for a cooperative negotiation process with the opponent. The conceder negotiation style tries to find bids that favor the opponent's preferences to have a mutual outcome that doesn't fully favor any side. By using the truthful explanation of conceder, the information of the agent is transparent and can help to build a trust connection between the human and the agent while finding mutually beneficial outcomes in the domain. The truthful explanation of an agent using the conceder negotiation style used in the research is:

"You shall be assisted by a negotiation agent in the following negotiation session. In the process of evaluating, the agent shall take your preferences in consideration and based on that it shall evaluate bids to and from the opposing party. The agent would propose bids that will be progressively more favourable to the other party over time until the end of the negotiation. The goal is to find a mutually satisfactory outcome, even if it means accepting less favourable terms than initially desired."

By this explanation human in negotiation expects the agent's behavior might favor the opponent party as described by the explanation of the agent.

The Opposite Explanation

The opposite explanation of the agent using a conceder negotiation style is stated to not reveal the intentions of the agent, unlike the truthful explanation. It states the opposite behavior that the conceder negotiation style follows which is the truthful explanation of the hardliner negotiation style. The hardliner negotiation style tries to send bids fully favorable

to the party, human in this case, which is the opposite of the conceder style. By not stating its behavior of itself and stating the opposite, the agent hides the negotiation style it uses and tries to be cooperative toward the opponent. The opposite explanation of an agent using the conceder negotiation style used in the research is:

"You shall be assisted by a negotiation agent in the following negotiation session. In the process of evaluating, the agent shall take your preferences in consideration and based on that it shall evaluate bids to and from the opposing party. This agent will not settle for anything less than the values, preferences and objectives indicated by the user. The goal is to hold a dominant position in the negotiation in order to obtain maximum benefits from the negotiation."

By this explanation, human in negotiation expects the agent to not give up any preferences and suggest a bid that has the highest utility for his/herself.

3 Methodology

This section discusses the experimental setup and methodology used to answer the research question.

3.1 Participants

The target group of the research is people with a sufficient level of background in computer science and/or related fields. The reason behind the target group is to have people who might have familiarity with this topic and system. Any prior knowledge of negotiations and the tool Pocket Negotiator is not mandatory. The experience of the participants in negotiations and the tool Pocket Negotiator [Jonker et al., 2017] are asked to the participants in the first part of the questionnaire that is given to the participants before the experiment. Each explanation used in the research has been experimented with 15 participants.

Regarding the participants' demographics, all participants (30) who participated in the experiment were found and recruited using personal networking of team members. Most of the participants who have participated in the experiment part of this research are studying or studied computer science at a university (24) and the others are studying in related fields, such as Electrical Engineering (4) and UX Design (1). One person who has participated in to experiment studies Business Administration, but has prior knowledge in computer science. All of the participants are between the age group 18 - 24 years old and grew up in Europe except 1 person who grew up in Asia. For the gender demographics, 27 people who participated in the experiment identified themselves as male and 3 people identified themselves as female. As in past experience with Pocket Negotiator and knowledge in negotiations, the majority of participants (24) have not used the tool Pocket Negotiator and 10 people who participated in the experiment have theoretical knowledge in negotiations. This data is retrieved using the first part of the questionnaire and the results of this part don't have any effects on the result of the research.

3.2 Tools

The Pocket Negotiator [Jonker et al., 2017] is used to simulate the negotiation process. The Pocket Negotiator is a tool

where a party in the negotiation can set up its preferences regarding the tasks in the negotiation domain. In order to investigate the explanation of the preferred type of agent for negotiating in such scenarios, a domain with tasks can be built. In the research, a kitchen setting with tasks is built as an example of a domain where tasks can be split among parties depending on their preferences.

3.3 Measuring Trust

Measures have been used in order to measure the trust of the participant throughout the second part of the questionnaire. Measuring each question is essential since each of them provides a different type of information regarding the trust of the human. To measure the score, answers to the second part of the questionnaire are used. The questions in the questionnaire asked the participants if they are confident in the negotiation agent, if the outputs of the agent are predictable or not, if the agent is reliable, if the agent works quickly, if the negotiation agent can perform better than a human, if they are wary of the agent or not and lastly, if they liked the system for decision making.

The results of the experiments are calculated from the answers to questions in the second part of the questionnaire that is given to the participants. Each answer to questions is given a score to measure the trust score. The answer "Strongly disagree" counted as 1 whereas "Strongly agree" counted as 5. The trust scores of the participants are calculated while summing the scores for all questions. Overall scores were calculated by summing up the scores for individual questions, inverting those negatively phrased such as the question "I am wary of the negotiation assistant". The reason questionnaires are used in this research is that it is a common method to evaluate trust in previous research papers in this field [Hoffman et al., 2021].

3.4 Procedure

The experiment conducted is a between-subject study. The participants are divided into two equal-sized groups for each explanation. In the experiment part of the research, the Pocket Negotiator tool is used in the kitchen domain where parties prepare a pizza with given tasks and preferences of how much pizza to eat in terms of percentages. Before conducting the real experiments, pilot experiments are conducted to test the usability of the system. In the setup of the pilot experiment, the Boulware negotiation strategy is chosen with two tasks in the kitchen domain to make the participant familiar with the Pocket Negotiator tool, the kitchen domain, and the negotiation process. After the pilot experiments, the end form of the experiment is decided and we started to do the experiments.

3.5 Experiment

In the beginning, participants were given a consent form to participate in the experiment. A questionnaire is used to check participants' familiarity and preferences in negotiations before the experiment is conducted. For familiarity with negotiations, questions were asked to participants whether they think they are good and experienced negotiators, if they are cooperative in negotiation scenarios in general, and if they

like tough competition. As an extra to those questions, participants' familiarity with the tool Pocket Negotiator and their trust in AI, in general, are asked through the questionnaire. The questionnaire can be found in the Appendix section of this paper. At the beginning of the experiments, the agent that uses the conceder negotiation strategy is explained to the participants using a truthful or opposite explanation depending on which group they are in.

In the tool Pocket Negotiator, the kitchen domain is set with tasks. The tasks in the kitchen domain are assembling pizza topping, chopping ingredients, rolling out dough, the share of the pizza, washing ingredients, and washing used utensils. Participants could change the weights and value evaluations of the tasks. By adjusting the weights and value evaluations of the tasks, participants indicated their preference for the adjusted task whether they prefer to do it or not. In Figure 1, how these adjustments can be done in Pocket Negotiator can be seen.

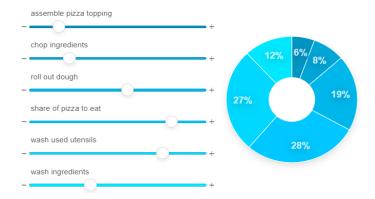


Figure 1: Setting up the preferences in Pocket Negotiator

After these adjustments, the opponent's issue weights and value evaluations are changed regarding the changes done by the participant for their side. Opponents' (stated as 'other' in Pocket Negotiator) preferences are set to the same or very similar weights and evaluations. This is done to have an environment where two parties have similar preferences on the same tasks and negotiate on them. After setting up the issue (task) weights and value evaluations participants gave their first bids. The first bid is filled automatically by the negotiation using the preferences indicated by the participant. The bid is not sent and it could be changed by the participant in each bidding step. The outcome of these changes in the bid could be observed through the bar graph on the page which indicates if the bid is good for the participant (me) or good for the opponent (other). Participants could change the bid to fill their own bids for each task or use the utility graph to fill their bidding regarding their utility for the specified bid. The bar indicating the outcome of the bid and the utility graph can be seen in Figure 2.

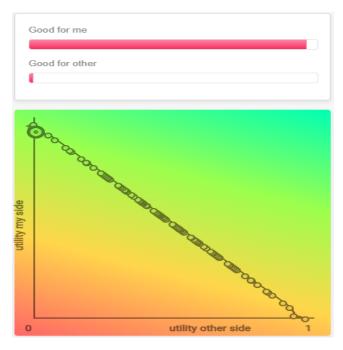


Figure 2: The Bar Graph indicating the utility of the current bid and the Utility Graph

4 Results

In this section, the results of the experiments are presented. The result of the experiment that uses the opposite explanation has a mean of 21.716 and a standard deviation of 1.971. The result of the experiment using the truthful explanation has a mean of 24.349 and a standard deviation of 4.759. The box plot of the results of these experiments can be seen in Figure 3.

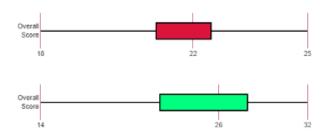


Figure 3: Box-plots of results of the opposite and truthful explana-

The Shapiro-Wilk test is used to check the normality of the results [Shapiro and Wilk, 1965]. By the definition of the Shapiro-Wilk test, if a sample has a p-value higher than 0.05 it can be concluded that the sample is normally distributed. Based on the results that are got from the Shapiro-Wilk test, both of the samples are normally distributed as the opposite explanation one has a p-value of 0.5105, and w-value is 0.9491. The truthful one has a p-value of 0.5581 and a w-value of 0.9491. Both samples' p-value are both greater than 0.05 which means the data is normalized.

Since both of the samples are normally distributed the two-tailed t-test [Ross and Willson, 2017] is applied. After applying the T-test [Bevans, 2022], it is seen that the two-tailed P of the sample is 0.033, and the t-value is 2.2385. The two-tailed P value of the T-test is 0.033 which is less than 0.05 which led us to a conclusion where we could tell there is a significant difference between the two samples of results.

5 Responsible Research

This section discusses the ethical implications and considerations of the experiment in each part of the experiment. The research has the approval of the Human Research Ethics Committee (HREC) at TU Delft. The experiment has no possible risks that could harm the participant. Data collected by the experiment is not identifiable information and cannot be used to identify the participant.

The data collected by the participant includes the participant's background information, including age, gender, the region where the participant grew up, and lastly their field of study. On top of this information participants' familiarity with negotiations, trust in AI, and preferences in negotiations are also collected for the purpose of the experiment. The data provided by the participants are not linked with their name, student number, or any personal related information. This is done to minimalize the risk of identifying personal information from the experiment data for any purpose.

Data collected in the negotiation regarding preferences in Pocket Negotiator is not stored and deleted at the end of the experiment which does not lead to any risk. As an extra to the answers that are collected through the questionnaire, the only information kept from the negotiation part is if the participant reached an agreement or not. We decided to store this information due to research purposes.

6 Discussion

This section discusses the evaluation of the results and the limitations of the research. The research has been done to examine and conclude how different explanations of the agent that uses the same negotiation style affect the trust of the human in the agent.

6.1 Evaluation of Results

The results of the experiments showed that there is a significant difference between the two samples used in this research. Participants trusted more the truthful explanation than the opposite explanation. As a result, the hypothesis "people tend to trust less an agent that does not do what it states in its explanation" is accepted.

The reason behind the results is the opposite behavior of the agent. As it was the main argument indicated, the agent lies about the behavior that is going to follow in the negotiation process and does the opposite. Humans tend to trust less in an agent (or a party) which does not tell the truth about its behavior even if the outcome favors their side in the end which was not the case for most of the experiments. Therefore, the negative effect of the opposite explanation of the agent on the trust of the human is observed.

6.2 Limitations

Indicating the limitations are important for research since it might help improve the future work that can be done in this field. The research had three main limitations.

The first limitation of the research was the lack of diversity in terms of gender, age group, and region they grew up in, of the participants who participated in the experiment part of the research. Most of the people that have joined the experiment were identified as male, between the age group 18-24, and grew up in the region of Europe. This situation might add bias to the results since there is not a variation of people with different backgrounds.

The second limitation that should be stated is the size of the participants. Since there are only 15 people evaluated for each explanation in the experiment, there could be more data to (un)validate the hypothesis and see the relation clearer. This would have increased the accuracy of the conclusion and also possibly increase the diversity of participants.

Lastly, all people who have conducted the research have at least a piece of knowledge in the field of computer science. The aim was to recruit participants with a background in computer science, as their familiarity with the subject matter and they would encounter less difficulty when engaging in the research. Even though it was intended, experimenting with people from different disciplines would help to have diversity in terms of background knowledge of the participants which might also improve the diversity of the participants as mentioned previously.

Except for these limitations, the experiment setup was the same for every person in each step. These steps were signing the consent form, doing the pilot experiment, filling out the first part of the questionnaire, doing the real experiment, and lastly finishing the second part of the questionnaire. For each step, the same texts and explanations were used for each of the participants which improved the reliability of the results.

7 Conclusion and Future Work

In this section, the conclusion of the experiment is discussed with the future work that could be followed. This research is done to examine the effect of two explanations on the trust of the human in the agent.

7.1 Conclusion

This research aims to check whether people tend to trust less an agent that does not do what it states in its explanation. In order to check the trust, an experiment was conducted with the tool Pocket Negotiator where participants negotiated in a domain with the help of a negotiation agent. Trust is measured through the answers in the questionnaire. The conclusion of the research is that there is a significant difference between the results of the two explanations used. As a result, the hypothesis is accepted and the negative effect of using an opposite explanation on the trust between humans and agents is concluded.

7.2 Future Work

Future work on this research topic might use different negotiation agent styles, explanations, methods, and tools to

measure trust. In this research, trust is measured using the questionnaire that was given to participants. For future work, adding more measurements to the questionnaire to have more reliable results and conclusions could be done. Both parts of the questionnaire that is used in this research could be modified and new questions can be added to measure new connections between humans and agents such as the reliance of the human on the agent. New hypotheses could be constructed to research new connections between humans and agents using existing or new techniques for measurements.

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A Appendix

A.1 First Part of the Questionnaire

Questions in the first part of the questionnaire are related to the background information of the participant including the familiarity with negotiations, experience with Pocket Negotiator, and their trust in AI in general.

- 1. What is your age group?
 - 0 18-24
 - o 25-34
 - 0 35-44
 - o >44
 - o prefer not to say
- 2. What is your gender?
 - o Male
 - o Female
 - o None-binary
 - o prefer not to say
- 3. In which region did you grow up?
 - o Asia
 - o Europe
 - o Africa
 - o North-America
 - o South-America
 - Oceania
 - o prefer not to say
- 4. What is the highest level of education that you have completed?
 - o Middle school
 - o High school
 - o Bachelor
 - o Master
 - o Higher than the above
 - \circ Other
 - o prefer not to say

- 5. What is your field of study/work?
 - o Mathematics
 - o Computer Science
 - o Electrical Engineering
 - o Other
 - o prefer not to say
- 6. Do you have theoretical knowledge in negotiations?
 - o Yes
 - o No
 - o prefer not to say
- 7. Questions about negotiation skills
 - I am a good negotiator
 - o Strongly disagree
 - Disagree
 - Neutral
 - o Agree
 - o Strongly agree
 - I am an experienced negotiator
 - o Strongly disagree
 - o Disagree
 - o Neutral
 - o Agree
 - o Strongly agree
 - I am always cooperative in negotiations
 - o Strongly disagree
 - o Disagree
 - o Neutral
 - o Agree
 - o Strongly agree
 - I like tough competition
 - Strongly disagree
 - o Disagree
 - o Neutral
 - o Agree
 - o Strongly agree
- 8. Have you used or seen Pocket Negotiator before the experiment?
 - o Yes
 - o No
 - o prefer not to say
- 9. Question about your view on Artificial Intelligence (AI)
 - I generally trust artificial intelligence (AI) to make accurate and reliable decisions
 - o Strongly disagree
 - o Disagree
 - o Neutral
 - o Agree

A.2 Second Part of the Questionnaire

Questions in the second part of the questionnaire have been used to measure the trust score. Each answer (from strongly disagree to strongly agree) is given scores from 1 to 5 and in the end all of them are summed up to have the overall score for each participant.

- I am confident in the negotiation assistant. I feel that it works well.
 - Strongly disagree
 - o Disagree
 - Neutral
 - o Agree
 - o Strongly agree
- The outputs of the negotiation assistant are very predictable.
 - o Strongly disagree
 - o Disagree
 - Neutral
 - o Agree
 - o Strongly agree
- 3. The negotiation assistant is very reliable. I can count on it to be correct all the time.
 - o Strongly disagree
 - o Disagree
 - Neutral
 - o Agree
 - o Strongly agree
- 4. I feel safe that when I rely on the negotiation assistant I will get the right answers.
 - o Strongly disagree
 - o Disagree
 - Neutral
 - o Agree
 - o Strongly agree
- 5. The negotiation assistant is efficient in that it works very quickly.
 - o Strongly disagree
 - o Disagree
 - Neutral
 - o Agree
 - o Strongly agree
- 6. I am wary of the negotiation assistant.
 - o Strongly disagree
 - o Disagree
 - o Neutral
 - o Agree
 - o Strongly agree

- 7. The negotiation assistant can perform the task better than a novice human user.
 - o Strongly disagree
 - o Disagree
 - o Neutral
 - o Agree
 - o Strongly agree
- 8. I like using the system for decision-making.
 - o Strongly disagree
 - o Disagree
 - Neutral
 - o Agree
 - o Strongly agree