

Emotionally Intelligent Negotiation Agent

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ABSTRACT

Just like a human, a negotiation agent system can be developed to distinguish negotiation techniques used by professionals in their field and be able to reach more efficient deals that would save companies, organizations, and perhaps even countries a lot of time, effort, monetary and other types of resources. However, emotional intelligence is important in negotiations and existing negotiation agents would benefit from it. We propose to perform a qualitative narrative review on emotional intelligence, its importance in the negotiation context and how a negotiation agent can be made more effective by integrating the development of emotional intelligence into their system. By the end of the paper, it should be clearer why and how to advance negotiation agent systems by making them more emotionally intelligent.

Keywords

Negotiation, emotional intelligence, intelligent agent, methodology, systems, models.

1. INTRODUCTION

As modern technological advancements are made at a rapid pace, it is important to modernize the way negotiations are conducted as well, as the human mind is partially equipped to handle negotiations, and artificial intelligence can assist [1]. In the context of negotiations, emotional intelligence is a significant contribution to having effective negotiations. Therefore, the relevance of emotional intelligence in a negotiation setting will be explored and substantiated [2], [7].

To better understand what negotiation agents are, the definitions of existing systems have been explored. These definitions are summarized in Table 1.

Table 1.

A negotiation agent is an autonomous entity that manages the negotiation process through three phases: pre-negotiation, where it determines attributes and elicits preferences; negotiation, where it generates offers, models opponents, and evaluates offers; and an optional post-negotiation phase, where it assesses the optimality of the offers [29].
A negotiation agent is a system that negotiates based on user preferences learned from past interactions. It operates within an experimental smartphone tool where users share private data. The agent autonomously negotiates potential agreements, which users can refine manually [30].
A negotiation agent strategically determines concession rates based on opponent behavior, real-time factors, and deadlines. It generates multi-issue offers to maximize utility, integrating advanced techniques like Pareto-search and Bayesian learning for diverse negotiation domains [31].
A negotiation agent adjusts concession levels based on market dynamics, competition, deadlines, and trading options. It employs fuzzy rules to handle negotiation pressure, such as stiff competition, and utilizes an enhanced market-driven strategy and fuzzy decision rules for effective negotiation [32].

Within the context of this paper, a negotiation agent is a computer system specifically designed to negotiate, with the potential ability to negotiate on behalf of a human being. As emotional intelligence is an important step towards eventually having intelligent agents represent humans in negotiations, it is important to research how to effectively develop it in negotiation agents [2], which is the eventual objective [4].

As the topic of negotiating agents is already being researched [1], [5], [4] it would also be beneficial to see how such agents could be developed from a more emotional point of view in a negotiation context. Examples of emotionally intelligent interactive systems in research are quite basic and simplistic, for instance, the use of Loubeth's gestures and interaction [5]. Incorporating the aspect of emotional intelligence in the way negotiation agents operate would result in such agents being more effective at what they do. To understand how best to incorporate the more emotionally intelligent approach to how negotiation agents operate, existing automated negotiation agent systems [6] need to be explored and their way of working needs to be understood.

As the initial step of emotional intelligence development in negotiation agents, it is important for the agents to learn to interpret the emotions expressed by the negotiation counterparty by means of facial expressions, change in tone of voice, (in)voluntary body movements.

The next step in the development of emotional intelligence in negotiation agents would be the ability to express emotions to the counterparty that would be beneficial in the context of negotiation, meaning it would give a clearer idea of how the agent perceives the actions or words expressed by the counterparty. Giving a clearer idea of how each party perceives each other will improve the process of negotiation, as techniques, such as labeling [15] help diffuse the emotions that may arise from not identifying how a person feels in the setting of negotiation.

Other important concepts, summarized by terms like active listening and cultural differences, which are important to understand in the context of negotiations will also be briefly explored and covered in this paper.

By the end of this research, this paper is expected to contribute in several ways. To begin with, the effect of emotional intelligence in a negotiation context will be clearer. Furthermore, it will be clear what are the currently existing automated negotiation agent systems and how they work. Finally, a methodology will be proposed on how such negotiation agents can be developed from the perspective of emotional intelligence.

The structure of the proposal is as follows. In section 2 a problem statement will be identified. Section 3 will consist of related work in the field of negotiation agent systems. Section 4 will detail the methodology used to answer the research questions. Finally, section 5 will provide an insight into the planning of writing the paper.

2. PROBLEM STATEMENT

There is a sufficient amount of literature on the topic of negotiations, emotional intelligence in negotiation, and intelligent agents as separate topics, which will make it easier to review and understand the already existing findings on the topic. However, there is a lack of connection between negotiation agents and emotional intelligence [6]. Because of that, this paper will analyze the existing information about intelligent negotiation agents, the supporting negotiation systems used in practice, the methodologies to train the intelligent agents, and the existing research about the aforementioned topics will be useful to better understand each topic separately and form collective conclusions when answering the research questions. The overall objective will be to combine insights of research in negotiation concerning emotional intelligence and negotiation agent systems, in order to provide meaningful insights to eventually contribute to the theoretical and practical understanding of how increase the emotional intelligence of negotiation agents.

2.1 Research Question

The overall objective of this paper will consist of several sub-goals. Firstly, the paper will explore the concept of emotional intelligence. Furthermore, it will investigate the topic of negotiation with a focus on emotional intelligence. After that, negotiation agent systems will be explored. Moreover, the requirements to develop a more emotionally intelligent negotiation agent system will be established. Finally, a methodology will be proposed to approach the emotional intelligence development of a negotiation agent system.

The research question of this paper is as follows:

How can negotiation agent systems be made more emotionally intelligent?

Sub-questions:

What is emotional intelligence in the context of negotiation?

What is a negotiation agent?

What are the requirements for an emotionally intelligent agent?

3. RELATED WORK

In this section, we will outline key related work on negotiation agent systems. Jonker et al. [1] provide essential insights on negotiation phases, automated agents, and modeling emotion in negotiation. Additionally, Cairó and Olarte's [5] work on Loubeth highlights the autonomy and emotional intelligence in negotiation agents. Further relevant contributions include Baarslag et al. [4] on challenges and opportunities for autonomous negotiators and Chawla et al. [6] on emotion-aware agents for negotiation dialogues. Moreover, papers about emotional intelligence [2], [3], [9], [7], [14], human behavior

[18], will be reviewed and emphasized in this paper if it will contribute towards the definition or future suggestions for the creation of an emotionally intelligent negotiation agent. Another important paper by Jonker et al. on automated negotiation agents competition will be relevant to explore to further understand the way negotiation agents perform and what they are being evaluated on [11]. Furthermore, the research on various existing negotiation agent models and their definitions will be emphasized [29], [30], [31], [32]. Additionally, the International Negotiation Journal has been explored as an important resource for any relevant contributions to this paper, mainly on emotional intelligence in negotiations [33], [34] and intelligent negotiation agents [34], [35].

Cultural differences should be taken into account in any negotiation to make use of emotional intelligence effectively. Therefore, the paper published in 2010 written by Hofstede et al. [12] will also be a relevant contribution to my research, as it will help develop a more sound methodology to evaluate the performance of emotionally intelligent negotiating agents. More specifically, Hofstede's five dimensions of culture will provide a tangible guideline to the aforementioned methodology from a cultural perspective.

Finally, a paper on a formal approach to negotiating agents' development [13] will be beneficial to investigate as it explores the evolution of automated negotiation from a futuristic vision to a promising technology, but from an earlier point of view, as it was written in 2002.

4. METHODS

This section will entail a description of the research methodology that will be used to answer the research questions of this paper and it will detail the tangible steps that will be taken to answer each of the research questions.

The research for this paper will be performed based on the secondary study methodology, which indicates that the primary studies relating to my research question will be reviewed with the aim of integrating and synthesizing evidence related to a specific research question. To elaborate even further, a systematic literature review will be performed, which is a more specific form of the secondary study methodology [16].

In order to best-achieve the objective of a systematic literature review, it is important to adopt the mindset of a judge and jury, but not the one of a lawyer [17].

For the purpose of elaborating more on the tangible steps that will be taken to conduct research, the literature research will be performed on the topic of negotiation, more specifically emotional intelligence and its relevance in the context of negotiation. Then, the current negotiation agent systems will be explored and identified. Next, it will be determined how to develop more emotionally intelligent negotiation systems, and finally, a methodology will be created on how to evaluate the performance of presumably intelligent negotiation agent systems. Finally, in order to combine both of these topics and collectively explore them even further, the last section is about emotional intelligence in negotiation agents.

The main platforms used to find relevant papers were Scopus, accessed through the University of Twente, and Google Scholar.

Table 2 provides information about the International Negotiation Journal that was used to find relevant research to contribute to this paper. Table 3 provides information on the

search strings that were eventually chosen to successfully retrieve relevant articles for this paper.

Table 2. Overview of the relevant papers in the International Negotiation Journal

Journal	Papers in period	Papers relevant according to abstract	Usable and assessed papers
International Negotiation Journal	771	73	3

Table 3. Search strings for used in the International Negotiation Journal library

Keywords	Initial hits	Usable and assessed papers	Search key
Intelligent negotiation agent	50	2	intelligen* negotiati*** agent
Emotional intelligence	40	2	emotional*** intelligen**

The approach to the literature review is described below. Most important keywords were identified regarding the main research topic and relevant sub-questions. Examples include: Emotional Intelligence in Negotiation and Conflict Resolution; Negotiating Agents; Autonomous Negotiation Agent Systems; Negotiation Methodologies in Negotiation Agent System.

The following table (Table 4) lists the search queries used to find relevant literature for this research. These queries were designed to focus on specific aspects of emotional intelligence and negotiation agents. The table includes the keywords, initial hits, usable and assessed papers, and the search keys used in various research databases.

Table 4. Focused literature search results

Keywords	Initial Hits	Usable and Assessed Papers	Search Key
Autonomous Negotiation Agent Systems	69	5	"autonomous negotiation agents" AND "systems"
Emotional Intelligence in Mediation and Negotiation	11300	12	"emotional intelligence" AND "mediation" AND "negotiation"
Multi-Agent Negotiation Frameworks	299	4	"multi-agent" AND "negotiation frameworks"
Negotiation Agent Systems and Simulations	1660	9	"negotiating agent*" AND "simulation" AND "system*"

Emotional Intelligence in Conflict Resolution	26900	8	"emotional intelligence" AND "conflict resolution" AND "framework"
Negotiation Agent Development	56	3	"negotiating agents development" AND "negotiation"

Studies were selected based on criteria involving relevant information on topics such as emotional intelligence, negotiation agents, and negotiation models. These overarching topics were expanded by using similar wording or narrowing the search with more elaborate queries, encapsulating the essence of the four main themes discussed in this paper:

Emotional Intelligence in Negotiation; Negotiation Agent Systems; Emotional Intelligence in Negotiation Agents; Autonomous, Interactive, Intelligent Negotiation Agents.

Finally, credible and accredited books written by reputable authors were read, used, and cited as sources for this research, including: "Never Split the Difference" by Chris Voss and "Beyond Reason: Using Emotions as You Negotiate" by Roger Fisher and Daniel Shapiro.

5. RESULTS

This section explores important topics relevant to the research question in more detail. Each topic was researched with the systematic literature review approach, which was covered in the Methodologies section. However, it was not predetermined that such exact subtopics would be derived before more elaborate research was conducted. These topics are a product of synthesized information that was gathered from the explored literature.

The results of the research can be split up into four sections. Each section will expand on the topics relevant to the main research question, which will namely cover:

Emotional Intelligence; Existing Automated Negotiation Agent Systems; Emotional Intelligence in Negotiation Agents; Loubeth's model.

Emotional intelligence is an important concept in the field of negotiations and it also covers the more niche, but no less important concepts to negotiation, such as active listening and cultural differences. As such, it deserves its own section in this paper.

As the paper explores the concept of intelligent interaction in the field of negotiations, existing negotiation agent systems were researched and explored. Therefore, it deserves a separate section as well.

Finally, Loubeth's model captures the essence of a more autonomous negotiation agent because of the emphasis on the agent's ability to perceive the environment and act appropriately.

5.1 Emotional Intelligence in Negotiations

Emotional intelligence is not usually brought up in conversations, but it is a rather important concept and plays a significant part in human interactions.

In the context of this paper, emotional intelligence, also known as emotional quotient, is the ability to use, understand and manage emotions, which can be used to communicate effectively with others, empathize, identify and overcome

challenges and defuse conflict [38]. Goleman's work is widely cited and respected, which makes his definition of emotional intelligence reliable for this paper.

Developing emotional intelligence means developing four key elements [2], which include:

Self-awareness; Self-management; Social awareness; Relationship management

Negotiation consists of complex processes, which include emotional, behavioral and cognitive competencies. For too long the emotional aspect of the process has been minimized or passed over, often to the serious detriment of processes involving domestic, personal injury, transaction and international political and commercial issues. The effective negotiator in the twenty-first century must be able to address the emotional dynamic not only by recognizing and managing his or her own emotional self but also by recognizing and addressing the emotional aspects of all relevant parties [2].

Individuals that are capable in using their emotional intelligence effectively provide a more positive negotiating experience. However, being emotionally intelligent is not enough, because the research also emphasizes that such individuals achieved significantly lower objective scores than their counterparts.

Accordingly, effective negotiating depends on the ability of parties to manage both the integrative and distributive components of the task [3]. Hence, although emotional intelligence in negotiations has beneficial positive attributes, such as creating a more positive negotiation setting and establishing a better rapport with the counterparties [3], it needs to be integrated into the process of negotiation together with a distributive approach, as a disbalance between the focus on emotional intelligence and objective components of the negotiation can be detrimental to the outcome of the negotiation.

It is apparent from the results in literature, that the most effective way to handle emotions in the negotiation setting is to address the following concerns, including appreciation, acceptance, affiliation, role and status. Based on the five core concerns the negotiator may use the following skills to build empathy and trust improving the emotional aspects of a negotiation: to work with emotions across all dimensions of a negotiation; to understand emotional nuance, as a result of power differential, cultural nuance, or past experience; to address process issues with the same vigor as substance issues; to actively listen and to encourage all the parties to listen to each other [2].

Relationship management can be described as the ability to influence, develop and inspire others while managing conflict. The emotionally intelligent negotiator has to develop four main skills: the ability to identify one's own emotions and those of others; the ability to harness emotions and apply them to tasks such as thinking and problems solving; the ability to manage emotions, including the ability to regulate the negotiator's or mediator's own emotions, and the ability to affect the emotions of the others in the negotiation [2]. Goleman identifies the competencies associated with relationship management as influence, inspirational leadership, and ability to be a change-catalyst, ability to create and maintain networks, and where appropriate the ability to build effective constituencies [14].

While speaking and expressing oneself in other means is a vital part to communication and getting a point across the table in negotiations, it is just as much, if not more important to listen [14].

Knowing how to attentively listen is crucial as it allows to retrieve information from the counterparty which will help understand the parties participating in a conversation and steer the negotiation towards a desirable outcome. As such, being able to actively listen significantly contributes to the development of emotional intelligence.

Active listening consists of five interactive frameworks, with an overriding focus (Rost, Wilson, 2013):

Active Frame is about enhancing the listener's personal involvement. Top Down Frame is about deepening the understand of ideas and solidifying interpretations. Bottom Up Frame focuses on the perception of sounds, recognizing words and the syntactic structures more accurately. Interactive Frame focuses on building a cooperative, collaborative atmosphere and interdependence during the listening process. Autonomous Frame is about developing effective listening and learning strategies.

These frameworks offer a distinctive approach to understanding information and provide collective insights on how to improve the effectiveness of active listening. This results in a more consistent capture of relevant information. Each framework adds complementary information to the overall understanding of the person that is speaking, and as such all of the aforementioned frameworks should be integrated into the listening development.

Emotional intelligence is also relevant in the context of cultural differences. Being aware of these differences and using this knowledge in order to establish a good rapport with the counterparties can lead to a much more successful tangible and intangible outcome [12].

Finally, a study carried out in the University of Twente [28] showed that interviewees with a high level of emotional intelligence used more tactics and additionally more competitive actions during negotiations, but the same amount of integrative actions. Hence, it is likely that they obtain better outcomes.

5.2 Existing Negotiation Agent Systems

In the context of this paper, negotiation agent is a sophisticated computer program that negotiates autonomously. At this day and age, a completely autonomous negotiation agent is certainly not a realized concept, however for this concept to come closer to reality, currently existing systems are explored and later ideas on how to improve such systems will be derived later.

It has been demonstrated that automated negotiation agent systems can obtain substantial insights in negotiation, emotions, and niche negotiation domains. Moreover, negotiation agents can improve the utility of an agreement [1].

An example of an automated negotiation agent system is The Pocket Negotiator. This agent is to enhance the negotiation skills and performance of the user by helping the user to explore the negotiation space and obtain win-win outcomes that are better for both parties [1].

The Pocket Negotiator acts as a support to the user in an integrative bargaining task., which includes, but is not limited to the following activities: regulating emotions, coping with negative consequences of emotions and assessing the negotiation situation. In order to help the user, the agent has to be equipped with means of establishing the emotional state of the user and preferably the one of the counterparty, and I should also have the ability to link emotions to core concerns (appreciation, affiliation, status, autonomy, and role) [18].

The agent needs to be able to incorporate its knowledge about emotions, personalized coping styles, which are displayed below in Figure 1.

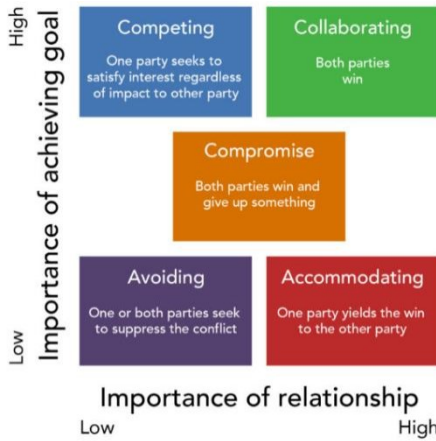


Figure 1. Five primary styles of conflict management [25]

The Thomas-Kilmann conflict mode instrument [26] suggests there are five main conflict resolution styles, and although each person has their own unique style, this model can help deduct the kind of negotiator any person is. One of the axis represents the importance that a negotiator places on achieving a certain goal, and the other represents the importance they place on establishing and maintaining a good relationship.

Even though programmed negotiation agents are able to outperform people in well-defined negotiation domains, generally such agents are unable to reach optimal, effective outcomes without sufficient knowledge about the negotiation domain or their counterparties [19]. Hence, the goal arises to maximize the performance of an automated negotiation agent system given the limited availability of information.

It is considered to be unwise practice to reveal the reservation value to the counterparty, as it will give away vital information about your position which the counterparty will try to enforce [20]. However, if the negotiating parties establish an atmosphere that promotes trust, information will be shared more openly. There are various techniques that have been proposed to uncover private preferences [21].

To further explore some of the other existing negotiation agent systems and how they were programmed, it was beneficial to discover the platform of IAGO. The Interactive Arbitration Guide Online (IAGO) platform [8] was specifically developed as a test bench for negotiation between agents and humans. It is a web-based servlet hosting system that provides services for data collection and recording, providing an HTML5 GUI for use by humans and an API to design agents with corporeality and dialogues. Built with web technologies, IAGO supports a variety of functions for realistic communication between human agents such as partial offers, preference statements, natural language argumentation phrases (customizable) and expressive humanoid virtual agent.

In order to understand the general architecture for a negotiating agent [13], it is wise to explore an example displayed in Figure 2.

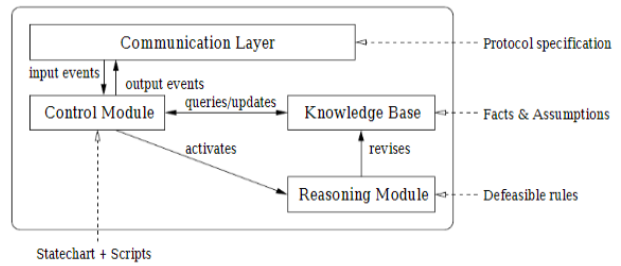


Figure 2. Architecture of a negotiating agent

The abstract architecture illustrated above shows a set of important modules that are useful to negotiation agent systems to effectively negotiate and reach agreements. Each of the 4 modules serves a particular purpose. First of all, a memory contains a history of past decisions and interactions of the agents, or simply its experience, including its current intentions. Secondly, a communication module is responsible for sending messages to other agents or interacting with the user. Thirdly, the reasoning module encodes the decision-making part of an agent. Lastly, a control module coordinates helps coordinate all other components.

Each time an agent is notified about a change regarding the status of negotiation, it updates the base knowledge database accordingly and activates the reasoning module. The reasoning module reads the facts from the updated knowledge base and then deduces new facts while concurrently refuting the ones that existed previously, and later updates the knowledge base accordingly. After that, the control module determines if the communication module should submit an offer or a counter-offer immediately or if it should wait for more information.

In summary, a negotiation strategy is composed based on a set of scripts, a logic program, a set of initial facts and information about the involved parties in a negotiation. One major limitation of a potentially autonomous negotiation agent that has been prevalent in the past was that they lacked natural language processing support required to enable real-world types of interactions [27]. A Negotiation agent called NegoChat was “the first negotiation agent that successfully addresses this limitation” (Rosenfeld et al., 2014, p. 1). Research published in 2024 is focused on multi-party, multi-modal and cross-cultural negotiation scenarios [37]. It provides a more elaborate and comprehensive overview to guide future developments in human-computer interaction. Furthermore, due to the complexity of negotiations, it may be better to first develop domain-specific tools, guided by an integrated theoretical framework, rather than one general negotiation support system [33]. Hybrid human-machine systems can enhance mediators' roles by addressing AI limitations in peacemaking [36]. Research should explore agency distribution in mediator-machine networks, machine-supported participatory approaches, and the impact on power dynamics, as future challenges “may be overcome by hybrid human-machine systems in support of peacemaking” (Hirblinger, 2022, p. 94).

5.3 Emotional Intelligence in Negotiation Agents

Up until this point, emotional intelligence and negotiation agents were explored as separate topics. It is therefore time to combine the two. Doing so will confront the research question and help derive important conclusions.

To start with, it is important to highlight the potential of negotiation agent systems according to (Barslaag et al., 2017, p. 143 “Computers that negotiate on our behalf hold great promise for the future and will even become indispensable in emerging application domains such as the smart grid and the Internet of Things. Much research has thus been expended to create agents that are able to negotiate in abundance of circumstances.” Such a conclusion made by more prominent and elaborate research proves it is a relevant topic to explore and this effort will prove to be a worthy investment.

Even research conducted in 2004 highlights how human-computer simulations can reveal the impact of mediator style on crisis negotiations, suggesting that simulations can enhance insights beyond those gained from traditional case studies and empirical analysis [35].

To approach the topic of emotional intelligence in negotiation agent systems in a more tangible manner, it is relevant to explore the idea of According to Chawla et al. (2021) “In order to advance the development of emotion-aware negotiation agent systems, it is important to focus on two subjective objectives in negotiation, which are outcome satisfaction and partner perception.”

Another interesting idea proposed (is as follows: “Since negotiations and other mixed-motive situations can be fraught with emotional decisions, our findings suggest that it would be useful for designers of agents that negotiate with humans to be armed with algorithms for understanding the unfolding emotions displayed by users in terms of their emoticon use and natural language” (Chawla et al., 2021, p. 7).

Negotiation research can be clustered around one of the three main orthogonal dimensions of autonomy, as shown in the Figure 3. These include Self-sufficiency; Self-directedness; Interdependence.

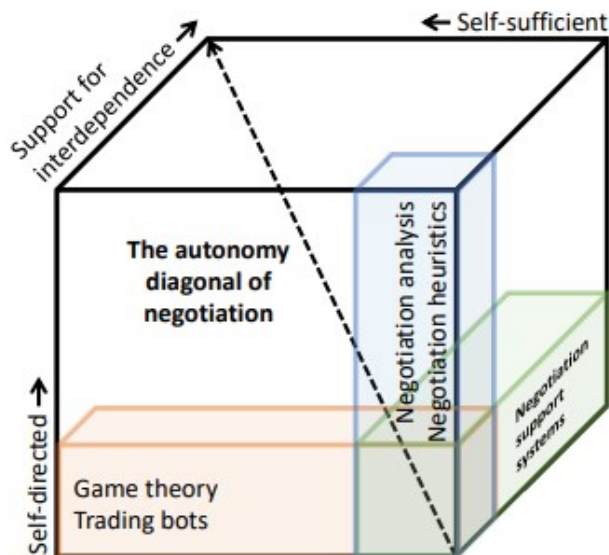


Figure 3. The autonomous diagonal of negotiation [4]

In order for the agent to become a truly autonomous negotiator, all three dimensions, representing progress in each of the aforementioned characteristics need to progress along the diagonal of autonomy.

Autonomous negotiation is more than just automated negotiation; it is the freedom to negotiate independently. Rather than being uni-dimensional, autonomy incorporates at least two

components: self-sufficiency (the capability of the actor to take care of itself) and self-directedness (the freedom to act within the environment and the means to reach goals) [22]. Following up on that, is possible to distinguish a third dimension, which is called support for interdependence [23]. It describes the ability to work well with others, which will include influencing and being influenced by team members.

5.4 Loubeth’s model

The agent proposed in the prototype of Osvaldo Cairó and Juan Gabriel Olarte is a prime example of an autonomous negotiation agent. The autonomy is evident in its ability to manage and execute negotiation tasks in a dynamic environment. Hence, it is important to highlight it. This agent is capable of not only perceiving, but also appropriately responding to its environment [5], as shown in Figure 4.

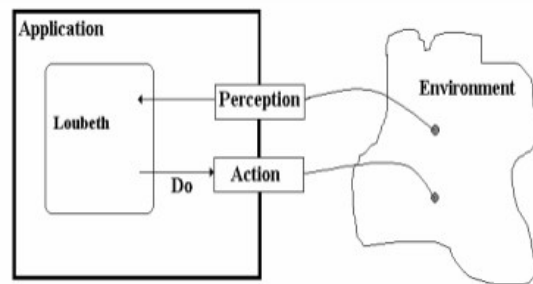


Figure 4. Loubeth’s communication architecture

Furthermore, there are important capabilities that should be measured in the agent-mediated systems. These capabilities help determine to what extent the prototype of Loubeth can behave as a real human being, which is the goal of the project. The aforementioned capabilities should include emotion, personality, perception, language understanding and many others [5]. In order to perform these activities, the agent must have three main attributes, which consist of beliefs, capabilities, commitments.

Beliefs represent the present state of Loubeth’s internal and external world, which is constantly updated as new information is perceived. *Capabilities* represent a construct used by the agent to associate the necessary preconditions with an action which is to be performed. *Commitments* represent an agreement, which frequently comes in a form of communication with the counterparty or simply another agent to perform a specific action at an agreed upon time.

To train the negotiation agent effectively using artificial intelligence, it is important to explore the Utterance-level emotion training [6]. It concerns natural language processing and large deep learning models, which have achieved huge success in recent years on tasks such as sentiment analysis, machine translation, which fundamentally made the work of researchers easier. The primary way of training a model for a certain task consists of two steps:

First, it is important to pre-train a large language model with freely available text data in either the supervised or self-supervised manner.

Second, the model has to be fine-tuned on the task-specific dataset based on supervised learning.

6. DISCUSSION AND CONCLUSION

The goal of this paper is to explore and substantiate the relevance of concepts, such as EI, negotiating agents and the subtopics of these concepts, such as active listening, cultural differences, involving referenced models, architectures and methodologies, such as Loubeth's model, architecture of a negotiating agent, Hofstede's five dimensions of culture, or even prototypes, such as The Pocket Negotiator.

Before the research was started, it was important to make sure the concepts of emotional intelligence and negotiation agents are relevant, and also relatable. When it comes to emotional intelligence, some profound insights were found and emphasized in this paper from different sources, that substantiated its relevance in the setting of negotiation.

When it comes to negotiation agents, it was important to discover and better understand the already existing systems. More importantly, what kind of development was made regarding emotional intelligence in these agents. Even though it is quite a complex task to develop fully autonomous negotiation systems, it is helpful to evaluate current progress in the literature in order to provide clarity and guidelines for future researchers. The Loubeth's model and The Pocket Negotiator certainly do not represent the potential of a fully autonomous, sophisticated negotiation agent, but they do represent of what is already possible. Large deep learning models in the field of natural language processing, new and advanced technology regarding motion capture, artificial intelligence applications need to be collectively combined in order to be able to create more autonomous negotiation agents. Furthermore, the three main dimensions of autonomy need to be accounted for when creating the autonomous negotiation agent, which include self-sufficiency, self-directedness, and interdependence.

To address the research sub-questions, including the definition of emotional intelligence in negotiations, the concept of negotiation agents, and the requirements for an emotionally intelligent agent system, this paper identified several key findings. Firstly, emotional intelligence has a significant impact on the negotiation process and its' outcome. It is the ability to connect with the counterparty, understand their needs, empathize with them. Emotional intelligence also makes the process of conflict resolution easier. Therefore, important elements of emotional intelligence, such as the Hofstede's cultural differences should be considered and incorporated for effective negotiations. Secondly, negotiation agents are defined as autonomous machines designed to manage the negotiation process through phases such as pre-negotiation, negotiation, and post-negotiation. The observed negotiation agents, such as the Pocket Negotiator and Loubeth's model are capable in specific negotiation tasks but lack elaborate and effective emotional intelligence integration. Hence, as automated negotiation agents, they fail to make full use of their negotiation potential. The main research question was "How can negotiation agent systems be made more emotionally intelligent?"

To develop emotionally intelligent agent systems, it is essential for them to be able to interpret and respond to human emotions. This means they need to be adept, among other areas, in natural language processing, motion capture and emotion recognition. Moreover, they ought to be capable of processing and using that information effectively. In a negotiation context that means building rapport with the counterparty and maximizing the value of a deal that is to be negotiated. It is expected that future research will bridge these gaps, which will lead to the creation of more sophisticated and effective emotionally intelligent negotiation agents.

7. LIMITATIONS

Due to the constraint of time and resources for this paper, further research would be required to make use of the findings in this paper and build upon them, in order to make consistent progress towards building a substantial theoretical model, which in the future would be incorporated towards building an emotionally intelligent negotiation agent. Nevertheless, this research provides insights and evidence of the progress that has been made by the academics to discover the fundamentals of what it takes to build such an agent.

8. FUTURE WORK

For future work, it would be rather beneficial to make an even more thorough and elaborate research into what makes an effective negotiation agent. If such an agent is to autonomously negotiate against another human being, perception in what people in the field of negotiation like to call emotional intelligence is of great importance.

However, it is not as simple to tell what exactly is it that makes one emotionally intelligent agent from another. The most significant differences should be discovered by programming these agents slightly differently, testing their ability to negotiate in a series of isolated simulations with human beings and having a clear scoring criterion. Each of the negotiation agent's performance could be assessed by two evaluators. One of them would be a neutral negotiation expert that would observe the negotiation and the other would be the person negotiating against the agent.

To conclude, further research, more resources and a series of isolated negotiation simulations would be required in order to test the assumptions of conducted research and find out which exact components are most relevant when programming a truly intelligent negotiation agent.

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