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Empathy's Impact on Patient Satisfaction:

A Comparison of Human and Chatbot Interactions in Healthcare.

Ana Margarida Gouveia Gomes

Master Thesis

presented as partial requirement for obtaining a Master's Degree in Information Management

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação

Universidade Nova de Lisboa

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Master Thesis presented as partial requirement for obtaining the Master's degree in Information Management, with a specialization in Business Intelligence

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07, 2025

STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism, any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledged the Rules of Conduct and Code of Honor from the NOVA Information Management School.

Lisboa, 15 de julho de 2025

Ana Margarida Gomes

DEDICATION

Reaching the end of this master's programme is undoubtedly a remarkable moment, and I can only thank all the people who have accompanied me on this journey.

Firstly, to my family, who even from afar continue to be my greatest pillar: grandparents, cousins and uncles. A very special thank you to those at home: my mum, dad and sister. Thank you for always being there, at every stage. And, above all, to my mum, who, apart from being a fantastic woman, never let me give up on doing this master's degree.

To my friends, who have been essential to keeping my sanity: thank you to those who sat with me and kept me company while I wrote my master's thesis and thank you to the others who helped me relax when I needed it most - and that was worth as much as any bibliographical reference. Thank you for always being around.

To my supervisor, Professor Diego, thank you for your guidance and support throughout the process. And to my co-supervisor, Professor Mariana, a special thanks: she's only been doing this for a short time and she's already an incredible professional, always available, helpful and eager to help.

And of course, to everyone who, in one way or another, supported me throughout this journey - with advice, a friendly word or simply by being there - my sincere thanks.

ABSTRACT

This study explores the impact that the type of agent, human vs. voice-based Artificial Intelligence (AI), has on patient satisfaction (*PS*) in a telephone call with Serviço Nacional de Saúde (SNS 24) with the purpose of studying the perception of empathy as a mediating effect.

An experiment was carried out with 216 Portuguese participants, randomly assigned to one of two possible scenarios: a virtual appointment with a human agent or an AI agent.

PS and three dimensions of empathy were measured: perspective-taking (*PT*), empathic concern (*ECC*) and emotional contagion (*ECT*). The results revealed that there was no significant direct effect of the type of agent on *PS*. However, *ECC* and *ECT* significantly mediated this relationship, suggesting that a lower perception of empathy in AI interactions may indirectly reduce satisfaction.

These findings contribute to advancing the study of integrating empathy into AI agents, with a view to improving the quality of services in healthcare environments. Future research should explore real clinical interactions and consider other relevant contextual factors.

KEYWORDS

Satisfaction; Chatbots; Healthcare; Empathy; AI; Human

Sustainable Development Goals (SDG):



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LIST OF ABBREVIATIONS AND ACRONYMS

AI	Artificial Intelligence
SNS	Serviço Nacional de Saúde
PS	Patient Satisfaction
PT	Perspective Taking
ECC	Empathic Concern
ECT	Emotional Contagion

1. INTRODUCTION

The use of AI-powered chatbots in many sectors and services is seen as a significant possibility for improving operational efficiency and even reducing costs for human labor. Consequently, the chatbot industry has grown massively and is expected to expand much further in the coming years (Yu et al., 2024). The health sector's stakeholders are becoming interested in utilizing innovative AI solutions to improve the efficacy of their services, which exist on a massive volume. However, some surveys have indicated that in this sector there are still critical barriers among people to accepting the use of AI. Specialists consider that in the future it is vital to shift this belief to realize the potential of AI in medicine, which could bring positive benefits to society (Longoni et al., 2019). Unfortunately, despite their potential, healthcare AI services still fail to build empathy by making people feel like objects. Empathy is a key element in the doctor-patient relationship: Once the patient has the feeling of being listened to as well as supported by the doctor, they become more satisfied and more confident in the medical recommendations provided. As a result, there is a need to encourage more interactive and patient-centered effective conversations. In order to improve this factor, it is necessary to understand which psychological and behavioral factors of the doctor influence the patient's perception of empathy (Silvester et al., 2007).

Past studies in these sectors have concluded on the comparison between the types of human agents and chatbots in diverse contexts, although they point to the need to specify this study in other sectors, such as healthcare (Pavone et al., 2023), as well as highlighting the importance of understanding the reasons for society's resistance to AI agents, since in-depth analyses are still needed (Longoni et al., 2019), and finally, in the same way, that it is necessary to analyze transactional communication and empathy judgements between doctors and patients (Silvester et al., 2007). Therefore, it is necessary to combine these subjects and investigate the gap of empathy as a factor that influences *PS* when chatbots rather than humans provide healthcare services. (Silvester et al., 2007; Longoni et al., 2019).

The main objective of this study is to understand how the type of agent (human or chatbot) influences *PS* in the provision of healthcare services, considering empathy as the mediator variable. In addition, the aim is to understand the mediating role of the three dimensions of empathy (*PT*, *ECC* and *ECT*) and their effect on the level of empathy perceived by the patient during interactions. This study will be conducted through a questionnaire, in which each participant will answer the same questions about how they would feel during a phone call with a chatbot or with a human agent, to assess their satisfaction with the healthcare service provided. With this, it is hoped to gain a deeper understanding of the relevance of empathy and the most effective way of measuring it.

If this study shows the importance of human empathy, the adoption of empathetic chatbots will be an essential advantage due to their accuracy and ability to expand the access to

healthcare services, with the aim of increasing the empathy perceived in interactions, improving *PS* and promoting the acceptance of this type of technology in the sector.

This study is structured as follows: Initially, an introduction and abstract are presented to contextualize the research topic. Next, the literature review demonstrates what has been studied previously and the model and hypotheses are developed to be tested through a questionnaire. The results will be analyzed and the study's conclusions and suggestions for future work will be presented.

2. LITERATURE REVIEW AND HYPOTHESES

After carrying out the research, several concepts and theories were crucial to understanding the background to this study.

The Concept of Empathy has been defined as “the ability to experience and understand another person's affective or psychological state (i.e. imagining oneself in another person's shoes)”. Thus, Empathy Theory is important in our society, as it can explain and anticipate social behavior, as well as change the behavior of individuals to create social equity (Argo et al., 2008). At the core of this Concept of Empathy comes the *ECT* Theory because ‘in an interpersonal context, it involves the synchronization of one person's feelings with those of another’, in this case illustrates the importance of a person's mental state in their interactions, since the feelings they reflect can become the emotions of the people with whom a person is interacting (Liu-Thompkins et al., 2022).

The concept of Human-Robot Interaction can be expressed through various theories, firstly the Anthropomorphizing Theory that “is the attribution of humanlike physical or nonphysical characteristics, motivations, intentions, or emotions to a non-human agent or an inanimate object”, in this sense it has been supported in past studies that the trust transmitted by the human to the robot increases if it has human attributes (Han et al., 2023). Secondly, according to the Computers-as-Social-Actors Theory suggests that “customers tend to adopt confrontive coping strategies even when interacting with an AI-based chatbot, thus applying social rules”, people will interact with chatbots by communicating as they would speak to a human when they are frustrated, assigning responsibility and making judgements (Pavone et al., 2023). Thirdly, the Uniqueness Theory ‘views the pursuit of self-uniqueness as a motivational drive, and suggests that people have a need to see themselves as unique and distinct from others’, it also points out that when this individuality is threatened individuals feel themselves becoming anxious and tend to change their behavior in order to re-establish it, in addition this research suggest that AI is not capable of structuring this uniqueness in the same way as humans (Longoni et al., 2019). Finally, we look at the Valley Theory, “suggests that the introduction of highly humanlike robots might create 'feelings of eeriness or a threat to (a customer's) human identity”, this study addresses how service providers need to recognize the negative and positive implications that customers feel towards human-like robots. (McLeavy et al., 2021).

2.1 HUMAN REACTIONS TO AI

Nowadays, AI is considered an essential source of innovation that is widely used in a range of services (Huang et al., 2018), as it maximizes productivity, improves efficiency and guarantees precision (Vorobeva et al., 2022). As a result, people have started to use AI for various purposes, such as the design and development of new products, imitating or even replacing

human creativity (Pantano et al., 2022), but also to effectively check for anomalies in existing products (Huang et al., 2021). They also see AI as a digital partner to support their needs, such as in the purchasing experience, where it can make personalized recommendations (Pantano et al., 2022), generating feelings of trust during the interaction and contributing positively to the business (Vorobeve et al., 2022).

Anthropomorphism refers to the attribution of human physical and cognitive characteristics to an AI agent, either in the hardware design, such as the shape of the body, or in the software, such as the human voice. These characteristics boost people's trust in robots (Han et al., 2023). Studies indicate that people tend to increase their affection for an object that has human characteristics, as with a humanoid robot, which can lead to a feeling of affection for the brand to which the robot belongs (Hoyer et al., 2020). These robots are characterized as empathic AI machines that behave as if they had feelings (Huang et al., 2018) and can be considered by humans as artificial best friends (Puntoni et al., 2021).

The continuous development of valuable algorithms by companies has led humans to trust in their technologies increasingly (Hoyer et al., 2020). The acceptance of AI by individuals has different points. Firstly, employees are liberated from mechanical and repetitive tasks (Vorobeve et al., 2022). Secondly, marketing professionals believe that it is an innovative and promising tool for improving services (Pantano et al., 2022). Finally, customers will benefit and accept the help of AI agents to better understand and predict their own preferences (Hoyer et al., 2020).

Conversely, there is also rejection of the IA. Some service employees show negative feelings towards the presence of AI, with a real fear of being replaced even in the tasks in which they are most competent (Vorobeve et al., 2022; Huang et al., 2018). Similarly, some consumers reject AI because they feel uncomfortable in interactions with service robots, feeling concern, distrust (Pantano et al., 2022) and believing that the capture of their data makes them complicit for commercial exploitation (Puntoni et al., 2021).

On the other hand, in healthcare, consumers tend to have lower reservation prices and show resistance to services provided by AI, as they believe that machines only operate in a programmed way, without considering cases as individual and without presenting human cognitive characteristics that a healthcare provider should contain. Similarly, people feel less able to blame a machine in the event of failures, either for errors during the medical act or for issues related to privacy and data security (Longoni et al., 2019). However, surgical robots are more accurate than human health professionals, they carry out their work more quickly and reliably (Puntoni et al., 2021), as is the case with the use of deep learning to diagnose skin cancer, a task in which machines outperformed dermatologists (Huang et al., 2018). In conclusion, even though machines are highly accurate, people only trust the success of treatments carried out by them when they are supervised by a doctor (Puntoni et al., 2021).

2.2 ROBOTS AND CHATBOTS

Service robots are system-based interfaces that provide services and interact autonomously with the organization's customers, without requiring help from the human employees (McLeavy et al., 2021). Thus, robots are automated computer programs that respond and act according to customer requests, while simulating the human-like ability to show feelings and empathize (Xiao et al., 2021). Their emergent use has been remarkable in terms of making front-line services more automated, faster, reliable and efficient when performing their simple and repetitive tasks (Holthöwer et al., 2022).

Despite that, robots don't only have advantages, they also have some challenges and ethical considerations, such as customers' concerns about sharing data that can place their privacy and security at risk, since robots can store data in the cloud and perhaps share it with other sources later or even receive attacks from hackers. Furthermore, there is also the emotional concern of clients about the replacement of humans by machines in some jobs, such as human carers for the elderly, causing a dehumanization of the service and consequently the existence of emotionless care staff that isolate older people. Finally, this doesn't just affect customers, but also employees who feel that they could be replaced by robots and lose their jobs (McLeavy et al., 2021).

Like robots, chatbots are currently one of the most used AI agents for providing service to customers. They are described as responsive computer programs that use natural language to simulate human-like conversations, through text or dialogue, with the aim of responding instantaneously and in real time to their customers' needs (Barreto et al., 2023). These conversations are possible through pattern matching techniques where there is a database of dialogues trained for the chatbot, but without the possibility of it learning anything from the interaction with customers (Ramesh et al., 2022). As a result, chatbots can now be found in the most diverse sectors and are used by companies to improve their efficiency in interactions with customers while collecting and storing their data (Yu et al., 2024).

However, in consequence of customer dissatisfaction because chatbots have proven ineffective with complex and non-routine tasks, a trend has emerged of growth of hybrid agents in services, this integrate AI chatbots and human employees in the same interface and has confused people about the difference between the service provided through interactions with humans or AI. Consequently, recent political initiatives have forced companies to identify their chatbots as non-real people to their clients (Gnewuch et al., 2024). This indicates that transforming services into intelligent environments, which include triads between customers, AI and employees, is a challenge for service providers (Fan et al., 2024).

H1: AI (vs. human) agents lead to lower (vs. higher) PS.

2.3 EMPATHY FROM PROFESSIONALS

To understand the context of this study, we need to better understand the concept of empathy. Early research describes that empathy can be approached from various perspectives. By analyzing interpersonal relationships considering the different characteristics of the people who interact with each other, we can consider empathy as a personal skill or characteristic, an experience or an interpersonal process. It may also be distinguished between cognitive or emotional and, in addition, unidimensional or multidimensional (Wieseke et al., 2012). Cognitive empathy describes the internal understanding of the other person, understanding their mind, their thoughts and their *PT* (Argo et al., 2008; Wieseke et al., 2012). Emotional empathy, on the other hand, is defended as an emotional response to the other person's state of mind, which contains *ECC*, describing how individuals behave when demonstrating their concern for the well-being of others as well as *ECT*, meaning that emotions are transferred, and people are synchronized (Wieseke et al., 2012). Empathy is increasingly understood as multidimensional because it is both cognitive and emotional (Hattula et al., 2015; Wieseke et al., 2012).

Within this context, empathy is the ability to put yourself in the other person's shoes, experiencing their emotional and psychological state, this concept is gaining in importance because it can explain and predict important pro-social behaviors that contribute to everyone's well-being (Argo et al., 2008). Research carried out between employees and customers concluded that the demonstration of empathy by the employee improves customer satisfaction and smoothest out the negative effects of mistakes, increasing the likelihood of forgiveness, since the customer recognizes the employee's efforts. Empathy is therefore crucial in these service interactions as it influences customer satisfaction and subsequently also customer loyalty (Wieseke et al., 2012). It has also been defended that involuntarily, the empathy in a sales manager makes them mentally assume the position and identity of the consumer and makes it easier to identify consumer preferences, but it can also lead to biased forecasts (Hattula et al., 2015).

Similarly, when evaluating the same concept in the healthcare sector, empathy on the part of doctors has been defended as crucial for effective guidance (Argo et al., 2008) and is essential for promoting *PS* and adherence to treatment (Silvester et al., 2007). Therefore, within this area, studies argue that interpersonal and social interaction between the doctor and the patient is indispensable as it is the form of connection between them (Hausman et al., 2004). Thus, there are communication styles that are associated with empathy, such as more supportive discourses from doctors and dialogues mostly led by patients. In addition, doctors should improve their care through good communication and the ability to take the patient's perspective (Silvester et al., 2007).

The emotional support shown is seen as a form of empathy and comprehension, which is an encouragement and shows concern and affection for the other person. This should reduce, in addition to the side effects of medication, the effect of loneliness and depression mentioned

by hospitalized patients (Yao et al., 2015). Thus, doctors have a special responsibility to show concern for their patients, and extensive information sharing encourages the patients to evaluate the service based on this interaction. However, as doctors often must witness human suffering, this creates an emotional barrier, which can make it difficult for them to show concern and compassion for their patients (Hausman et al., 2004).

2.4 EMPATHY FROM AI

In services, the use of AI machines must go beyond their ability to reason; they need to evolve into sensitive machines with more empathetic interactions and capable of responding to their customers' emotions (Bagozzi et al., 2022). This development represents an advance to the next level, in which machines combine thought, creativity and empathy (Esmailzadeh et al., 2022). As a result, customer service should move from traditional automation to service comparable to that given by a human (Huang et al., 2024).

Studies indicate that, just like human agents, the emotional support given by an AI agent also affects customer outcomes (Gelbrich et al., 2021), should be implemented designs and coding of computer models with affective and cognitive empathy in machines (Liu-Thompkins et al., 2022). The more interactions the AI agent has with its client, the easier it will be to assess them, as they will reveal more thoughts and feelings, but there are factors that will never become clear, due to the difficulty AI agents have in identifying their clients' subtle issues and needs (Huang et al., 2024).

ECT, as a way of demonstrating empathy, shows the need for machines to be able to adequately distinguish each individual situation, ensuring that they only apply it when it is appropriate. In this context, the logistical implementation of *ECT* in AI agents should always begin by properly recognizing and assessing the consumer's emotions and then determining whether it is appropriate to synchronize their feelings towards them (Liu-Thompkins et al., 2022).

In services, a digital AI agent displaying empathetic and soothing discourse is enough to generate customer satisfaction and the perception of emotional closeness (Gelbrich et al., 2021), and there are experiences with AI that can be emotionally positive, such as fun and joyful moments, which contribute to improving people's mental and physical health (Bagozzi et al., 2022). On the other hand, studies in the field of health show that people believe that experiencing the act of being cared for requires the perception of positive emotions, something that it is not yet certain that robots can offer as effectively (Kipnis et al., 2022), as is the case with carers of the elderly (Esmailzadeh et al., 2022).

Recent research reinforces the importance of including a digital assistant in e-services that is able to provide comforting and empathetic feedback to customers (Gelbrich et al., 2021). Empathetic and aware AI becomes especially relevant in services that treat their consumers

as unique individuals (Esmailzadeh et al., 2022), as it can accompany each customer and promote the creation, identification and monitoring of positive emotions as well as replies tailored to each one (Bagozzi et al., 2022). However, companies will only be able to achieve this personalization of service through an AI agent that combines customer knowledge with brand knowledge (Huang et al., 2024).

It has been proven that in situations where people self-disclose sensitive topics, the use of AI with sensitive emotional capabilities has a similar result to what would be expected with human agents (Kim et al., 2022). Therefore, developing a sensitive AI and identifying its strengths and weaknesses is essential to empower customer-IA interaction (Huang et al., 2024). Similarly, trust in aware AI can also be useful in less sensitive moments, such as in hedonic contexts, so it becomes a benefit in different scenarios (Esmailzadeh et al., 2022).

In short, the development of conscious AI not only represents a benefit for companies and the economy in general, but also for society, since it is eventually expected to improve people's well-being in their daily lives (Bagozzi et al., 2022). It is therefore essential to develop marketing strategies that empower sensitive AI for customer service, as well as developing theories to manage customer emotions (Huang et al., 2024). This advance will be largely innovative and could impact cultures by adding new norms or transforming existing ones (Esmailzadeh et al., 2022).

H2: The relationship between agent type (human vs. AI) and *PS* is mediated by a) *PT*, b) *ECC*, and c) *ECT*.

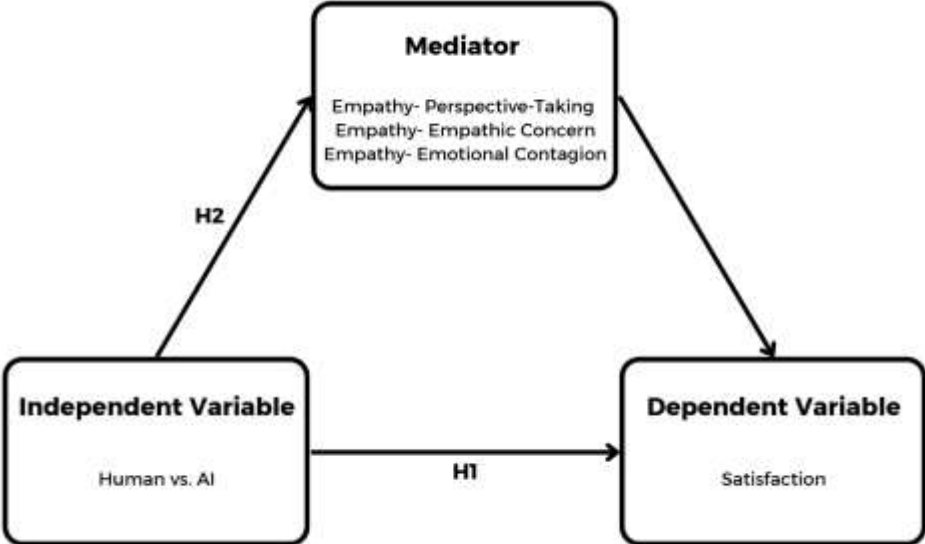


Figure 2-1 Conceptual model of the research

3. METHODOLOGY

This study was carried out on European territory, more specifically in Portugal. Its target population was all the individuals reached, covering different demographic and social characteristics, given that everyone needs to use health services. To facilitate participation, the study was conducted in Portuguese.

The instrument used to collect the data was a questionnaire administered using Qualtrics, created to measure the model presented in the previous section. All the measurement items used were taken from ABS3/4 articles with their value previously validated, were adapted to the context of this study and can be found in Appendix C.

PS was measured with three items evaluated by Bettencourt (1997), while the remaining constructs, Patient Empathy, *PT*, *ECC* and *ECT* were measured with items taken from Wieseke (2012) with four, three, four and five items respectively. All these constructs will be used to assess *PS* in both interactions, with the chatbot and with the human agent. The constructs were measured with scales ranging from 1 to 9, where 'Strongly disagree' (1) and 'Strongly agree' (9). Regarding demographic data, options for *gender*, *level of education* and *salary* were provided for selection, with salary being measured on a metric scale. *Age*, on the other hand, was requested as an open response.

4. EMPIRICAL STUDY

Our theoretical framework makes several predictions that we test empirically. Firstly, we investigate whether the type of agent in healthcare services (human vs. AI) affects *PS*. Secondly, we explore whether perceived empathy underlies and influences the mechanism of this relationship, by considering three ways in which empathy can be perceived by the patient. We test these predictions through one experimental study. The design and procedures were preregistered (AsPredicted #276487).

4.1 DATA

This study used a single factor (agent type: voice-based AI vs. human), focusing on a virtual appointment scenario presented as context in the questionnaire. This study involved the participation of 486 interviewed, due to the attention check question ($n=3$) and some withdrawals before the survey was fully completed, several participants were excluded, resulting in a final sample of 216 Portuguese participants. The average age of participants was 26.94 years, with a standard deviation of 9.20. Approximately 45.4% of participants self-identified as male, 54.2% as female, and 0.5% as other. Most participants held a bachelor's degree (50.9%), followed by those with a master's degree (19%), a high school diploma (15.7%), some university education without a degree (12.5%), and finally, those with less than a high school diploma. Regarding monthly income, 14.8% of participants reported earning less than 500 euros, while 16.2% reported earning between 501 and 1000 euros. The largest group (38.4%) reported a monthly income between 1001 and 2000 euros, followed by 8.8% who earned between 2001 and 3000 euros, and 1.4% who earned more than 3000 euros. Notably, 20.4% of participants chose not to disclose their income.

4.2 PROCEDURES

The experiment used vignette scenarios as stimuli, a method commonly used in research examining new technologies (Jörling et al., 2019). Each participant, recruited through social media on a voluntary basis, was randomly assigned one of the scenarios, which described a telephone call representing a digital appointment provided by the NHS with either a human agent or a voice-based AI agent, both agents referred to as Mário. The scenario was identical in both cases, differing only in the way Mário presented himself, as “a first-line assistant” or as “a human”. To make the interviewee's experience more immersive and make it easier to imagine the phone call, an audio of Mário was added to both scenarios, after the description of the context.

The scenario invited the interviewee to imagine being in the shoes of a person who has moderate head pain and has decided to call SNS 24 to find out whether it would be advisable

to see a doctor. His call was answered by Mário (a human assistant or voice-based AI), Mário confirms some personal details and asks several questions to check all the symptoms. Once the diagnosis has been made, he suggests that the patient go to the health center and offers to make an appointment for the same day, and the patient agrees and accepts.

This call took about ten minutes, and the appointment was made at the scheduled time. The pain he was feeling improved the following day with the pills prescribed by the doctor. Afterwards, questions were asked to assess Mário. The full stimulus of the experiment is shown in Appendix B and C, with the English and Portuguese versions. The questionnaire was administered in Portuguese to make it easier for the participants to understand and adhere to, since the study was conducted in Portugal.

4.3 MEASURES

In the questionnaire, all measures had a reliability level above 0.7, as recommended by the threshold (Juquelier et al., 2025). The dependent variable *PS* showed a reliability of $\alpha = 0.95$, while the mediator constructs, *PT*, *ECC* and *ECT* had reliabilities of $\alpha = 0.81$, $\alpha = 0.87$ and $\alpha = 0.93$, respectively. To validate our experimental design, we added two complementary measures. Firstly, participants completed a manipulation check to verify their recognition of the type of agent (voice-based AI versus human). Then, they evaluated the degree of realism of the scenario to guarantee its external validity. The survey was finalized by collecting demographic information.

4.4 ANALYSES

To investigate the effect of agent type on *PS* in appointments (*H1*), a t-test was performed to the dependent variable (*Y*). The type of agent was the independent variable (*X*), with the human agent coded as 0 and the voice-based AI agent as 1. This same t-test analysis was also carried out on separate empathy variables to understand their main effect.

On the other hand, to test the mediating role of patient-perceived empathy towards *PS* during the appointment (*H2*), the PROCESS, model 4, was used, with 5,000 bootstrapped samples and a 95% confidence interval (Hayes et al., 2017). Again, the type of agent was the independent variable (*X*), the different types of perceived empathy were assessed individually as mediators (*M*), and customer satisfaction was the dependent variable (*Y*).

5. RESULTS AND DISCUSSION

5.1 MANIPULATION CHECKS

The results showed that the manipulation of the data was more clearly proven for the interviewees who had the human assistant questionnaire, while the others may have been slightly more confused by the manipulation question. An independent samples t-test revealed that participants who had seen the human assistant questionnaire had significantly higher agreement with the statement that the call agent was a human ($M_{\text{human}} = 3.73$, $SD = 2.98$, $MAI = 2.42$, $SD = 2.48$, $t(201.714) = -3.488$, $p < 0.001$). Although participants interacting with the AI agent showed slightly higher agreement with the statement that the call agent was AI-based, this difference was not statistically significant compared to the human agent condition ($M_{\text{human}} = 7.24$, $SD = 2.60$, $MAI = 7.68$, $SD = 2.21$, $t(212) = 1.342$, $p = 0.091$).

In addition, the results indicated that although the context, identical in both questionnaires, was not considered highly realistic, it was evaluated as ecologically valid and slightly higher than average, both in the human agent condition ($M = 5.47$, $SD = 2.42$) and in the AI-based condition ($M = 5.57$, $SD = 2.37$). The result that an NHS telephone appointment was not perceived as a particularly realistic scenario can be explained by the next question in the questionnaire, which asked if the participants had already experienced a symptom assessment or medical check-up by telephone call. The responses were very low, both in the human agent condition ($M = 1.43$, $SD = 0.50$) and in the AI condition ($M = 1.52$, $SD = 0.50$).

5.2 PATIENT SATISFACTION

Contrary to our prediction, there was no significant main effect of agent type on *PS*. Participants who interacted with the voice-based AI agent ($M = 6.50$, $SD = 2.08$) did not report significantly lower satisfaction compared to those who interacted with the human agent ($M = 6.71$, $SD = 2.13$), $t(214) = -0.742$, $p = 0.229$. Therefore, *H1* was not supported.



Figure 5-1 Average level of satisfaction with a human agent and voice-based AI agent

5.3 PERSPECTIVE TAKING

The results for *PT* did not show that this dimension of empathy had a significant effect on the study. The participants who evaluated the voice-based AI agents ($M = 4.72, SD = 2.10$) did not differ significantly from those who evaluated the human agents ($M = 5.13, SD = 1.82, t(214) = -1.529, p = 0.128$). In addition, the confidence interval for this mediator includes both negative and positive values in the indirect effect, which suggests that the impact of this dimension of empathy may be null or inconsistent across participants ($Effect = -0.1729, BootSE = 0.1176, 95\% CI [-0.4224, 0.0421]$). These results imply that the doctor's ability to consider different points of view and recognize the two-sidedness of issues does not influence the patient's perception of empathy during the appointment.

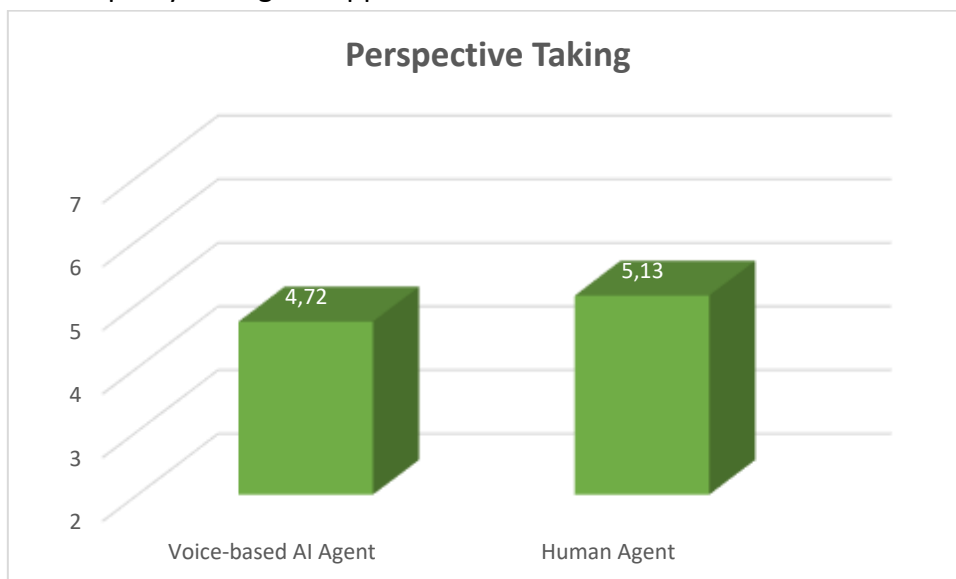


Figure 5-2 Average level of *PT* perceived with a human agent and a voice-based AI agent

5.4 EMPATHIC CONCERN

There was a significant effect of the type of agent on *PS* through the perception of empathy, over the dimension *ECC*. Participants who interacted with the voice-based AI agent ($M = 2.96$, $SD = 1.74$) reported lower levels of perceived *ECC* compared to those who interacted with the human agent ($M = 4.06$, $SD = 1.82$, $t(211.694) = -4.543$, $p < 0.001$). These results support hypothesis *H2* indicating that the type of agent can damage the level of perceived *ECC* and can consequently have a negative impact on *PS*.

Firstly, the effect of the type of agent on the *ECC* dimension was evaluated. The model proved to be significant ($R^2 = 0.0882$, $F(1,214) = 20.6957$, $p < 0.001$) and shows that the type of agent influences the perception of empathy in this dimension. Participants who interacted with the voice-based AI agent obtained lower levels of *ECC* compared to those who interacted with the human agent, so this difference is considered statistically significant ($\beta = -1.1026$, $SE = 0.2424$, $t(214) = -4.5493$, $p < 0,001$).

Next, we ran an analysis that considers the effect of *ECC* on *PS*. Again, the model was significant ($R^2 = 0.1099$, $F(2,213) = 13.1555$, $p < 0.001$), and therefore in this context we can consider *ECC* to be a significant predictor of satisfaction ($\beta = 0.3878$, $SE = 0.0765$, $t(213) = 5.0692$, $p < 0.001$). Furthermore, by including *ECC* in the model, the direct effect of the type of agent on satisfaction became non-significant ($\beta = 0.2150$, $SE = 0.2841$, $t(213) = 0.7569$, $p = 0.45$), which suggests a mediation effect.

Analyzing the indirect effect revealed a significant effect ($Effect = -0.4276$, $BootSE = 0.1353$, 95% $CI [-0.7213, -0.1990]$), confirming that *ECC* significantly influences the relationship between the type of agent and satisfaction, which confirms hypothesis *H2*.

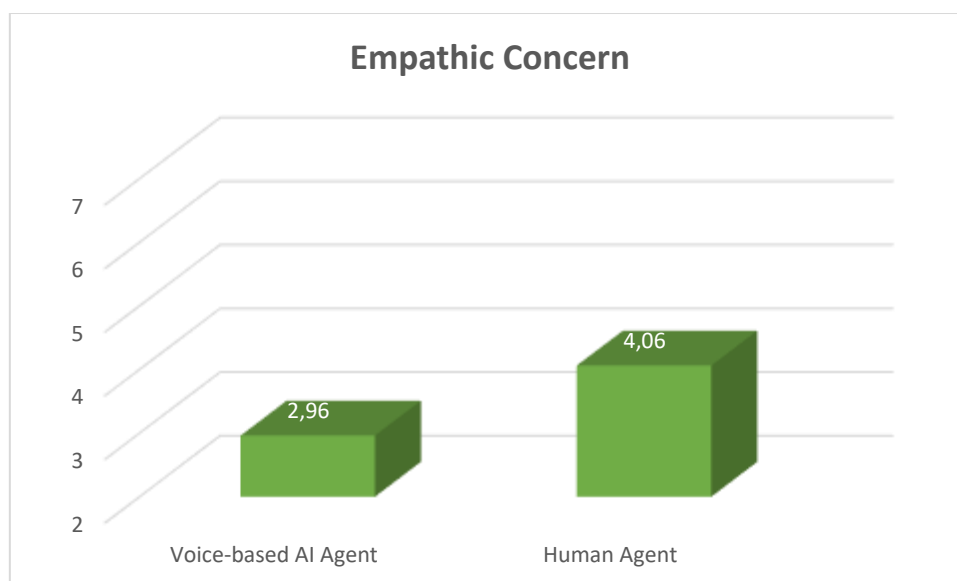


Figure 5-3 Average level of *ECC* perceived with a human agent and a voice-based AI agent

5.5 EMOTIONAL CONTAGION

In this dimension of empathy, there was a significant effect of the type of agent on *PS*. Participants who interacted with the voice-based AI agent ($M = 2.51, SD = 1.82$) reported lower satisfaction compared to those who interacted with the human agent ($M = 3.69, SD = 1.90, t(211.997) = -4.658, p < 0.001$). These results further strengthen hypothesis *H2*, indicating that interactions with voice-based AI agents compared to human agents, considering the level of empathy through *ECT*, are detrimental to customer satisfaction.

Once again, we began by evaluating the effect of the type of agent on the *ECT* dimension. The model was significant ($R^2 = 0.0923, F(1,214) = 21.7501, p < 0.001$) and shows that the type of agent influences the perception of empathy in this dimension. Participants who interacted with the voice-based AI agent obtained lower levels of *ECT* compared to those who interacted with the human agent, so this difference is statistically significant ($\beta = -1.1792, SE = 0.2528, t(214) = -4.6637, p < 0.001$).

When assessing the impact of the type of agent on *PS* according to this empathy dimension, the general model proved to be significant ($R^2 = 0.0561, F(2,213) = 6.3267, p = 0.0021$). We noticed that *ECT* had a significant positive effect on satisfaction ($\beta = 0.2624, SE = 0.0755, t(213) = 3.4748, p = 0.0006$). In contrast, the direct effect of agent type on satisfaction was not significant ($\beta = 0.0969, SE = 0.2932, t(213) = 0.3303, p = 0.7415$), suggesting that *PS* is not directly impacted by agent type. When analyzing the indirect effect, we have a significant effect ($Effect = -0.3095, BootSE = 0.1218, 95\% CI [-0.5748, -0.1026]$). As the confidence interval reveals the non-inclusion of 0, this dictates a mediating role of perceived *ECT* in *PS* according to the type of agent, which confirms hypothesis *H2*.

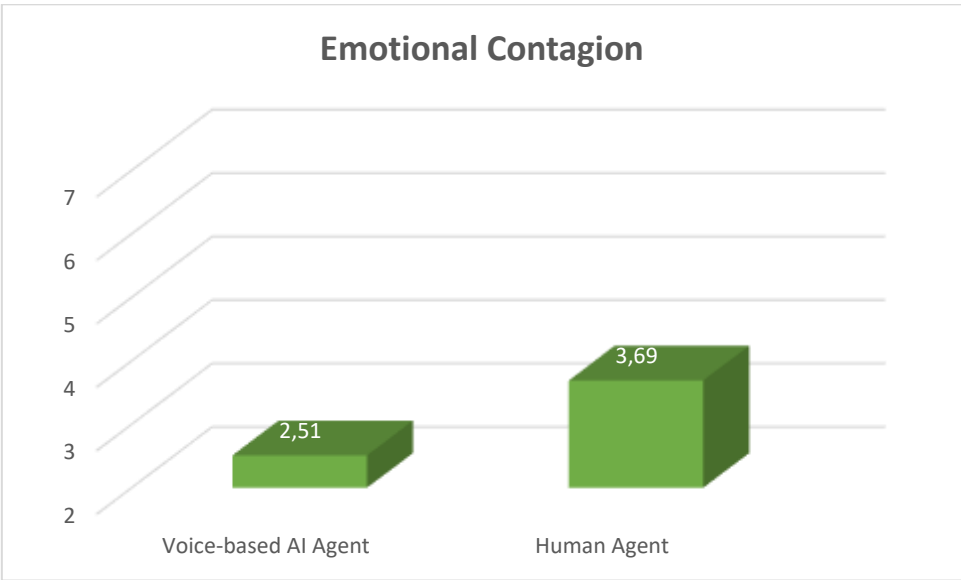


Figure 5-4 Average level of *ECT* perceived with a human agent and a voice-based AI agent

5.6 DEMOGRAPHIC DATA

When we evaluated the demographic data as moderators, we realized that none of them were significant. In addition, *age* had a significance level of 0.93, *gender* 0.55 and *salary* 0.09.

6. DISCUSSION

This study showed that the direct effect of *PS* does not differ between appointments with the different types of agents, human or AI-based voice agents. However, when empathy is considered as a mediating variable, the results reveal a significant indirect effect.

The empathy experienced by the patient, particularly through the most emotional dimensions of empathy, *ECC* and *ECTT*, was shown to mediate the relationship between the type of agent and satisfaction, whereas perspective-taking had no such effect. These results suggest that while AI agents can simulate conversations and provide accurate recommendations, they still face challenges in conveying emotional intelligence (Van Doorn et al., 2017).

Considering that two of the three dimensions of empathy studied showed significant mediating effects, we can confirm that empathy influences *PS*.

7. CONCLUSIONS AND FUTURE RESEARCH

The type of agent, human or voice-based AI, influences *PS* when empathy is considered as a mediating factor, through the dimensions of *ECC* and *ECT*. This reinforces the fundamental role of empathy in promoting *PS* during a medical appointment. All in all, although AI agents are technologically efficient, they are still incapable of conveying emotional intelligence in the same way as humans.

This idea emphasizes the importance of developing AI systems that are emotionally intelligent, with a focus on integrating empathy into their design to promote patient trust and acceptance.

As a limitation, this study presented a questionnaire based on a simulated scenario. The scenario was evaluated by the participants as acceptable, but not highly realistic, which can be justified by the fact that most people had never experienced a telemedical appointment on SNS 24.

Future research could explore studies in other, more realistic contexts, such as face-to-face interactions, including physiological metrics such as heart rate, eye movements or facial expressions (using emotion recognition software). Another scenario will be to carry out studies integrating the participation of AI agents and humans in the same session, to analyze whether there are changes in the attitude of the patients being monitored. Other dimensions of empathy could also be explored, or even other variables with a potential impact on *PS*, such as accessibility to available health resources.

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APPENDIX A – ETHIC COMMITTEE

The This is to certify that

Project No.: **OTHER2024-12-276487**

Project Title: **Empathy's Impact on Patient Satisfaction**

Principal Researcher: **Ana Margarida Gouveia Gomes**

According to the regulations of the Ethics Committee of NOVA IMS and MagIC Research Center this project was considered to meet the requirements of the NOVA IMS Internal Review Board, being considered **APPROVED** on 12/27/2024.

It is the Principal Researcher's responsibility to ensure that all researchers and stakeholders associated with this project are aware of the conditions of approval and which documents have been approved.

The Principal Researcher is required to notify the Ethics Committee, via amendment or progress report, of

- Any significant change to the project and the reason for that change;
- Any unforeseen events or unexpected developments that merit notification;
- The inability of the Principal Researcher to continue in that role or any other change in research personnel involved in the proj*ECT*.

Lisbon, 12/27/2024

NOVA IMS Ethics Committee

ethicscommittee@novaims.unl.pt

APPENDIX B – QUESTIONNAIRE ITEMS

Figure A. 1 Questionnaire Items

Constructs	Items	Measurement items	References
Patient Satisfaction (PS)	<i>PS1</i>	All in all, I am very satisfied with the call to Mário.	(Bettencourt, 1997)
	<i>PS2</i>	The call to Mário met my expectations of an ideal encounter with a health service.	
	<i>PS3</i>	The call to Mário fulfilled my expectations.	
Perspective Taking (PT)	<i>PT1</i>	Mário tries to look at everybody's side of a disagreement before he makes a decision.	(Wieseke, 2012)
	<i>PT2</i>	When Mário is upset at someone, he usually tries to "put himself in their shoes."	
	<i>PT3</i>	Mário believes that there are two sides to every question and tries to look at them both.	
Empathic Concern (ECC)	<i>ECC1</i>	I would describe Mário as a pretty soft-hearted person.	(Wieseke, 2012)
	<i>ECC2</i>	If I were unhappy, Mário would quickly realize this, even if he does not know me well.	
	<i>ECC3</i>	Other patients' misfortunes usually disturb Mário a great deal.	
	<i>ECC4</i>	Mário often has tender, concerned feelings for people less fortunate than himself.	
Emotional Contagion (ECT)	<i>ECT1</i>	Mário becomes nervous if others around him are nervous.	(Wieseke, 2012)
	<i>ECT2</i>	Mário cannot remain calm if others around him are excited.	
	<i>ECT3</i>	Mário gets easily infected by the mood of others.	
	<i>ECT4</i>	If Mário sees unhappy people, he feels unhappy himself.	
	<i>ECT5</i>	If Mário sees happy people, he feels happy himself.	

Figure A. 2 Translated questionnaire items in Portuguese

Constructs	Items	Measurement items	References
Patient Satisfaction (PS)	<i>PS1</i>	Em suma, estou muito satisfeito/a com a chamada para o Mário.	(Bettencourt, 1997)
	<i>PS2</i>	A chamada para o Mário correspondeu às minhas expectativas de um serviço de saúde ideal.	
	<i>PS3</i>	A chamada para o Mário cumpriu as minhas expectativas.	
Perspective Taking (PT)	<i>PT1</i>	O Mário tenta olhar para o lado de todos numa discordância antes de tomar uma decisão.	(Wieseke, 2012)
	<i>PT2</i>	Quando o Mário está chateado com alguém, normalmente tenta “colocar-se no lugar dessa pessoa.”	
	<i>PT3</i>	O Mário acredita que há dois lados em cada questão e tenta olhar para ambos.	
Empathic Concern (ECC)	<i>ECC1</i>	Eu descreveria o Mário como alguém com o coração muito mole.	(Wieseke, 2012)
	<i>ECC2</i>	Se eu estivesse infeliz, o Mário aperceber-se-ia rapidamente disso, mesmo que não me conhecesse bem.	
	<i>ECC3</i>	Os constrangimentos de outros pacientes geralmente perturbam bastante o Mário.	
	<i>ECC4</i>	O Mário tem frequentemente sentimentos de ternura e preocupação por pessoas menos afortunadas do que ele.	
Emotional Contagion (ECT)	<i>ECT1</i>	O Mário fica nervoso se os outros à sua volta estiverem nervosos.	(Wieseke, 2012)
	<i>ECT2</i>	O Mário não consegue manter-se calmo se os outros à sua volta estiverem excitados.	
	<i>ECT3</i>	O Mário deixa-se contagiar facilmente pelo humor dos outros.	
	<i>ECT4</i>	Se o Mário vê pessoas infelizes, ele próprio sente-se infeliz.	
	<i>ECT5</i>	Se o Mário vê pessoas felizes, ele próprio sente-se feliz.	

