Erasmus School of Economics

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Decentralized Versus Centralized AI-Powered Chatbots: The Consumer Perspective

Student name: Zen Aytemir

Student number: 541146

Supervisor: Dr. A. Scekic

Second assessor: Dr. A. Bayerl

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Abstract

This study investigates the impact of decentralized AI-powered chatbots on customer satisfaction and how it is affected by consumer perceptions of privacy and trust in their interactions with centralized and decentralized AI-powered chatbots. For this, an online experiment was conducted with 175 participants. The findings indicate that customer satisfaction does not significantly differ between the different chatbot types (unspecified, centralized, decentralized). The results of mediation analyses suggested that consumer privacy concerns and trust did not significantly mediate the relationship between the chatbot type and customer satisfaction. However, in a comparison between the centralized and unspecified chatbot types, the model showed that being aware of the centralized type, decreased consumer trust and that consumer trust increased customer satisfaction. Also, consumer AI familiarity was found to significantly increase trust but not affect the relationship between the chatbot type and customer satisfaction. Although the study lacks key significant findings, it manages to provide important insights for companies to optimally make use of AI-powered chatbots by enhancing transparency, privacy and data protection, and improving the user experience. Future research should investigate consumer awareness of the differences between the chatbot types in detail and identify effective communication methods of the benefits of decentralized AI-powered chatbots to consumers.

Chapter 1: Introduction

1.1 Topic Background

The introduction of Artificial Intelligence (AI) into the dynamic digital marketplace marks one of the most influential technological advancements. Especially with the implementation of AI-powered chatbots, which also contributed to a permanent change in the way customers and brands interact with each other. The impact and increase in popularity of AI can be seen in forecast calculations. While the global AI market size in 2021 amounted to nearly 100 billion U.S. dollars, this number is expected to turn into over 420 billion U.S. dollars in 2025 and reach nearly two trillion U.S. dollars by the year 2030 (Statista, 2023a). This market consists of a large number of industries where AI is applied for different purposes, such as automation, customer service, and marketing. Focusing specifically on the global chatbot market, it amounted to just over 190 million in 2016 and is expected to be around 1.25 billion U.S. dollars by 2025 (Statista, 2023b). One of the reasons for this significant growth is because AI-powered chatbots are capable of, and constantly improving in the use of natural language processing (NLP), which allows the chatbots to understand the intention behind the words of (potential) customers. This makes it possible for the chatbots to provide more personalized content and customer support that meets consumer preferences (The Enterprise Project, 2023). This even made way to AI-powered chatbot applications that operated as virtual doctors with the ability to communicate like human beings to deliver support to patients during the COVID-19 pandemic (Bharti et al., 2020) and AI-powered chatbots that enhanced the online informed consent process for participants of research and experiments (Xiao et al., 2023). So, in turn, marketing strategies can be developed more efficiently and be more effective.

The concept of decentralization adds more to the nature and capabilities of AI and chatbots, as decentralized AI systems utilize technology such as blockchain, which allows systems to operate on multiple online ledgers or nodes. This makes it possible to distribute the control and oversight over the technology and tools over multiple entities with various motivations and goals. This is in contrast to centralized AI systems, whose operations are usually controlled by a limited number of organizations. Thus, decentralizing AI-powered chatbots would lead to open networks that are more transparent and secure. It also allows the systems to better meet consumer needs and provide more personalized responses because it can make use of more diverse data inputs from multiple sources, which improves the understanding of chatbots and their ability to provide to individual preferences (Emmons, 2024).

1.2 Problem Statement and Research Question

Despite the growing popularity of implementing AI-powered chatbots in marketing strategies, there is also a growing concern about the use of AI technology, regarding various topics such as data privacy and security, ethical use, accuracy, and transparency in the AI decision-making processes (Haan, 2023). The privacy concerns are related to various aspects, such as the extensive data collection and processing operations of AI-powered systems. Because consumers integrate these services by interacting on a daily basis, they become increasingly wary of how their personal information is being processed and stored. CDP.com, the customer data platform resource, conducted a survey on more than 2,500 adults in the United States of America and found that 82% of the respondents are somewhat or very concerned that their privacy can be compromised because of AI-usage in marketing, customer service, and technical support (Onorato, 2022). A growing concern about the potential misuse of personal information also means that customer satisfaction and loyalty could be negatively affected. When it comes to personalizing AI-powered chatbot interactions, the findings of the same survey indicate that 44% of consumers are in favor of AI-powered recommendations, though they emphasize that it depends on the company that utilizes these recommendations. At the same time, personalization of interactions can also cause more privacy concerns as it requires the processing of more personal data. That is why it is crucial to understand the balance between personalization and data privacy measures, that satisfy consumer expectations while simultaneously respecting the privacy boundaries as much as possible. As a result of these growing privacy problems and related concerns, new strategies and solutions need to be implemented.

One of those is the idea of decentralization, which is also applicable in the field of AI systems and is expected soon to be implemented by companies (Azhar, 2024). What it means is that it allows AI services to run locally on nodes, phones, and computers as opposed to centralized AI systems. According to Carlos (2024), it helps to distribute data across multiple nodes so that the risk of large data breaches gets minimized. This makes decentralized AI systems also more transparent because the decisions and processes are recorded on multiple nodes, which allows for verification and examination by multiple independent entities. This ensures that no single entity can alter the decision-making process without any oversight. Another advantage of using multiple nodes to operate, is that the system will continue to run, even when one node turns inactive, reducing downtime close to zero. This means that the customer experience will be more positive as there will be fewer disturbances. Besides, it allows multiple developers and AI services to operate independently and collaboratively, utilizing distributed computing resources to provide better and unique solutions to its users. Another important benefit is that it spreads control over AI systems and therefore prevents a couple of entities from having full control over the systems and data.

Even though the decentralization of AI-powered systems and chatbots has a lot of benefits and provides solutions to important problems like data privacy, which are the main challenges for centralized systems, it is undetermined how consumers perceive the decentralization of AI-powered systems and chatbots at the time of writing. Therefore, this research aims to investigate how consumer privacy concerns and trust in AI-powered chatbots differ between the use of centralized and decentralized AI-powered chatbots. Ultimately, the research investigates how these factors influence customer satisfaction. Given the stated goal of the study, the central research questions are formulated as follows:

1. **"How does the decentralization of AI-powered chatbots affect customer satisfaction?"**
2. **"How do consumer perceptions of privacy and trust impact customer satisfaction in interactions with centralized versus decentralized AI-powered chatbots?"**

1.3 Academic Relevance

Together with promising expectations, the rapid increase in popularity of AI usage in the marketing sector highlights the importance and relevancy of this study. At the time of writing, the existing research has been mainly around centralized AI-powered systems and chatbots in general, and the benefits and concerns of these systems. For example, Xie et al. (2022) leveraged meta-analysis to analyze the impact of gratifications on user satisfaction with AI-powered chatbots. The study focused on four types of gratifications: utilitarian, technology, hedonic, and social gratification. The authors find that utilitarian gratification has the strongest influence on user satisfaction which relates to the practicality of AI chatbots and conclude that these gratifications are important in developing user satisfaction with AI-powered chatbots. Focusing on a different aspect of the topic, Jiang et al. (2022) explore the impact of AI-powered chatbot communication on customer engagement and behavior. The key findings emphasize the importance of chatbot communication in enhancing customer engagement and behavior, as they indicate that responsiveness and conversational tone have positive effects on customer satisfaction, which leads to improved social media engagement and purchase intention.

Phansalkar et al. (2019) emphasize the need for decentralized AI applications through blockchain solutions. They state that centralized AI models are limited in learning and performance capabilities due to data control issues and argue that decentralization offers solutions to the security, trust, and efficiency problems, stated in the earlier sections of this paper. However, it remains mainly unexamined what the perceptions of consumers are regarding the decentralization of AI-powered systems and chatbots, and whether they see the value of it. A comparison of both systems from the viewpoint of the consumer and the impact that they have on customer satisfaction is also missing. It is even unclear whether consumers themselves are actually aware of the differences between centralized and decentralized systems, as these are usually quite technical differences and are not explained to users in chatbot interactions. This research paper aims to address this gap in the literature by investigating how consumer perceptions of privacy and personalization influence customer satisfaction in AI-powered chatbot interactions, and whether the impact differs between centralized and decentralized systems. In order to provide answers to these questions, this study will only focus on AI-powered chatbot interactions.

1.4 Managerial Relevance

This study also offers important insights for business leaders and marketing managers who utilize or consider implementing AI-powered chatbots, specifically decentralized systems. The research highlights how an understanding of consumer perceptions regarding privacy and personalization can improve the customer experience and satisfaction. As security and personalization become more important factors for consumers in the services that businesses offer, decentralized AI-powered chatbots represent an innovative strategy. In addition to addressing important privacy concerns, it also provides a platform for more tailored customer interactions.

The findings of this research can also prove to be valuable for marketers who aim to utilize technology to boost customer engagement and retention. Integrating decentralized AI technology can allow companies to offer more transparent and secure customer interactions. This could enhance customer trust and satisfaction, and, in turn, lead to increased brand loyalty and competitive advantage over companies that do not utilize decentralized AI technology.

Moreover, the insights can initiate the development of targeted marketing strategies that actively make use of the strengths of decentralized systems. Marketers could, for example, develop interaction strategies that put an emphasis on the security and personalization capabilities of the chatbots. Through these strategies, customers can be made more aware of the advantages of decentralized systems, potentially increasing user acceptance and customer satisfaction.

Altogether, this study underlines the importance of aligning technological advancements with the expectations of consumers and provides a framework for how companies can adapt their strategies in the rapidly changing area of AI-powered customer interactions.

Chapter 2: Literature Review

2.1 Theoretical Frameworks

This study will make use of numerous theoretical frameworks to answer the main research question. In this section of the paper, these theories will be explained. The first theory was developed by Davis (1985), who introduced the Technology Acceptance Model (TAM) to explain how users use new technological tools or systems and why they accept them. According to the model, two important factors are considered by users: perceived usefulness and perceived ease of use. It implies that when (new) users find a technology useful and easy to use, it is more likely that they will accept it and use it during their daily activities (Davis, 1985). TAM will help in the research process of this paper, specifically in understanding the factors that influence consumers' acceptance of implementing and using decentralized AI-powered chatbots.

Culnan and Armstrong (1999) provide the second theoretical framework for this study. With the Privacy Calculus Theory, the authors state that individuals tend to make rational decisions by weighing the benefit of disclosing personal information against the potential privacy risks that come with it. This implies that when the perceived benefits outweigh the perceived risks, individuals are more likely to disclose personal information (Culnan & Armstrong, 1999). The Privacy Calculus Theory can be used to understand and identify which benefits consumers weigh and how they weigh them against their data-privacy concerns when it comes to the usage of decentralized AI-powered chatbots. To a certain extent, this theory also allows for an assessment of the impact of privacy and personalization on consumer satisfaction.

2.2 Consumer Privacy Concerns and Trust in AI-powered Chatbots

2.2.1 Consumer Privacy Concerns in Chatbot Interactions

As mentioned earlier, the usage of AI services and interactions with AI-powered chatbots are becoming increasingly popular among consumers. However, a clear understanding of consumer privacy concerns and how they differ between centralized and decentralized AI-powered chatbots is needed as these have an impact on customer satisfaction. The importance of ethical considerations in the use of AI and digital technologies is underlined by Ashok et al. (2022), who, by developing a conceptual model with twelve propositions, highlight the impact of digital ethics on societal outcomes. The model identifies critical ethical considerations such as intelligibility, accountability, fairness, autonomy, and privacy, that are related to the deployment of AI technology. These are also applicable to AI-powered chatbots.

One of the ethical concerns that are discussed by Coghlan et al. (2023) is that chatbots are required to be supervised by humans so that they can operate as intended, continuously. They state that the supervision is often neglected, partly because the supervision also increases the workload of service providers. Not only does this increase the risk of potential harm and inaccuracy by chatbots, but also a suboptimal quality standard in business operations. Rivas and Liang (2023) focus specifically on the integration of ChatGPT in marketing practices. It states the benefits and advantages of implementing ChatGPT into marketing strategies through automation, increasing customer engagement, and gaining insights. However, it also highlights the importance of addressing several ethical issues related to consumer privacy and transparency. The authors state that companies should communicate clearly what type of consumer data they collect, for which purposes it will be used, and how the decision-making processes and algorithms work, to ensure that customers have a sufficient understanding of how their data is being processed. In turn, this will have a positive impact on the trust between companies and consumers.

The impact of consumer privacy on customer satisfaction has been shown by several studies that state that privacy concerns among consumers have significant negative effects on the consumers' satisfaction with the services provided by AI-powered chatbots. Cheng and Jiang (2020) studied the impact of AI-driven chatbots on the user experience of 1,064 consumers in the U.S. They found that increased perceived privacy risk reduces the extent to which users are satisfied with the chatbots and that it therefore is a major concern, which stands in the way of continued usage and customer loyalty. The researchers state that future research should examine relationships between privacy concerns, machine heuristics, and different privacy protection behaviors. Similarly, Sağlam et al. (2021) investigated users' privacy concerns among 491 British citizens. The researchers found an issue regarding the feeling of losing agency or control over the data provided to chatbots. They also found that consumers are concerned about how their data is used and the ability to delete provided data. Moreover, these concerns are more present for older users (above the age of 45) compared to younger users. Rese et al. (2020) utilized the uses and gratifications (U&G) theory to measure the acceptance of a text-based chatbot "Emma" among 205 German respondents. They concluded that the authenticity of the conversation, perceived usefulness, and perceived enjoyment had positive effects on the acceptance of the chatbot. However, high levels of privacy concerns and perceived immaturity of the technology negatively affected the usage intention and frequency.

The findings of these papers indicate that addressing privacy concerns is crucial for ensuring customer satisfaction and maintaining loyalty. As explained in earlier sections of this study, decentralizing AI-powered chatbot systems allows for a distribution of data processing and storage across multiple entities as opposed to centralized systems. This reduces the risk of data misuse and unauthorized access and thus addresses the aforementioned concerns of consumers that are mainly present in centralized AI-powered chatbots. Phansalkar et al. (2019) emphasize the need for decentralized AI applications to improve data protection, security, trust, and efficient use of resources.

Based on these findings, assumptions are made for this study. First, due to differences between centralized and decentralized AI-powered chatbots, mainly regarding security and privacy concerns, the chatbot type affects customer satisfaction directly. This means that decentralized chatbots lead to more satisfied consumers compared to centralized chatbots. Second, this means that the relationship is mediated by consumer privacy concerns. However, it is important to acknowledge that consumers might have difficulty in completely understanding the technical differences between centralized and decentralized AI-powered chatbots. Therefore, it should be noted that the hypotheses in this study are based on the assumption that these differences create noticeable experiences for consumers. For example, decentralized systems may offer more transparent data handling practices and reduce risks of data breaches, which can be communicated to consumers through marketing practices. When consumers notice and feel that their data is secure, their satisfaction is more likely to increase. Given the conclusions of the discussed studies and the assumptions, the following hypotheses are stated for this paper:

H1: The chatbot type (unspecified, centralized, decentralized) has a direct effect on customer satisfaction, where decentralized AI-powered chatbots are expected to lead to higher customer satisfaction compared to centralized AI-powered chatbots and those where the type is not specified.

H2: Consumer privacy concerns mediate the relationship between the chatbot type (unspecified, centralized, decentralized) and customer satisfaction, such that decentralized AI-powered chatbots decrease privacy concerns, which in turn increase customer satisfaction, compared to the unspecified and centralized AI-powered chatbot types.

2.2.2 Trust in AI-Powered Chatbot Interactions

Trust is also an important factor that defines how consumers interact and engage with AI-powered chatbots that affect customers' satisfaction. Følstad et al. (2018) found that consumers' trust in chatbots is influenced by the chatbot's quality, human likeness, and the brand that hosts the chatbot service, as well as perceived security, privacy, and risks. The findings of Kasilingam (2020) indicate that the intention to use chatbots and interact with them is directly affected by trust, personal innovativeness, and attitude. Contradicting, Ryan (2020) argues that AI cannot be considered trustworthy as the author explains that trust in AI involves multiple dimensions and divides these into three main accounts, including rational, affective, and normative trust. He concludes that AI only meets the requirements of the rational account, which is not a form of trust, but rather a form of reliance. According to the paper, attributing trustworthiness to AI undermines the value of one of the most important activities in human relationships.

Gillath et al. (2021) explored the connection between attachment styles and trust in AI. Amongst others, the study found a significant association between attachment anxiety and trust in AI, where higher attachment anxiety leads to lower trust in AI and enhancing attachment security increases trust in AI. It also emphasizes that building trust in AI is vital for its successful integration in, for example, the workplace and other public settings. The importance of trust in AI technologies is further underscored by Choung et al. (2022), who examined its role through two studies. Similar to Følstad et al. (2018) and Kasilingam (2020), their results confirmed that trust had a significant effect on the intention to use AI technologies, operating through perceived usefulness and the participant's attitude towards the technology. However, they identified two distinct dimensions of trust: human-like trust and functionality trust. Human-like trust relates to the ability of AI to have human-like interactions and its character. Functionality trust, on the other hand, relates to its reliability and safety. The authors found that both types of trust significantly affect the user acceptance of AI technologies, with functionality trust having a relatively greater total impact on the AI usage intention than human-like trust.

Based on these findings and together with the aforementioned information about the differences between centralized and decentralized AI-powered chatbot differences, regarding quality, security, privacy, and human-likeness, it is assumed that decentralized chatbots can increase trust more than centralized ones. Decentralized systems are expected to be perceived as more transparent and safe because of its distributed operations, which lowers the risk of data breaches and lack of oversight on centralized systems. This allows the decentralized systems to provide more reliable results. Therefore, the assumption is that decentralized AI-powered chatbots can improve trust, and in turn, also increase customer satisfaction. So, the third hypothesis in this study can be stated as follows:

H3: Consumer trust in AI-powered chatbots mediates the relationship between the chatbot type (unspecified, centralized, decentralized) and customer satisfaction, such that decentralized AI-powered chatbots enhance trust more than the unspecified and centralized chatbot types, which in turn increases customer satisfaction.

2.2.3 Literature Gap: Consumer Awareness of Chatbot Types

From the existing theory and literature, it becomes evident that numerous studies investigated the effects of several factors, such as security, consumer privacy, and chatbot personalization on customer engagement and satisfaction with AI-powered chatbot interactions. However, it remains underexplored how consumer awareness of the differences between chatbot types, specifically centralized and decentralized chatbots, affects trust in these AI systems. Therefore, this study proposes to fill this gap in the literature by investigating how consumer awareness of the two different chatbot types plays a role in the relationship between chatbot type and customer satisfaction. The study also looks at the case in which the chatbot type is not clear. Even though directly relatable findings are lacking, theory and findings regarding technology acceptance and consumer behavior form a strong indication of the presence of the expected awareness effects (Choung et al., 2022; Del Giudice et al., 2023; Ostrom et al., 2018). For example, Shin (2019) underlines the importance of including causability and explanatory capabilities in AI systems to increase transparency and accountability in AI systems which in turn increases consumer trust.

In this study, the assumption is that consumers who are aware that an AI-powered chatbot is decentralized, are more reassured about the security and ethical use of consumer-provided data, which would reduce their privacy concerns, increase trust, and thus also enhance their satisfaction. The opposite would be observed, when consumers are aware that an AI-powered chatbot is of the centralized type or when it is unspecified, which would increase privacy concerns and deteriorate trust, thus damaging the customer satisfaction levels.

2.3 AI-Familiarity

Understanding the role of consumer AI familiarity is important, as it explains the relationship between multiple variables better. Horowitz et al. (2023) studied how familiarity and expertise with AI and similar technologies, affect public opinions on AI-powered autonomous technologies in transportation, medicine, and national security in the United States. The main results indicated that individuals who were more familiar with AI and similar technologies were more likely to support all tested autonomous applications except for the weapon technologies. This implies that, to an extent, familiarity with AI leads to a more positive attitude towards it. Gillath et al. (2021) support this conclusion in a similar study where, as mentioned in an earlier section, they investigated the relationship between individuals' attachment styles and their trust in AI. One of their findings indicates that older individuals and individuals who are more familiar with AI, are more likely to trust AI implications. Belanche et al. (2019) found that users who are more familiar with various robotic and AI systems value the usefulness of those systems higher and have a more positive attitude toward them compared to less familiar users. The findings of a more recent study indicated that higher levels of consumers' trust and AI familiarity mitigate negative perceptions towards AI involvement in product creation and increase the willingness to engage (Kučinskas, 2024).

Given the provided information from the theory, the assumption is that consumers who are more familiar or have prior experience with different AI systems such as chatbots, have more trust in those applications, have a more positive attitude towards AI, and are more willing to engage. In turn, this affects customer satisfaction more positively. Based on this, the following hypothesis is proposed:

H4: Consumer AI familiarity moderates the mediated relationship between the chatbot type (unspecified, centralized, decentralized) and customer satisfaction through consumer trust in AI-powered chatbots, specifically, consumers who are more familiar with AI have more trust in decentralized AI-powered chatbots than centralized and unspecified types, which then leads to higher customer satisfaction compared to less familiar consumers. The effect of the chatbot type on customer satisfaction is stronger for consumers who are more familiar with AI compared to less familiar consumers.

2.4 Conceptual Research Model

Based on the findings, stated in the literature review of this paper, the following four hypotheses (H) are tested and presented in the conceptual research model in Figure 1:

H1: The chatbot type (unspecified, centralized, decentralized) has a direct effect on customer satisfaction, where decentralized AI-powered chatbots are expected to lead to higher customer satisfaction compared to centralized AI-powered chatbots and those where the type is not specified.

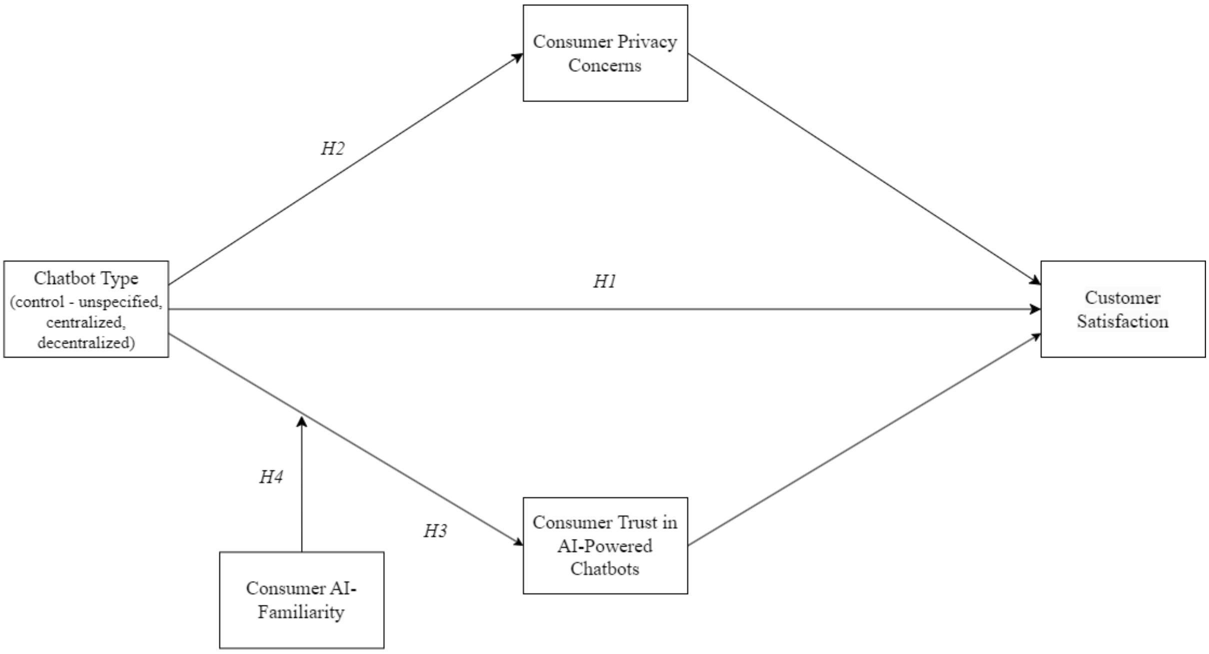
H2: Consumer privacy concerns mediate the relationship between the chatbot type (unspecified, centralized, decentralized) and customer satisfaction, such that decentralized AI-powered chatbots decrease privacy concerns, which in turn increase customer satisfaction, compared to the unspecified and centralized AI-powered chatbot types.

H3: Consumer trust in AI-powered chatbots mediates the relationship between the chatbot type (unspecified, centralized, decentralized) and customer satisfaction, such that decentralized AI-powered chatbots enhance trust more than the unspecified and centralized chatbot types, which in turn increases customer satisfaction.

H4: Consumer AI familiarity moderates the mediated relationship between the chatbot type (unspecified, centralized, decentralized) and customer satisfaction through consumer trust in AI-powered chatbots, specifically, consumers who are more familiar with AI have more trust in decentralized AI-powered chatbots than centralized and unspecified types, which then leads to higher customer satisfaction compared to less familiar consumers. The effect of the chatbot type on customer satisfaction is stronger for consumers who are more familiar with AI compared to less familiar consumers.

Figure 1

Conceptual Research Model



Chapter 3: Research Methodology

3.1 Introduction

This chapter explains the methods and approaches that are used to investigate the two central research questions:

1. "How does the decentralization of AI-powered chatbots affect customer satisfaction?"
2. "How do consumer perceptions of privacy and trust impact customer satisfaction in interactions with centralized versus decentralized AI-powered chatbots?"

This section covers the research approach, data collection, data analysis methods, and provides descriptive statistics of the research sample.

3.2 Research Approach

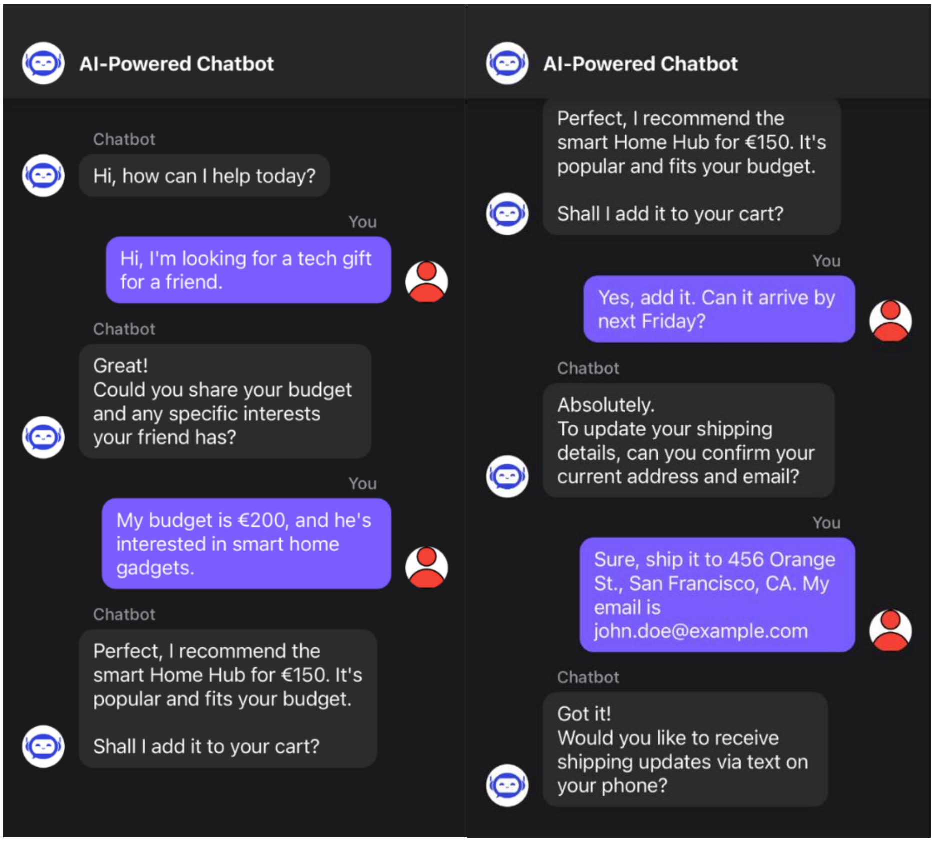
This research takes a quantitative research approach to measure and analyze the variables of interest. An online experiment was conducted to gather the data, which allows for a controlled manipulation of the variables and random assignment of participants to different conditions. The goal of the experiment was to evaluate how privacy concerns, trust, personalization, awareness, and perception of decentralized and centralized AI-powered chatbots influence customer satisfaction. The online experiment of this study was designed on the Qualtrics XM platform and was made into a survey. This was seen as a suitable method to collect the needed data for analysis, considering the limited amount of time available to conduct this research and a survey allows to reach a large audience quickly.

3.3 Survey Design

The survey contained a simulation that represented a hypothetical scenario in which the survey participant held a conversation with an AI-powered chatbot. The respondents were requested to imagine that they were looking for a gift for a friend, interested in smart home gadgets, and that they asked for help from an AI-powered chatbot. A part of the simulated conversation is shown in Figure 2. The complete conversation is provided in Appendix B.

Figure 2

Part of Chatbot Simulation



The survey was designed in such a way that respondents were randomly assigned to three groups. This was done to minimize the presence of a potential selection bias. In the experiment, one group of respondents functioned as the control group who interacted with either a centralized or decentralized AI-powered chatbot without being made aware of its type prior to the interaction. The second group functioned as the awareness group who was informed that they would interact with a decentralized AI-powered chatbot. Lastly, the third group functioned as the comparison group who was informed that they would interact with a centralized AI-powered chatbot. To control the experiment, each group experienced the same simulated interaction with the chatbot. This means that the chatbot and customer responses were predetermined (Appendix B). The survey included Likert-scale and multiple-choice questions. The definitions and measurements of the variables that were incorporated into the survey are provided in Table 1. Also, the survey incorporated validated statements (scale items) from past studies. These are provided in Table 2.

The survey was divided into four sections. In the first section, respondents were randomly assigned to one of the three groups as explained earlier, and in the second section, respondents participated in the AI-powered chatbot simulation. The third section consisted of the main questions to test the research model. Lastly, the fourth section consisted of socio-economic and demographic questions. Additionally, there was a question in the survey that functioned as an attention and understanding check. Only respondents who were part of the groups that were informed of a specific AI-powered chatbot type (centralized and decentralized) received this question. Respondents were asked to answer this question between the third and fourth sections of the survey (Appendix B).

Table 1

Variable Insights

Variables	Definition	Measurement
Dependent Variable (DV)		
Customer Satisfaction	Customer satisfaction with the presented AI-powered chatbot interaction.	Measured with Likert scale questions using a 5-point scale, ranging from strongly disagree to strongly agree. Scale items derived from related prior research.
Independent Variable (IV)		
Chatbot Type	The extent to which consumers are informed of the type of AI-powered chatbot they interact with, prior to the experiment.	Serves as a categorical variable with values: 0 for not aware, 1 for aware of interacting with a centralized chatbot, and 2 for aware of interacting with a decentralized chatbot.
Mediator Variables		
Consumer Privacy Concerns	The extent to which consumers worry about how their provided personal data is used and secured by AI-powered chatbots.	Measured with Likert scale questions using a 5-point scale, ranging from strongly disagree to strongly agree. Scale items derived from related prior research.
Consumer Trust in AI-Powered Chatbots	The extent or degree to which individuals have trust in the fairness, integrity, and	Measured with Likert scale questions using a 5-point scale, ranging from strongly

	competence of decentralized AI chatbots.	disagree to strongly agree. Items that assess trust in technology from prior research.
Moderator Variable		
Consumer AI-Familiarity	The extent to which consumers are familiar and experienced with AI.	Measured using questions regarding understanding and usage frequency of AI technology, measured on a 5-point Likert scale ranging from terrible to extent and from never to always.

Table 2

Statement Overview

Variables	Codes	Scale items	References
Customer satisfaction	CS_1	I am satisfied with the AI-powered chatbot.	Adapted from Chung et al. (2020); Cheng and Jiang (2020).
	CS_2	I am happy with the AI-powered chatbot.	
	CS_3	The AI-powered chatbot did a good job.	
	CS_4	The AI-powered chatbot did what I expected.	
Consumer privacy concerns	CPC_1	The information I submit via the AI-powered chatbot could be used in a way I did not foresee.	Adapted from Van Eeuwen (2017); Cheng and Jiang (2020).
	CPC_2	The information I submit via the AI-powered chatbot could be misused.	
	CPC_3	I am concerned about submitting information via the AI-powered chatbot, because of what others might do with it.	
Consumer trust in AI-powered chatbots	CT_1	The AI-powered chatbot is trustworthy.	Adapted from Chung et al. (2020); Kim et al. (2011). Cheng et al. (2022).
	CT_2	The AI-powered chatbot is reliable.	
	CT_3	I trust the suggestions and decisions provided by this AI-powered chatbot.	
	CT_4	The AI-powered chatbot is honest and truthful.	
AI Familiarity	AIF_1	How would you rate your understanding of AI technologies in general?	N/A

AIF_2	How frequently do you use services or devices that are powered by AI in your daily life?	N/A

3.4 Data Collection

Prior to collecting the data, the aim was to collect at least 150 respondents to have a more or less equal number of respondents in three groups. After the data collection period, in which the survey was active from the 26th of May until the 14th of June, the total number of responses collected was 253. The survey was not aimed at a specific target group and was available to everyone who wanted to participate. There were no limitations placed because the intention was to gather insights into potential differences in the results which could be explained by differences in the socio-economic and demographic factors. To properly do this, it was expected to be more effective if the survey could be filled out by as many respondents with differing characteristics. Thus, no respondents needed to be filtered out based on specific criteria related to their characteristics.

The participants were selected through convenience sampling, a non-random sampling method. The survey was distributed through various channels. Specifically, it was posted on social media platforms such as Instagram, Reddit, and LinkedIn, shared in WhatsApp groups, and through word-of-mouth. Respondents were also requested to share it with others in the introduction section of the survey (Appendix B). Most of the distribution was done on the campus of the Erasmus University Rotterdam (EUR). Additionally, flyers with scannable barcodes and a brief explanation of the survey and research goal were randomly distributed in the mailboxes of residential buildings in the Rotterdam area (Appendix C).

3.5 Research Sample

The survey data initially included responses from 253 participants. However, 70 respondents left the survey incomplete. Out of these responses, 65 respondents were excluded from the dataset as they exited the survey during or immediately after the chatbot simulation without answering any of the key questions. The remaining 5 respondents were retained in the dataset as they had answered all key questions except for the socio-demographic questions. The unanswered sections of these responses were left blank. After these changes, the dataset consisted of 188 responses. Furthermore, 13 respondents showed response bias, characterized by a particular pattern of choosing only the top or bottom option for each question. To ensure a robust and reliable analysis, these biased responses were also removed from the dataset. After all these changes were implemented, the final dataset consisted of 175 responses which were used as the research sample in this study. An overview of the dataset is provided in Appendix D.

3.6 Data Analysis Methods

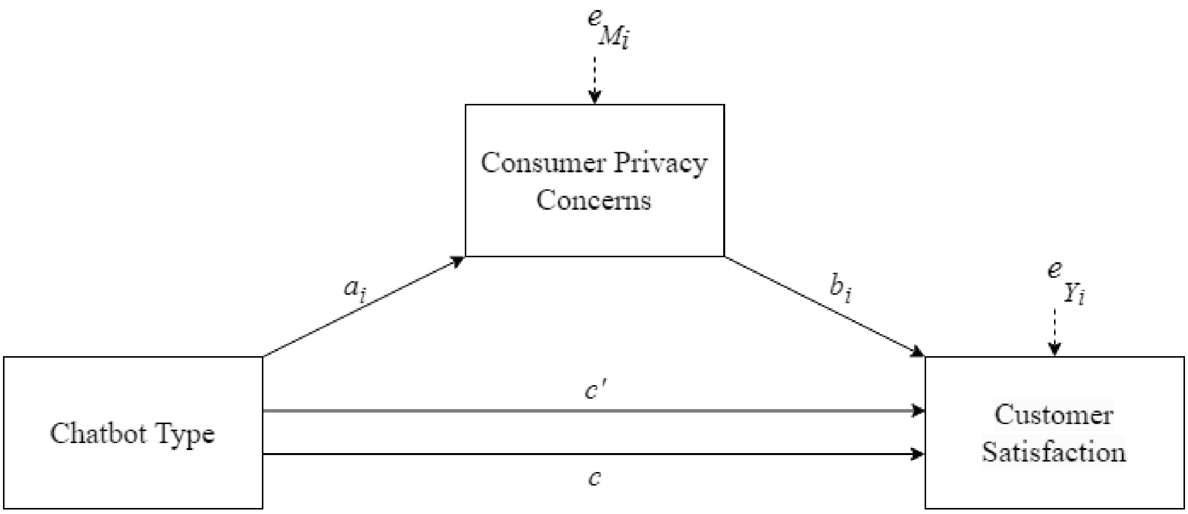
There are several data analysis methods used in this study to test the hypotheses and answer the two main research questions:

1. "How does the decentralization of AI-powered chatbots affect customer satisfaction?"
2. "How do consumer perceptions of privacy and trust impact customer satisfaction in interactions with centralized versus decentralized AI-powered chatbots?"

First, descriptive statistics were calculated for an overview of the research sample and the key variables. Then, to test whether there is an effect of the three chatbot types (unspecified, centralized, and decentralized) on customer satisfaction (H1) and compare the effects, one-way ANOVA was conducted. Afterward, mediation analyses were performed to test whether consumer privacy concerns and trust mediated the relationship between the chatbot type and customer satisfaction (H2 & H3). This was done using PROCESS macro by Hayes, model 4. The conceptual models of both mediation relationships are provided in Figures 3 and 4, which also represent the different effect paths in the mediation models.

Figure 3

Conceptual Model of Mediation Analysis, H2

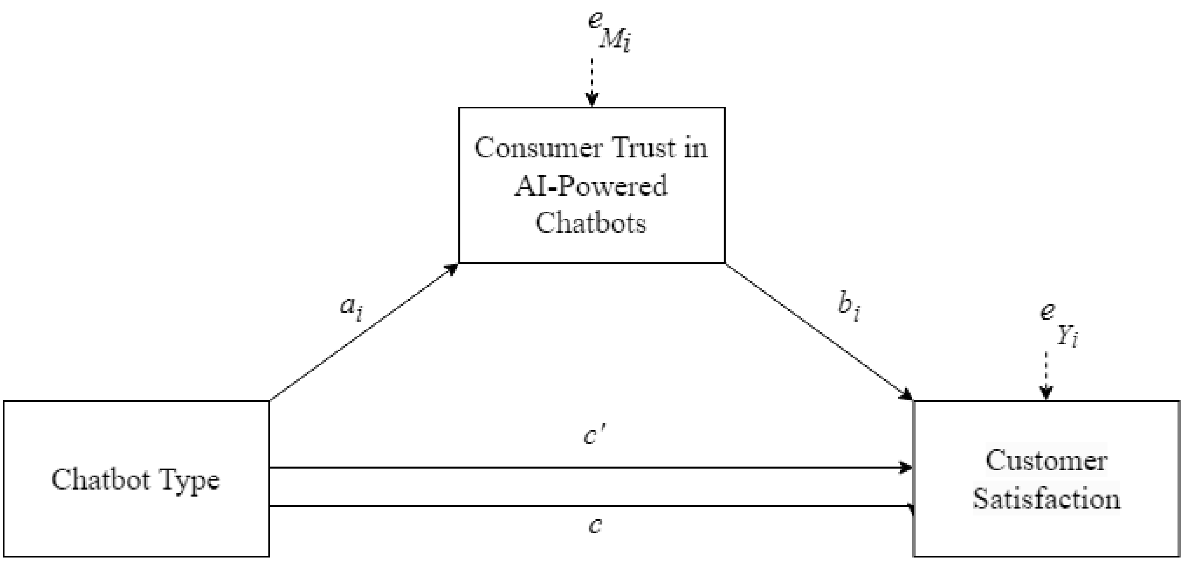


In Figure 3:

- *c'* represents the direct effect of chatbot type on customer satisfaction.
- *a*b* represents the indirect effect of chatbot type on customer satisfaction through consumer privacy concerns.
- *c* (= *c'* + *a*b*) represents the total effect of chatbot type on customer satisfaction, which includes both the direct and indirect effects.

Figure 4

Conceptual Model of Mediation Analysis, H3



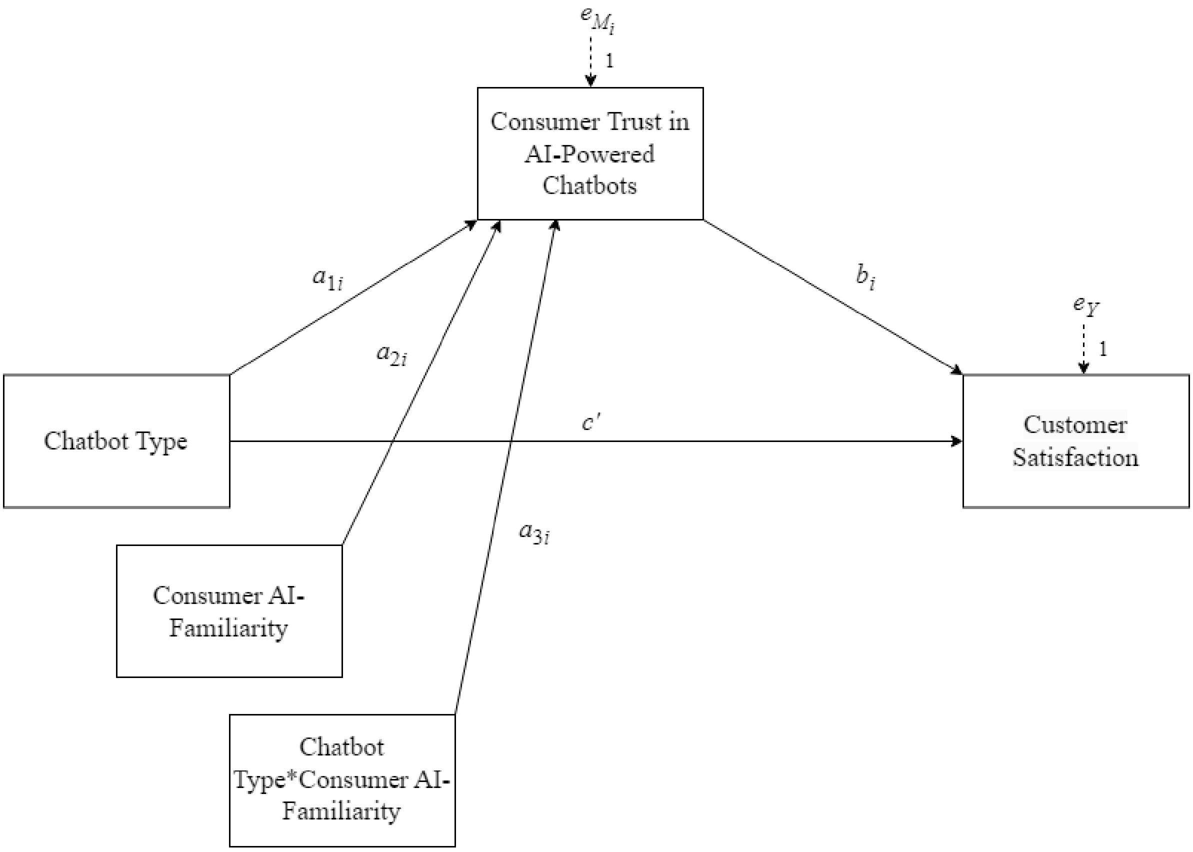
In Figure 4:

- *c'* represents the direct effect of chatbot type on customer satisfaction.
- *a*b* represents the indirect effect of chatbot type on customer satisfaction through consumer trust in AI-powered chatbots.
- *c* (= *c'* + *a*b*) represents the total effect of chatbot type on customer satisfaction, which includes both the direct and indirect effects.

Finally, moderated mediation analyses were conducted to test whether the mediation effects of consumer privacy concerns and trust were moderated by AI familiarity (H4). These analyses were performed using PROCESS macro, model 7. A conceptual model of the moderated mediation relationship is provided in Figure 5.

Figure 5

Conceptual Model of Moderated Mediation Analysis, H4



In Figure 5:

- *c'* represents the direct effect of chatbot type on customer satisfaction.

- a_1*b represents the indirect effect of chatbot type on customer satisfaction through consumer trust in AI-powered chatbots.
- a_1 represents the effect of chatbot type on consumer trust in AI-powered chatbots.
- a_2 represents the effect of consumer AI-familiarity on consumer trust in AI-powered chatbots.
- a_3 represents the interaction effect of chatbot type and consumer AI-familiarity on consumer trust in AI-powered chatbots.
- b represents the effect of consumer trust in AI-powered chatbots on customer satisfaction.

Chapter 4: Results

4.1 Introduction

In this section of the study, the results of the quantitative analysis are provided. The descriptive statistics are presented first, providing more insight into the research sample regarding their socio-demographic characteristics and understanding and awareness of the different AI-powered chatbot types, followed by descriptive statistics of the key continuous variables. Afterward, inferential statistics are analyzed, to test the four hypotheses of the study.

4.2 Descriptive Statistics

4.2.1 Socio-Demographic Characteristics

The socio-demographic characteristics of the research sample are provided in Table 3. Out of the 175 respondents in the sample, the majority (57.7%) were male, followed by 36.6% of females, 2.3% with a different gender, and a relatively small percentage of respondents (1.7%) who preferred not to mention their gender. From the age distribution, it becomes clear that the largest group of respondents (39.4%) were between 25 and 34 years old, followed by 28.6% of respondents between 18 and 24 years old. It also becomes apparent that most respondents (34.9%) had completed a University Bachelor's study, followed by respondents with a University Master's degree (19.4%), and HBO or high school degree (18.3%). In terms of occupation, 46.9% mentioned that they were employed, followed by 26.3% who were students, the second largest group, and 13.7% were either self-employed or entrepreneurs. Also, as expected prior to the survey period, most respondents identified as Dutch, with relatively smaller groups that identified as American (6.3%) or other nationalities (16.6%). Finally, Table 1 shows that respondents were close to equally assigned to one of the three chatbot groups. The variance in these groups is also a bit larger due to the exclusion of some respondents as explained in the previous chapter.

Table 3

Descriptive Statistics of Research Sample

Characteristic	Category	Fraction of sample	
		N	%
Gender			
	Male	101	57.7
	Female	64	36.6
	Other	4	2.3
	Prefer not to say	3	1.7
	Missing	3	1.7
Age group			
	<18	3	1.7
	18 - 24	50	28.6
	25 - 34	69	39.4
	35 - 44	33	18.9
	45 - 54	10	5.7
	55 - 64	7	4.0
	65>	1	0.6
	Missing	2	1.1
Highest Education Finished			
	High school	32	18.3
	MBO*	12	6.9
	HBO**	32	18.3
	University bachelor	61	34.9
	University Master	34	19.4
	Missing	4	2.3
Occupation			
	Student	46	26.3
	Self-employed/Entrepreneur	24	13.7
	Employed	82	46.9
	Unemployed	5	2.9
	Retired	1	0.6
	Housemaker	5	2.9
	Other	3	1.7
	Prefer not to say	4	2.3

	Missing	5	2.9
Nationality			
	Dutch	132	75.4
	American	11	6.3
	Other†	29	16.6
	Missing	3	1.7
Chatbot Type			
	Unspecified	54	30.9
	Centralized	62	35.4
	Decentralized	59	33.7

Note. *N* = 175. *MBO = Vocational education. **HBO = Higher professional education. †Includes respondents with various, less frequently reported nationalities such as Australian, Belgian, Canadian, etc.

4.2.2 Chatbot Type Understanding

Table 4 presents the understanding of the chatbot type of respondents that interacted with either a centralized or decentralized AI-powered chatbot. Of the 62 participants who interacted with a centralized chatbot, 62.9% correctly identified that a centralized chatbot operates in one main computer system. However, 22.6% answered incorrectly, 11.3% were not sure what the correct answer was. From the 59 participants who interacted with a decentralized chatbot, 57.6% answered correctly that a decentralized chatbot spreads data across multiple computer systems, while 30.5% answered incorrectly and 11.9% were in doubt.

Table 4

Understanding of Chatbot Type in Centralized and Decentralized Groups

Group	**Answer Type**	**Answer Option**	***N***	**%**
Centralized				
	True	"A centralized chatbot stores and processes all information in one main computer system, allowing it to respond quickly and consistently."	39	62.9
	False	"A centralized chatbot spreads all the data and processing across many different computer systems, helping to protect data privacy by not storing all information in one central place."	12	19.4

	False	"A centralized chatbot processes and stores data locally on the user's device, enhancing privacy and security."	2	3.2
	Doubt	"I am not sure."	7	11.3
	Missing	Missing	2	3.2
Decentralized				
	True	"A decentralized chatbot spreads all the data and processing across many different computer systems, helping to protect data privacy by not storing all information in one central place."	34	57.6
	False	"A decentralized chatbot relies on a central server for processing, making it more efficient but less secure."	10	16.9
	False	"A decentralized chatbot processes and stores data locally on the user's device, enhancing privacy and security."	8	13.6
	Doubt	"I am not sure."	7	11.9

Note: $N = 175$.

Table 5 shows participants' awareness of the chatbot type that they interacted with. Out of the 54 participants who were not informed of any chatbot type, the majority still thought that they were informed that the chatbot was centralized (42.6%) or decentralized (13.0%). 27.8% answered correctly that they were not aware of the chatbot type. The results in the group of participants that interacted with a centralized chatbot are different. Out of the 62 respondents, the majority (74.2%) answered correctly that they were informed that the chatbot was centralized. The results in the group of participants that interacted with a decentralized chatbot are more comparable to the unspecified group. 37.3% correctly identified the chatbot as decentralized, like they were informed about it. However, a relatively large portion thought that the chatbot was centralized (28.8%) or answered that they were not made aware of the type (25.4%). This misidentification of the chatbot types poses a significant limitation for the study, as it means that many participants may not have fully grasped the chatbot type or that they may not have paid attention to the explanation in the survey.

Table 5

Chatbot Type Awareness

Group	Answer Type	Answer Option	*N*	%
Unspecified				
	True	"No, I was not aware."	15	27.8
	False	"Yes, it was centralized."	23	42.6
	False	"Yes, it was decentralized."	7	13.0
	False	"Yes, but I forgot."	9	16.7
Centralized				
	True	"Yes, it was centralized."	46	74.2
	False	"Yes, it was decentralized."	4	6.5
	False	"Yes, but I forgot."	4	6.5
	False	"No, I was not aware."	8	12.9
Decentralized				
	True	"Yes, it was decentralized."	22	37.3
	False	"Yes, it was centralized."	17	28.8
	False	"Yes, but I forgot."	5	8.5
	False	"No, I was not aware."	15	25.4

Note. N = 175. *Note: N* = 175. The answers were based on the question: "*Were you made aware of the type of AI-powered chatbot before the conversation?*".

4.2.3 Key Continuous Variables

The descriptive statistics presented in Table 6 provide an overview of the perceptions and experiences of respondents with the different chatbot types. Overall, the scores were relatively similar between the different groups. For all key variables, customer satisfaction, consumer privacy concerns, consumer trust in AI-powered chatbots, and consumer AI-familiarity, the mean scores were taken by averaging participants' responses to the individual questions in each scale. Because the questions were rated on a Likert scale, the overall score for each variable is the average of these ratings.

The mean customer satisfaction scores were the highest in the unspecified chatbot type group (M = 4.046, SD = 0.768), followed by the group who interacted with a decentralized chatbot (M = 3.915, SD = 0.966), and the group who interacted with a centralized chatbot (M

= 3.734, SD = 0.984). These scores indicate that, overall, respondents were satisfied with the chatbot interaction. The mean consumer privacy concern scores were the highest in the centralized chatbot group (M = 3.812, SD = 0.978), followed by the decentralized chatbot group (M = 3.763, SD = 0.931), and the unspecified chatbot group (M = 3.586, SD = 1.036). These scores indicate that participants, overall, participants neither agreed nor disagreed that they had privacy concerns. The mean scores of consumer trust in the AI-powered chatbot were highest in the unspecified chatbot group (M = 3.472, SD = 0.798), followed by the decentralized chatbot group (M = 3.339, SD = 0.847), and the centralized chatbot group (M = 3.109, SD = 0.964). These scores imply that, overall, participants neither trusted nor distrusted the chatbot. The consumer AI familiarity scores were the highest for the unspecified chatbot group (M = 3.296, SD = 0.756), closely followed by the decentralized chatbot group (M = 3.254, SD = 0.883), and the centralized chatbot group (M = 3.105, SD = 0.901). These scores explain that, on average, the participants of all three groups believe that their understanding and usage of AI in general is average.

Table 6

Descriptive Statistics of Key Variables

Characteristic	Chatbot Type	N	Mean	Std. Deviation	Minimum	Maximum
Customer Satisfaction						
	Unspecified	54	4.046	0.768	1.75	5.00
	Centralized	62	3.734	0.984	1.00	5.00
	Decentralized	59	3.915	0.966	1.25	5.00
Consumer Privacy Concerns						
	Unspecified	54	3.586	1.036	1.00	5.00
	Centralized	62	3.812	0.978	1.00	5.00
	Decentralized	59	3.763	0.931	1.00	5.00
Consumer Trust in AI-powered Chatbot						
	Unspecified	54	3.472	0.798	1.00	5.00
	Centralized	62	3.109	0.964	1.00	4.75
	Decentralized	59	3.339	0.847	1.50	5.00
Consumer AI Familiarity						

	Unspecified	54	3.296	0.756	1.50	5.00
	Centralized	62	3.105	0.901	1.00	5.00
	Decentralized	59	3.254	0.883	1.50	5.00

Note. N = 175.

The Cronbach's Alpha for each variable is reported in Table 7. The values for customer satisfaction, consumer privacy concerns, and consumer trust in AI-powered chatbots are above 0.80, which indicates good internal consistency. These values suggest that the scales are reliable. Compared to these values, the Cronbach's Alpha for consumer AI familiarity is lower (0.62), indicating that the measurement items for this variable are less correlated and may not be as reliable. This could be due to this construct having only two measurement items compared to the other variables that have three or four items.

Table 7

Cronbach's Alpha

Variable	α
Customer Satisfaction	0.86
Consumer Privacy Concerns	0.81
Consumer Trust in AI-powered Chatbots	0.81
Consumer AI Familiarity	0.62

4.3 Analyses Results

4.3.1 Hypothesis 1

In this section, the analysis results of the first hypothesis are presented. As explained earlier in the research, this hypothesis is stated as:

H1: The chatbot type (unspecified, centralized, decentralized) has a direct effect on customer satisfaction, where decentralized AI-powered chatbots are expected to lead to higher customer satisfaction compared to centralized AI-powered chatbots and those where the type is not specified.

To test and compare the effect of chatbot type awareness on customer satisfaction, an ANOVA was conducted of which the results are presented in Table 10. Prior to this analysis, it was important to make sure that the data met the assumptions for ANOVA. First, to ensure the independence of observations, the responses were collected independently and randomly assigned to the chatbot groups, as explained earlier. The assumption of normality of residuals was tested using the Shapiro-Wilk test and Q-Q plots. The Shapiro-Wilk test showed that the distribution of the residuals deviated significantly from normality at the 5% significance level (0.919, p-value < 0.001), as is reported in Table 8. However, it is important to note that this test is very sensitive to deviations from normality for large sample sizes. ANOVA, on the other hand, is quite robust to these deviations when samples sizes are more or less equal across groups. Therefore, this non-normality is not considered to be a serious violation of the assumption.

Table 8

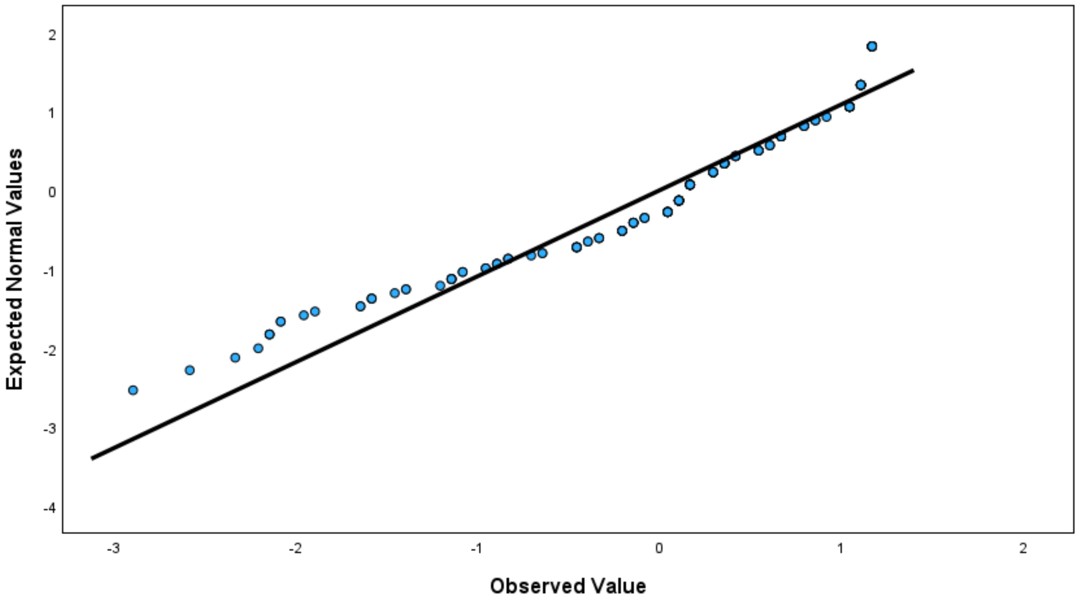
Tests of Normality

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Unstandardized Residual	0.148	175	<0.001	0.919	175	<0.001

Figure 6 shows the Q-Q plot which suggests that the residuals approximately follow a straight line, indicating that the assumption of normality is reasonably met, although there is some slight deviation noticeable.

Figure 6

Normal Q-Q Plot of Unstandardized Residuals



To test for homogeneity of variances of customer satisfaction across the three chatbot groups, Levene's test was performed. Table 9 shows that the results were not significant (1.671, p = 0.191), indicating that the assumption of homogeneity of variance was met.

Table 9

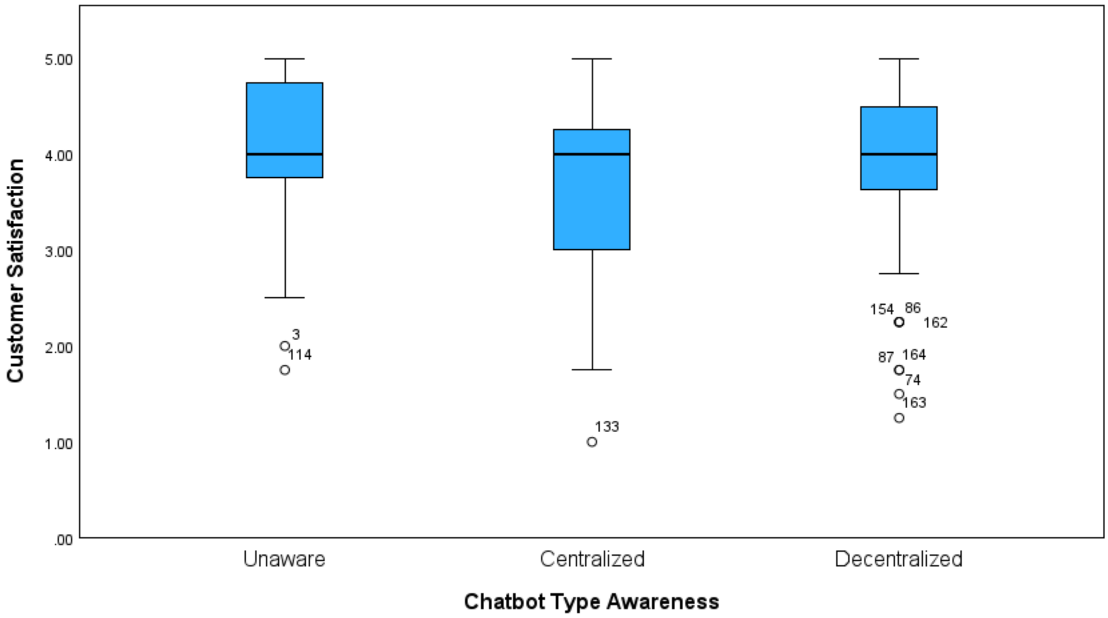
Tests for Homogeneity of Variances

Customer Satisfaction	Levene Statistic	DF1	DF2	Sig.
Based on Mean	1.671	2	172	0.191
Based on Median	0.818	2	172	0.433
Based on Median and with adjusted df	0.818	2	159.849	0.433
Based on trimmed mean	1.328	2	172	0.268

Lastly, to identify outliers, boxplots were used. Figure 7 shows that there are several outliers present in each of the three chatbot-type groups. However, it is important to note that these outliers represent true variations in responses and are not due to, for example, data entry errors. It is expected that some respondents would provide lower satisfaction scores than others because the survey items were on a Likert scale. Therefore, the outliers were not excluded from the analyses.

Figure 7

Boxplot of Customer Satisfaction by Chatbot Type



As was mentioned in an earlier section, the mean customer satisfaction score was highest for the unspecified chatbot group (M = 4.05, SD = 0.77). However, the ANOVA results show that there are no significant differences in customer satisfaction between the three groups as, $F(2, 172) = 1.71$, $p > 0.05$ (Table 10). This indicates that the type of chatbot did not have a significant effect on customer satisfaction. The effect size (η^2) was valued at 0.02, which is considered as a relatively small effect size because it indicates that only 2% of the variance in customer satisfaction can be explained by the type of chatbot awareness. Post hoc comparisons using the Tukey HSD test also showed that no particular group had a significantly different customer satisfaction score compared to others (Appendix E). These findings indicate that the chatbot type does not have a direct effect on customer satisfaction. As a result, hypothesis 1 is rejected.

Table 10

ANOVA Results

Measure	Unspecified		Centralized		Decentralized		*F*(2, 172)	η^2	p
	M	*SD*	*M*	*SD*	*M*	*SD*			
Customer Satisfaction	4.05	0.77	3.73	0.98	3.92	0.97	1.71	0.02	0.184

4.3.2 Hypothesis 2 & 3

In this second section, the analysis results of both H2 and H3 are discussed. These hypotheses are stated as follows:

H2: Consumer privacy concerns mediate the relationship between the chatbot type (unspecified, centralized, decentralized) and customer satisfaction, such that decentralized AI-powered chatbots decrease privacy concerns, which in turn increase customer satisfaction, compared to the unspecified and centralized AI-powered chatbot types.

H3: Consumer trust in AI-powered chatbots mediates the relationship between the chatbot type (unspecified, centralized, decentralized) and customer satisfaction, such that decentralized AI-powered chatbots enhance trust more than the unspecified and centralized chatbot types, which in turn increases customer satisfaction.

First, the results regarding H2 are discussed, followed by the results of H3. To test whether consumer privacy concerns and consumer trust mediate the relationship between the chatbot type (unspecified, centralized, decentralized) and customer satisfaction, mediation analyses were conducted, using the PROCESS macro by Hayes, model 4. In the first analysis, the unspecified chatbot type is considered as the baseline and is compared to the centralized and decentralized chatbot types for which dummy variables were created. The consumer privacy concerns variable was taken as the mediator. Figure 8 illustrates the statistical outcomes of the main effect and mediation in this analysis.

The first part of the analysis examined how the chatbot type affected consumer privacy concerns. This model indicated that the chatbot type did not significantly predict consumer privacy concerns, as $R^2 = 0.010$. The positive effect of the centralized chatbot type on consumer privacy concerns was not found to be statistically significant (0.225, $p = 0.236$). The decentralized chatbot type also did not have statistically significant positive effect (0.176, $p = 0.349$). These results indicate that neither of the two chatbot types significantly increase consumer privacy concerns compared to the unspecified chatbot type.

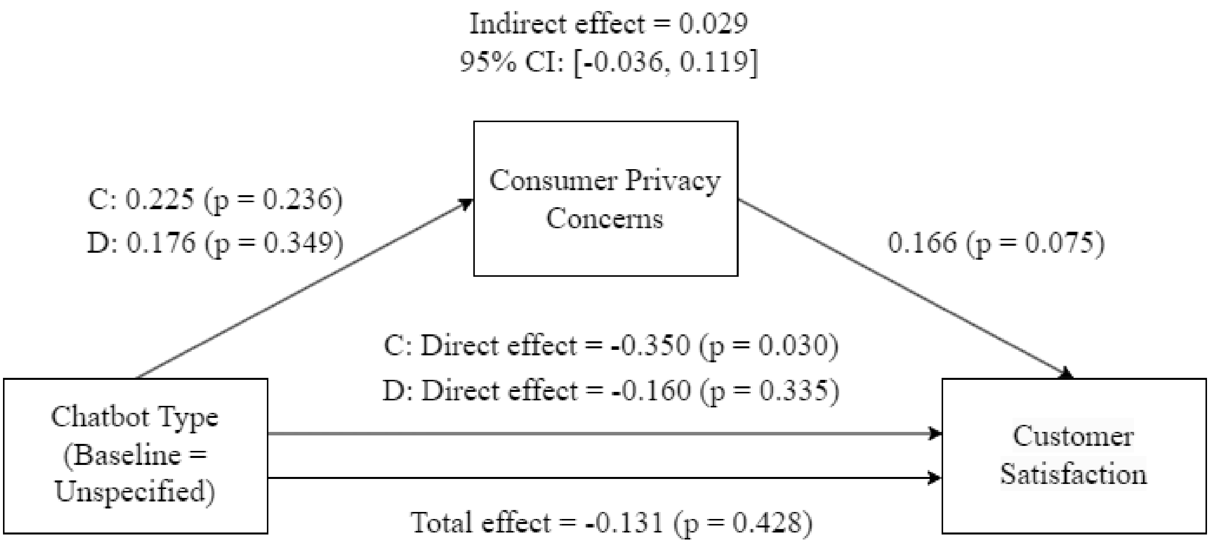
The second part of the analysis examined the direct and indirect effects of the chatbot type on customer satisfaction. This model explained 5% of the variance in customer satisfaction ($R^2 = 0.050$). The direct effect of the centralized chatbot type on customer satisfaction was negative and statistically significant (-0.350, $p = 0.030$), indicating that the centralized chatbot type decreases customer satisfaction scores compared to the unspecified condition. However, the decentralized chatbot type did not have a significant direct effect on customer satisfaction (-0.160, p = 0.335). The coefficient for consumer privacy concerns as a mediator was also not significant (0.166, p = 0.075).

Lastly, the analysis results indicated that the total effect of the decentralized chatbot was not significant (-0.131, p = 0.428). The indirect effect through consumer privacy concerns was also not found to be statistically significant (0.029, 95% CI [-0.036, 0.119]), as the confidence interval included zero. This finding indicates that consumer privacy concerns did not mediate the relationship between the decentralized chatbot type and customer satisfaction.

Overall, the direct effect of decentralized chatbot type and the indirect effect through consumer privacy concerns did not significantly affect customer satisfaction. Also, while the centralized chatbot type significantly decreases customer satisfaction scores compared to the unspecified type, this relationship is not mediated by consumer privacy concerns. These findings suggest that consumer privacy concerns do not mediate the relationship between the chatbot type (unspecified, centralized, decentralized) and customer satisfaction, which means that hypothesis 2 is rejected.

Figure 8

Statistic Visualization of Mediation, H2 (Baseline = Unspecified)



Now follow the mediation analysis results for H3. The same method of H2 was applied here. In the analysis, the unspecified chatbot type is considered as the baseline and is compared to the decentralized and centralized chatbot type. The consumer trust variable is taken as the mediator and dummy variables were created for the centralized and decentralized chatbot types. Figures 10 and 11 illustrate the statistical outcomes of the main effect and mediation of this model.

The first section of the analysis examined the effect of the chatbot type on consumer trust. The model indicated that the dummy variables explained 2.9% of the variance in consumer trust as R^2 = 0.029. The effect of the decentralized chatbot type on consumer trust was not statistically significant (-0.133, p = 0.395). However, the centralized chatbot type did have a significant negative effect on consumer trust (-0.363, p = 0.029), suggesting that being aware of interacting with a centralized chatbot significantly reduces consumer trust.

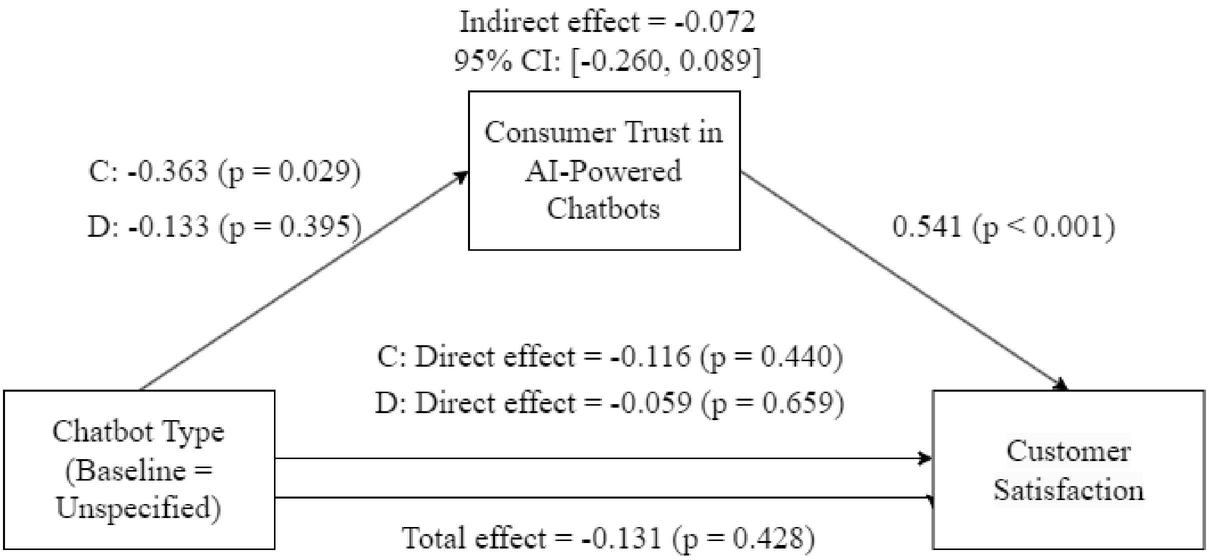
The second part of this analysis examined the direct and indirect effects of the chatbot type on customer satisfaction. This model explained 28.1% of the variance in customer satisfaction (R^2 = 0.281). The direct effect of the decentralized chatbot type on customer satisfaction was not found to be significant (-0.059, p = 0.659) and the direct effect of the centralized chatbot type was also not statistically significant (-0.116, p = 0.440). However, the results indicated that consumer trust strongly affected customer satisfaction (0.541, p < 0.001), meaning that higher consumer trust in the AI-powered chatbot leads to significantly higher customer satisfaction.

Lastly, the results indicated that the total effect of the decentralized chatbot on customer satisfaction was not statistically significant (-0.131, p = 0.428). Also, the indirect effect of the decentralized chatbot type on customer satisfaction through consumer trust was also not found to be significant (-0.072, 95% CI [-0.260, 0.089]), as zero was present in the confidence interval. This indicates that consumer trust does not significantly mediate the relationship between the decentralized chatbot type and customer satisfaction.

To conclude, the findings suggest that the centralized chatbot type significantly reduces consumer trust, which is a strong predictor of customer satisfaction. However, consumer trust does not significantly mediate the relationship between the decentralized chatbot type and customer satisfaction, as the indirect effect was not found to be statistically significant. Thus, H3 is also rejected.

Figure 9

Statistic Visualization of Mediation, H3 (Baseline = Unspecified)



4.3.3 Hypothesis 4

In this third section, the analysis results of H4 are discussed. The hypothesis is stated as follows:

H4: Consumer AI familiarity moderates the mediated relationship between the chatbot type (unspecified, centralized, decentralized) and customer satisfaction through consumer trust in AI-powered chatbots, specifically, consumers who are more familiar with AI have more trust in decentralized AI-powered chatbots than centralized and unspecified types, which then leads to higher customer satisfaction compared to less familiar consumers. The effect of the chatbot type on customer satisfaction is stronger for consumers who are more familiar with AI compared to less familiar consumers.

To test this hypothesis, a moderated mediation analysis was conducted, using the PROCESS macro by Hayes, model 7. In this analysis, the centralized chatbot type was taken as the baseline. So, two comparisons were made, X1 (centralized vs. unspecified) and X2 (centralized vs. decentralized). Table 11 shows that the direct effects of the chatbot type on customer satisfaction (X1 and X2) were not statistically significant. X1 had an effect of 0.116 with p = 0.436>0.5 and X2 had an effect of 0.057 with p = 0.693>0.5. The interaction effects between the chatbot types and consumer AI familiarity on consumer trust (X1*AI_Fam and X2*AI_Fam) were also not significant (-0.031, p = 0.868, and 0.029, p = 0.864, respectively). This implies that AI familiarity does not significantly change the effect of the chatbot type on consumer trust. However, the main effect of consumer AI familiarity on consumer trust was found to be statistically significant (0.409, $p < 0.001$, 95% CI [0.182, 0.636]). This means that higher levels of AI familiarity increase consumer trust. Consumer trust also has a statistically significant positive effect on customer satisfaction (0.541, $p < 0.001$).

Table 11

Moderated Mediation Analysis Results (Centralized = Baseline)

Relationship	Coefficient	SE	t	p	95% CI
Outcome Variable: Consumer Trust					
X1 (Centralized vs. Unspecified	0.388	0.621	0.625	0.533	[-0.838, 1.613]
X2 (Centralized vs. Decentralized)	0.076	0.550	0.138	0.890	[-1.010, 1.162]
AI Familiarity (AI_Fam)	0.409	0.115	3.561	<0.001	[0.182, 0.636]
X1*AI_Fam	-0.031	0.187	-0.167	0.868	[-0.400, 0.337]
X2*AI_Fam	0.029	0.167	0.172	0.864	[-0.300, 0.357]
Outcome Variable: Customer Satisfaction					
X1	0.116	0.149	0.781	0.436	[-0.177, 0.409]
X2	0.057	0.144	0.396	0.693	[-0.227, 0.341]
Consumer Trust	0.541	0.069	7.896	<0.001	[0.406, 0.676]

Table 12 shows the conditional indirect effects of the chatbot type on customer satisfaction (centralized vs. unspecified and centralized vs. decentralized) via consumer trust at different levels of AI familiarity (low, medium, and high). These mediation effects were not found to be significantly different for the three levels of AI familiarity as zero was included in the confidence intervals.

Table 12

Conditional Indirect Effects of Chatbot Type on Customer Satisfaction via Consumer Trust

	AI Familiarity	Effect	SE	95% CI
X1 (Centralized vs. Unspecified)	Low (2.5)	0.168	0.114	[-0.050, 0.398]
	Medium (3.0)	0.159	0.091	[-0.009, 0.343]
	High (4.0)	0.108	0.113	[-0.062, 0.389]
X2 (Centralized vs. Decentralized)	Low (2.5)	0.080	0.118	[-0.153, 0.309]
	Medium (3.0)	0.087	0.089	[-0.088, 0.261]

	High (4.0)	0.103	0.097	[-0.087, 0.295]

Finally, Table 13 shows the index of moderated mediation for both comparisons (centralized vs. unspecified and centralized vs. decentralized), which were also found to be non-significant (95% CI [-0.204, 0.177] and [-0.171, 0.206], respectively). This indicates that the moderating effect of AI familiarity on the mediation of consumer trust between the chatbot type and customer satisfaction is not statistically significant.

Table 13

Index of Moderated Mediation

Moderator	Index	SE	95% CI
AI_Fam (Centralized vs. Unspecified)	-0.017	0.097	[-0.204, 0.177]
AI_Fam (Centralized vs. Decentralized)	0.016	0.094	[-0.171, 0.206]

These findings indicate that while consumer AI familiarity significantly impacts consumer trust, it does not significantly moderate the mediation effect of consumer trust on the relationship between the chatbot type and customer satisfaction. Thus, hypothesis 4 is also rejected.

4.4 Summary of Analyses Results

This section provides a summary of all analysis results in the study. The first hypothesis proposed that the chatbot type has a direct effect on customer satisfaction. To test this hypothesis, an ANOVA was conducted and the results indicated that the main effect of chatbot type (centralized vs. decentralized) on customer satisfaction was statistically insignificant on the 5% significance level ($F(2, 172) = 1.71$, $p > 0.05$). Therefore, H1 was rejected.

Hypotheses 2 and 3 were tested by conducting mediation analyses, using PROCESS macro model 4. H2 suggested that consumer privacy concerns mediate the relationship between the chatbot type and customer satisfaction. The results showed that the mediation effect was not statistically significant, as zero was included in the 95% confidence interval. This indicates that consumer privacy concerns do not mediate the relationship between the chatbot type and customer satisfaction. Therefore, H2 is also rejected.

The third hypothesis stated that consumer trust in AI-powered chatbots mediates the relationship between the chatbot type and customer satisfaction. In this case, the analyses' results were slightly different. First, it indicated that the centralized chatbot type significantly reduces consumer trust. However, consumer trust did not significantly mediate the relationship between the decentralized chatbot type and customer satisfaction, as there was no significant indirect effect. Based on these findings, H3 is also rejected.

The fourth hypothesis suggested that consumer AI familiarity moderates the mediated relationship between the chatbot type and customer satisfaction through consumer trust. This was tested by conducting moderated mediation analysis using PROCESS macro model 7. The results indicated that the interaction effects between the chatbot types and consumer AI familiarity on consumer trust were not statistically significant. Also, the indices of moderated mediation were not showing significant results either. However, consumer AI familiarity significantly impacted consumer trust. Nonetheless, these findings suggest that consumer AI familiarity does not moderate the mediated relationship between the chatbot type and customer satisfaction through consumer trust. Therefore, H4 was also rejected.

Chapter 5: Conclusions

5.1 Overview of Goal and Research Questions

In this study, the goal was to answer the following two central research questions:

1. "How does the decentralization of AI-powered chatbots affect customer satisfaction?"

2. "How do consumer perceptions of privacy and trust impact customer satisfaction in interactions with centralized versus decentralized AI-powered chatbots?"

In order to answer these questions, the following four hypotheses were tested:

H1: The chatbot type (unspecified, centralized, decentralized) has a direct effect on customer satisfaction, where decentralized AI-powered chatbots are expected to lead to higher customer satisfaction compared to centralized AI-powered chatbots and those where the type is not specified.

H2: Consumer privacy concerns mediate the relationship between the chatbot type (unspecified, centralized, decentralized) and customer satisfaction, such that decentralized AI-powered chatbots decrease privacy concerns, which in turn increase customer satisfaction, compared to the unspecified and centralized AI-powered chatbot types.

H3: Consumer trust in AI-powered chatbots mediates the relationship between the chatbot type (unspecified, centralized, decentralized) and customer satisfaction, such that decentralized AI-powered chatbots enhance trust more than the unspecified and centralized chatbot types, which in turn increases customer satisfaction.

H4: Consumer AI familiarity moderates the mediated relationship between the chatbot type (unspecified, centralized, decentralized) and customer satisfaction through consumer trust in AI-powered chatbots, specifically, consumers who are more familiar with AI have more trust in decentralized AI-powered chatbots than centralized and unspecified types, which then leads to higher customer satisfaction compared to less familiar consumers. The effect of the chatbot type on customer satisfaction is stronger for consumers who are more familiar with AI compared to less familiar consumers.

5.2 Key Findings of The Study

The main results of this study show that there are no statistically significant relationships between the variables in the conducted analyses. Firstly, the ANOVA showed that the chatbot type did not have a significant direct effect on the customer satisfaction and thus there was no clear difference in effect between centralized or decentralized AI-powered chatbots on customer satisfaction. Secondly, the mediation analysis suggested that consumer privacy concerns do not significantly mediate the relationship between the chatbot type and customer satisfaction. Another mediation analysis showed that trust in AI-powered chatbots also did not significantly mediate the relationship between the chatbot type and customer satisfaction variables. Finally, a moderated mediation analysis was performed, which showed that consumers' AI familiarity did not significantly moderate the mediation effect of consumer trust on the relationship between the chatbot type and customer satisfaction. This means that AI familiarity does not change the effect that consumer trust has on satisfaction across the different chatbot types.

To sum up, the study found that neither the chatbot type nor consumer privacy concerns significantly impact the customer satisfaction. However, trust is an important factor that affects customer satisfaction. The chatbot type itself does however only improves consumer trust significantly in the case of a centralized chatbot type. Finally, AI familiarity improves consumer trust, though it does not significantly affect the relationship between the chatbot type and customer satisfaction. In conclusion, the main findings of this study showed that all of the key variable relationships in the analyses were not statistically significant at the 5% significance level. Therefore, the proposed hypotheses in this study, H1, H2, H3, and H4, are rejected.

However, it is also important to note that the lack of statistically significant findings in this study could be explained by several possibilities. These limitations might be caused by issues related to measurement errors, the context in which the study experiment was conducted, or underlying variables for which this study did not account for. Therefore, the insignificant results in this study do not prove that these relationships are not present.

5.3 Comparison of Key Findings

Comparing the study's results with the main findings in the literature shows some similarities but also notable differences. The literature highlighted the importance of consumer privacy concerns and suggested that the features of decentralized AI-powered chatbots would reduce these concerns and in turn increase the customer satisfaction. However, the study results showed that there are no significant differences in customer satisfaction between centralized and decentralized chatbots, indicating that the decentralization of AI-powered chatbots does not notably affect the privacy concerns of consumers. The literature also suggested that consumers' trust in AI-powered chatbots is an important factor and that decentralization of chatbots would improve this trust. To an extent, the study's results confirmed this. Consumer trust significantly impacts customer satisfaction, however, decentralization did not significantly improve trust. Another difference in results is that while the literature suggested that consumers' familiarity with AI enhances their trust and satisfaction with decentralized chatbot systems, the research results indicated that there are no significant differences between the effects of centralized and decentralized chatbots. Possible reasons for these discrepancies are discussed at the end of this chapter.

5.4 Recommendations to the Market

While this study lacks key significant findings, they can still be used to provide recommendations for companies that want to effectively make use of AI-powered chatbots. Firstly, to take advantage of the benefits of AI-powered chatbots, companies should become more transparent by clearly communicating the nature of the implemented AI-powered chatbots. This can improve the trust between customers and the company, and customers will also know better what to expect from the chatbots. Secondly, companies should also want to address consumer privacy concerns by implementing improved data protection measures and informing consumers of these practices. Moreover, as was suggested by the findings, trust is an important factor that significantly affects customer satisfaction. Therefore, companies should invest their resources in the development of chatbots that ensure reliable and safe interactions. Providing educational resources and demonstrations are also expected to be beneficial, as this can enhance consumers' familiarity with AI technologies. This improved understanding could make them more likely to trust and engage with AI-powered chatbots. Additionally, companies should aim to smooth out the user experience by ensuring that AI-powered chatbots are user-friendly and capable of understanding consumer needs more effectively. Following these recommendations and suggestions may contribute to higher customer satisfaction levels.

5.5 Research Limitations and Academic Recommendations

Although this study offers insights into the influence of consumer perceptions of consumer privacy concerns and trust in interactions with centralized and decentralized AI-powered chatbots on customer satisfaction, it is important to acknowledge and mention several limitations that could have impacted the outcome of the discussed findings, their validity, and reliability.

The first potential limitation is that there could be an unintentional risk of researcher bias in the data collection, analysis, and interpretation that could have influenced the outcomes presented. However, several measures were taken to avoid and reduce these biases to a minimum. For example, survey respondents were gathered by random sampling methods, standardized survey instruments were used, and rigorous data analysis methods were conducted. Second, the sample used for this study, although collected randomly, was also collected through convenience sampling. Thus, it may not represent the broader population. Most of the respondents were students, specifically from the Erasmus University Rotterdam and the surrounding area. This could mean that the findings and conclusions in this research may not apply to other demographic groups. Therefore, a suggestion for future research is to include a more diverse and representative sample so that findings can be more reliable and applicable to the related population.

One of the most significant limitations in this study was that a large number of participants misidentified the chatbot type they were told to interact with. This could indicate that participants may not have correctly understood the differences between the chatbot types, the explanations in the survey could have been insufficient, or they were not attentive enough of the instructions. Future research should therefore investigate the consumer awareness of the differences between centralized and decentralized AI-powered chatbot types more detailed and look into how companies and other organizations can effectively communicate the benefits of decentralized systems and key discrepancies with centralized systems to consumers. Another key limitation is that the study focused on a pre-determined, hypothetical interaction with an AI-powered chatbot. This method allowed for a controlled examination of the key variables, given the time and resource limitations for this study. However, it may fall short of capturing the complexity and variability of a real-time chatbot interaction. This means that the perceptions and satisfaction levels of the respondents might differ in a real AI-powered chatbot usage case. Future research could consider opting for longitudinal studies and real-world experiments to provide more comprehensive insights into this field of study.

Moreover, the data collected in this study relied on self-reported measures. So, there could be the possibility that respondents might have provided socially acceptable answers or might not have accurately recalled their experiences and perceptions. Additionally, the Cronbach's Alpha for the consumer AI Familiarity variable was relatively low, indicating that the measurement may not have been sufficiently reliable. Therefore, future studies should consider including multiple, more robust and validated measurement items. There is also a possibility that this study has some issues with the setup or analyses, as there is a lack of statistically significant conclusions. It is therefore recommended that future researchers consider implementing alternative analysis methods and include additional variables that this study did not account for.

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Appendix B: Survey Layout

Introduction

ERASMUS UNIVERSITEIT ROTTERDAM

Welcome to this Study!

Thank you for your interest in participating. This study is conducted by the Erasmus School of Economics as part of my master's thesis.

Purpose of the Study

This study explores how different interactions with AI-powered chatbots can influence customer satisfaction. Your feedback will contribute to a better understanding of how consumers perceive the use of AI-powered chatbots by companies.

Survey Procedure

- You will observe a hypothetical interaction with an AI-powered chatbot.
- You will be asked to answer a series of questions based on this interaction.
- The survey should take approximately 4 minutes to complete.

Voluntary Participation

Participation in this study is completely voluntary. You are free to withdraw at any point during the survey without any consequences.

Confidentiality

Your responses will be kept confidential and individual responses will not be identifiable.

Consent

By proceeding with this survey, you acknowledge that you have read the information in this introduction and agree to participate under these conditions.

Contact Information

If you have any questions or concerns about the study, please feel free to contact me at: z.aytemir@student.eur.nl

If you are ready to begin, please click the "**Next**" button below.

Randomized Group Assignment

1. Chatbot Type – Unspecified:

Please read the description before proceeding.

You will have a conversation with an AI-powered chatbot simulation.
In this conversation, imagine that you are looking for a gift for your friend who is interested in smart home gadgets. On a shopping website, you ask for help from the AI-powered chatbot.
Begin your conversation with the chatbot by clicking "**Next**".

2. Chatbot Type – Centralized:

Please read the description before proceeding.

You will have a conversation with an AI-powered chatbot simulation.
This chatbot is **centralized**. This means that the chatbot stores and processes all information in one main computer system. It handles all tasks centrally, which allows it to respond quickly and consistently.

In this conversation, imagine that you are looking for a gift for your friend who is interested in smart home gadgets. On a shopping website, you ask for help from the AI-powered chatbot.
Begin your conversation with the chatbot by clicking "**Next**".

3. Chatbot Type – Decentralized:

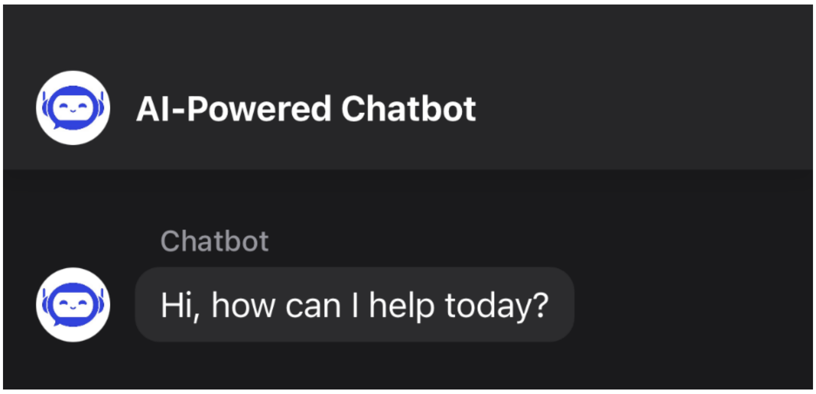
Please read the description before proceeding.

You will have a conversation with an AI-powered chatbot simulation.
This chatbot is **decentralized**. This means that the chatbot spreads all the data and processing across many different computer systems instead of just one. This can help protect data privacy by not storing all information in one central place.

In this conversation, imagine that you are looking for a gift for your friend who is interested in smart home gadgets. On a shopping website, you ask for help from the AI-powered chatbot.
Begin your conversation with the chatbot by clicking "**Next**".

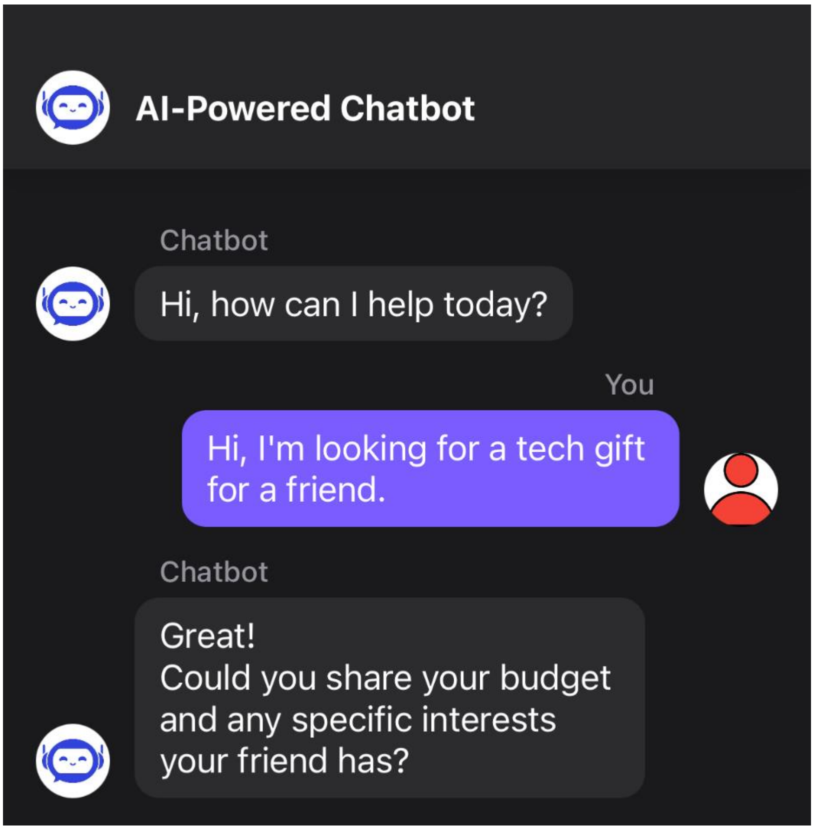
Chatbot Simulation

1. **Please read the message and respond below.**



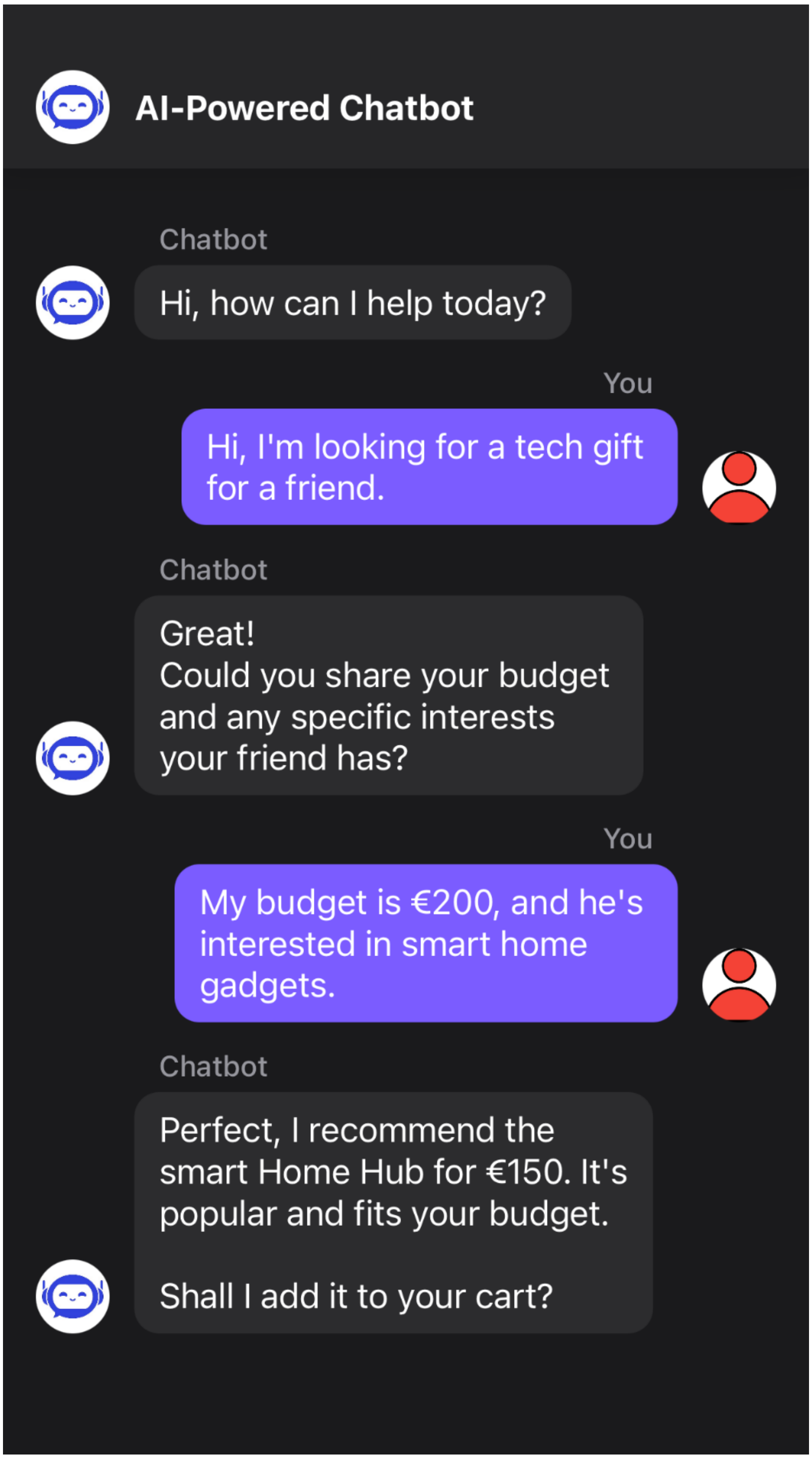
- “Hi, I’m looking for a tech gift for a friend.”

2. **Please read the message and respond below.**



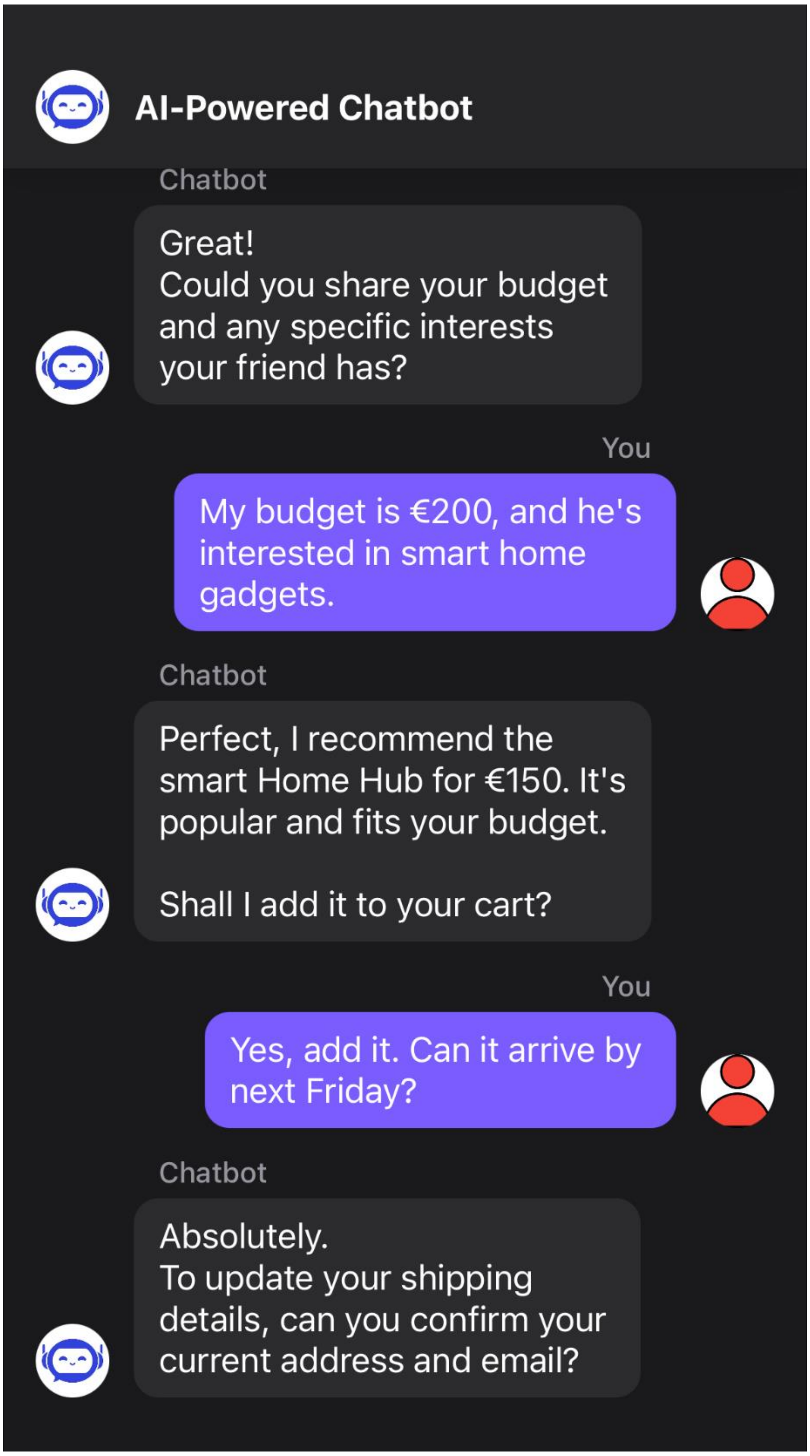
- “My budget is €200, and he’s interested in smart home gadgets.”

3. **<u>Please read the message and respond below.</u>**



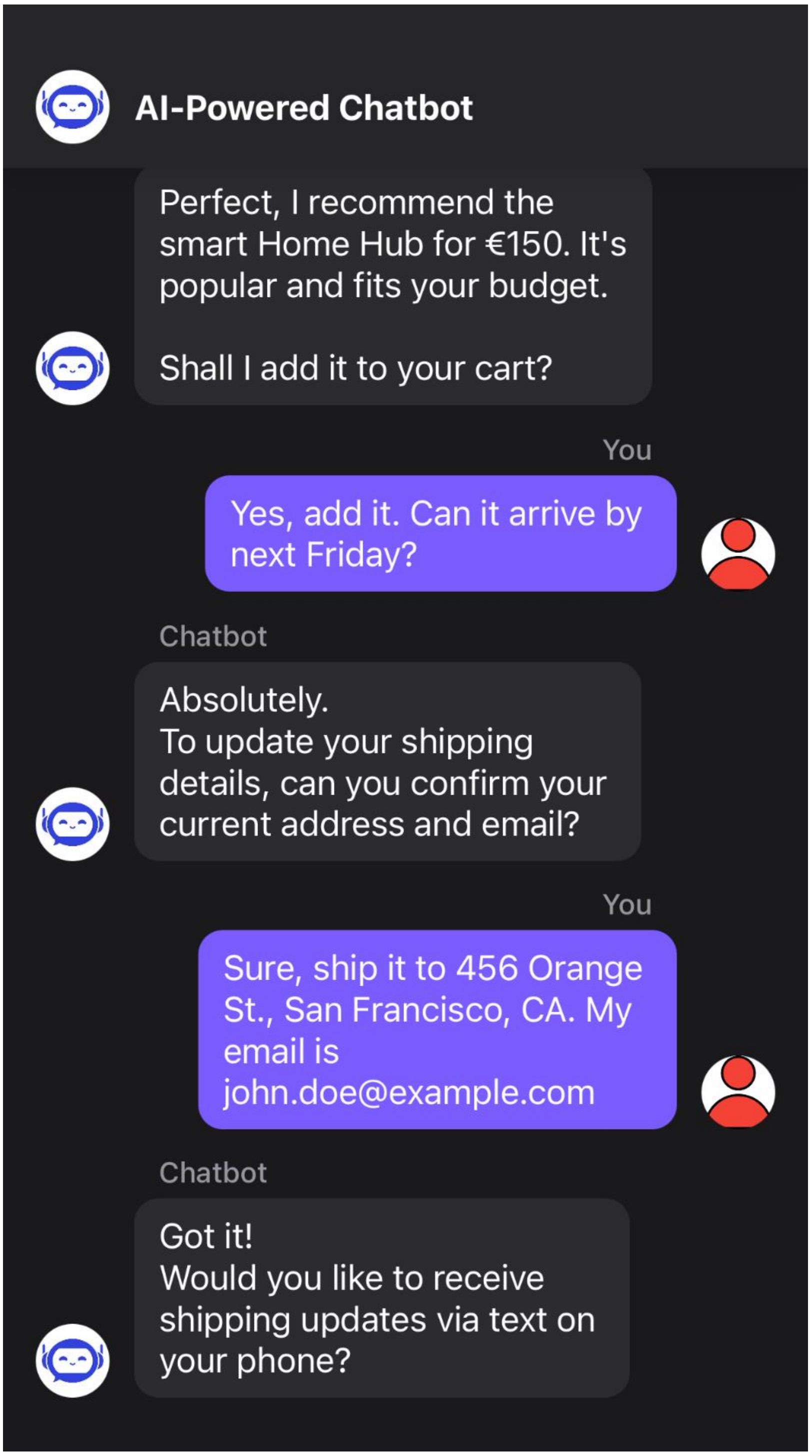
- "Yes, add it. Can it arrive by next Friday?"

4. **Please read the message and respond below.**



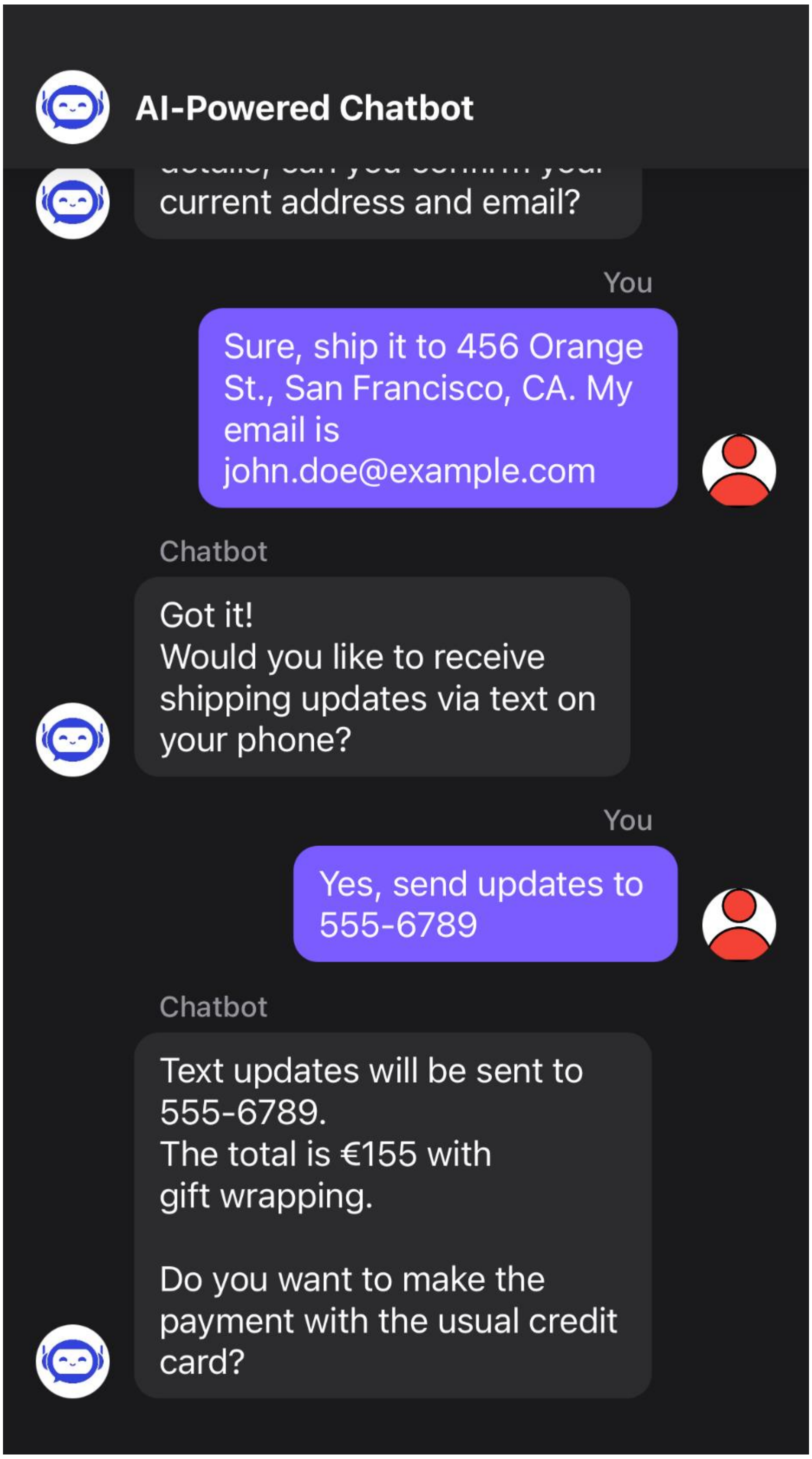
- "Sure, ship it to 456 Orange St. San Francisco, CA. My email is john.doe@example.com"

5. **<u>Please read the message and respond below.</u>**



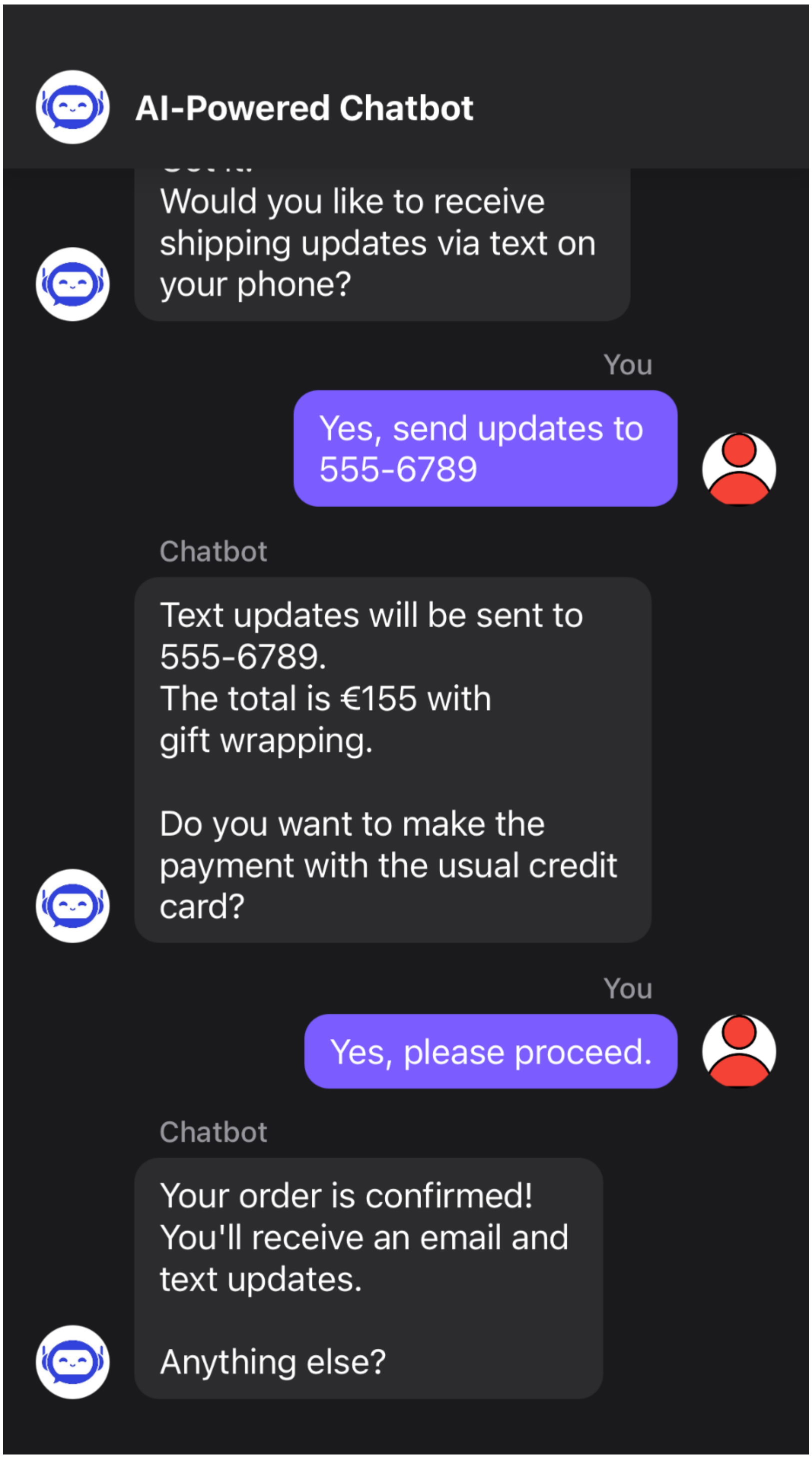
- "Yes, send updates to 555-6789."

6. **Please read the message and respond below.**



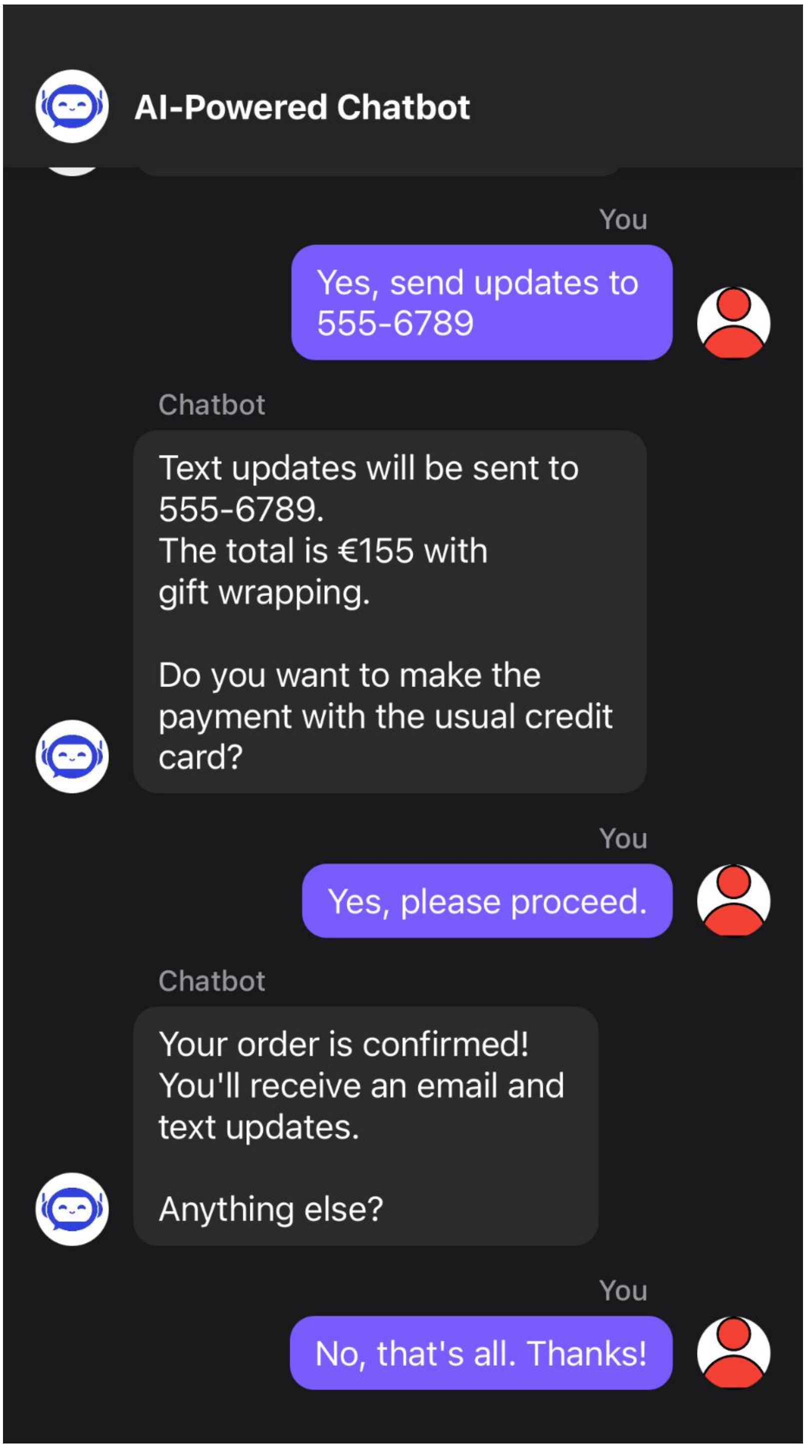
- "Yes, please proceed."

7. **Please read the message and respond below.**



- “No, that’s all. Thanks!”

8. <u>Finish the conversation by clicking "Next" to answer the questions.</u>



- Next

Key Research Questions

Q9. Awareness Validation

Were you made aware of the type of AI-powered chatbot before the conversation?

- Yes, it was centralized.
- Yes, it was decentralized.
- Yes, but I forgot.
- No, I was not aware.

Q10. Customer Satisfaction

Imagine you are considering to use this chatbot again.

To what extent do you agree with the following statements?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I am satisfied with the AI-powered chatbot.	O	O	O	O	O
I am happy with the AI-powered chatbot.	O	O	O	O	O
The AI-powered chatbot did a good job.	O	O	O	O	O
The AI-powered chatbot did what I expected.	O	O	O	O	O

Q11. Consumer Privacy Concerns

Imagine you are considering to use this chatbot again.

To what extent do you agree with the following statements?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
The information I submit via the AI-powered chatbot could be used in a way I did not foresee.	O	O	O	O	O
The information I submit via the AI-powered chatbot could be misused	O	O	O	O	O
I am concerned about submitting information via the AI-powered chatbot, because of what others might do with it.	O	O	O	O	O

Q12. Consumer Trust

Imagine you are considering to use this chatbot again.

To what extent do you agree with the following statements?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
The AI-powered chatbot is trustworthy.	O	O	O	O	O
The AI-powered chatbot is reliable.	O	O	O	O	O
I trust the suggestions and decisions provided by the AI-powered chatbot.	O	O	O	O	O
The AI-powered chatbot is honest and truthful.	O	O	O	O	O

Q13 & Q14. Consumer AI-Familiarity

How would you rate your understanding of AI technologies in general?

Terrible	Poor	Average	Good	Excellent
O	O	O	O	O

How frequently do you use services or devices that are powered by AI in your daily life?

Never	Sometimes	About half the time	Most of the time	Always
O	O	O	O	O

Q15. Understanding Decentralized Chatbot Type

Based on the description provided at the start of the survey, which of the following statements best describes the **decentralized** AI-powered chatbot?

- A decentralized chatbot spreads all the data and processing across many different computer systems, helping to protect data privacy by not storing all information in one central place.
- A decentralized chatbot relies on a central server for processing, making it more efficient but less secure.
- A decentralized chatbot processes and stores data locally on the user's device, enhancing privacy and security.
- I am not sure.

Q16. Understanding Centralized Chatbot Type

Based on the description provided at the start of the survey, which of the following statements best describes the **centralized** AI-powered chatbot?

- A centralized chatbot stores and processes all information in one main computer system, allowing it to respond quickly and consistently.
- A centralized chatbot spreads all the data and processing across many different computer systems, helping to protect data privacy by not storing all information in one central place.
- A centralized chatbot processes and stores data locally on the user's device, enhancing privacy and security.
- I am not sure.

Socio-economic and Demographic Questions

Q17. Age Group

What is your age group?

- <18
- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65>

Q18. Gender

What is your gender?

- Male
- Female
- Other (please specify)
- Prefer not to say

Q19. Nationality

What is your nationality?

- Dutch
- Other (please specify)

Q20. Education

What is the highest degree of education you have **finished**?

- High School
- MBO
- HBO
- University bachelor
- University master

Q21. Occupation

What is your occupation?

- Student
- Self-employed/Entrepreneur
- Employed
- Unemployed
- Retired
- Housemaker
- Other (please specify)
- Prefer not to say

End of Survey

ERASMUS UNIVERSITEIT ROTTERDAM

Thank you very much for your time spent taking this survey!

Your response has been recorded and will remain anonymous.

you can close this page now.

Appendix C: QR Code Flyer Template

Translated from Dutch to English

Dear reader,

ERASMUS UNIVERSITEIT ROTTERDAM

- My name is **Zen Aytemir** and I'm a **master's student at the Erasmus University Rotterdam**.
- Do you have 4 minutes to fill out this short survey about AI-powered chatbots? It is for my **master's thesis.**
- **Scan the barcode to start**. Please also complete the survey. (The text is in English)
- I would also appreciate it if you could share it with a few friends or family members 😳
- Questions or comments? -> z.aytemir@student.eur.nl

Thank you in advance!

Appendix D: Data Overview

Web-link to the research data repository:

https://figshare.com/articles/dataset/Dataset_for_Master_s_Thesis_AI-powered_Chatbots/26068954

Appendix E: SPSS Output

Descriptive Statistics

Table 3

Descriptive Statistics of Research Sample

Statistics

		Age groups (Q17)	Gender (Q18)	Nationality (Q19)	Education Finished (Q20)	Occupation (Q21)	Chatbot Type Awareness
N	Valid	173	172	172	171	170	175
	Missing	2	3	3	4	5	0

Age groups (Q17)

	N	%
<18	3	1,7%
18-24	50	28,6%
25-34	69	39,4%
35-44	33	18,9%
45-54	10	5,7%
55-64	7	4,0%
65>	1	0,6%
Missing -99	2	1,1%

Gender (Q18)

	N	%
Male	101	57,7%
Female	64	36,6%
Other	4	2,3%
Prefer not to say	3	1,7%
Missing -99	3	1,7%

Nationality (Q19)

	N	%
Dutch	132	75,4%
Other	29	16,6%
American	11	6,3%
Missing -99	3	1,7%

Education Finished (Q20)

	N	%
High School	32	18,3%
MBO	12	6,9%
HBO	32	18,3%
University Bachelor	61	34,9%
University Master	34	19,4%
Missing -99	4	2,3%

Occupation (Q21)

	N	%
Student	46	26,3%
Self-employed/Entrepreneur	24	13,7%
Employed	82	46,9%
Unemployed	5	2,9%
Retired	1	0,6%
Housemaker	5	2,9%
Other	3	1,7%
Prefer not to say	4	2,3%
Missing -99	5	2,9%

Chatbot Type Awareness

	N	%
Unaware	54	30,9%
Centralized	62	35,4%
Decentralized	59	33,7%

Table 4

Understanding of Chatbot Type in Centralized and Decentralized Groups

ONLY centralized (Q16)[a]

	N	%
A centralized chatbot stores and processes all information in one main computer system, allowing it to respond quickly and consistently.	39	62,9%
A centralized chatbot spreads all the data and processing across many different computer systems, helping to protect data privacy by not storing all information in one central place.	12	19,4%
A centralized chatbot processes and stores data locally on the user's device, enhancing privacy and security.	2	3,2%
I am not sure.	7	11,3%
Missing -99	2	3,2%

a. Chatbot type = Centralized

ONLY decentralized (Q15)[a]

	N	%
A decentralized chatbot spreads all the data and processing across many different computer systems, helping to protect data privacy by not storing all information in one central place.	34	57,6%
A decentralized chatbot relies on a central server for processing, making it more efficient but less secure.	10	16,9%
A decentralized chatbot processes and stores data locally on the user's device, enhancing privacy and security.	8	13,6%
I am not sure.	7	11,9%

a. Chatbot type = Decentralized

Table 5

Chatbot Type Awareness

POST_SIM AWARENESS[a]

	N	%
Yes, it was centralized.	23	42,6%
Yes, it was decentralized.	7	13,0%
Yes, but I forgot.	9	16,7%
No. I was not aware.	15	27,8%

a. Chatbot Type Awareness = Unaware

POST_SIM AWARENESS[a]

	N	%
Yes, it was centralized.	46	74,2%
Yes, it was decentralized.	4	6,5%
Yes, but I forgot.	4	6,5%
No. I was not aware.	8	12,9%

a. Chatbot Type Awareness = Centralized

POST_SIM AWARENESS[a]

	N	%
Yes, it was centralized.	17	28,8%
Yes, it was decentralized.	22	37,3%
Yes, but I forgot.	5	8,5%
No. I was not aware.	15	25,4%

a. Chatbot Type Awareness = Decentralized

Table 6

Descriptive Statistics of Key Variables

Descriptive Statistics[a]

	N	Minimum	Maximum	Mean	Std. Deviation
Customer Satisfaction	54	1,75	5,00	4,0463	,76798
Consumer Privacy Concerns	54	1,00	5,00	3,5864	1,03591
Consumer Trust in AI-powered Chatbots	54	1,00	5,00	3,4722	,79750
Consumer AI Familiarity	54	1,50	5,00	3,2963	,75560
Valid N (listwise)	54				

a. Chatbot Type Awareness = Unaware

Descriptive Statistics[a]

	N	Minimum	Maximum	Mean	Std. Deviation
Customer Satisfaction	62	1,00	5,00	3,7339	,98438
Consumer Privacy Concerns	62	1,00	5,00	3,8118	,97812
Consumer Trust in AI-powered Chatbots	62	1,00	4,75	3,1089	,96413
Consumer AI Familiarity	62	1,00	5,00	3,1048	,90144
Valid N (listwise)	62				

a. Chatbot Type Awareness = Centralized

Descriptive Statistics[a]

	N	Minimum	Maximum	Mean	Std. Deviation
Customer Satisfaction	59	1,25	5,00	3,9153	,96558
Consumer Privacy Concerns	59	1,00	5,00	3,7627	,93064
Consumer Trust in AI-powered Chatbots	59	1,50	5,00	3,3390	,84685
Consumer AI Familiarity	59	1,50	5,00	3,2542	,88265
Valid N (listwise)	59				

a. Chatbot Type Awareness = Decentralized

Reliability Analysis

Table 8

Tests of Normality

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Unstandardized Residual	.148	175	<.001	.919	175	<.001

a. Lilliefors Significance Correction

Table 9

Tests for Homogeneity of Variances

Tests of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Customer Satisfaction	Based on Mean	1.671	2	172	.191
	Based on Median	.818	2	172	.443
	Based on Median and with adjusted df	.818	2	159.849	.443
	Based on trimmed mean	1.328	2	172	.268

Hypothesis 1 - ANOVA

Table 10

ANOVA Results

Descriptives

Customer Satisfaction

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Unaware	54	4.0463	.76798	.10451	3.8367	4.2559	1.75	5.00
Centralized	62	3.7339	.98438	.12502	3.4839	3.9839	1.00	5.00
Decentralized	59	3.9153	.96558	.12571	3.6636	4.1669	1.25	5.00
Total	175	3.8914	.92012	.06955	3.7541	4.0287	1.00	5.00

ANOVA

Customer Satisfaction

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.868	2	1.434	1.707	.184
Within Groups	144.444	172	.840		
Total	147.312	174			

ANOVA Effect Sizes[a,b]

		Point Estimate	95% Confidence Interval	
			Lower	Upper
Customer Satisfaction	Eta-squared	.019	.000	.070
	Epsilon-squared	.008	-.012	.059
	Omega-squared Fixed-effect	.008	-.012	.059
	Omega-squared Random-effect	.004	-.006	.030

a. Eta-squared and Epsilon-squared are estimated based on the fixed-effect model.

b. Negative but less biased estimates are retained, not rounded to zero.

Multiple Comparisons

Dependent Variable: Customer Satisfaction

Tukey HSD

(I) Chatbot Type Awareness	(J) Chatbot Type Awareness	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Unaware	Centralized	.31243	.17058	.162	-.0909	.7157
	Decentralized	.13104	.17258	.728	-.2770	.5391
Centralized	Unaware	-.31243	.17058	.162	-.7157	.0909
	Decentralized	-.18138	.16667	.523	-.5754	.2127
Decentralized	Unaware	-.13104	.17258	.728	-.5391	.2770
	Centralized	.18138	.16667	.523	-.2127	.5754

Customer Satisfaction

Tukey HSD[a,b]

Chatbot Type Awareness	N	Subset for alpha = 0.05
		1
Centralized	62	3.7339
Decentralized	59	3.9153
Unaware	54	4.0463
Sig.		.160

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 58,143.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Hypothesis 2 - Mediation

Figure 8

Statistic Visualization of Mediation, H2 (Baseline = Unspecified)

```
Run MATRIX procedure:

***************** PROCESS Procedure for SPSS Version 4.2
*****************

          Written by Andrew F. Hayes, Ph.D.
www.afhayes.com
    Documentation available in Hayes (2022).
www.guilford.com/p/hayes3

**************************************************************
************
Model  : 4
    Y  : CS
    X  : DecenDum
    M  : CPC

Covariates:
 CentDum

Sample
Size:  175

**************************************************************
************
OUTCOME VARIABLE:
 CPC

Model Summary
          R       R-sq        MSE     F(HC3)        df1
df2          p
       ,098       ,010       ,962       ,758      2,000
172,000       ,470

Model
              coeff    se(HC3)          t          p
LLCI       ULCI
constant      3,586       ,142     25,205       ,000
3,306      3,867
DecenDum       ,176       ,188       ,940       ,349      -
,194       ,547
CentDum        ,225       ,190      1,189       ,236      -
,149       ,600
```

```
**************************************************************************
************
OUTCOME VARIABLE:
 CS

Model Summary
          R       R-sq        MSE     F(HC3)        df1
df2          p
       ,224       ,050       ,818      2,412      3,000
171,000       ,069

Model
              coeff    se(HC3)          t          p
LLCI       ULCI
constant      3,452       ,368      9,371       ,000
2,725      4,179
DecenDum      -,160       ,166      -,967       ,335       -
,487       ,167
CPC            ,166       ,093      1,790       ,075       -
,017       ,348
CentDum       -,350       ,160     -2,183       ,030       -
,666      -,033

************************* TOTAL EFFECT MODEL
****************************
OUTCOME VARIABLE:
 CS

Model Summary
          R       R-sq        MSE     F(HC3)        df1
df2          p
       ,140       ,019       ,840      1,807      2,000
172,000       ,167

Model
              coeff    se(HC3)          t          p
LLCI       ULCI
constant      4,046       ,105     38,357       ,000
3,838      4,255
DecenDum      -,131       ,165      -,795       ,428       -
,457       ,195
CentDum       -,312       ,164     -1,901       ,059       -
,637       ,012


************** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y
**************

Total effect of X on Y
     Effect    se(HC3)          t          p       LLCI
ULCI
```

```
      -,131       ,165      -,795       ,428      -,457
,195

Direct effect of X on Y
     Effect    se(HC3)          t          p       LLCI
ULCI
      -,160       ,166      -,967       ,335      -,487
,167

Indirect effect(s) of X on Y:
        Effect     BootSE   BootLLCI   BootULCI
CPC       ,029       ,038      -,036       ,119

************************ ANALYSIS NOTES AND ERRORS
************************

Level of confidence for all confidence intervals in output:
  95,0000

Number of bootstrap samples for percentile bootstrap
confidence intervals:
  5000

NOTE: A heteroscedasticity consistent standard error and
covariance matrix estimator was used.

------ END MATRIX -----
```

Hypothesis 3 - Mediation

Figure 9

Statistic Visualization of Mediation, H3 (Baseline = Unspecified)

```
Run MATRIX procedure:

***************** PROCESS Procedure for SPSS Version 4.2
*****************

          Written by Andrew F. Hayes, Ph.D.
www.afhayes.com
    Documentation available in Hayes (2022).
www.guilford.com/p/hayes3

**************************************************************
************
Model  : 4
    Y  : CS
    X  : DecenDum
    M  : CT

Covariates:
 CentDum

Sample
Size:  175

**************************************************************
************
OUTCOME VARIABLE:
 CT

Model Summary
          R       R-sq        MSE     F(HC3)        df1
df2          p
       ,171       ,029       ,767      2,442      2,000
172,000       ,090

Model
              coeff    se(HC3)          t          p
LLCI       ULCI
constant      3,472       ,110     31,697       ,000
3,256      3,688
DecenDum      -,133       ,156      -,854       ,395      -
,441       ,175
CentDum       -,363       ,165     -2,202       ,029      -
,689      -,038
```

```
************************************************************
************
OUTCOME VARIABLE:
 CS

Model Summary
          R       R-sq        MSE      F(HC3)        df1
df2         p
       ,530       ,281       ,619     14,090      3,000
171,000      ,000

Model
              coeff    se(HC3)          t          p
LLCI       ULCI
constant      2,169       ,330      6,574       ,000
1,518      2,820
DecenDum      -,059       ,133      -,443       ,659      -
,322       ,204
CT             ,541       ,086      6,274       ,000
,371       ,711
CentDum       -,116       ,150      -,773       ,440      -
,412       ,180

************************* TOTAL EFFECT MODEL
****************************
OUTCOME VARIABLE:
 CS

Model Summary
          R       R-sq        MSE      F(HC3)        df1
df2         p
       ,140       ,019       ,840      1,807      2,000
172,000      ,167

Model
              coeff    se(HC3)          t          p
LLCI       ULCI
constant      4,046       ,105     38,357       ,000
3,838      4,255
DecenDum      -,131       ,165      -,795       ,428      -
,457       ,195
CentDum       -,312       ,164     -1,901       ,059      -
,637       ,012


************** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y
**************

Total effect of X on Y
     Effect    se(HC3)          t          p       LLCI
ULCI
```

```
     -,131       ,165      -,795       ,428      -,457
,195

Direct effect of X on Y
     Effect    se(HC3)          t          p       LLCI
ULCI
     -,059       ,133      -,443       ,659      -,322
,204

Indirect effect(s) of X on Y:
       Effect     BootSE   BootLLCI   BootULCI
CT      -,072       ,088      -,260       ,089

************************ ANALYSIS NOTES AND ERRORS
************************

Level of confidence for all confidence intervals in output:
  95,0000

Number of bootstrap samples for percentile bootstrap
confidence intervals:
  5000

NOTE: A heteroscedasticity consistent standard error and
covariance matrix estimator was used.

------ END MATRIX -----
```

Hypothesis 4 – Moderated Mediation

Table 11, 12, 13

Moderated Mediation Analysis Results (Centralized = Baseline),

Conditional Indirect Effects of Chatbot Type on Customer Satisfaction via Consumer Trust,

Index of Moderated Mediation

Run MATRIX procedure:

***************** PROCESS Procedure for SPSS Version 4.2 *****************

Written by Andrew F. Hayes, Ph.D.   www.afhayes.com

Documentation available in Hayes (2022). www.guilford.com/p/hayes3

****

Model : 7

Y : CS

X : ChatbotT

M : CT

W : AI_Fam

Sample

Size: 175

Coding of categorical X variable for analysis:

ChatbotT	X1	X2
,000	,000	,000
1,000	1,000	,000
2,000	,000	1,000

****

OUTCOME VARIABLE:
CT

Model Summary

R	R-sq	MSE	F	df1	df2	p
,4310	,1858	,6550	7,7121	5,0000	169,0000	,0000

Model

	coeff	se	t	p	LLCI	ULCI
constant	1,8378	,3714	4,9480	,0000	1,1046	2,5710
X1	,3877	,6207	,6246	,5331	-,8377	1,6131
X2	,0759	,5501	,1380	,8904	-1,0100	1,1618
AI_Fam	,4094	,1150	3,5612	,0005	,1824	,6363
Int_1	-,0312	,1867	-,1669	,8676	-,3998	,3374
Int_2	,0286	,1665	,1717	,8638	-,3000	,3572

Product terms key:
Int_1 : X1 x AI_Fam
Int_2 : X2 x AI_Fam

Test(s) of highest order unconditional interaction(s):

	R2-chng	F	df1	df2	p
X*W	,0005	,0499	2,0000	169,0000	,9514

****
OUTCOME VARIABLE:
CS

Model Summary

R	R-sq	MSE	F	df1	df2	p
,5305	,2814	,6190	22,3241	3,0000	171,0000	,0000

Model

	coeff	se	t	p	LLCI	ULCI
constant	2,0530	,2352	8,7295	,0000	1,5887	2,5172
X1	,1160	,1485	,7807	,4361	-,1773	,4092
X2	,0570	,1440	,3957	,6928	-,2272	,3411
CT	,5407	,0685	7,8955	,0000	,4055	,6759

****************** DIRECT AND INDIRECT EFFECTS OF X ON Y *****************

Relative direct effects of X on Y

	Effect	se	t	p	LLCI	ULCI
X1	,1160	,1485	,7807	,4361	-,1773	,4092
X2	,0570	,1440	,3957	,6928	-,2272	,3411

Omnibus test of direct effect of X on Y:

R2-chng	F	df1	df2	p
,0026	,3049	2,0000	171,0000	,7376

Relative conditional indirect effects of X on Y:

INDIRECT EFFECT:

ChatbotT -> CT -> CS

	AI_Fam	Effect	BootSE	BootLLCI	BootULCI
X1	2,5000	,1675	,1135	-,0500	,3980
X1	3,0000	,1591	,0907	-,0093	,3429
X1	4,0000	,1422	,1139	-,0620	,3889

Index of moderated mediation:

	Index	BootSE	BootLLCI	BootULCI
AI_Fam	-,0169	,0968	-,2039	,1769

	AI_Fam	Effect	BootSE	BootLLCI	BootULCI
X2	2,5000	,0797	,1176	-,1528	,3093
X2	3,0000	,0874	,0890	-,0880	,2612
X2	4,0000	,1029	,0970	-,0868	,2954

Index of moderated mediation:

	Index	BootSE	BootLLCI	BootULCI
AI_Fam	,0155	,0941	-,1709	,2064

********************** ANALYSIS NOTES AND ERRORS ***********************

Level of confidence for all confidence intervals in output:
95,0000

Number of bootstrap samples for percentile bootstrap confidence intervals:
5000

W values in conditional tables are the 16th, 50th, and 84th percentiles.

------ END MATRIX -----