Trust and Empathy in AI-Powered Genetic Counseling: Comparing Chatbot and Social Robot Interactions

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ABSTRACT: Genetic counseling aims to inform patients and their families about potential health risks associated with inherited conditions, often involving emotionally sensitive topics. Conversational agents (CAs), such as AI-powered chatbots and social robots, are increasingly integrated into healthcare communication due to their accessibility and responsiveness. This research investigates differences between perceived trust and empathy in genetic counseling interactions with a chatbot and a humanoid social robot, focusing on conditions related to Hypertrophic Cardiomyopathy (HCM). By engaging participants in simulated counseling sessions with both systems, the research explores how different embodiments of conversational AI influence empathy and trust. User perceptions are evaluated through post-interaction semi-structured interviews, to assess the effectiveness of trust and empathy of each agent.

Additional Key Words and Phrases: Human-robot interaction, human-computer interaction, conversational agents, trust in AI, empathic AI, AI-powered healthcare.

1 INTRODUCTION

Genetic counseling is defined as a communication process with the scope of informing patients about risks they or their family members could have as a result of a congenital disease [6, 18]. Its main focus is complex and sensitive information that must be transmitted in a comprehensive way, to ensure that the patient will make an informed decision about their health. This study will focus on genes associated with HCM (Hypertrophic Cardiomyopathy).

1.1 Context

Genetic counseling involves analyzing and interpreting the personal and family medical history. Moreover, the result of the genetic counseling session can bear significant impact on the patient's life. Therefore, trust and confidentiality are essential in the genetic counseling process. Similarly, empathy has an important role in this practice, since the findings of genetic counseling can have strong emotional impact on the patient [6].

Chatbots are computer programs designed to simulate human-human conversations, and are considered to be a type of conversational agent (CA). They are widely used in health care for reasons such as convenience, novelty, and productivity [1]. Considering trust in chatbots, it depends on how the chatbot presents itself and its professionalism [1], while empathy seems to still be a lacking feature, regardless of the latest technological advancements [5].

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Furhat is a social humanoid robot developed by Furhat Robotics[1]. It is designed to sustain natural face-to-face conversations. Featuring a back-projected face on a moving head, it allows for complex facial animations and eye contact with the user. Its capabilities include speaking, listening, and displaying emotions through facial expressions. The architecture of the robot allows for the integration of a Large Language Model (LLM). This allows for the possibility to use specific prompts to design the interaction of the robot. Such features include tasks, responsibilities, and perceived personality of the robot.

1.2 Problem Statement

The increasing demand for genetic counseling services has created significant scalability concerns, leading to growing interest in healthcare agents as potential solutions [3]. However, genetic counseling requires high levels of trust and empathy due to the sensitive nature of genetic information and its impact on patients and their families. Current AI technologies, including chatbots and social robots, show promise in healthcare applications. Nevertheless, there remains a significant gap in understanding how these technologies can establish and maintain the trust and empathy needed for successful genetic counseling interactions. Without addressing these human-centered requirements, AI-powered genetic counseling could fail to provide an environment that is supportive, necessary for patients to make informed decisions about their genetic health.

1.3 Research Goal

The following research question was identified, which can be divided into three corresponding sub-questions:

How can AI-powered chatbots and social robots be designed to optimize user perceptions of trust and empathy in genetic counseling interactions?

- **SRQ1.** What differences in user experience emerge when interacting with a chatbot versus a humanoid social robot, specifically in terms of perceived trust and empathy?
- **SRQ2.** Which specific verbal and nonverbal behaviors of the chatbot and social robot contribute most to perceptions of trust and empathy, and to what extent?
- **SRQ3.** How do users rate the chatbot and the robot in terms of trustworthiness and empathy when delivering sensitive information, such as in genetic counseling?

2 RELATED WORK

This section will explore current research on the topic of perceived trust and empathy in conversational agents. Moreover, it will address design and evaluation guidelines for modeling characteristics that achieve these goals, especially in genetic counseling. It will begin by defining CAs and their role in healthcare, as well as the use

[1] https://www.furhatrobotics.com

of AI in these agents. Following, the review will assess research investigating the design and impact of empathetic CAs and the factors that contribute to user trust. This will lead to an examination of studies that compare different CA modalities, such as chatbots and social robots, in eliciting these responses.

2.1 AI-Powered Dialogue Systems In Health Care

AI-powered dialogue systems in the form of chatbots and social robots have numerous uses in healthcare [17]. Various studies have assessed the most important characteristics these systems, which include emotional intelligence, conscientiousness, thoroughness, identity and personality [4]. This highlights the critical importance of investigating perceived trust and empathy in conversational agents for genetic counseling, as these factors directly influence patient engagement, decision-making quality, and overall counseling effectiveness.

2.2 Empathy

AI-powered conversational agents are seen as an opportunity for personalized communication with users, opposed to deterministic agents [14]. Empathy is defined as *'the action of understanding, being aware of, being sensitive to, and vicariously experiencing the feelings, thoughts, and experience of another of either the past or present without having the feelings, thoughts, and experience fully communicated in an objectively explicit manner'* [10]. Displaying emotional intelligence, which includes empathy, has been shown to impact perceived warmth of the chatbot, which leads to higher trust. In addition, AI-powered CAs have higher capacity for displaying empathy and sympathy compared to deterministic agents, as responses can be highly tailored to patient input. Additionally, patients' perceptions of their physician's competence are closely linked to the quality of their relationship with that physician [21].

A systematic review of AI-powered CAs in healthcare highlighted that an important point of research is how users feel and relate to CAs [13]. Research on genetic counseling about breast cancer risks by a humanoid robot showed that participants felt comfortable with the robot, while also increasing their knowledge of breast cancer risks [22]. This is supported by findings from the article presenting chatbot Edna, where patients were noticed to interact with the chatbot in a similar way as they would with a human [7]. Based on these findings, participants are expected to feel comfortable to interact with both the chatbot and the robot in the experiment, which will constitute of a simulated genetic counseling session.

It has been found that users prefer CAs that display sympathy and empathy [7]. Additionally, there is a strong relationship between physician empathy and overall trust of the patient in the physician [21]. However, it is recommended to not exaggerate the display of sympathy and empathy in these systems, as this can be perceived as less genuine and affect trust in the system [19]. This was noticed as well in a study where online counseling sessions were conducted using an AI-powered CA. The virtual counselor was better perceived in terms of credibility, trust and empathy when participants were told that they were operated by human counselors rather than an AI, although in all conditions the same AI-powered agent was utilized [20]. Furthermore, it has been found that empathy between a CA and a human participant is not possible if the participant does not express emotional cues. The author highlights that it is important that the experiment scenario leads participants to express such cues without external intervention (such as asking one how they feel) [16]. Overall, these research findings point towards the importance of adaptive behavior, language and empathetic display in CAs for genetic counseling, as well as a carefully designed experiment scenario.

2.3 Trust

In regards to building trust, active empathetic listening has been discovered to generate the most trust in interactions with CAs. Moreover, the same study found that the addition of nonverbal body cues of the robot did not create a difference in general perceived trust of participants [2].This suggests that the physical aspect of the Furhat robot, which consists of a humanoid head, should not affect perceived trust of the participants. Furthermore, the same techniques that will be employed for the design of empathy behavior will also account for building trust: emotional expression, short dialogue responses, and acknowledgment of patient's feelings.

2.4 Conversation Design

Chatbots have been found to be perceived better when asked to give short responses, such as in a spoken conversations. The same article found that the only disadvantage of a chatbot prompted this way is 'conversation elegancy' (sophisticated quality of dialogue, in terms of language, tone, and word choice) [15]. However, this study was limited to psychologist participants, and the rationale for the gendered chatbot design was not provided by the authors. Nevertheless, the findings suggest that prompts for the LLM should be designed to generate short responses, to improve conversation naturalness.

The LLM will make use of a genetic counseling knowledge base obtained from University Medical Center Utrecht[2]. The knowledge base contains information about HCM, including transmission, lifestyle adaptation, and symptomatology. Aside from this, it also includes detailed information about the options a patient has, including testing and screening procedures.

2.5 Evaluation

The studies investigated in this literature review usually conduct experiments that consist of a (scripted) interaction with the CA, and a post-experiment survey and/or interview. Oftentimes, a pre-experiment survey or interview is included as well [9].

3 METHOD

This study will employ a within-subjects experimental design. Each participant will experience both conditions (chatbot and social robot) in counterbalanced order.

3.1 Participants

Participants will be recruited through convenience sampling. Criteria for participation includes not having family members that have genetic conditions, genetic risks or heart conditions, to ensure

[2]https://www.umcutrecht.nl/en

participant well-being during the experiment. Condition order will be determined through simple randomization using the coin flip method. Each participant will have an equal probability of being assigned to either order sequence (chatbot-first or robot-first).

3.2 Materials

3.2.1 AI-Powered Agents. Both the chatbot and social robot share the same backend, and therefore the same counselor identity. The counselor, June, is portrayed as a woman counselor specialized in HCM.

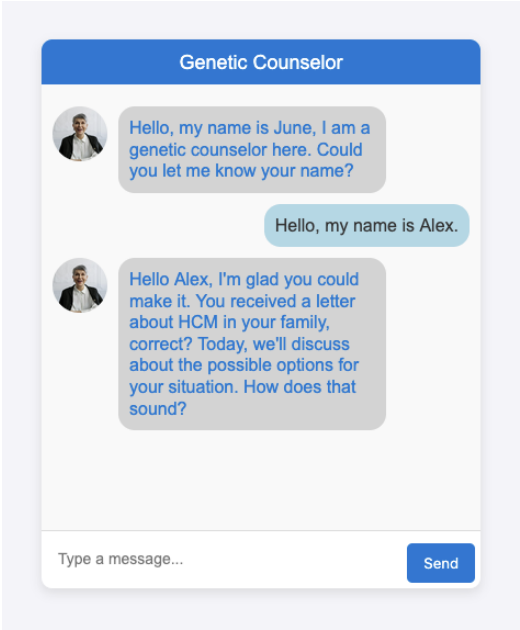

Fig. 1. Chatbot Interface

The chatbot is designed using HTML, CSS and Javascript, featuring text-based interaction. The back-end for the chatbot consists of Python, with a Flask localhost server. Considering the locality of the server and the scope of the study, no security measures are implemented for the server. To improve the authenticity of the chatbot, a picture of a woman is added to the chatbot interface to represent June, the counselor. Fig. 1 shows the chatbot interface.

As for the other study condition, the Furhat robot is used. To maintain consistency with the identity of the chatbot counselor, the female mask *'Isabel'* is used, together with the voice *'Ami-neural(GB)'*.

To ensure appropriate study conditions, both the chatbot and the social robot are integrated with the same LLM, the *Claude Haiku 3* model by Anthropic [3]. Both CAs have their responses based on the same prompts, with identical output structure. The exception is the gesture generation prompt, specific to the robot condition. Prompt functionalities are detailed in the following section.

[3]https://docs.anthropic.com/en/docs/about-claude/models/overview

3.2.2 Prompts. The following prompts are used for the conversational agents:

- Role prompt: specifies the role of the LLM as a counselor in this interaction, as well as key considerations regarding language to be used, and what the LLM should avoid during the interaction.
- Stage prompts: prompts specific to each of the conversation stages: Greeting, Exploration, Discussion about options, Summary, Goodbye. Each prompt specifies what is the goal for the corresponding conversation stage.
- Summary prompt: generates a summary of the conversation, as well as a list of questions asked in the conversation by both the agent and the user.
- Stage transition prompt: transitions from one stage of the conversation to another based on specific criteria, such as questions asked and participant request.
- Gesture generation prompt: only utilized by the Furhat robot. Receives the LLM response for the conversation, as well as the question that generated that response, and the conversation summary. This prompt returns a gesture from the Furhat *Gestures* library, which is executed at the same time with the LLM response. Possible gestures include smiling, nodding, thinking, expressing sadness.

Prompts are designed to favor efficiency of tokens used as input. To construct the prompt for generating a conversation response, the Role Prompt is concatenated with the prompt specific to the current stage, and with the following parameters:

- User input
- Conversation summary
- Questions asked by the counselor
- Last two conversation turns.

The rest of the functionalities (summary generation, stage transition, gesture generation) are achieved through using the respective prompt, with the necessary parameters.

3.2.3 Persona and Scenario. Participants will be provided with a persona scenario that they will be asked to role-play. The persona is designed as a gender-neutral individual, who finds themselves at risk of HCM. The scenario is based on typical genetic counseling cases involving HCM. It includes realistic family history details and decision-making dilemmas commonly encountered in genetic counseling practice. For the persona scenario, refer to Appendix B.

3.2.4 Interview Design. The interviews will be recorded using the ZOOM H2n Handy Recorder[4]. The interview will have a semi-structed approach, where participants will answer a series of 9 questions about their experience interacting with both agents. Since the study employs a qualitative approach, interview questions are developed based on established trust and empathy scales (PETS, RoPE, MDMT, TOAST) and adapted for the AI-powered genetic counseling context. The interview questions can be found in Appendix A.

[4]https://zoomcorp.com/en/us/handheld-recorders/handheld-recorders/h2n-handy-recorder/

3.2.5 Data Collection. Data collection will be achieved in person, during the interview. This will take place after the interaction with both agents.

3.2.6 Data Analysis. Following data collection, interviews will be transcribed using the transcription functionality of Microsoft Word for Web[5]. Afterwards, they will be analyzed using Naeem et al.'s thematic analysis process: (1) transcript creation and data familiarization, (2) keyword identification, (3) code selection, (4) theme development, (5) conceptualization, and (6) conceptual model development.

3.2.7 Ethical Considerations. The reseach received ethical approval from the Computer & Information Sciences (CIS) committe of University of Twente[6]. The approval is correspondent to application number 251003.

3.3 Procedure

3.3.1 Experiment Procedure. The experiment was conducted in a meeting room on the University of Twente campus. Participants were seated at a table for the whole duration of the experiment, while the researcher was seated in the same room, out of the visual field of the participant, to prevent distraction. For the experiment setup please refer to Fig. 2.

Fig. 2. Experiment Setup

Firstly, participants were informed about the procedure of the experiment and provided informed consent. To mitigate the potential novelty effect regarding the social robot condition, participants were given a 5-minute familiarization period with the Furhat robot before beginning the experimental interactions. During this time, they engaged in casual conversation with the robot unrelated to the genetic counseling scenario. This allowed them to become comfortable with the robot's appearance, voice, and interaction modalities.

[5]https://support.microsoft.com/en-us/office/transcribe-your-recordings-7fc2efec-245e-45f0-b053-2a97531ecf57

[6]https://www.utwente.nl/en/eemcs/research/ethics/

Participants were then given 10 minutes to read and familiarize themselves with the role-playing scenario. The experiment continued with the participant interacting with the experiment conditions. Each interaction lasted between 10-15 minutes, and participants had a break between the conditions. The in-person interview took place immediately after the participant completed the two interactions. During the interview, participants' perceptions of trust and empathy were assessed.

To prevent participants from comparing the two conditions during interactions, participants were initially told the study aimed to "evaluate AI-powered agents for genetic counseling effectiveness." The comparative nature of the study (examining trust and empathy differences between conditions) was not disclosed until the post-interview debriefing. During debriefing, participants were fully informed about the study's true objectives, given opportunity to ask questions, and confirmed their continued consent for participation.

4 RESULTS

4.1 Participants

In total, 6 participants were involved in the experiment, with ages 21-24 years. All participants reported familiarity with technology but limited prior experience with social robots or AI-powered healthcare. Participants were randomly assigned an order to complete the two study conditions.

4.2 Themes Identified

As a result of the qualitative analysis of the interview transcripts, the following key themes were identified:

- Embodiment Creates Authenticity Concerns
- Cognitive Mediation Hypothesis
- Trust Calibration Mechanism
- Emotional Expression Paradox

These themes will be further presented below.

4.2.1 Theme: Embodiment Creates Authenticity Concerns This theme states that physical embodiment of the Furhat robot creates contradictory effects. On one hand, the embodiment leads to the social robot seeming more natural. On the other hand, it makes the social robot be perceived as more artificial, uncanny, and exhibiting forced empathy.

Four participants perceived the social robot as more natural and easy to speak to (*'Whereas the robot was easier to follow. And it also felt more natural'* [P1], *'I think the content was less formal, so it was easier to speak to'* [P2]). The remaining two participants found the social robot as odd and artificial, and even ungenuine (*'The interaction with the robot felt a bit weird. Like, she looks weird.'* [P5], *'It would move the eyebrows, make a sad face, return to normal and say with a straight face "I understand your situation". So yes, it felt quite artificial.'* [P4]).

In contrast, participants have not expressed feelings of artificiality regarding the chatbot. What emerged instead is the 'professional' character of the chatbot (*'I preferred the chatbot actually because it felt more professional. I suppose in some way it's because everything was written.'* [P5], *'I guess the content [of the robot dialogue] was less*

formal, more easy to speak to. Yeah, the chatbot was more technical, so that was the main difference for me.' [P2]).

4.2.2 Theme: Cognitive Mediation Hypothesis. This theme asserts that text-based agents increase comfort, as well as skepticism. This is because such agents allow for more deliberate thinking, due to having more time to doubt or verify the information.

Such findings appear for the chatbot condition. Several participants reported having more time to think (*'I preferred the chatbot [...] because it gave me more time to think'* [P5], *'[With the chatbot] I could explain better when I was writing, I could make my thoughts, my questions, and then respond. Meanwhile, when I was doing it with the robot, it was way difficult'* [P6]). Participants reported considering the agents' advice, without providing a clear positive or negative answer (*'I would consider it [the advice]. I don't know what I would choose, but I would be willing to think it over.'* [P4], *'I will consider [the advice] for sure. But I would need more convincing, from a human. More fact checking as well on my own'* [P2]). However, this additional thinking time also led to increased skepticism, with participants expressing verification behaviors (*'Before making a concrete decision, I would do my own research as well. To see if it aligns with their statements. If it does align, yes, I would probably go with their advice.'* [P1]).

4.2.3 Theme: Trust Calibration Mechanism. This theme proposes that participants do not exhibit binary trust/distrust toward AI agents. Instead, they actively calibrate their trust levels based on multiple contextual factors, resulting in conditional acceptance behaviors.

Participants demonstrated variable trust responses rather than absolute positions. They expressed conditional acceptance: *'I would consider [the advice]. I don't know what I would choose, but I would be willing to think it over.'* [P4] and *'I will consider [the advice] for sure. But I would need more convincing, from a human. More fact checking as well on my own'* [P2]. This suggests an active evaluation process rather than predetermined trust decisions.

Several factors emerged as trust calibration influences:

- Familiarity: Participants' prior experience with technology types affected their trust baseline. The chatbot benefited from familiarity: *'I feel like with the chatbot it was easier. It was well known.'* [P4], *'It was easier to talk with the chatbot, because I am used to it.'* [P3]. This familiarity appeared to lower initial skepticism and create a more favorable trust starting point.
- Technical Knowledge: Participants' AI background knowledge influenced their calibration sensitivity. Those with higher AI knowledge demonstrated more cautious calibration: *'I don't know if the options they provided are actually realistic, so they might just be hallucinations. But they are a starting point for a discussion with a human specialist.'* [P5]. This suggests that domain expertise creates stronger trust evaluation criteria.
- Contextual Dialogue: Trust levels shifted based on the specific interaction context and dialogue content, with participants adjusting their acceptance based on the conversation's progression and the agents' responses. They expressed conditional acceptance combined with verification behaviors(*'Before making a concrete decision, I would also do my own research as well. To see if it aligns with their statements. If it does align, yes, I would probably go with their advice.'* [P1]). This suggests active trust calibration rather than binary trust decisions.

4.2.4 Theme: Emotional Expression Paradox. This theme states that although the social robot is perceived as expressing emotional aspects better, it is perceived as lacking empathy.

Participants experienced conflicting feelings about the robot's embodiment, sometimes within the same interview. P4 noted the robot was *'easy to speak to'* while also finding it *'very unnatural,'* illustrating how physical embodiment creates contradictory authenticity perceptions.

Both agents were linked to empathy during the interviews (*'It wasn't very personal. I mean, [the agents] tried to be personal, but it their empathy was limited.'* [P6]). Meanwhile, the social robot was the only agent that was linked positively to empathy (*'The robot enabled much more empathy, compared to the chatbot. It might be because it has a face and a voice.'* [P3]).

The effect of the embodiment and emotional expression could also be noticed in participants' preferred agent. Out of six participants, four prefer the chatbot over the social robot. When asked about the reasoning behind their choice, several motives emerged: familiarity and ease of use of the chatbot, unfamiliarity with the social robot, the aspect and behavior of the social robot, unauthentic emotional expression of the social robot.

4.3 Additional Findings

Aside from the identified themes, there were also findings regarding the participant's perception of being understood by the agents. Several participants considered that the agents understood them well: *'They understood the situation pretty well, they would acknowledge certain things and give good advice for that.'* [P4], *'Yes, I think they understood the situation. I think so, because I was explaining about the relatives and relationship, and they took it into consideration.'* [P6]. Meanwhile, other participants considered otherwise: *'I don't think they fully understood the situation because I feel like it might be better if both the agents would ask a bit more questions about Alex's [persona] context in life rather than starting with his concerns.'* [P1], *'They understood the general situation. But not the individual details. At least, I didn't feel understood.'* [P5].

5 DISCUSSION

This researched aimed to answer the following research question:

How can AI-powered chatbots and social robots be designed to optimize user perceptions of trust and empathy in genetic counseling interactions?

The research question is divided into the following sub-questions:

- **SRQ1.** What differences in user experience emerge when interacting with a chatbot versus a humanoid social robot, specifically in terms of perceived trust and empathy?
- **SRQ2.** Which specific verbal and nonverbal behaviors of the chatbot and social robot contribute most to perceptions of trust and empathy, and to what extent?

- **SRQ3.** How do users rate the chatbot and the robot in terms of trustworthiness and empathy when delivering sensitive information, such as in genetic counseling?

5.1 Answer to SRQ1

Several differences were noticed in user experience between the chatbot and the social robot condition. Let us consider the theme 'Embodiment Creates Authenticity Concerns'. The physical embodiment of the social robot was intended to improve naturalness and social connection. Instead, the experiment results show that it simultaneously creates authenticity concerns, particularly among technically knowledgeable participants. This aligns with existing uncanny valley research [8], but it supports it further by capturing how individual differences in technical expertise influence these effects. The finding that participants with technology knowledge were more likely to perceive artificiality suggests that familiarity with AI technology may increase critical evaluation of embodied agents.

With a more extensive analysis, it was revealed the theme 'Embodiment Creates Authenticity Concerns' is highly influenced by the educational background of the participant. Participants with a background in computer science were more likely to perceive the social robot as 'weird' and 'artificial'. At the same time, participants with less knowledge about embodied agents and AI had more positive impressions of the social robot.

In contrast, none of the participants expressed feelings of artificiality or authenticity concerns regarding the chatbot. What is more, the theme 'Cognitive Mediation Hypothesis' provides insights into how the familiar modality of the chatbot influenced trust formation. Text-based interaction appears to allow users more deliberate cognitive processing time. This increases comfort through familiarity, as the pressure felt by the participants to perform is much lower.

Moreover, as the theme 'Emotional Expression Paradox' states, the emotional expressions of the social robot caused it to be perceived as lacking empathy, as a result of the uncanny valley effect. The conflicting impressions felt by the participants negatively affected their experience with the social robot. At the same time, although the dialogue content was identical, the chatbot was perceived as *'professional'*, which improved the user experience with the chatbot for four out of six participants.

Another contribution to the theme 'Emotional Expression Paradox' is represented by the response time for the social robot. Although the response time was relatively the same as for the chatbot, it is a familiar aspect to await a response in a text-based online conversation with a human. For this reason, the response time was not noticed in the chatbot condition. However, in face-to-face human conversations, the response time should be under 300 ms for the conversation to seem natural [12]. This response time was not achieved for the social robot condition, which was noticed by participants (*'It was weird when it was saying "Hm" or "Interesting" and then just staring at me for a while before giving the answer.'* [P3]).

5.2 Answer to SRQ2

The chatbot's professionalism was enhanced by several nonverbal cues. The counselor image contributed to perceived credibility. In addition, the chatbot dialogue content was perceived as 'professional' and 'technical' by majority of the participants.

The text-based modality of the chatbot was familiar for participants. This contributed to reduced cognitive load, as well as increased comfort, as is stated by the theme 'Cognitive Mediation Hypothesis'. Moreover, the lack of embodied features eliminated uncanny valley concerns. Therefore, professionalism, familiarity and comfort all contributed beneficially to the perception of trust for the chatbot condition. Regarding empathy, participants did not associate the chatbot with empathetic behavior.

For the social robot condition, facial expressions and physical embodiment were meant to enhance the perception of trust and empathy. Instead, as a result of the uncanny valley effect, the effect was opposite to that intended. This is also supported by the themes 'Embodiment Creates Authenticity Concerns' and 'Emotional Expression Paradox'.

5.3 Answer to SRQ3

Between the two agents, the social robot was linked to empathy and emotional expression more often than the chatbot. Also, it was considered to have higher empathy and emotional expression than the chatbot. In contrast, the chatbot was linked more often to trust. This is also expressed by the themes 'Embodiment Creates Authenticity Concerns' and 'Cognitive Mediation Hypothesis'.

Regarding the delivery of sensitive information for genetic counseling, it is important for the agents to make the patient feel understood. As discussed in subsection 4.3, only some participants felt understood by the agents. For the rest of participants who did not feel understood, it was noticed that trust was therefore affected negatively.

5.4 Answer to Main Research Question

The findings reveal that sophisticated embodied features do not necessarily translate to improved trust and empathy perceptions. Instead, authenticity emerges as the important design principle. The social robot's emotional expressions and physical embodiment were intended to enhance trust and empathy. In actuality, they created authenticity concerns that affected both trust and empathy perceptions.

The chatbot provided more deliberate cognitive processing time for participants, allowing more consideration of sensitive genetic information. This suggests that for high-stakes healthcare decisions like genetic counseling, interfaces that allow for reflective processing while maintaining a natural conversation flow would be beneficial.

The following design recommendations were identified:

For Trust Optimization:

- Professional Visual Design: Including credible visual elements (such as the counselor image), and utilizing technical yet understandable language can enhance perceived professionalism and credibility.

- Familiar Interaction Modalities: Utilizing interfaces that reduce cognitive load through familiarity can lead to increased trust through comfort.
- Transparency and Predictability: Participants' trust calibration processes should be supported, rather than attempting to achieve complete trust.

For Empathy Optimization:

- Simplicity of Responses: Simple, short and genuine responses may be more effective than complex emotional displays.
- Natural Facial Expressions: Facial expressions should be well integrated in the dialogue content to ensure effectiveness and naturalness, as well as prevent uncanny valley effects.
- Focus on Understanding: Agents should demonstrate comprehension of participant context through appropriate questioning and acknowledgment.

For Genetic Counseling Context:

- Support Individual Processing: Interfaces should be designed to allow participants time to process sensitive genetic information.
- Enable Contextual Understanding: Mechanisms that allow agents to gather and acknowledge personal context and family history more extensively should be integrated in CAs to ensure efficient genetic counseling practices.

5.5 Practical Implications

5.5.1 AI-Powered Agents Considerations. These findings suggest several design considerations for healthcare AI-powered agents:

- Modality Selection
  The choice between embodied and text-based AI-powered agents should consider the target user population's technical expertise and the decisions that users have to make. For technically knowledgeable users or high-stakes healthcare decisions, text-based systems may be more appropriate due to reduced authenticity concerns and higher cognitive processing affordances.
- Trust Building Strategies
  Rather than pursuing complete, unconditional trust, AI-powered agents should be designed to support users' natural trust calibration processes through enhanced transparency, explainability, and consistent performance indicators.
- Emotional Design
  Emotional expression capabilities should prioritize authenticity over sophistication. Simple, genuine emotional responses may be more effective than complex emotional displays that can trigger uncanny valley effects.

5.5.2 Healthcare Context Considerations. In addition to the implications for the design of AI-powered healthcare agents, considerations for the healthcare context were also identified.

In healthcare settings, the findings of this research are particularly relevant given the high-stakes nature of health decisions and the diverse technical backgrounds of patients. The trust calibration mechanism suggests that patients naturally develop protective verification behaviors, which should be supported rather than discouraged through system design that facilitates easy information verification and second-opinion seeking.

5.6 Limitations

Several limitations should be acknowledged. The participant population was relatively homogeneous in age and technical familiarity, limiting the diversity of perspectives captured. Additionally, the experiment setting may not fully capture real-world healthcare interaction dynamics.

The experiment used convenience sampling. However, this limits the generalizability of the findings considerably. Furthermore, the researcher was present in the room with the participant throughout the whole duration of the experiment. This can lead to the observer effect [11]. Therefore, it's possible that the participant's behavior was different than normal.

The order effects of experiencing both conditions may have influenced comparative judgments, though randomization was employed to minimize this bias. Future research should consider between-subjects designs or longer break periods between conditions to better isolate condition-specific effects.

Lastly, facial expressions of the social robot were automated through LLM processing. For this reason, it is difficult to analyze the impact of the facial expressions on trust and empathy. The LLM's expression choices were not documented, preventing analysis of expression-outcome relationships.

5.7 Future Research Directions

These findings open several avenues for future investigation of AI-powered CAs in genetic counseling:

- Individual Differences: Further research should explore how personality traits, technology anxiety, and cultural backgrounds influence the identified theoretical mechanisms.
- Design Interventions: Empirical testing of design modifications based on these themes could validate their practical utility and refine our understanding of optimal AI interaction design.
- Clinical Validation: Testing these themes in real healthcare settings with actual patients could assess their ecological validity and clinical relevance.

6 CONCLUSION

This study investigated differences in perceived trust and empathy for genetic counseling. Two AI-powered conversational agents were compared with this scope during the experiment, a text-based chatbot, and a humanoid Furhat social robot. Data collection was done through post-experiment semi-structured interviews. As a result of qualitative analysis, four main themes emerged, which were able to explain the effects of the different embodiments on trust and empathy: 'Embodiment Creates Authenticity Concerns', 'Cognitive Mediation Hypothesis', 'Trust Callibration Mechanism' and 'Emotional Expression Paradox'.

Several advantages were associated with the chatbot condition: the familiarity and comfort of the modality, professional aspect and higher cognitive processing allowances. All these factors led

to increased trust in the chatbot. However, the chatbot was rarely associated with empathetic behavior.

In turn, the social robot was regarded as more empathetic, and with higher emotional display. Nonetheless, as a result of the physical embodiment, uncanny valley effects emerged. This lead to authenticity concerns and decreased trust and empathy perceptions.

The study's findings provide insights into how AI-powered agents should be designed to enhance trust and empathy in a genetic counseling context. Future research should focus on maintaining authenticity and lower cognitive processing loads through familiarity and comfort, while improving response time and emotional expressions for embodied conversational agents.

7 Appendix

A Interview Questions

(1) How was your interaction with the agents? How would you describe the differences?
(2) Do you trust the agents? Why (not)? What about the content of the dialogue you had with them? Would you follow their advice?
(3) Can you describe how well the system seemed to understand Alex's emotional state and situation during the interaction? What made you feel this way?
(4) How effectively did the system react to the emotional aspects of Alex's genetic situation? Can you give specific examples?
(5) Describe your overall level of trust in this agent. What specific qualities made you feel you could or couldn't depend on it?
    - Trust in information given about HCM
    - Trust in the system's reliability and consistency
    - Trust in the system's transparency
(6) How well do you feel you understood what the system was capable of and what its limitations were? Did these limitations affect your trust?
(7) How authentic and genuine did the system's responses feel to you? Did you sense any artificiality or insincerity? What made you feel that way?
(8) Overall, how well did this system help achieve Alex's goals for this genetic counseling session? What worked well and what didn't?
(9) Which agent would Alex choose, and why? What agent would you choose, and why?

B Persona and Scenario: Alex van der Berg

B.1 Persona

You are Alex van der Berg, a 30-year-old data analyst from Utrecht. You work in a hybrid setup (office/remote) and have been in a committed relationship with your partner Sam for 3 years. You're both health-conscious and enjoy cycling together on weekends.

B.2 Scenario

Your Situation:

Your parent was diagnosed with HCM (hypertrophic cardiomyopathy) at age 45 after experiencing chest pain during a routine bike ride. Your aunt died suddenly at 38 from suspected undiagnosed HCM. You received a cascade screening invitation 6 weeks ago. You and your partner are planning to start a family within 3 years and want to make informed decisions about genetic risks. Your partner is supportive but worried about the emotional impact of testing.

Your Main Concerns:

- *"What if I pass this condition on to our future children?"*
- Whether you'll need to stop cycling competitively if diagnosed
- How HCM might affect your work performance (you often work long, stressful hours)
- The impact on your relationship if you test positive

Your Internal Conflicts:

- *"I've always been healthy. Maybe I should just keep living normally"*
- You're analytical by nature but find yourself emotionally overwhelmed by this decision

Your Approach:

- You balance logical thinking with emotional considerations
- You're open about your concerns but don't want to seem overly anxious
- You value your partner's input and consider the relationship impact of decisions

Your Goal for This Session:

You want to understand the realistic implications of HCM for your lifestyle, learn about family planning options that consider genetic risk, get information on the topic of HCM, and get practical guidance about managing this situation within your relationship and family dynamics. Your goal is to reach a solution about genetic testing - will you have it, will you choose cardiac screening, or will you wait further?

References

[1] Eleni Adampoulu and Lefteris Moussiades. "An Overview of Chatbot Technology". In: *Artificial Intelligence Applications and Innovations*. Sprint International Publishing, 2020, pp. 373–383. ISBN: 978-3-030-49185-7 978-3-030-49186-4.
[2] N. Anzabi and H. Umemuro. "Effect of Different Listening Behaviors of Social Robots on Perceived Trust in Human-Robot Interactions". In: *International Journal of Social Robotics* (2023).
[3] T.C. et al. Beinema. "DNA-poli: Design and development of a digital platform for family communication support and predictive genetic counseling on inherited diseases". In: *Parent Education and Counseling* (2025).
[4] Ana Paula Chaves and Marco Aurelio Gerosa. "How Should My Chatbot Interact? A Survey on Social Characteristics in Human–Chatbot Interaction Design". In: *International Journal of Human-Computer Interaction* (2020).
[5] M.H. Huang and R.T Rust. "Engaged to a Robot? The Role of AI in Service". In: *Journal of Service Research* 24(1) (2020), pp. 30–41. DOI: https://doi.org/10.1177/1094670520902266.
[6] Human Genetics Society of Australasia Ltd. *Clinical Genetic Services Framework*. Document Number: 2024GL01. Feb. 2024.

[7] D. Ireland, D.K. Bradford, and E. et al. Szepe. "Introducing Edna: A trainee chatbot designed to support communication about additional (secondary) genomic findings". In: *Journal of Patient Education and Counseling* (2020).

[8] Jari Kätsyri et al. "A review of empirical evidence on different uncanny valley hypotheses: support for perceptual mismatch as one road to the valley of eeriness". In: *Frontiers in Psychology* (2015).

[9] M. Kyrarini et al. "A Survey Of Robots In Healthcare". In: *Technologies, MDPI* (2021).

[10] Merriam Webster Medical Dictionary. *Empathy.* URL: https://www.merriam-webster.com/dictionary/empathy (visited on 06/14/2025).

[11] Sage Research Methods. *Oberver Effect.* URL: https://methods.sagepub.com/ency/edvol/sage-encyclopedia-of-educational-research-measurement-evaluation/chpt/observer-effect (visited on 06/26/2025).

[12] A.S. Meyer. "Timing in Conversations". In: *Journal of Cognition* 6(1), 20 (2023). DOI: https://doi.org/10.5334/joc.268.

[13] Madison et al Milne-Ives. "The Effectiveness of Artificial Intelligence Conversational Agents in Health Care: Systematic Review". In: *Journal of Medical Internet Research* (2020).

[14] Shivani et al. Nazareth. "Chatbots & artificial intelligence to scale genetic information delivery". In: *National Society of Genetic Counselors* (2020).

[15] I Nordgren and G Svensson. "Prompt engineering and its usability to improve modern psychology chatbots". MA thesis. KTH Royal Institute of Technology, 2023.

[16] S. Park and M. Whang. "Empathy in Human-Robot Interaction: Designing for Social Robots". In: *International Journal of Environmental Research and Public Health* (2022).

[17] L. Rango et al. "Application of Social Robots in Healthcare: Review on Characteristics, Requirements, Technical Solutions". In: *Sensors* (2023).

[18] R. et al. Resta. "A New Definition of Genetic Counseling: National Society of Genetic Counselors' Task Force Report". In: *Journal of Genetic Counseling, Vol. 15, No. 2* (2006).

[19] Lennart Seitz. "Artificial empathy in healthcare chatbots: Does it feel authentic?" In: *Computers in Human Behavior: Artificial Humans* (1 2024). DOI: 10.1016/j.chbah.2024.100067.

[20] R Shao. "An Empathetic AI for Mental Health Intervention: Conceptualizing and Examining Artificial Empathy". In: *EMPATHICH '23* (2023).

[21] Q. Wu, Z. Jin, and P Wang. "The Relationship Between the Physician-Patient Relationship, Physician Empathy, and Patient Trust". In: *Journal of General Internal Medicine* Volume 37 (2022), pages 1388–1393.

[22] Shou et al. Zhou. "Cancer Genetic Counseling by Humanoid Robot Model: Modeling Multimodal Communication of Health Risk". In: (2020). DOI: https://doi.org/10.1145/3371382.3378303.