Exploring Perceptions & Reactions to Digital Humans

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Abstract — **In our increasingly digitalized society, interactions with digital human avatars are becoming more commonplace. Consequently, it is important to explore how humans perceive and react to digital human avatars. In this work, we conduct, and report findings of, an empirical study to explore perceptions and reactions to digital humans with human-like resemblance in appearance and behavior. The study compared perceptions and reactions between different user generations and genders, and its research methodology was underpinned by the four theories of anthropomorphism, social presence, personality inference, and parasocial interaction. The study encompassed interacting with a digital human, investigating notions of digital human avatar appearance for different professions, and in-depth interviews. Our findings indicate how demographic factors may play a part in affecting consumer perceptions and reactions to digital humans, with our older Generation-Y participants and male participants having more positive perceptions, and our younger Generation-Z participants and female participants being the least positive. Furthermore, exploration of digital humans within different professions highlights the potential for prevailing stereotypes, of features such as gender and age, to impact perceptions and reactions. This presents important design considerations and implications for digital human systems, in terms of explicitly leaning into, or pushing against, such stereotypes.**

Keywords—Digital Avatars, Media Design, Anthropomorphic User Interfaces, Social Presence in Virtual Environments, Digital Parasocial Interaction

I. INTRODUCTION

Chatbots have been around for decades and today they are often accompanied by a digital human avatar, which is a virtual character that represents human-like features, facial expressions, and reactions [1]. Previously, some have conjectured that chatbots would never replace humans no matter how complex they get, due to not being able to replicate a human conversation in a fully natural way [2]. However, today chatbots are evolving and becoming more sophisticated, and are able to have more unstructured dialogues [3]. Today, within the Chat-GPT era we are seeing a trend of AI technology making chatbots more advanced [4], and even passing the Turing test in some's eyes [5]. Such chatbots have become so advanced, they can be used to facilitate personal therapeutic seances [6], and one can have very realistic conversations with them [7]. Digital humans are becoming popular as digital entities that operate within domains including media, service, news, and tourism. The rapid advancements of AI and digital avatars together are transforming many aspects of interactions within society, promising a future where digital and real-world interactions will become more and more seamlessly blended. This highlights the importance of exploring how humans perceive and react to digital humans as a crucial area of research. With industries having recently started to take an interest in this phenomenon, many fundamental facets of users' perceptions and reactions to these artificial digital humans remains somewhat unexplored.

In this work, we conduct, and report results and discussions of, an empirical study to explore how digital humans with human-like resemblance in appearance and behavior, impact user perceptions and reactions. The study explored potential contrasts of perceptions between different user generations, exploring a comparison between i) Generation-Z, people born between 1997 to 2012, and Generation-Y (also called Millennials), people born between 1981 to 1996. The study additionally looked to explore potential contrasts between perceptions from different user genders. The study was founded on the theoretical framework of four theories, that of anthropomorphism, social presence, personality inference, and parasocial interaction. Quantitative data was collected via participant survey responses and eye tracking, whilst qualitative data was collected via user test observations and in-depth interviews.

The findings from our study indicate that demographic factors may play a part in affecting consumer perceptions and reactions to digital humans. Moreover, the exploration of digital humans within various professions highlights the potential for prevailing stereotypes, regarding factors such as gender and age, to impact perceptions and reactions. These findings present important media design considerations and implications for digital human systems, in terms of a design awareness to explicitly lean into, or to explicitly push against such stereotypes.

II. STUDY SETUP AND METHODOLOGY

The study took a phenomenological approach and was underpinned by four theories that informed the study's framework and methodology. The four theories were 1) anthropomorphism, 2) social presence, 3) personality inference, and 4) parasocial interaction. Next, we outline these four theories and their relation to our study.

1) Anthropomorphism: Anthropomorphism relates to the attribution of human traits, emotions, or intentions to non-human entities [8]. Chatbot avatar interfaces with human-like features, and a high level of realism, can provide more positive social interactions [9]. However, anthropomorphism has also the potential to impact user behaviour due to partialities such as sexism [10]. Humans are seen to attribute personality traits to computers and machines with anthropomorphic characteristics, for example, users favor a computer with a strong and consistent personality [11]. **Regarding Anthropomorphism, our study explores if we see patterns in relation to the observation of**

any attribution of human traits, emotions, or intentions to digital humans.

2) Social Presence: Social presence can be defined as *"the salience of the other in a mediated communication"* [12]. Psychologically, social presence is often measured as the perceived warmth, conveying a feeling of human contact, sociability, and sensitivity embodied in a medium [13]. Implementing chatbots within digital settings, facilitates interaction between a user and company where more social information can be shared, which can help a user form beliefs and perceptions on the company, and influence the perception of trustworthiness [14]. Within e-commerce the perspective of social presence focuses on the capability to convey a sense of human warmth and sociability [15], and websites with embedded elements like physically embodied digital humans, may help to enhance the perceived social presence [16]. Regarding appearance, digital humans that are like a user's actual or ideal physical appearance may be the best fit [17]. **Regarding social presence, our study explores how feelings of warmth, human contact, sociability, and trustworthiness impact perceptions of digital humans.**

3) Personality Inference: Personality inference can be defined as a perception of someone's personality, to deduce personality traits based on observations [18]. Communication behaviour via text in blogs, or other texts, can be coupled with certain personality traits [19], whilst voices, images and videos can be used to evaluate personality traits [20]. Socio-psychological theory shows that people wish to classify others through trait dimensions such as warmth [21], to try to comprehend the perceived intent of a person, as the idea of others' intention has a high weight in the overall impression formation and evaluation of others [22]. Digital humans, it has been has argued, may be ascribed the same personality evaluations as in human-to-human perceptions [23]. **Regarding personality inference, our study explores if we observe personality traits attributed to digital humans.**

4) Parasocial interaction: Parasocial interaction encompasses audiences interacting and bonding with media characters, such as characters from tv shows, talk show hosts and celebrities, influencers on social media influencers, and cartoons or anime-like characters [24]. A parasocial interaction is experienced as immediate, personal, and reciprocal, where certain behaviour provided by a media performer effectively triggers an intuitive feeling of taking part in a normal social interaction, despite just being a parasocial interaction [25]. Such parasocial interaction may still take affect for a user interacting with digital entities such as virtual digital humans [26], and virtual influencers [27]. **Regarding parasocial interaction, our study explores if we observe any cognitive, emotional, and behavioral responses relating to parasocial responses towards digital humans.**

These four theories inform our study, which consisted of two parts. Part 1 consisted of a user test and part 2 consisted of an in-depth interview. Part 1 was broken down into two sub parts, that of an online interaction with a digital human, followed by a digital test that related both to the previous interaction experience and to additional avatar illustrations. Our study

facilitated the collection of quantitative and qualitative data. The data collected within part 1 could be drilled down into within the interview in part 2. Next, after a discussion of our participant selection, the two parts of our study are outlined.

A. Study parpicants and selection methodology

For our study 12 participants were recruited, with our selection founded on the concept of purposive sampling [28] where a sample group of people is intentionally chosen to represent and inform the research problem in question. For a phenomenological study this sample size is considered suitable [29]. The selection was based firstly on securing an equal distribution between our Generation-Z and Generation-Y generation dimension, and secondly between genders. The participants were selected through an online survey asking people to participate in the research project. This survey was shared on Facebook, LinkedIn, and colleagues' networks. Our main segmentation criterion was age group generation distribution as we wanted to investigate how Generation-Z and Generation-Y would differ during the test, whilst looking to secondly explore the dimension of gender. The breakdown of the 12 participants with respect to these two dimensions is shown in TABLE 1, which shows how our participants were equally split with respect to our main generation dimension, whilst also split somewhat evenly with respect to the gender dimension. Next, we discussion the setup and methodology of the parts of our study, starting with part 1, the user test.

TABLE 1: Participants

	Generation Z	Generation Y
Male	1	3
Female	5	3
Total	**6**	**6**

B. Part 1 – The User Test

The user test constituted a moderated in-person test with an explorative focus. Initially the participants were briefed orally on the test setup; the purpose of the test, the test scenario and the functionality involved[1]. The user test was conducted on a laptop machine with additional IMotions[2] peripheral equipment which recorded eye tracking data and video recording of the participants. Then, the participants were introduced to a tourist guide digital human and were given 5-minutes to interact and converse freely with her[3]. The interface of the system and the digital human is shown in two examples in Fig 1. The participant could verbally speak and interact with the system, and the system additionally provided prompts regarding travel suggestions to ask about, as shown in the right image in Fig 1. These prompts could also be selected nonverbally. After the interaction with the digital human the participant was presented with a set of 8 questions relating to the experience. These questions consisted of questions that related to each of our four theoretical focuses of our study. The set of 8 questions, along with which of the four theoretical focuses the questions most related to, is shown in TABLE 2. The questions were presented with a 5-point Likert Scale with options from Strongly Agree to Strongly Disagree. Next, the participants were shown a set of 6 digital human avatars and requested to select one in relation to

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[1]Participants were also asked to sign a consent form.
[2] https://imotions.com/

[3] We collaborated with NTT Data who provided a digital human application to utilise, where the scenario was a tourist guide - https://www.nttdata.com/

specific professions. Each time they were shown the same set of 6 avatars and asked who they would choose as a i) Doctor, ii) HR assistant, iii) Receptionist and iv) Nurse. The set of 6 Avatars used are shown in Fig 2[4]. After this, participants moved onto part 2.
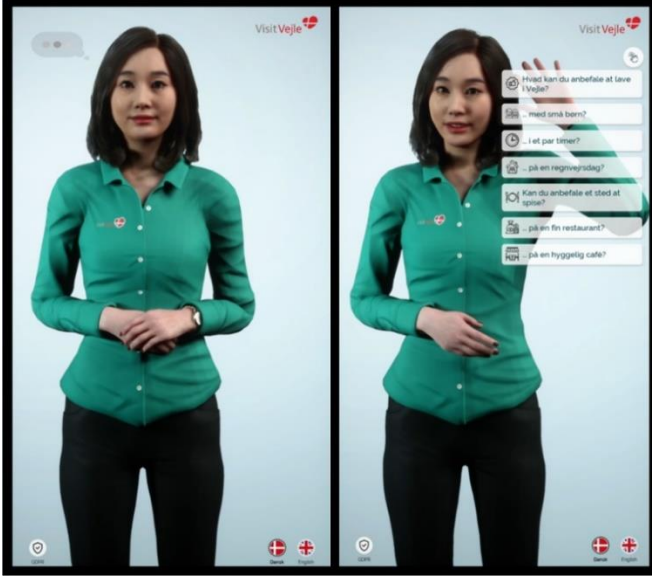

Fig 1: Digital Human Interface

C. Part 2 – Interview

In part 2 of our study the participants undertook a semi-structured in-depth interview. The purpose of the interview was to drill down and examine the participants' experience in meeting a digital human and investigate their sentiments and perceptions. Interviews of this magnitude are recommended for such a phenomenological study [28]. The interviews were informal interviews and reciprocal, where both researcher and participant were engaged in dialogue, without the researcher replying with guiding or leading answers.

III. RESULTS AND DISCUSSIONS

Next, we present the results and analysis from our study followed by discussions.

TABLE 2: The set of Dimensional questions

	Dimension	Question
Q1	Anthropomorphism	Did the interaction feel human?
Q2		Did the digital human feel like a good match for the scenario?
Q3	Social Presence	Did the interaction seem like a human social interaction?
Q4		Did you perceive the digital human as trustworthy?
Q5	Personality inference	Did you find the digital human friendly?
Q6		Did you feel like the digital human had a personality?
Q7	Parasocial interaction	Did the meeting with the digital human feel like a social interaction?
Q8		Did the body language of the digital human feel natural and humanlike?

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[4] The selection of the avatars and professions were chosen to represent a diverse cross-section of society and a variety of diverse roles.
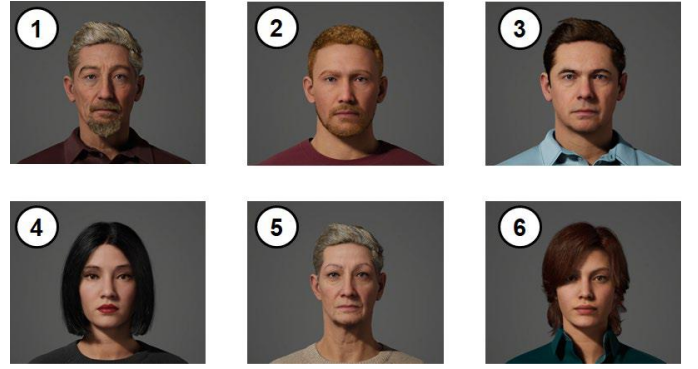

Fig 2: Set of 6 digital human avatars

A. Study Results

From the responses of our set of 8 dimensional questions shown in TABLE 2 the responses were aggregated with respect to our dimensions of generation and gender. The results of aggregating the responses with respect to generation is shown in Fig 3, and the aggregations of the responses with respect to gender is shown in Fig 4.

From Fig 3 we observe that across all questions Generation-Y were more positive towards the digital human, with an overall average from all 8 questions of 3.38, versus 2.38 for Generation-Z. The highest scoring questions, for both generations, were those pertaining to the digital human being humanlike (Q1), the encounter feeling like a human social interaction (Q3) and the digital human feeling like it had a personality (Q6). Conversely, Q5, relating to if they found the digital human friendly, scored lowest for both generations. Moreover, although we observed that Generation-Y were generally more positive, there was a high level of agreement between the generations in terms of which questions scored the highest and the lowest, just with Generation-Y being more positive in absolute terms. The interviews reinforced these findings, for example, a response from a Generation-Z participant was:

"[with] not scripted narratives like here, you can tell that it's just a script they've thrown in, and it is a little late in responding"
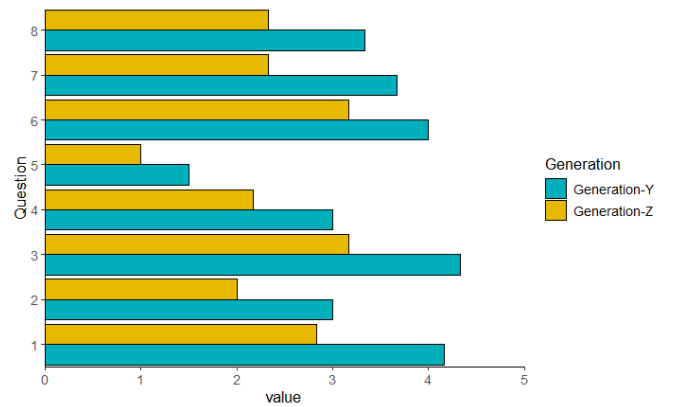

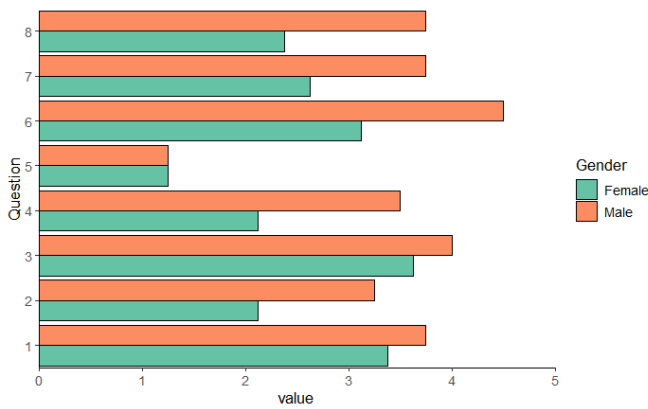Fig 3: Average Generation.-Z and Generation.-Y dimension question answers

Fig 4: Average Male and Female dimension question answers

This Participant also laughed when the digital human did not understand a common word. Such comments and reactions suggest that Generation-Z, with more experience with digital interfaces, have higher expectations in this regard.

From Fig 4 we observe that the male participants were generally more positive with an overall average from all 8 questions of 3.47, versus 2.58 for the females. This difference was most prominent for questions pertaining to if the digital human had a personality (Q6), if the meeting felt like a social interaction (Q7), and if the body language of the digital human felt natural (Q8). However, for questions regarding whether the digital avatar felt human like (Q1), if it felt like a real social interaction (Q3), and whether the digital human seemed friendly (Q5), the male and female participants' responses were much closer. The interviews reinforced these findings, for example, a response from a female participant depicted a reservation towards digital humans with a response of:

"When you go in and meet those people [a tourist guide] they are just passionate. You know - where you get a bit infected by that energy, I would get annoyed with her [the digital human]"

Such a response suggests that females can be more reserved and have higher expectations towards digital human interactions.

From the responses of avatar selection for different professions, the participant responses, in terms of the choice between 1-6, were aggregated with respect to our different generations, and different gender dimensions. Similar aggregation of the eye tracking data during selection was also created and turned into heat maps. For the choice of the avatar most preferred for a doctor, the participants' choices, colored with respect to generation is shown in Fig 5. Here, the x-axis numbers correspond to the numbers of the 6 avatars as shown in Fig 2. The corresponding heatmap data aggregated for Generation-Y is shown in Fig 6, and for Generation-Z in Fig 7.

From the analysis of choice of an avatar for a doctor, we observe an overall choice preference for males as doctors (although, less so for younger looking male number 2). Moreover, the heatmaps show that for both generations all the male choices got more attention during the selection, suggesting more implicit consideration of males as doctors even when it was not the final selected choice. However, it is also the case that all 6 possible choices were selected, with the

Generation-Y participants showing more variety in their choice. The interviews reinforced these tendencies, for example, a response from a Generation-Y participant exemplifies the inclination to choose an older male as a doctor:

"I would prefer to have a male doctor because of gender stereotypes, I also feel that to be a good doctor, he must of course be listening and compassionate and empathetic and sympathetic. Because he looks like he is good at his job".

For the choice of an avatar most preferred for a receptionist, the participants' choices, colored with respect to gender is shown in Fig 8. The corresponding heatmap data aggregated for the male participants is shown in Fig 9, and for the female participants in Fig 10.
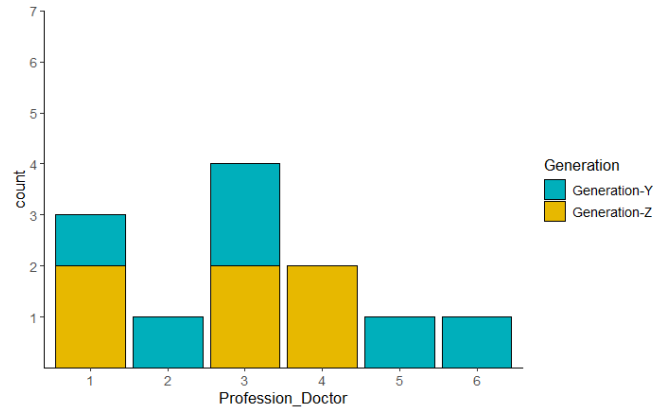

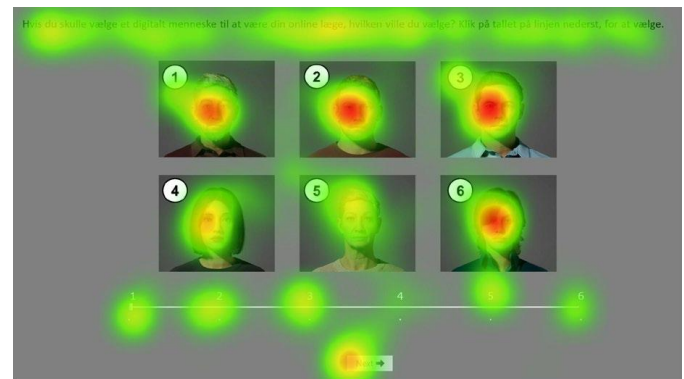Fig 5: Choice of Doctor coloured by generation

Fig 6: Choice of Doctor heatmap for Generation-Y
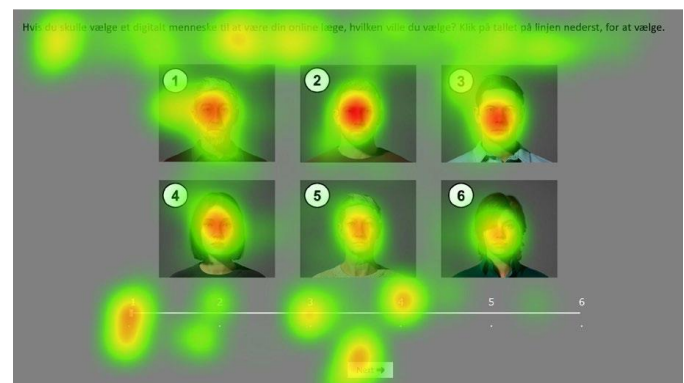

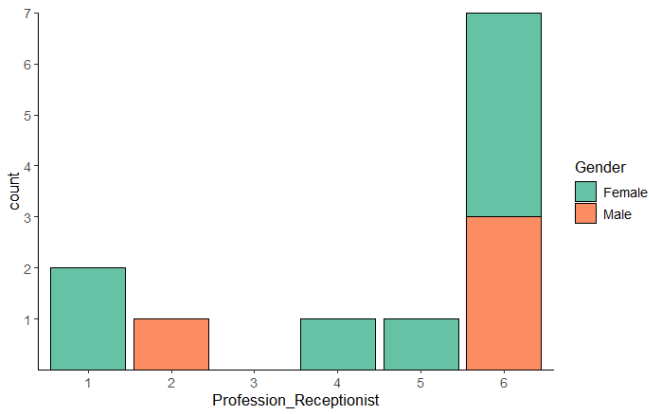Fig 7: Choice of Doctor heatmap for Generation-Z

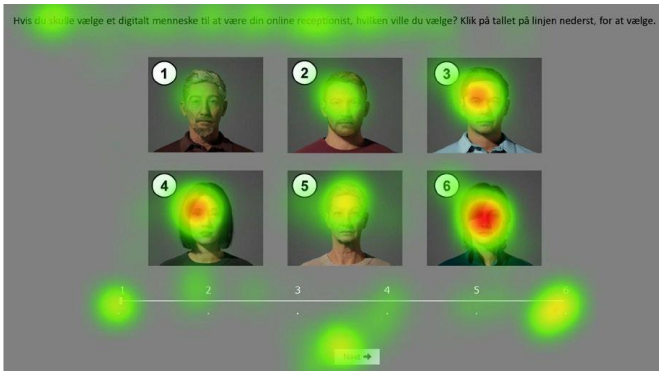Fig 8: Choice of Receptionist coloured by Gender

Fig 9: Choice of Receptionist heatmap for Males

Fig 10: Choice of Receptionist heatmap for Females

From the analysis of choice of an avatar for a receptionist, we observe a large bias for a choice of a female avatar as a receptionist. Moreover, the heatmaps highlight that the female participants gave a lot more attention to all the female choices during selection, suggesting more implicit consideration of females as receptionists before the final selected choice. The interviews helped to uncover rationale behind such biases, as shown by a response from a female participant of:

"It is completely stereotypical. It's just the kind of person you go up to at a counter and then say what you want, and you get the information you want. I think I have met most like her as a receptionist and she does her job and is good at it. She gets things done."

Although the interviews provided such quantitative discussions backing up the observed underlying biases towards prevailing stereotypes, the interviews also uncovered some very participant unique perspectives that influenced their thinking and choices. For example, responses such as that one of the avatars reminded them of his/her mother, which then impacted the reaction and choice considerations.

B. Study Discussions

Regarding the analysis from our study, overall, we observed more positive responses in relation to parasocial interaction from our older Generation-Y participants and our male participants. Regarding personality inference, such as whether the digital human came across as friendly, we generally found that it seen as not friendly by all the participants. However, this lack of personality inference did not stop the sense of other dimensions, such as a sense of some social presence and parasocial interaction, being observed. Overall, we observed clear demographic differences with our older Generation-Y participants and male participants giving more positive reactions to the interaction, whereas the younger Generation-Z participants and females participants were the least positive.

Regarding choices of an avatar for different professions, our results highlight that, despite being aware of the synthetic nature of the different avatars, and the possibility for the same algorithm to be in driving all the avatars, stereotypes and biases from the real world were still exhibited within the digital world. Such observations present interesting implications regarding looking to foresee and predict preferences users might have for different types of avatars in certain scenarios and situations. Such implications should be an important consideration in future planning and designing of such media interfaces, which will only become more common place in the ever-digitalized world. Should one look to lean into stereotypes and biases, to seek to provide a user with an interaction they would expect, if it might lead to a higher chance of a sale. More justly, leaning into such stereotypes and biases might be a useful design choice within scenarios where it would be important for a user to feel at ease, such as within a doctor's appraisal setting where a user feeling at ease might be critical to make them more likely to provide uncomfortable but vitally important information. On the other hand, one could consider designing to try to actively push against such stereotypes and biases, to try to counter them instead of perpetuating them. A system could utilize a mismatch between the presented front facing digital human avatar's appearance and its algorithmic underpinnings in terms of personality and knowledge, to try to explicitly break down and diminish such biases and stereotypes. Such design considerations, of whether to lean in or push against biases, would be context and objective specific.

Although, underlying biases, towards prevailing stereotypes regarding different professions was observed, we also observed how very specific individual context, such as seeing a resemblance to a family member, also influenced perceptions and choices. Such individual context specific observations make it harder to design for specific objectives and reactions in mind. However, these observations could present interesting opportunities within a domain of hyper personalization, given enough user data being available. For example, a system could utilize a digital avatar with a resemblance to a family member to strive for a specific perception and reaction objective.

IV. Conclusions

This paper reported the results and discussions of an empirical study exploring perceptions and reactions to digital human avatars. The phenomenological study, informed by the theories of anthropomorphism, social presence, personality inference, and parasocial interaction, explored perception and reaction differences between generations and gender. In the study, participants interacted with a digital human, explored digital human appearance for different professions, and underwent interviews. Our findings indicate our older Generation-Y participants and male participants had more positive perceptions, our younger Generation-Z participants and female participants had less positive perceptions, and that prevailing profession stereotypes around gender and age impact perceptions. The findings present important design considerations for digital human systems, such as tailoring a system to explicitly lean into, or push against, such stereotypes.

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