Genders & Smart Home Voice Assistants: Advantages & Disadvantages in Relation to a Non-Binary Society

Rick Buijs

Eindhoven University of Technology, Department of Industrial Design
Eindhoven, The Netherlands
r.c.h.f.buijs@student.tue.nl

ABSTRACT

Non-binary is still a term that is vastly underrepresented in design and design research. Highly gendered aspects are heavily implemented in our domestic environment. This paper aims to increase awareness of non-binary genders, and analyses what the advantages and disadvantages are of genders in smart home voice assistants in relation to a non-binary society. To answer this question, surveys were sent out and interviews were conducted, after which a thematic analysis method was used to analyse the qualitative data from the study. Results indicate that knowledge and awareness on non-binary aspects is lacking, yet they also uncover that there is a possibility to grow and develop more inclusive design.

This study concludes on several advantages and disadvantages of genders in smart home voice assistants, and emphasises that designers could benefit from increased non-binary knowledge and awareness in both professional and educational settings in order to increase inclusiveness in design.

KEYWORDS

Gender, Voice Assistants, Non-binary, Smart Home, Society, Genderqueer, Genderless, Gender-neutral, Design, Human Computer Interaction.

INTRODUCTION

Non-binary is an umbrella term that refers to individuals who do not have a gender identity that falls exclusively in traditional binary opposition such as male and female. Non-binary individuals thus define themselves as neither exclusively masculine or feminine. These individuals could either have their gender fall on a spectrum between masculine and feminine, feel elements of both, or experience their gender as different from either [14].

Increasingly more non-binary aspects are implemented into society. Think of genderless clothing and gender-neutral toilets, for instance. However, non-binary is still a term that is vastly underrepresented in media and in design. It is true that a lot of sites like Facebook already let their users choose from a variety of gender options [9]. However, allowing for self-identification does not necessarily equate to representation. There has also been little attention focussed on this absence of representation, even though non-binary individuals are of more sizeable proportions than some might realise. A 2019 survey of the Two-Spirit and LGBTQI+ population in the Canadian city of Hamilton, Ontario showed that 19% of the 906 respondents identified as non-binary [13]. An anonymous online survey conducted in the US in 2015 showed that 35% of the nearly 28.000 transgender respondents identified as non-binary [11].

This underrepresentation can, sometimes unconsciously, lead to harmful biases and discrimination [3]. For instance, studies done on transgender individuals have shown that social stigma is positively associated with psychological distress [2, 18]. Studies also show that the number of individuals who self-diagnosed with gender dysphoria increased substantially [12, 4]. Even though studies done on the health of non-binary individuals are few and far between, it is clear that these individuals are part of a stigmatised and underrepresented population, which is detrimental to a fully inclusive society.

It is therefore important that not only designers in the Human Computer Interaction (HCI) field, but all designers, obtain knowledge and awareness on non-binary implications and aspects in design. This knowledge and awareness could contribute to a more inclusive society for all. "We as designers must become aware of our responsibility and our power to make a change. . . . [H]ere, the notion of gender plays a significant role." (Erhnberger, Räsänen, & Ilstedt, 2012) [7].

This study zooms in on the environment where we spend the most hours of the day in: Our homes [8]. More specifically speaking, this study zooms in on smart home voice assistants. It does so because voice assistants are used globally and widely, but are very rarely examined in terms of gender [21].

Thus, this leads to the research question: "What are the advantages and disadvantages of genders in smart home voice assistants, in relation to a non-binary society?" To find these answers, a genderless voice was created in order to conduct surveys and interviews with participants.

The paper is structured as follows. First, related work in different design fields is presented and discussed. Next, the study is presented, including the design and the approach. Finally, the findings are presented, and the broader implications of the results are discussed.

RELATED WORK

Related work in connection to gender includes studies that have been done with a focus on feminism or feministic methods in design. They highlight valid concerns that everyday practices in a domestic environment are already highly gendered, and that technology designed for the home is coming from an industry that is already suffering from a lack of gender diversity [22, 16, 17]. However, they do so through a binary view on genders, focussing solely on the male and female gender.

Bardzell (2010) [1], for instance, gives a critical outline of her vision for feminism in different design fields. She believes feminism provides opportunities for designers, including feminine approaches to design. In their work, Søndergaard and Hansen (2018) [19] present gender issues through a feminist design methodology, and they argue that our perspective on digital personal assistants in our homes and lives are interwoven with gender issues concerning these assistants. While not untrue, these studies lack a broader and less binary view of gender. Other studies seem similar in this manner. Take for instance the work of Strengers and Nicholls (2017). The authors highlight the increase of household work and play, and see voice assistants as 'wife replacements', proclaiming that this results in more housework for men—insinuating that a relationship consists of a man and a woman—, and possibly leading to "more work for father" [20], which insinuates that a mother and father have assigned tasks in the home, merely dependant on their gender. An essay by Chatterton and Newmarch (2016) explores these social inequalities and highlights an unequal distribution of the 'everyday futures' in the present. Chatterton and Newmarch state that sometimes, intentionally or not, certain social groups (identifiable by for instance gender, class, race, etc.) are excluded from visions of the future [5]. The essay concludes in a stream of rhetorical questions, inspiring readers to think more carefully about the present and how it affects the future. The Authors make one thing clear, however: Business-as-usual is not an option.

Amazon's Alexa, Microsoft's Cortana, and Apple's Siri, all have female names. While Google's voice assistant, named the Google Assistant or Google Home, does not have a female name, it does have a female voice. As West, Kraut, & Chew (2019) point out, most leading voice assistants today are exclusively female or female by default. This includes both name and sound of voice [23]. The authors further talk about the option to add the male voice alternative, or to remove the default female voice setting. They only very lightly touch on the various ways other projects have introduced new voices that can help address gender issues.

A study that has been done on voice assistants and gender by Obinali (2019) indicates that there should be an increase in conversations and research on how users have a major preference for, and enjoy being assisted by, a female-voiced voice assistant. The author states that additional research needs to be conducted as this could translate into societal expectations for women [24].

These studies all concern gender in some way or another. However, the focus is mostly on female or binary gender aspects concerning existing design or voice assistants.

Spiel and Keyes (2019) make a sound case against the HCI community, and project their dissatisfaction of their rarely considered non-binary gender onto them by sharing their own experiences and possible alternatives to what they call 'gender bugs'. They have highlighted the casual violence that technology presents towards non-binary people, and present the HCI community with utopian 'bug fixes' that urge them to do better. The authors even go as far as to say that "rather than take the easy way out when it comes to inclusion, we must embrace the complexity and plurality of existence. Only then will this fictional utopia—a utopia of conditions others take for boring and granted—turn into our everyday reality as well" (Spiel and Keyes, 2019) [21]. This shows a clear and very understandable dissatisfaction with the current binary view on genders in design.

West, Whittaker, & Crawford (2019) explain that the diversity problem is not just about women. In their opinion it's about gender, race, and most fundamentally, about power. This power affects how companies operate, what products get built, who they are designed to serve, and who benefits from their development [24]. This paper also highlights the pushback against diversity. Demands for inclusion and equity, together with a growing awareness, have led to some change. However, the authors state that "there has also been resistance, especially among those implicitly privileged by the status quo."

A work by Haverkamp (2018) [10] aims to increase knowledge of gender in engineering, and calls for broader literature and awareness on gender in classroom and professional interactions. The work prompts a necessary discussion around non-binary inclusion, and gives engineers several options regarding the discussion, reflection, researching and collaboration for gender inclusiveness.

While these works highlight problematic gender-specific views, it is unfortunate that no studies have yet explicitly focussed on non-binary implications for design concerning voice assistants. There is one project that has tried to take a first step towards a truly genderless voice, which is simply named 'Q' [6]. This is a voice that was created by Copenhagen Pride, Virtue, Equal AI, Koalition Interactive and thirtysoundsgood using data from audio researchers. The voice was assembled using recorded voices of people who identify as non-binary. Unfortunately to date, however, no fully functional non-binary voice assistant has been brought onto the market, or has even ever been realised. This calls for research into genders and voice assistants, especially concerning a non-binary society.

In conclusion, it is clear that a lot of work has already been conducted on genders and different design fields. However, the underrepresentation of the non-binary is clear. Marginalised groups like the non-binary or genderqueer seem to yet serve little interest to designers or researchers in the field of design, which is simply detrimental to a fully

inclusive society. This study adds to already existing research that has been done on genders and voice assistants, and hopes to improve inclusiveness in design.

STUDY SETUP

This study aims to find the advantages and disadvantages of genders in smart home voice assistants, in relation to a non-binary society. Data was gathered through an online survey to assess thoughts and opinions on genders in existing voice assistants, and to trigger thoughts about future non-binary voice assistants. Another, although smaller, goal of the survey was to generate data on the thoughts, opinions and views of participants on a non-binary society. Through triangulation, the semi-structured interviews were another method through which the study was conducted, and gave deeper insights into the answers of participants to further expand on the questions and answers from the survey.

Before the start of the study, an ethical procedure for the Eindhoven University of Technology (TU/e) was completed. An ethical review form that needed to be sent in before the study could be initialised was submitted to the ethical review board within the university. This board then assessed the form and approved the study. The ethical review form guarantees that the privacy, data and wellbeing of participants is protected, and no personal data or contact information is stored. Interviews were not recorded to protect participants, as some participants identified as non-binary. Thus recording them could decrease the feeling of safety and secureness participants felt while sharing personal data. Participants were asked to read and accept a consent form before participating in the survey. This consent form can be found in appendix 1: Survey consent. Participants were assured that all of their information would be treated with care and that their data would remain fully anonymous.

Both the survey and the interview were conducted entirely via online means. Due to the COVID-19 pandemic, the study had to be fully online in order to safely conduct the research. The survey was created in Microsoft Forms, and interviews were conducted through the use of Microsoft Teams. Both of these platforms were approved by the ethical review board of the TU/e. The survey was distributed via the personal and professional network of the researcher.

Participants for both the survey and the interviews were randomly chosen. Although there was a preference for participants that identified as designers. All participants were of 18 years or older, and did not need to reside in The Netherlands. The focus of the study was to gather qualitative data from participants, which meant the amount of participants did not need to be of sizeable proportions. Data was gathered until main themes amongst answers from different participants became clear, and clear conclusions could be drawn from the data.

Participants were presented with a short audio fragment of a non-binary voice. This voice, named 'A', was created for the purpose of this study, and is based on the previously mentioned genderless voice named 'Q' [13]. The voice in the audio fragment implements the research and knowledge that was used by the creators of 'Q', in order to make the voice sound non-binary. It does this by placing the voice between 145Hz and 175Hz, a range defined by audio researchers as gender neutral [13]. The voice was also given the name 'A', which is not explicitly male or female, in order to further increase the gender neutrality of the voice.

The audio fragment gave participants information on different non-binary terminology, and highlighted the differences between a person's gender (someone's own gender role or identity, determined by themselves) and sex (someone's assigned or biological sex, determined at birth). This was done in order to clearly convey all questions to the participants, to safeguard answers from any unnecessary comments or confusion regarding the subject, and because it can be assumed that non-binary terminology and information on the subject is not widely known.

After listening to the audio fragment, participants were asked to share their thoughts and opinions on gendered and non-binary voice assistants. The survey consisted of open-ended questions, which gave the participants an incentive to share their views. The specific questions used in the survey and in the interviews can be found in appendix 2: Questions & Gathered data.

The interviews were conducted in order to gain deeper insights into the answers of participants. The interview was therefore similar to the survey in tone and questioning. The interviews were semi-structured, which allowed open discussions, follow-up questions and gave participants ample time to share thoughts and perspectives.

Because the data from the survey and interviews was qualitative in nature, a thematic analysis was used. This type of analysis is widely used with qualitative research data, and allowed data to be analysed, examined and finally combined into themes efficiently. This made it more efficient to grasp the broader image of what was being shared by participants.

FINDINGS

The purpose of this study is to find the advantages and disadvantages of genders in smart home voice assistants, in relation to a non-binary society. A more detailed overview of the questions, obtained data and charts can be found in appendix 2: Questions & Gathered data.

The interview and survey counted 38 participants combined. The amount of participants per age group can be seen in the chart 1. A large portion of participants were of ages 20 to 30 years old.
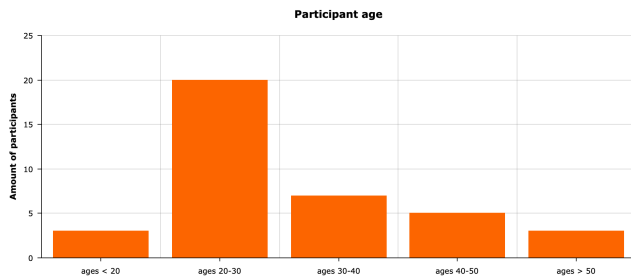
Chart 1: Amount of participants per age group.

As can be seen in chart 2: 52% of participants identified as male, 39% of participants as female, and 9% of participants as a non-binary gender.
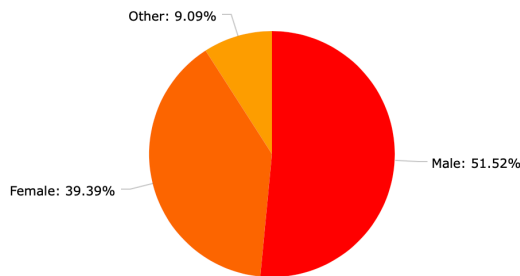

Chart 2: Amount of participant per gender in percentages.

It is also of importance to highlight that 45% of participants identified as designers.

Results indicate that 82% of participants had previous experience with voice assistants. However, of those participants 93% had exclusively talked to female voice assistants. Participants referred to various voice assistants by their own perception of the gender of that voice assistant, using gendered pronouns like 'her' and 'she'.

- *"Yes I have talked to Siri, which is set to be a female voice for me. I'm sure I attribute feminine characteristics to her."*

- *"Just to the Samsung version of Siri... she is a robotic female voice."*

When asked about the advantages or disadvantages while listening to the non-binary voice, 64% of participants did not encounter any. Of the other 36% of participants, opinions on advantages and disadvantages were evenly split: 18% of participants saw advantages in a non-binary voice, and 18% saw disadvantages.

- *"For me it would not really matter if the voice is female/ male/genderless, since I only use voice assistants for functional purposes."*

However, when later asked about a non-binary voice assistant, 59% of participants expressed doubts. Some participants even mentioned that they didn't see the need for such a voice assistant.

- *"I think it's hard to create a genderless voice assistant, especially in the current society where people still have a gender assigned to voice."*

- *"It's something I would need to get used to. The default female voice on my Google Home has become pretty familiar."*

- *"I think they can be very meaningful to certain people but I do not believe they are necessary."*

- *"I personally don't see a need for it."*

Also, 46% of participants were doubtful about a non-binary voice assistant having the potential to prevent harmful biases and discrimination.

- *"I don't think it will help against discrimination because I think it will have the opposite effect on the situation."*

- *"People are stuck in their ways sometimes and let their ignorance get in the way of progress. I think it'll take more than voice assistants to prevent discrimination."*

- *"I don't think it would have a big impact on the non-binary community. Because I don't think people will associate their voice assistant with a non-binary person."*

- *"I think most people will assume the gender they want to hear."*

Participants were asked about a genderless voice and possible distractions that could come from having a voice assistant with no clearly indicated gender. 70% of participants mentioned that they thought it would not distract them, or that the distraction would not be based on the gender of the voice.

- *"I don't think so. You ask the voice AI (Artificial Intelligence) something, so you expect a voice back, no matter how it sounds."*

- *"No, I imagine it to be the opposite. A genderless voice will be more neutral so it won't distract you."*

- *"I don't really think so. I'm not usually all too concerned about the gender of the person I'm speaking to."*

67% of participants felt that it was not important for a gender to be clearly indicated when using a voice assistant.

- *"I don't think it is important. However, I do think it is important for a voice AI to have a name to make it more likeable for people."*

- *"I don't think a gender should be connected to a voice assistant."*

- *"As part of the LGBT community I feel very comfortable with breaking gender norms and being more inclusive of non-binariness."*

Moreover, 52% of participants stated that they thought their perception of a voice would change if the voice would be assigned to a specific gender.

- *"Yes, if that was the case, I would imagine a female or male in my head."*

- *"Yes I think so! Because my ears are more used to specific female or male voices in things like that."*

- *"Yes, because I believe our knowledge and initial attitude shapes our perception."*

42% of participants even mentioned that an advantage of a gendered voice was the increased feeling of comfort.

- *"People are able to place the voice in their mind and can therefor feel more comfortable with it."*

- *"It makes you feel comfortable, trusted and safe more quickly."*

- *"It will help people to feel more understood."*

- *"I might feel more comfortable talking to something with a stronger identity about certain topics, I think they can better help me with this."*

It it interesting, however, that earlier on in the survey and interview 82% of participants did not name any disadvantages to non-binary voice assistants. Only 18% of participants indicated seeing a disadvantage in a non-binary voice. Of participants that saw a disadvantage, no comments were made about the feeling of comfort when using a voice assistant. Only one participant commented on the fact that the voice sounded emotionless and monotone.

- *"My brain was still trying to put a label on the voice as male/female and I spent a lot of time thinking about that."*

- *"The voice sounded a bit monotone and emotionless (it should function as close to a person as possible)."*

When asked about disadvantages of gendered voice assistants, 38% of participants admitted they felt directed towards a certain feeling when using such a voice assistant.

- *"It directs you to a certain feeling."*

- *"A male or female voice will play tricks on our emotions. For example in the movie Her, where a guy falls in love with a female voice."*

- *"The way people think of obtained information is dependant on who is saying it to them."*

And when asked about the reason for genders in voice assistants, 25% of participants responded that they thought genders are implemented to influence users.

- *"To reach certain groups of people, to influence you."*

Although 32% of participants did not see any disadvantages to gendered voice assistants.

- *"I don't feel like there is any negative part to it."*

- *"I don't think there is a disadvantage."*

- *"I can't think of any. I don't think it really matters if it's a man, woman, or something in between."*

31% of participants thought genders are incorporated in voice assistants in order to sound more human.

- *"Because people in real life have "gendered" voices and so I can imagine it being nice to have a voice assistant with that feature."*

- *"Because everyone is born with a certain gender, (male/female) so it is only normal to create a voice that fits with what we know."*

- *"This way it feels more like you are talking to a person instead of an AI."*

- *"People like to link a voice assistant to a person. Most people view a person as having a gender that is the same as their sex."*

Only 15% of participants were of the opinion that gendered voice assistants reinforce traditional gender roles.

- *"It can reinforce gender roles. Like Siri being a woman, and basically being your assistant."*

- *"I think it's minor, but it could reinforce a certain image I have of that gender, even though I'm not talking to a male/female at all but a machine."*

- *"A female voice gives power to the idea that the woman in a relationship should always stay home and care for the man/husband, the same way secretaries are still seen as female."*

In a later question about what role genders play in connection to voice assistants, 29% of participants responded with thinking it reinforces traditional gender roles.

- *"I think female voices are used too much in the smart home control devices. This is actually very old fashioned, it can be perceived as the woman who 'controls' the home environment when back in the days woman stayed home and the men worked."*

- *"I can't tell you how many straight guys I have seen flirting with female voice assistants. I think that would be different if they had a neutral voice."*

- *"We probably project gendered expectations onto the voice assistant even though that is not necessary."*

61% of participants had no experience with non-binary aspects. Responses to questions show that a high amount of participants confused gender and sex, and did not know the difference between the two terms. This was the case with, for instance, the last question of the survey, which asked participants what their thoughts were on a fully inclusive non-binary society.

- *"This will simply never happen. Nature made feminine and masculine aspects for a reason."*

- *"I don't think it will ever be completely genderless. I hope society will be more open, accepting and the genders will blend more into each other. But there will always be a biological difference between genders."*

- *"Striving for equal chances is better than trying to suppress the biology of humankind."*

Yet, 71% of participants indicated that they had no problem with a fully non-binary society. Some participants were even enthusiastic of such a prospect in their responses.

- "Great! Gender is a social construct anyway. The end of toxic masculinity and sexism will make the whole a much brighter place."

DISCUSSION
A brief re-stating of the research question: "What are the advantages and disadvantages of genders in smart home voice assistants, in relation to a non-binary society?"

Results indicate that a large portion of participants had previous experience with voice assistants. However, of those participants with experience, almost all had only exclusively talked to female voice assistants. Participants are quoted as saying that "the default female voice on my Google Home has become pretty familiar", and "when installing the device, we left the voice settings as is and it works fine for us." Perhaps participants lack experience with male voice assistants because most voice assistants are female or female by default [22]. This inconsequential mindset towards the gender of existing voice assistants hints to a lack of thoughtfulness and awareness under participants.

The results also indicate somewhat contradicting data. Initially, 82% of participants commented that they saw no disadvantage to a non-binary voice assistant. However, over half of the participants expressed doubts about the necessity of a non-binary voice assistant, stating that they "did not personally see a need for it", or that they "didn't think they are necessary." Also, when asked later about the possible advantages of a gendered voice assistant, 42% of participants mentioned that an advantage of a gendered voice was the increased feeling of comfort. These results could hint to the lack of experience that a lot of participants have with non-binary aspects. It seems that participants feel comfortable talking to a gendered voice assistant, but do not immediately link a non-binary voice assistant or non-binary voice to the feeling of discomfort.

Participants also referred to various voice assistants by their own perception of the gender of that voice assistant, using gendered pronouns like 'her' and 'she'. Participants seemed to think, or want to think, of voice assistants like people, wanting to "link a voice assistant to a person" or sound "like a person instead of an AI", even mentioning that "it should function as close to a person as possible". One participant mentioned that they were sure to attribute "feminine characteristics" to their female voice assistant. Perhaps they meant traditionally feminine characteristics, like for instance sensitivity and gentleness. Of course it would be easy to create a voice assistant that sounds like a robot in order to erase traditional gender attributes and characteristics from a voice assistant, which would directly solve the problem concerning the reinforcement of traditional gender roles in voice assistants. However, as the results have indicated, participants like to imagine a person when talking to a voice assistant, which seems to make the voice assistant appear less like an AI. In this sense, users

get the impression that someone is talking to them, rather than something. This could perhaps be beneficial for users, as some participants indicated they feel more comfortable with a gendered voice assistant. However, this raises other questions, for instance: How harmless is it for users to think of a voice assistant as a person? Wouldn't it be better to completely remove genders from voice assistants as they are computers and ultimately not empathetic, kind or sensitive?

Other interesting results surfaced when participants were asked about their need to have a gender specifically indicated when using a voice assistant. More than half of the participants stated that a clear indication of gender is not important with voice assistants. Moreover, half of the participants think that their perception of a voice would change if there was a clear gender specified. Results also show that, when asked about the disadvantages of a gendered voice assistant, over a third of the participants admitted they felt directed towards a certain feeling when using such a voice assistant. This is echoed when participants were asked about the reason for genders in voice assistants. A quarter of participants responded that they thought genders are implemented to influence users. This demonstrates a correlation with the work of Obinali (2019), as they stated that "people are more likely to be more receptive to a voice that is pleasant. It also suggests there may be persuasive power in women and femininity vocally thereby having influence on users of both genders." [24]. From these results one could imagine that through the use of a non-binary voice assistant, there would be no perception of gender. Thus, a non-binary voice assistants could perhaps eradicate the gendered influences on users, and help prevent gender biases and discrimination.

However, participants had varied opinions on the role gender plays in voice assistants. While one participant even expressed that they "can't tell you how many straight guys I have seen flirting with female voice assistants", on average, less than a quarter of participants agreed with the statement that genders in voice assistants reinforce traditional gender roles. This is less than could be expected going by the work of Erhnberger, Räsänen, & Ilstedt (2012) [7], Haverkamp (2018) [10], and Spiel and Keyes (2019) [19]. These works indicate a long term call for action, knowledge, attention and awareness to genders, the non-binary and their implications. Yet, there still seems to be a low level of awareness of the reinforcement of gender roles in voice assistants. This also raises questions on the communication people would have with a non-binary voice assistant. Are people not going to flirt with a non-binary voice assistant? Or perhaps users would flirt with it differently?

Even though most participants saw disadvantages to a gendered voice assistant, a third of the participants did not see any disadvantages to gendered voice assistants. This is indicative of the other results, and hints towards a lack of gender awareness amongst participants. Most participants also did not initially know the difference between gender and sex, and findings show—even after explicit explanation of sex and genders—that participants continued to confuse

the two terms. Answers that stood out when asked about a fully non-binary society, for instance, were "because everyone is born with a certain gender, (male/female) so it is only normal to create a voice that fits with what we know.", and "there will always be a biological difference between genders."

Although a high percentage of participants indicated to having no problem with a fully inclusive non-binary society, results show doubts about the effectiveness of a non-binary voice assistant towards the prevention of harmful biases and discrimination. Participants argued it would take more than a voice assistant to prevent discrimination towards non-binary individuals, or that the implementation of a non-binary voice assistant would have no impact at all. Some participants even stated that they thought it would have the opposite effect on the situation. These findings point out that perhaps a voice assistant is not the optimal way to prevent harmful biases or discrimination.

Humans have evolved to classify everything we perceive into groups and subgroups: this is how we distinguish a dog from a cat, and how we can recognise a specific dog we have never seen before as a dog, because it is conform with the general rules that apply to dogs. This is an important skill to have, because without it humans would not survive. It does, however, raise questions such as: Can biases or discrimination ever truly go away, especially when we consider the concept of intersectionality? On the other hand, what could society stand to lose when we implement a non-binary voice into smart home voice assistants, especially as a third alternative option? Will people get used to this non-binary voice? Or is a non-binary voice perhaps a better alternative because a voice assistant is, after all, a computer?

To answer the research questions from this study: Participants indicated that advantages to genders in smart home voice assistants consisted of the feeling of talking to a person and feeling more comfortable when talking to the voice assistant. Found disadvantages included participants stating that they felt like being influenced towards a certain feeling, and the reinforcement of traditional gender roles through the use of such voice assistants.

Unfortunately to date, no fully functional non-binary voice assistant has been brought onto the market, or has even ever been realised. While this is problematic in and of itself, it does give designers opportunities to create products, in this case voice assistants, that are more inclusive. While previous research has focused on feminism, stating that women should be more heavily involved with the implementation of voice assistant technology [9], the lack of awareness and knowledge in these results demonstrate that the implementation of non-binary individuals in professional environments could be equally as beneficial. A greater awareness for non-binary aspects could be generated, which could increase inclusiveness in design. After all, if we do not consider such a large portion of society [11, 13] when we design something that is so

heavily concentrated with gender, then how can society ever become fully inclusive?

Thus, I am of the opinion that it would be beneficial to introduce non-binary aspects in professional and educational settings, especially considering design fields. This could ultimately increase knowledge, awareness and inclusiveness in design.

CONCLUSIONS

This study does research on the advantages and disadvantages of genders in smart home voice assistants, in relation to a non-binary society. The goal in doing so is to increase knowledge and awareness on non-binary implications and aspects in design, as non-binary is still a term that is vastly underrepresented in media and design, and knowledge and awareness on this subject could contribute to a more inclusive society for all.

Through the use of surveys and interviews, this study generated initial results on advantages and disadvantages of genders in smart home voice assistants, and highlights a problematic lack of knowledge and awareness in participants.

The simple truth is that change does not happen on its own. If we want to strive for a fully inclusive society for all, we need to actively cultivate it. Non-binary aspects in design, and teaching the newer generations of designers the knowledge they need to create more inclusive designs, are essential to that.

FUTURE WORK

Further research is needed to fully establish the results of this study. The generalisability of the results is limited by the relatively small amount of participants. Thus, future studies could benefit from a larger pool of participants, and an explicit focus on designers.

Research could also be conducted on the implementation of non-binary aspects in professional and classroom settings, with a specific focus on design and designers. These studies could build on the work of Haverkamp (2018) [10], as the work calls for broader literature and awareness on gender in classroom and professional interactions.

This study was also unable to address multiple questions on non-binary voice assistants and future implications of implementing non-binary voice assistants. For instance: Could people learn to work with a non-binary voice assistant? What could people learn from a non-binary voice? These are questions that further research will hopefully be able to answer. Thus, more research can be done on non-binary awareness and knowledge in design and on voice assistants, in relation to a non-binary society.

ACKNOWLEDGMENTS

Secondly, I would like to thank all of the participants for actively contributing to the study by filling out the survey and completing the interviews. I'm aware that for some participants it was a difficult subject to broach, and I'm thankful for the courage participants had to step forward and let themselves be heard.

Lastly, I would like to thank the staff and students of the department of Industrial Design at the University of Technology in Eindhoven for their feedback and support, which proved to be essential to the completion of this study.

REFERENCES

1. BARDZELL, S. 2010. Feminist HCI: taking stock and outlining an agenda for design. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '10). Association for Computing Machinery, New York, NY, USA, 1301–1310. DOI: https://doi.org/10.1145/1753326.1753521

2. BOCKTING, W.O., MINER, M.H., SWINBURNE ROMINE, R.E., HAMILTON, A., COLEMAN, E. Stigma, Mental Health, and Resilience in an Online Sample of the US Transgender Population. *American Journal of Public Health* 103, no. 5 (May 1, 2013): pp. 943-951. DOI: https://doi.org/10.2105/AJPH.2013.301241

3. BRADFORD, F., REISNER, S.L., HONNOLD, J.A., AND XAVIER, J. Experiences of Transgender-Related Discrimination and Implications for Health: Results From the Virginia Transgender Health Initiative Study. *American Journal of Public Health* 103, no. 10 (October 1, 2013): pp. 1820-1829. DOI: https://doi.org/10.2105/AJPH.2012.300796

4. VAN CAENEGEM, E., WIERCKX, K., ELAUT, E. *et al.* Prevalence of Gender Nonconformity in Flanders, Belgium. *Archives of Sexual Behavior,* 44, 1281–1287 (2015). DOI: https://doi.org/10.1007/s10508-014-0452-6

5. CHATTERTON, T., AND NEWMARCH, G. (2016) "The Future is Already Here - It's Just Not Very Evenly Distributed". In: *Spurling N. and Kuijer, L. (Eds) Everyday Futures.* (2016). Everyday futures. Lancaster: Lancaster University. Institute for Social Studies. Retrieved from http://wp.lancs.ac.uk/everydayfutures/files/2016/08/chatterton_newmarch.pdf

6. COPENHAGEN PRIDE, VIRTUE, EQUAL AI, KOALITION INTERACTIVE, THIRTYSOUNDSGOOD. 2019. Retrieved from http://www.genderlessvoice.com

7. EHRNBERGER, K., RÄSÄNEN, M., AND ILSTEDT, S. 2012 Dec 20. Visualising Gender Norms in Design: Meet the Mega Hurricane Mixer and the Drill Dolphia. *International Journal of Design* [Online] 6:3. Retrieved from http://www.ijdesign.org/index.php/IJDesign/article/view/1070

8. EUROPEAN COMMISSION. 2003. Indoor air pollution: new EU research reveals higher risks than previously thought. Retrieved from https://ec.europa.eu/commission/presscorner/detail/en/IP_03_1278

9. GOLDMAN, R. 2014. Here's a List of 58 Gender Options for Facebook Users. *ABC News,* (Feb. 2014). Retrieved from https://abcnews.go.com/blogs/headlines/2014/02/heres-a-list-of-58-gender-options-for-facebook-users/

10. HAVERKAMP, A. (2018). The Complexity of Nonbinary Gender Inclusion in Engineering Culture. Retrieved from https://www.researchgate.net/publication/328030540_The_Complexity_of_Nonbinary_Gender_Inclusion_in_Engineering_Culture

11. JAMES, S.E., HERMAN, J.L., RANKIN, S., KEISLING, M., MOTTET, L., AND ANAFI, M. (2016). The Report of the 2015 U.S. Transgender Survey. Washington, DC: National Center for Transgender Equality. Retrieved from https://www.transequality.org/sites/default/files/docs/usts/USTS%20Full%20Report%20-%20FINAL%201.6.17.pdf

12. KUYPER, L., WIJSEN, C. Gender Identities and Gender Dysphoria in the Netherlands. *Archives of Sexual Behavior*, 43, 377–385 (2014). DOI: https://doi.org/10.1007/s10508-013-0140-y

13. MILLS, S., DION, M., THOMPSON-BLUM, D., BORST, C., DIEMERT, J. 2019. Mapping the Void: Two-Spirit and LGBTIQ+ Experiences in Hamilton. Retrieved from https://labourstudies.mcmaster.ca/documents/mappingthevoid.pdf

14. MONRO, S. Non-binary and genderqueer: An overview of the field. *International Journal of Transgenderism,* Volume 20 (Jan. 2019), 126-131. DOI: https://doi.org/10.1080/15532739.2018.1538841

15. OBINALI, C. 2019. The Perception of Gender in Voice Assistants. SAIS 2019 Proceedings. 39. Retrieved from https://aisel.aisnet.org/sais2019/39

16. RODE, J.A., 2011. A theoretical agenda for feminist HCI. Interacting with Computers 23, 393-400. Retrieved from https://dl.acm.org/doi/10.1016/j.intcom.2011.04.005

17. RODE, J.A. and POOLE, E.S., 2018. Putting the gender back in digital housekeeping. In GenderIT ACM, Heilbronn, Germany, 14-15 May, 79-90. Retrieved from http://dx.doi.org/10.1145/3196839.3196845

18. SCANDURRA, C., AMODEO, A.L., VALERIO, P., BOCHICCHIO, V., FROST, D.M. Minority Stress, Resilience, and Mental Health: A Study of Italian Transgender People. *Journal of Social Issues* (Sep. 2017). DOI: https://doi.org/10.1111/josi.12232

19. SØNDERGAARD, M.L.J., AND HANSEN, L.K. (2018). Intimate Futures: Staying with the Trouble of Digital Personal Assistants through Design Fiction. In *Proceedings of the 2018 Designing Interactive Systems Conference* (DIS '18). Association for Computing

Machinery, New York, NY, USA, 869–880. DOI: https://doi.org/10.1145/3196709.3196766

20. SPIEL, K., KEYES, O., AND PINAR BARLAS. 2019. Patching genders: non-binary utopias in HCI. In *Proceedings of CHI Conference on Human Factors in Computing Systems Extended Abstracts (CHI'19 Extended Abstracts), May 4–9, 2019, Glasgow, Scotland UK*. ACM, New York, NY, USA 10 Pages.DOI: https://doi.org/10.1145/3290607.3310425

21. STRENGERS, Y., NICHOLLS, L. 2017. Aesthetic pleasures and gendered tech-work in the 21st-century smart home. *Media International Australia.* 166. DOI: https://doi.org/10.1177/1329878X17737661

22. STRENGERS, Y., KENNEDY, J., ACARI, P., NICHOLLS, L., AND GREGG, M. 2019. Protection, Productivity and Pleasure in the Smart Home: Emerging Expectations and Gendered Insights from Australian Early Adopters. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (CHI '19). Association for Computing Machinery, New York, NY, USA, Paper 645, 1–13. DOI:https://doi.org/10.1145/3290605.3300875

23. UNESCO. 2019. I'd blush if I could. Retrieved form https://unesdoc.unesco.org/ark:/48223/pf0000367416.page=7

24. WEST, S.M., WHITTAKER, M., AND CRAWFORD, K. 2019. Discriminating Systems: Gender, Race and Power in AI. AI Now Institute. Retrieved from https://ainowinstitute.org/discriminatingsystems.html

APPENDICES

Appendix 1: Survey consent.

Appendix 2: Questions & Gathered data.

Appendix 3: Reflection.

APPENDIX 1: SURVEY CONSENT

1. Consent.

The project 'Genders & Smart Home Voice Assistants' from Rick Buijs in collaboration with the Eindhoven University of Technology looks into the relation of genders with smart home voice assistants. It is therefore essential that interactions with voice assistants are measured and opinions on this topic are gathered.

You are invited to take part in this study were research is done on how people perceive genders in voice assistants, etc. A master's student from the Eindhoven University of Technology will send you a sound file with a voice assistant. This voice assistant will explain a little bit about itself, and will then ask you some questions. Please fill in the answers to the questions below.

You are not in any way obligated to answer any of the questions that are presented to you. In case you would like to withdraw from this study, you are allowed to do so at any time. All information that is gathered through this survey will be treated as confidential, and all participants will remain anonymous. *

○ I have understood the 'consent', and voluntarily participate in this study. I understand that my consent does not damage my legal rights in the event of negligence or other legal fault of anyone involved in this study. I also give permission and understand that that my data may be used for the purpose of this research. I understand that this data will be processed anonymously.

APPENDIX 2: QUESTIONS & GATHERED DATA

Question 1: Could you tell me your age?
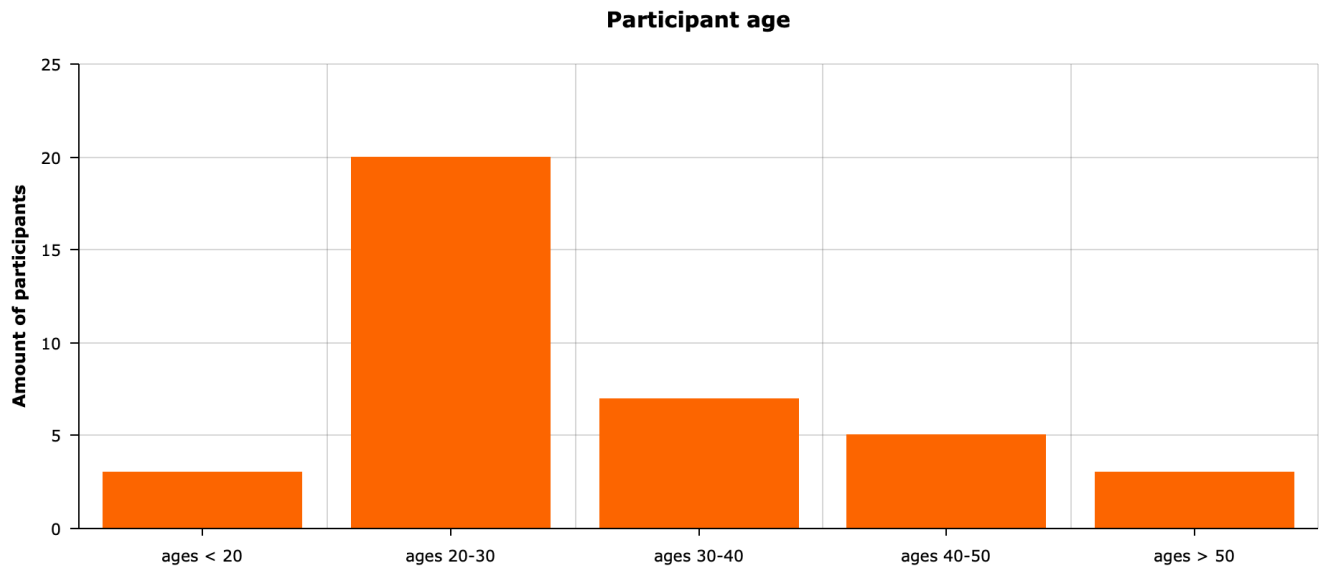
Participant age

Chart 1: Amount of participants per age group.
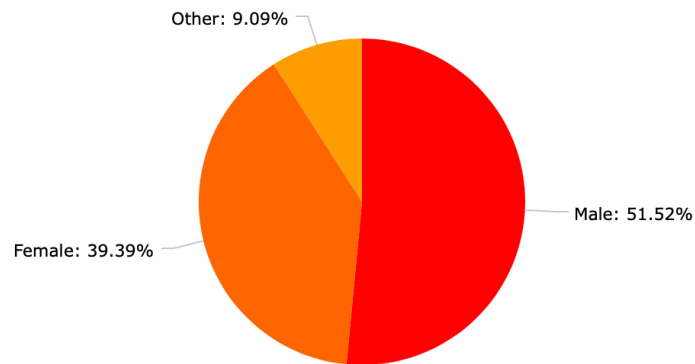
Question 2: What gender do you identify as?

Chart 2: Amount of participant per gender in percentages.

Question 3: What are your immediate thoughts on the audio fragment you just heard? What where you thinking while listening to the voice?

Self Description	Frequency	Examples
Voice sounded male	4	'Sounds not really neutral. It sounded more male than female.' 'Even though it said it was genderless, I still visualised a male in front of me while hearing the voice.'
Voice sounded female	3	'I kinda had the feeling it sounded like a woman.'
Voice sounded Genderless	6	'Voice kinda sounds "neutral" in a way, you can't tell if it's a man or a woman.' 'The voice was quite genderless. Easy to listen to and calming. '
Tried to determine gender of voice	6	'I noticed how I immediately tried to determine if the voice was male of female.' 'I was trying to determine which aspects of the voice were feminine and which ones were masculine.'
Voice was nice to listen to	7	'It has a very calming and soothing tone and pacing when it speaks.' 'The voice sounded friendly and warm. I felt comfortable listening to it.'
Voice exuded safety	1	'it's a voice that gives you a feeling of safety.'
Did not associate the voice with AI/ VA's	3	'Okay voice, not specifically associating the voice with AI.'
Compared it to other VA's	3	'The human part of an assistant is missing, it sounds hollow compared to others.' 'While listening I thought of the differences and similarities with my voice assistant Siri.'
Trying to sell VA	1	'I'm really not looking for a voice assistant. Don't try to sell me one.'
Thought nothing	4	'I had no specific thoughts and listened to the audio fragment.' 'Not much, I was just listening'

General themes & main points: Confusion (about the voice); Pleasant to hear; Disassociated/Compared voice (with/from other voice assistants); No thoughts (on the audio fragment).

- 18% of participants found the voice to be pleasant.

- 15% of participants tried to actively determine the gender of the voice.

- 18% of participants labeled the voice as either male or female.

- 15% of participants thought the voice was genderless.

Question 4: Do you think your perception of the audio fragment with the genderless voice assistant would change if the voice assistant would be assigned to either a male or female gender? Why do you think that?

Self Description	Frequency	Examples
No	18	'No. For me there is no difference as long as the voice is natural.' 'No, because I already view the voice of smart home systems as 'non-human'.' 'Not really, I already thought the voice was male/female anyway.'
Yes	20	Yes, if that was the case, I would imagine a female or male in my head.' 'Yes I think so! Because my ears are more used to specific female or male voices in things like that.' 'Yes, the gender of a voice assistant could be important depending on the user.' 'Yes, because I believe our knowledge and initial attitude shapes our perception.'

General themes & main points: Predefined opinion (on voice); Inconsequentiality; Gender projection (on voices).

- 52% of participants thought their perception of the voice would change if the voice would be assigned to a specific binary gender.

Question 5: Did you encounter any advantages and/or disadvantages while listening to the audio fragment? What are they?

Self Description	Frequency	Examples
None	24	'No, I could follow it easily. No advantages or disadvantages…' 'For me it would not really matter if the voice is female/male/genderless, since I only use voice assistants for functional purposes.'
Disadvantage	7	'My brain was still trying to put a label on the voice as male/female and I spent a lot of time thinking about that.' 'The voice sounded a bit monotone and emotionless (it should function as close to a person as possible).'
Advantage	7	'Feel nice to have my genderqueerness recognised enough to have such an audio created.' 'The voice was so easy to listen to. It didn't have a very deep or high voice, so it was super easy to understand.'

General themes & main points: Inconsequentiality; Labeling gender; Human projection; Feeling recognised.

- 64% of participants did not encounter any advantages or disadvantages while listening to the non-binary voice.

- 18% of participants found disadvantages.

- 18% of participants found advantages.

Question 6: Do you have any experience with gender-neutral or non-binary aspects in your life? Could you give me an example?
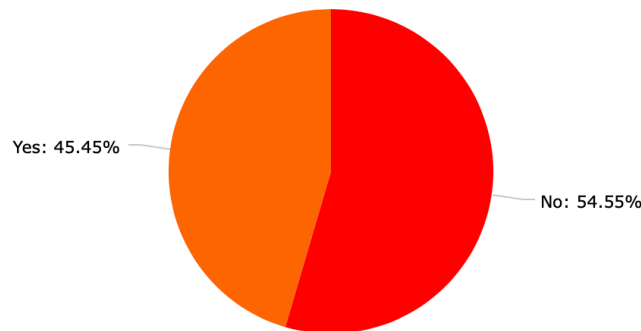

Yes: 45.45%
No: 54.55%

Chart 3: Participant experience with gender-neutral or non-binary aspects.

Self Description	Frequency	Examples
No	23	'The difference between gender and sex is a concept I didn't grow up with.' 'Not really, I've watched some documentaries about it. But I do not know anyone in my circle that defines as gender neutral or non-binary.' 'I don't think I've ever heard a true genderless voice assistent, and I don't think they will ever exist.'
Yes	15	'I know some people on the internet that are non-binary or rather gender-neutral. I know about public toilets adding a non-binary/gender-neutral option.' 'I know someone who identifies as non-binary and I've seen some videos about it online.' 'Yes. I have friends who identify as non-binary.' 'A friend of mine is gender-neutral, because of him I get more insights into the subject.' 'I am non-binary. All I know is that it effects me on a weird level in a sense if my masculinity or femininity is challenged or questioned.'

General themes & main points: Personal contacts; Family pressure; General knowledge.

- 61% of participants didn't have any experience with non-binary or gender-neutral aspects in their life.

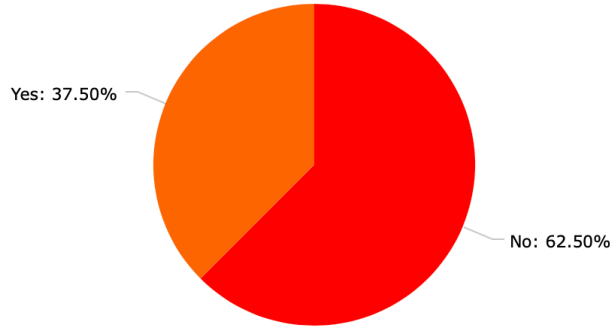Under the 45% of participants that are designers:

Yes: 37.50%

No: 62.50%

Chart 4: Experience with gender-neutral or non-binary aspects of designers within the participant group.

Question 7: Have you talked to any voice assistants before? What where they like?

Self Description	Frequency	Examples
Yes	31	'I havent given the female voice a lot of thought to be honest. When installing the device, we left the voice settings as is and it works fine for us.' 'Yes I have talked to Siri, which is set to be a female voice for me. I'm sure I attribute feminine characteristics to her.' 'Just to the Samsung version of Siri... she is a robotic female voice.'
No	7	'I have not had the opportunity.'

General themes & main points: Inconsequentiality; Impetuous set-up of voice assistant (standard voice left unchanged).

- 82% of participants have experience with voice assistants.

Of participants that have experience with voice assistants:

Self Description	Frequency
Talked only with male VA's	1
Talked with male and female VA's	1
Talked only with female VA's	29

Main points:

- Of participants that have experience with voice assistants, 93% have experience with only female voice assistants.

Question 8: Why do you think common voice assistants have gendered voices?

Self Description	Frequency	Examples
Reach certain people	3	'To specify a target group. To adjust to ones preferred voice assistant.'
To influence users	10	'To reach certain groups of people, to influence you.'
Sounds more like a real person	12	'Because people in real life have "gendered" voices and so I can imagine it being nice to have a voice assistant with that feature.' 'Because everyone is born with a certain gender, (male/female) so it is only normal to create a voice that fits what we know.' 'This way it feels more like you are talking to a person instead of an AI.' 'People like to link a voice assistant to a person. Most people view a person as having a gender that is the same as their sex.'
Identify with the voice	5	'Maybe because people can relate to the voice.' 'The fact that people identify with a gender within the voice.'
Avoid subject of non-binary	1	'Maybe a choice is made to just avoid the subject.'
Preference for binary voices	2	'User preference or biases from developers/designers based on stereotypes.' 'Preference? I think (I hope) there has been some research to back this up.'
Easier to understand	1	'Because I think it's easier to understand/less distractive a distinctive male/ female voice.'
Society is still binary	4	'Because society still largely thinks in a binary framework of gender.'

General themes & main points: Identifying; Connection to voice; Influencing users; Binary framework of society.

- 31% of participants thought in order to sound more human.

- 25% of participants thought it was based on influencing users.

- 14% of participants thought it was based on users identifying with the voice.

Question 9: What do you think is an advantage of having a gendered voice assistant?

Self Description	Frequency	Examples
None	5	'There is no advantage.'
Make VA's feel real	6	'Feels more recognisable and human.' 'You're able to draw a better picture of your voice assistant. Make them feel real. Tailored to the user's view of the perfect assistant.'
Identify with voice	9	'People can identify with what they're hearing.' 'That way I can relate to the voice.'
Feel more comfortable	16	'People are able to place the voice in their mind and can therefor feel more comfortable with it.' 'It makes you feel comfortable, trusted and safe more quickly.' 'It will help people to feel more understood.' 'I might feel more comfortable talking to something with a stronger identity about certain topics, I think they can better help me with this.'
Based on research	1	'I can imagine science proves hearing a female voice helps bonding with the voice assistant more.'
Easier to understand	1	'Less distractive, might be easier to understand.'

General themes & main points: Identifying; Connection to voice; Positive feelings.

- 42% of participants thought an advantage of having a gendered voice is because it feels more comfortable.

- 24% of participants thought it was so users can identify with the voice.

- 15% of participants thought in order to sound more human.

- 13% of participants saw no advantage to a gendered voice assistant.

- 3% of participants thought it was easier to understand a gendered voice assistant.

Question 10: What do you think is a disadvantage of having a gendered voice assistant?

Self Description	Frequency	Examples
None	12	'I don't feel like there is any negative part to it.' 'I don't think there is a disadvantage.' 'I believe there is no disadvantage of having one.' 'I can't think of any. I don't think it really matters if it's a man, woman, or something in between.' 'I've never had a problem with how voice assistants sounded.'
Directs to certain feelings	14	'It directs you to a certain feeling.' 'We probably project gendered expectations onto the voice assistant even though that is not necessary.' 'A male or female voice will play tricks on our emotions. For example in the movie Her, where a guy falls in love with a female voice.' 'The way people think of obtained information is dependant on who is saying it to them.' 'Tone of voice based on gender roles, a female would say something in a different way than a male.'
Reinforce traditional gender roles	6	'It can reinforce gender roles. Like Siri being a woman, and basically being your assistant.' 'I think it's minor, but it could reinforce a certain image I have of that gender, even though I'm not talking to a male/female at all but a machine.' 'A female voice gives power to the idea that the woman in a relationship should always stay home and care for the man/husband, the same way secretaries are still seen as female.'
Genderqueerness not represented	6	'People that identify as non-binary or gender-neutral may not feel represented.' 'If genders are locked in, it might be that the gender will not be to some people's preference.' 'Maybe genderless people will feel left out.'

General themes & main points: Reinforces gender roles; Inconsequentiality; Influencing users.

- 38% of participants felt directed to a certain feeling through the use of a gendered voice assistant.

- 32% of participants doesn't see any disadvantage in a gendered voice.

- 15% of participants thought genders in voice assistants reinforces traditional gender roles.

- 15% of participants thought genders in voice assistants did not (currently) represent enough genders.

Question 11: How do you think gender plays a role in conversations with voice assistants?

Self Description	Frequency	Examples
None	11	'None for me personally.' 'I think it doesn't play a role in conversations.' 'It really doesn't play a role in daily usage.'
Influences users	10	'People can be influenced by it. for instance a man will accept more from a male voice and a women from a female voice.' 'I think gender might have an effect on responses by the user and it might have an effect on the persons mood.' 'A gendered voice is more appealing if it's a gender that you are attracted to. I think female voices are also usually more trustworthy.'
Make VA's feel real	6	'I think women prefer to talk to a female voice and men prefer to talk to a male voice, this way they might think that their voice assistant is more real.' 'Unconsciously, people try to picture a person with the voice assistant.'
Reinforce traditional gender roles	11	'I think female voices are used too much in the smart home control devices. This is actually very old fashioned, it can be perceived as the woman who 'controls' the home environment when back in the days woman stayed home and the men worked.' 'I can't tell you how many straight guys I have seen flirting with female voice assistants. I think that would be different if they had a neutral voice.' 'I think it would play a role if the voice assistant were to misgender or to remove the option of an 'other' in addition to male or female. Without that option it reinforces gender roles.'

General themes & main points: Influencing users; Identifying with voice; Reinforcing traditional gender roles.

- 29% of participants saw no impact of genders in conversations with voice assistants.

- 29% of participants thought genders in conversations with a voice assistant played a role in reinforcing traditional gender roles.

- 26% of participants thought a gender in a voice assistant could influence users.

- 16% of participants thought gender made a voice assistant feel real.

Question 12: How important is it for you to clearly have a gender indicated when using a voice assistant? And why do you think that?

Self Description	Frequency	Examples
Not important	25	'For me personally, I do not find it important at all.' 'I don't think it is important. However, I do think it is important for a voice AI to have a name to make it more likeable for people.' 'I don't think a gender should be connected to a voice assistant.' 'As part of the LGBT community I feel very comfortable with breaking gender norms and being more inclusive of non-binariness.'
Somewhat important	6	'Depends. What are the features of the voice assistant. If it is used for just practical tasks it doesn't matter to me.' 'I like the idea of a voice assistant being a specific 'character'. It might have a 'life story' like a human being. This would also mean it would be clear what the sex and gender of the voice assistant are.'
Should just function correctly	7	'Not important as long as the message is clear.' 'I want my voice assistant to have a pleasant voice to listen to, it doesn't matter if it is male or female.'

General themes & main points: Practicality; Functional; Identifying with voice.

- 67% of participants said it was not important for a gender to be clearly indicated when using a voice assistant.

- 15% of participants indicated that a gender was somewhat important to them when using a voice assistant.

- 18% of participants thought a voice assistant should function correctly, and that gender did not matter.

Question 13: What are your thoughts on genderless voice assistants in general?

Self Description	Frequency	Examples
Positive	16	'A great addition to the female and male voices.' 'I think it will help genderless people to feel more understood and less left out. It also will help people to feel more comfortable while talking about certain subjects as surgery's and diseases.' 'I think it is a good idea and it will minimise sexualization of people.' 'I've never heard of it, but it's innovative and it will make sure no one feels left out.' 'I don't personally mind, but I would try it out if the option was there.' 'If other people will fill more included because of this, then why not?' 'I think it'd be great! As long as it still sounds like a human being.'
Doubtful	12	'I think it's a cool concept but would be difficult to execute in the real world. I don't know if it is possible to remove all of these aspects from a voice in order to make it fully genderless.' 'I think it's hard to create a genderless voice assistant, especially in the current society where people still have a gender assigned to voice.' 'It's something I would need to get used to. The default female voice on my Google Home has become pretty familiar.'
Negative	10	'I think they can be very meaningful to certain people but I do not believe they are necessary.' 'It is okay, I don't think I'll choose a genderless voice assistant in particular.' 'Consumers have to want it. Just making it because society wants it is a no-go. I don't want to change my way of life or be influenced to.' 'I personally don't see a need for it.'

General themes & main points: Enthusiastic; Inclusiveness; Doubtful; Unnecessary;

- 41% of participants have a positive attitude towards possible genderless voice assistants.

- 32% of participants is doubtful of genderless voice assistants.

- 27% of participants has a negative attitude towards possible genderless voice assistants.

Question 14: How do you think a genderless voice assistant could help prevent (harmful) biases and discrimination against the non-binary spectrum? Do you think it could be effective? Why?

Self Description	Frequency	Examples
Positive	21	'I think a genderless voice assistant could force people to think about the non-binary spectrum more often.' 'I think the majority of people will benefit from it.' 'It might help if popular tech companies would produce voice assistants with non-binary gender options.' 'Yes. I believe anything that contributes to the normalisation of genderlessness is helpful. I think mere exposure to non-gendered entities (or people) already makes people more aware of the fact that there is no harm in the concept of genderlessness.' 'I think people will be more aware and respectful about genderless people if they will hear more about it.' 'I don't think having it would hurt, especially not if it was an option.' 'If a large company would implement this, a lot of media attention would be given to it. This would mean that it becomes a more open and known subject, and people will talk about it.'
Doubtful	11	'I don't think it would have a big impact on the non-binary community. Because I don't think people will associate their voice assistant with a non-binary person.' 'A small part of society will perhaps not agree with the non-binary option because they revolt against anything new or not the norm.' 'I think most people will assume the gender they want to hear.'
Negative	6	'You can't change someone's opinion just by using a genderless voice.' 'I do not think that it would solve biases and discrimination completely because some people might not like it that their voice assistant has no clear gender.' 'I don't think it will help against discrimination because I think it will have the opposite effect on the situation.' 'People are stuck in their ways sometimes and let their ignorance get in the way of progress. I think it'll take more than voice assistants to prevent discrimination.'

General themes & main points: Thought provoking; Couldn't hurt; Beneficial; Not impactful; Assumptions; Reverse effect.

- 54% of participants have a positive attitude towards a genderless voice assistant preventing biases and discrimination.

- 29% of participants is doubtful about genderless voice assistants preventing biases and discrimination.

- 17% of participants has a negative attitude towards a genderless voice assistant preventing biases and discrimination.

Question 15: Could a genderless voice assistant possibly distract you from what it is saying through its way of speaking? Why do you think so?

Self Description	Frequency	Examples
Yes	11	'Yes, it can distract you because the voice itself makes you think of the gender. Your thoughts will automatically want to label it as male or female. However, it does also have the ability to make you listen more carefully.' 'I think in the beginning maybe. Because we are used to categorising voices based on gender and it might be confusing if we are unable to do so.' 'Yes, I was already distracted during the audio clip.' 'If it would be an actual human voice it would distract me because it would have been recorded by a male/female and I would try to guess which of the two it would be.'
No	17	'I don't think so. You ask the voice AI (Artificial Intelligence) something, so you expect a voice back, no matter how it sounds.' 'No I imagine it to be the opposite. A genderless voice will be more neutral so it won't distract you.' 'I don't really think so. I'm not usually all too concerned about the gender of the person I'm speaking to.'
Yes, but other cause	10	'It depends on the voice, not the gender.' 'Yes but this not linked to gender. A voice assistant could distract from what it is saying by using a weird accent or pitch or tone or whatever.' 'Sure. Just the way the voice of Darth Vader would distract me.'

General themes & main points: Labeling gender; Categorising voices; Neutrality causes focus.

- 45% of participants said it would not distract them.

- 30% of participants said that it could distract them.

- 25% of participants said it could, but that it was not dependant on the gender of the voice assistant.

Question 16: What if in 50 years society will become fully non-binary? We will not (un)consciously look for genders anymore. What are you thoughts on this?

Self Description	Frequency	Examples
It will not happen	11	'That could be really cool, I just doubt if that will ever happen. People really cling to what they are familiar with.' 'This will simply never happen. Nature made feminine and masculine aspects for a reason.' 'Striving for equal chances is better than trying to suppress the biology of humankind.' 'It's strange, not necessarily. Because it is in people's nature to identity themselves in/with a group.' 'That's difficult to answer. As I identify as a 100% woman. I don't think it's necessary to become fully non-binary.' 'I don't think it will ever be completely genderless. I hope society will be more open, accepting and the genders will blend more into each other (example: boys can play with dolls and wear make-up). But there will always be a biological difference between genders.'
No problem	27	'Great! Gender is a social construct anyway. The end of toxic masculinity and sexism will make the whole a much brighter place.' 'I think it's possible to achieve such a paradigm shift that we really treat people based on their characteristics, personalities and actions and not impose a gendered framework onto them. Ultimately, I think this would lead to a more equal and harmonious society.' 'I think it doesn't really matter if someone identify him/her/them herself/ himself/themselves as genderless/feminine or masculine. You do you. Just do what feels good and what makes you happy. It shouldn't be a problem. If we just all accept and respect each other.' 'This would simply be amazing, no more judging based on gender. People will be viewed individually instead of as a group.' 'I think it would be amazing for non-binary people, but personally I do not advocate it because I don't experience any negativity from gender.' 'Yes, please! This would help so many people.' 'It would be nice. I'm proud to be non-binary. It's one of the many characteristics that make me who I am.' 'I think a non-binary future is the next big step for humanity. We are still fighting for the rights for homosexuals, etc. but I believe this will happen (even though it might take a few generations).' 'You really can't be right at the moment. If you choose a female voice then you're a bigot, but if you choose a male voice you are asked what your problem with women is, or what your reason is for changing the standard voice. A third option in voice assistants would help this problem. But still, the names of current voice assistants are still female, and companies should fix that.' 'I don't think it's a problem, but as a woman I would feel left out if there was only a genderless option.'

General themes & main points: Doubtful; Unnecessary; Beneficial; Inclusiveness; Equality.

- 71% of participants have no problem with a fully non-binary society.

- 29% was doubtful or even against it ever happening.

APPENDIX 3: REFLECTION

I have a big passion for far-future projects, and already have experience doing projects that are more futuristic in nature. For instance, in my M1.1 semester I completed a highly theoretical project on future Artificial Wombs. This research project, however, was chosen out of a long love for equality and the underrepresentation of transgender, non-binary and LGBTQI+ communities in design. It was not only that I felt I could take this opportunity to positively impact designers and the design fields, creating awareness and knowledge. I also felt that this could help me personally grow as a designer, seeing as that I'm also still learning about non-binary aspects and implications in design.

As I mentioned in my PDP, one of my weaknesses is my ability to make decisions. This weakness very clearly reared its head during this research project, causing me to lose valuable time. This manifested itself in me creating unnecessary pressure on myself and the project, and thus resulted in me having trouble with the timely completion of the project due to stress and anxiety. In the end, I made a lot of similar mistakes that I also made in previous projects, but can one be expected to change so quickly? I personally feel like I did learn some new things from this experience, and that I have made steps towards decision making and not overthinking. I'm of this opinion because I started planning explicit moments for decision-making. There is still a long way to go, but I believe if I'll keep focussing on this goal, I'll fully figure out how to personally make decisions in a timely and concise manner.

This project helped me to think differently. It forced me to let go of the usual steps in a design project, as the creation of a prototype or demonstrator was not the main focus. I must admit that initially it was hard for me to take and realise this turn, as I noticed I was heavily focussed on what type of product could solve this or that. What I thus failed to realise sooner in the project was that the product was dependant on the research, not the other way around. I believe this cost me invaluable time during this project, but does also provide a clear learning point for me for future research projects.

This semester and this research project helped me to realise that my interests were more in line with the User & Society expertise are than the Technology & Realisation one. Through doing research, and thus stepping back from explicit product creation—which was hard for me as I have an affinity with the Creativity & Aesthetics expertise area—I began to understand that my interests lay more with users and implications for design in society. Therefore I decided to change to User & Society, as I think it would better suit me personally as the industrial designer I strive to be in the future.

Ultimately, this was the first time for me doing a research project. I was nervous about my academic writing and researching skills, but I feel like I've grown in that regard as a designer through simply doing. It was hard for me to make this switch towards researching during this project, but I'm proud of the study I created and put out into the world. I'm sure the knowledge and skills I obtained during this semester will prove to be invaluable during the completion of my master's course.