



## **STUDENTS' PERCEPTIONS OF FEMALE GENDERED VOICE ASSISTANTS**

Lappeenranta–Lahti University of Technology LUT

Bachelor's Programme in Software engineering, Bachelor's thesis

2023

Aino Pakarinen

Examiner: Research-teacher Dominik Siemon

## ABSTRACT

Lappeenranta–Lahti University of Technology LUT

LUT School of Engineering Science

Software Engineering

Aino Pakarinen

### **Students' perceptions of female gendered voice assistants**

Bachelor's thesis

2023

52 pages, 9 figures, 6 tables and 2 appendices

Examiner: Research-teacher Dominik Siemon

Keywords: Voice assistants, Gender stereotypes, Human-computer interaction

The aim of this thesis was to investigate why the female gendering of voice assistants is so common and students' perceptions of these gendered design choices by conducting a questionnaire. With voice assistants becoming more common, it's important to stop and consider the effects voice assistants that are mostly projected as female have on the human-computer interaction between the user and the voice assistant. The research was carried out by studying related works of the topic and by conducting a questionnaire on students' perceptions of the gendered voice assistants. Questionnaire data was analyzed by performing statistical tests and theme analysis. The related studies indicate that the female gendering of voice assistants has positive effects on how users see voice assistants, but the negative sides should be considered as well. The results of the questionnaire illustrate that participants didn't consider the gender of the voice assistants as important, but they still preferred many female traits on voice assistants. Limitation of the research was the limited number of responses to the questionnaire, because finding participants' perceptions of gendered voice assistants would require more data to create more reliable results.

## TIIVISTELMÄ

Lappeenrannan–Lahden teknillinen yliopisto LUT

LUT Teknis-luonnontieteellinen

Tietotekniikka

Aino Pakarinen

### **Opiskelijoiden näkemykset ääniassistenttien naiseksi sukupuolittamisesta**

Tietotekniikan kandidaatintyö

2023

52 sivua, 9 kuvaajaa, 6 taulukkoa ja 2 liitettä

Tarkastaja: Tutkijaopettaja Dominik Siemon

Avainsanat: Ääniassistentit, sukupuolistereotypiat, ihmisen ja koneen välinen vuorovaikutus

Tämän kandidaatintyön tarkoituksena oli tutkia, miksi ääniassistenttien sukupuolittaminen naiseksi on niin yleistä, sekä opiskelijoiden suhtautumista näihin sukupuolitettuihin suunnitteluvalintoihin kyselytutkimuksen avulla. Ääniassistenttien yleistyessä on tärkeää pysähtyä tutkimaan, millaisia vaikutuksia pääosin naisiksi sukupuolitetuilla ääniassistentteilla on ihmisten ja tietokoneen väliseen vuorovaikutukseen ääniassistenttien ja niiden käyttäjien välillä. Tutkimus suoritettiin alan kirjallisuuteen tutustumalla sekä kyselytutkimuksella, jolla tutkittiin opiskelijoiden näkemyksiä sukupuolitetuista ääniassistentteista. Vastaukset analysoitiin tilastollisilla testeillä ja teema-analyysillä. Alan tutkimukset osoittavat, että naissukupuolittamisella on positiivisia vaikutuksia siihen, miten käyttäjät näkevät ääniassistentit, mutta on tärkeää ottaa huomioon myös ääniassistenttien sukupuolittamisen negatiiviset puolet. Kyselyn vastaukset kuvaavat sitä, että vastaajat eivät kokeneet ääniassistenttien sukupuolta tärkeäksi, mutta silti he suosivat monia naisille tyypillisiä piirteitä ääniassistentteissa. Tutkimuksen rajoitteena oli saatujen vastauksien määrä, sillä vastaajien näkemykset sukupuolittuneista ääniassistentteista vaatisi laajemman datan, jotta tulokset olisivat luotettavampia.

## ACKNOWLEDGEMENTS

Thank you for my friends, partner, and mom for being my support team.

## ABBREVIATIONS

### Abbreviations

AI            Artificial Intelligence

GenderMag   Gender Inclusiveness Magnifier

HCI           Human-computer interaction

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# 1 Introduction

Consumers are using voice assistants increasingly and will continue to do so in the future (McCaffrey et al. 2018). The most common tasks for voice assistants are to help consumers with daily tasks like playing a song, answering questions the user would perhaps otherwise google, and checking the weather (Kinsella and Mutchler 2019). Voice assistants are digital assistants that use voice for both listening and responding to the user by generating answers using artificial intelligence (AI) and trying to copy a natural human language (West et al. 2019). The leading voice assistants on the market, Apple's Siri, Amazon's Alexa, and Microsoft's Cortana all have one thing in common: all of them are primarily or exclusively projected as females (West et al. 2019). Virtual personal assistants are primarily projected with a female voice and identity more often than with a male identity (Sey and Hafkin 2019). Because the market of voice assistants is expanding and they are becoming more common, it's important to stop to question and to study the design choice of projecting voice assistants as females. What impact does the gender of the voice assistant have in human-computer interactions (HCI), and does it affect the way voice assistants are perceived in our society?

The purpose of this bachelor's thesis is to study the reasons why almost all leading voice assistants on the market today are primarily projected as female (Sey and Hafkin 2019; West et al. 2019; Loideain and Adams 2020) and to investigate within the specific demographic of university students both the attitude and perception towards the gendered voice assistants. The work will aim to cover both the positive and negative impacts that the female gendering of voice assistants may cause to the human-computer interactions, as well as possible suggestions on how to improve the design of voice assistants. The work will conduct a survey of the topic directed for university students. The purpose of the questionnaire is to investigate what students think about voice assistants and how they perceive the gender aspect of voice assistants.

In the second chapter, virtual assistants and features that increase the humanness of them will be discussed. The functionalities of conversational agents and voice assistants will be presented. The work then considers that the positive impacts the female gendering of voice assistant can help make voice assistants to be perceived as more human-like and thus more



accepted by the user. Next, the work will discuss the possible harms that the female gendering of voice assistants might pose to users. Possible solutions for the design and development of the voice assistants will be suggested based on related studies. In the third chapter, the research methods for the questionnaire and its data analysis methods will be presented. The justifications for the used methodologies are given. In chapter 4, the results of the questionnaire are presented by using descriptive statistics, tables, and figures. The results and their meaning are discussed in chapter 5. The chapter 6 includes a summary of the work's results.

## 2 Related work

In this chapter, functionalities of voice assistants and the design choices that lead to the gendering of the voice assistants will be introduced. The harms of the female gendering of voice assistants from the related studies will also be discussed, as well as improvements based on existing studies and reports.

### 2.1 Basic information on voice assistants

Conversational agents are digital software, that communicate with the user either with written or spoken inputs, and outputs in natural language (Dale 2016). This means that there are no response options to choose the response from, unlike with some chatbots that only communicate via predefined response options and don't allow typing the response as you wish. Voice assistants are conversational agents that use primarily spoken voice as input and output format. Most of the voice assistants on the market use a synthetic female voice (West et al. 2019). Voice assistants can be mobile applications, physical speakers or integrated into mobile phone's operating system like Siri in iPhones (Shih 2020).

Voice assistants use artificial intelligence (West et al. 2019) and machine learning (Shih 2020) to generate responses to user's questions. First, the machine needs to recognize the query given in natural human speech by the user. The development of automatic speech recognition has helped machines to understand what is being said. Automatic speech recognition converts the spoken speech into text, which can be used to creating automatic subtitles to videos. Natural language understanding understands the meaning of the speech. Natural language understanding is used for the machine to analyse the speech in context. (Shih 2020)

Different requests can all mean the same because there are multiple ways to word the same questions. Google assistant generates follow-up questions to the previous questions, so that the user doesn't have to repeat the whole question for the voice assistant to understand that the context is same. For instance, after asking who the writer of a certain book is, the Google

Assistant will suggest the next question to be when did the author die, instead of the user having to ask when did the author of *the book* die. Google assistant will remember that the context in the questions is the book, so the name of the book doesn't have to be repeated in the follow-up question. (Boffy and Pieraccini 2022) Follow-up questions can make the tasks feel more conversational for the user, because the flow of the task feels like an interactive conversation.

Lastly, the context is important for voice assistants to recognise, because to answer what the user wants to know, the machine must know the context in which the question is being asked. For example, in different contexts, numbers are pronounced in different ways. Depending on if it's a year or phone number, the voice assistant needs to understand in which context the number is used to pronounce it correctly (Shih 2020). Based on previous questions and scenarios, natural language understanding technology uses machine learning to figure out what the context can be (West et al. 2019). The last step of the process is natural language generator technology that transforms the collected answers into a form that is understandable by humans and reads it out loud to the user (West et al. 2019; Shih 2020).

## 2.2 Warm and trustworthy female persona

Instead of listening to robot give out medical advice, most people would prefer listening to a human doctor (Longoni et al. 2019). This also applies to voice assistants and how they can be seen as more trustworthy. If the applications that use artificial intelligence to function have more anthropomorphic features, they are more likely to be trusted by the user (Waytz et al. 2014). Anthropomorphic features are human-like characteristics like gender, voice, and name. Systematic literature review by Feine et al. (Feine et al. 2019), created a taxonomy of social cues of conversational agents, which includes for example nonverbal signals such as jokes, facial expressions, and gender. Social cues can have a positive impact on how users trust and believe conversational agents (Waytz et al. 2014). Interaction between the computer and the human seems more like an interpersonal relationship if the conversational agent displays social cues such as warmth, because humans react sociably to social cues displayed by the computer (Nass et al. 1994). Developers want to improve how users perceive voice assistants by implementing human-like features into voice assistants.

To make users trust conversational agents, including voice assistants, many companies have tried to implement them to have a very human-like feature, gender, because gender stereotypes are also applied to human-computer interactions (Nass et al. 1994). The choice whether to develop female, male or genderless voice assistants is a question of do some of them further increase the perceived humanness of the software to make it more human-like to the users. Users apply social rules to computers, because humans react unconsciously in a natural way to social situations even when interacting with a computer, which means that relationships between users and computers are social (Nass et al. 1994). Humans apply gender stereotypes to not only humans, but to machines as well (Nass et al. 1994; Eyssel and Hegel 2012; Tay et al. 2014), which is why it's important to study what stereotypes would then increase the success of voice assistants.

Gendered machines, like voice assistants, are more liked by users when they have their own personality to match their gender stereotypes and expectations (Tay et al. 2014). Users prefer having a female healthcare robot over a male one (Tay et al. 2014; Borau et al. 2021), and a male security robot over a female one (Tay et al. 2014). Having the voice assistant follow the gender stereotypes we apply to them and to assume they would act as personal assistant, pleases the users (Tay et al. 2014), so the context in which the voice assistant is used matters too for the gendering, not just the voice of the assistant has. In a study by Borau et. al (Borau et al. 2021), women were perceived as more human than men on almost all aspects, and users would prefer female bots over male bots, because female gendered bots would more likely take more care of the unique needs the user has. Stereotypically women are seen as more warm and friendly than men (Eyssel and Hegel 2012). The role of many voice assistants used in daily lives is as an assistant, just like the assistant job is historically and stereotypically described for women (Stern 2017). Asking sometimes even stupid questions, would be easier, if the agent responding would be friendly and empathic, rather than cold and calculating. The role of the personal assistant fits the female gender stereotype too.

In conclusion, it's no wonder that the developers have found that the female gendering of the voice assistant would increase the user satisfaction. The preference for the voice is one reason why the female voice is often used in voice assistants. For both men and women, female voice is perceived as more warm and friendly than male voice (Stern 2017). In a literature review by EQUALS Skills Coalition (West et al. 2019), it was noticed that women change the default voice from female to male voice in several cases when it was possible,

whereas there was no evidence of men change the default female voice to male voice. On the other hand, Siri, Cortana, Alexa, and Google assistant don't describe themselves as women or female nor identify with any gender, but instead as technology-beings who don't have gender, even though they are in many ways projected as female in character (Chin and Robison 2020). The female gendering in these voice assistants is strong in the gendered names, voice, and behaviour, even when they don't admit to being of the female gender.

## 2.3 Harms of female gendering of voice assistants

This chapter contains the harms of gendering voice assistants as female and the negative impacts it has on the human-computer interaction between voice assistants and the users.

### 2.3.1 Tolerance of sexual and verbal harassment and abuse

Voice assistants are built to make the user feel comfortable and for the voice assistant to politely respond to everything that the user says. If users ask questions that have a sexual tone and which are directed to the voice assistant itself, the voice assistants Alexa, Cortana, and Siri all would respond with a somewhat flirtatious undertone, instead of telling the user off in 2017 (Fessler 2017). Market-leading voice assistants in Korea were also found to act submissive and to apologise to the user when the user abuses the voice assistant, as well as also giving somewhat positive and flirty responses to user's sexual comments (Hwang et al. 2019). Over the years, the flirty answers have been toned down and by 2019 the voice assistants Siri, Alexa, Cortana, and Google Assistant had changed their flirty answer to refusal to answer to sexual toned questions (Chin and Robison 2020). The submissive and sexualised design of voice assistants was not uncommon or a coincidence a few years earlier, but a choice that was thought to be fitting for many different voice assistants on the market. Responses to harassing questions could have been nice and polite because the developers didn't want to upset the users. Users don't like it if they are rejected by voice assistants (Bonfert et al. 2018). The role of the voice assistant is to serve the user with the best possible user experience, which is also one reason why the voice assistants are implemented to have their own personalities, but there should be a limit to how rudely the users can treat the voice assistants.

Furthermore, another reason for why the voice assistants have responded with entertaining and flirty comments to users' inappropriate requests (and would only later on be changed) could be because the development teams of the voice assistants are male-dominated. World Economic Forum's Global Gender Gap 2022 report (*Global Gender Gap Report 2022* 2022) announced that only 1,7 % of graduates out of all fields is women graduating from ICT, whereas out of all fields the percentage of men graduating in ICT is 8,2 %, which makes women underrepresented in the ICT field. Some women who are working in the AI field still face a lot of discrimination at work (Schulenberg et al. 2023). In a study by Schulenberg et al. (Schulenberg et al. 2023), women working in AI tell their experiences of being the gender minority in male-dominated teams and how the women's voices are not heard as much as men's, because of the discrimination in the workplace. The so-called "bro code" is a concept, in which men protect other men's ideas first and women's ideas are not heard or just seen as a backup plan. More diverse teams could be a solution to make the AI of the voice assistants more inclusive. Because voice assistants use AI, the voice assistants also could be implemented with the bias of the developers in the data that they use. The data used in AI application reflects the bias of its developers on how the data is collected and trained (Schnoebelen 2016). If the design team is male dominated, but the product is designed for everyone to use, can the gendering of the voice assistant be based on how men view women and gender stereotypes. This could lead to expansion of harmful stereotypes. Because there's not enough women working on developing and designing AI products, the bias of male developers and designers can end up ruling also in voice assistants. (Schulenberg et al. 2023)

### 2.3.2 Expansion of harmful gender stereotypes

Voice assistants have been criticised for objectifying women and for implementing sexist designs that increases the use of narrow gender stereotypes (West et al. 2019; Loideain and Adams 2020; Borau et al. 2021). Gendering of technology can lead to expansion of harmful gender stereotypes. In a study by (Hwang et al. 2019), top Korean voice assistants on the market were analyzed to find out about gender stereotypes which are projected in female voice assistants. All five voice assistants expressed and described themselves to be beautiful young women, even when none of the voice assistants had physical features, which enforces the stereotypes of women having to always look good, no matter what (Hwang et al. 2019). The beauty standards in the non-physical voice assistants can increase the pressure of

women's appearance. The beauty standards and stereotypes included in the voice assistant design can send negative messages to young girls that they need to be pretty to be able to work well enough, even when their appearance is not relevant to the job itself.

Voice assistants give response with only one simple and short answer, unlike web-based search engines. With web-based search engines like Google, the user can see tens of different answers within seconds. Voice assistants provide only one answer, because giving the output as speech takes longer. (West et al. 2019; Shih 2020) This is why it's important that the algorithms that choose responses that voice assistants give, are as accurate and as good as possible. Users could learn to associate the female voice and the simple responses of the voice assistant to women. Women could be seen as simple because voice assistants can't provide a long context to the answers because the spoken format doesn't suit long and detailed answers (West et al. 2019).

## 2.4 Improvements of the design and development of voice assistants

Review of how to study the human-computer interaction of conversational agents by Diederich et al. (Diederich et al. 2022) suggested that the ethical side of the HCI should be researched more, because their literature review of 262 studies found only one paper that discussed the ethical side of HCI with conversational agents, "*Investigate the unintended side-effects of CA design and study how to prevent such negative side-effects*" (Diederich et al. 2022, p.35). Solutions and suggestions on how to improve the design of voice assistants on gender aspect will be discussed in this chapter based on the related studies.

### 2.4.1 Variety of voice options

Another way to change the harms of only ever using feminine voice in voice assistants is to discover other options to use for the voice, such as male voice option. Offering new voice options could be hard to launch if the users have used voice assistants for many years. Changing the voice from female to something else could be difficult for users who are already used to the female version. Companies would be creating other voice options for nothing if the users wouldn't use them. It would also be hard for companies of the market-dominating voice assistants to change the gender of their primarily female voice assistants,

because many of these voice assistants have a female name and are strongly branded as women (Sutton 2020). Companies could completely give up the choice of the gender to the users by making every user to choose their preferred voice option when installing the voice assistant. That could also be a lazy solution because it would make it possible for the companies to ignore all the possible harms that the different options of gendering can cause. On the other hand, adding more options to choose the gender of the voice assistant would increase the diversity of voice assistants on the market and help users to customize the voice assistants as they want.

Genderless voice, robotic or just human voice, that is not clearly feminine or masculine, is one option to investigate. Q is a genderless voice created to sound gender neutral or genderless and to represent diversity of gender also in technology (The Design Museum [no date]). Gender is not only defined by the voice, but many other aspects as well, such as clothes, body language and gestures (Sutton 2020). Adding diversity in technology is important, so that it represents all kinds of people. The development of a neither feminine nor masculine voice could be one option to investigate.

#### 2.4.2 Feminist human-computer interaction principles

In a study by Schulenberg et. al (Schulenberg et al. 2023) women who work in AI were interviewed on how they approach the designing of AI with the gender aspect on mind. Social listening approach is a method that can be used by developers to think carefully about what the target group for the product really is by doing actual research, instead of letting the definition be based on pre-existing assumptions and biases that the developers have of the users in the target group (Schulenberg et al. 2023). So instead of thinking of the target group, the developers should focus on thinking about how the users would use the product, because wide target groups don't necessarily give accurate representation on how all the users would use the product. When designing AI products, the developers should also question if it's essential for the use case of the AI product to even have a gender and whether gender neutral design of the AI would help prevent the harmful gender stereotypes (Schulenberg et al. 2023). Giving the user the possibility to customize their voice assistant, can make the user's needs met, because every user is unique and it's hard to design something that would be universally pleasing for everyone (Schulenberg et al. 2023). These methods could help the



users feel more noticed by the computer and increase the HCI between the user and the voice assistant. According to Bardzell (Bardzell 2010), feminism can be utilized in HCI design to reveal outcomes that were not intentional or by directly influencing the design process requirements, decisions, and assessments. Utilizing the feminist HCI principles, the harmful stereotypes could be either noticed somewhere in the process or tried to be prevented from beginning.

### 2.4.3 From gender bias to gender inclusive design

Study by Vorvorenau et al. (Vorvoreanu et al. 2019) used GenderMag to not only find gender biases, but also on how to design the software in a way that decreases the amount of gender biases to make the software more inclusive. Gender Inclusiveness Magnifier (GenderMag) is a method used to find gender biases in software interfaces and during the work process (Vorvoreanu et al. 2019). Gender bias in the software systems can be because the data and algorithms have biases or because the developers have a bias about the users. Thinking about the possible biases and how they could form in the design process of voice assistants, can help to reduce them earlier. To build an inclusive AI, the developers need to have a gender-neutral mindset, try to reduce gender stereotypes and focus on the needs of the intended user instead of just thinking about the gender of the user (Schulenberg et al. 2023). Ethical standards for the design of AI and social bias should also be implied in policies for developers to follow (Loideain and Adams 2020).

### 2.4.4 Politeness

Instead of only asking questions in the same way as giving out command or order, the voice assistants could support a polite speech input from the user. Adding a polite word such as “please” could help children to respect the voice assistant and to ask, rather than demand or command. The same can also be applied to adults. (Bonfert et al. 2018) Instead of yelling at the voice assistant, the users would have to be polite and respectful. This would also help with the voice assistants that can’t even turn down and refuse to response to straight abuse and harassment. In a 2018 study (Bonfert et al. 2018), a test group in which the participants used a voice assistant that rebuked the user until they asked their questions in a nicer way,

the users would listen to the feedback and then change their question to sound more polite. Another test group were told to use the voice assistant as any other voice assistant they would normally use but without the participant knowing the voice assistant would refuse to answer questions that were not formed in a polite language. In the second group the participants got annoyed and angry that the voice assistant would refuse to work as they had expected it to. One participant in the experiment admitted that they would not have talked so harshly to the voice assistant, when they found out it was a real person acting as voice assistant behind in the experiment (Bonfert et al. 2018).

UNESCO's report (West et al. 2019) suggests that the voice assistants should be programmed to refuse to answer politely to harassing language and instead outright express to the user how harassment is not appropriate. Amazon has developed a kid version of Alexa which rewards children for using polite language like "please" by using positive enforcement instead of punishments (BBC 2018). Google Assistant offers kid-friendly voices that speak slower but more expressively to help kids understand better (Hsiao 2022). Adding features to guide the users on how to speak to and use the voice assistant could help decrease the harassing, if the user doesn't get annoyed with not being able to use the voice assistant in a way that feels most natural to them.

If humans react socially to computers the same way as with humans (Nass et al. 1994), is something stopping us from reacting to humans as we do with computers? Computers are not treated as nicely as we treat other people, but how should we behave with humanized computers? If voice assistants are perceived as female in character, yet treated with disrespect, could those behaviors possibly be seen in real world as how women are treated. No studies in this literature review for this thesis were found over of users treating female voice assistants badly or inferior to being correlated to the users also treating women the same way in real life.

## 3 Research methods

The survey is conducted as a questionnaire. The aim of the questionnaire is to investigate what students think about voice assistants and how they perceive the gendered design of them by using qualitative analysis methods.

### 3.1 Survey methods

Interviews are used in qualitative research, and the method is flexible, because the interviewer can repeat the questions or specify what the question means. There are many challenges of interviews, such as unclear questions, bias of the interviewer showing, and interviews taking a lot of time. (Heikkilä 1998) Interviews were not chosen as the research method, because interviews would require more work and time to arrange, and it would not be possible to organize enough interviews, as opposed to other methods such as online questionnaires.

Online questionnaire is a method in which the demographic of the respondents must be reachable (Heikkilä 1998). Positive aspect of online questionnaires is that the results can be analysed easily with statistics programs because the responses are easy to transfer to different programs such as Excel. Questionnaire was chosen as the survey method because it is a practical method to collect opinions online from students. In the conducted questionnaire, the aim was to investigate how the target group, university students, perceive voice assistants and their gender. The questionnaire was sent to LUT University students through online group chats, because it was not possible to receive an email list of students to create a specific demographic. Group chats are actively used within university students, so they are useful when trying to reach many students. The biggest group chats the questionnaire was shared with were LUT software engineering students and exchange students. Field of study was not specified in the questionnaire background questions, but the questionnaire was shared within information channels of LUT technology students, so most participants are likely to be technology students, especially software engineering students.

Questionnaire was created in Webropol, because LUT has a student license for it, and it comes with a statistics program. Questionnaire (appendix 1) was open for two weeks, 20.12.2022-3.1.2023. Background questions included gender, birthyear and previous experience with voice assistants. Questions about the perception of voice assistants were Likert scale (Strongly agree, agree, neither agree or disagree, disagree, strongly disagree), multiple choice questions and one open question to elaborate thoughts about gendered voice assistants. All questions were mandatory except for the final open question, which enabled the participants to clear up anything if they wanted to. Participants answered thoroughly to the questions, which can be noted on how all options were used during the survey and open questions were answered thoughtfully.

### 3.2 Data analysis methods

Descriptive research is used for empirical research and part of almost every research project, and a large amount of data is needed for survey to be considered a reliable (Heikkilä 1998). The results in this thesis are described in tables and bar figures to visualize the results to make the results easier to comprehend. Cross tabulation is used to figure out if there is a relation between two variables by placing the explanatory variable on the column and the dependent variable on row (Heikkilä 1998). The explanatory variable was the gender of the participant (male, female or other). The data analysis was done using cross tabulation by the gender of the participants in each question. Comparing every question to the genders of the participants was done by using “group by” -feature in Webropol. The age was not relevant to compare the answers to, because almost all participants were close in age.

Cross tabulation offers a possibility to figure out if there is a dependency between the column and row variables or if it's just by chance, which can be statistically calculated by executing Chi<sup>2</sup> independence test for nominal scale questions (Heikkilä 1998). Chi<sup>2</sup> test was selected because the aim was to investigate if there was a significance between the gender of the participants to the answers. Chi<sup>2</sup> -test was used to calculate the independence between gender and the different variables. Null hypothesis is that there is no significance between the variables. Significance describes how big risk there is that the dependency is coincidence. (Heikkilä 1998) Level of significance was selected to be 0,05 (5 %), so if the p value was under 0,05, the null hypothesis will be overturned, and the difference is significant. If the

gender was not differentiating factor to results, then the results are presented only with frequencies. Webropol analytics -tool was used to create the tables and to calculate the significances.

Pearson's correlation is used for finding the correlation between variables, where the data is continuous. Likert scale is ordinal, so Spearman's  $r$  is more suitable for finding correlation for non-continuous data, because it uses rankings. Spearman's correlation is a non-parametric test, and it can be used to find the correlation between two Likert scale variables. The scale of the correlation is +1 and -1. If the result is close to 1, both variables are increasing and there is a strongly positive coefficient. If the correlation is close to -1, then one variable's value is close to strongly agree and the other to strongly disagree. Correlation values near zero means that there is no relationship between the two Likert variables. (Heikkilä 1998) In the result analysis the Likert scale questions will be analyzed using the Spearman's correlation to find significant correlations. The null hypothesis for the correlation analysis means no relationship between the variables and the alternative hypothesis means that there is a relationship between the variables. This is tested with the 5 % significance, so if  $p < 0,05$ , the null hypothesis will be overturned and the alternative hypothesis will be chosen. Spearman's  $r$  will describe how strong the correlation between two variables is.

Open questions at the end of the questionnaire offered a possibility for participants to elaborate their thoughts about gendering of voice assistants. Qualitative answers can be analyzed by using different methods, such as grounded theory, which was utilized to analyze open questions. Grounded theory methodology gathers the data and then analyzed it by using coding to find different categories (Metsämuuronen 2006). The open question was answered 19 times. All the participants who answered to the survey were numbered from P1 to P19. The answers were analyzed to find themes in Microsoft Word, because it made the answers more readable and easier to color-code. Theme analysis was conducted by color coding each theme that appeared in the answers by highlighting them with different colors. All the themes that were found in the open question answers were all categorized to different groups by their colors. Direct quotes from the answers are used to describe the phenomena and themes better during the analysis of the results, as seen below:

*“This is an example quote from open question answers” -Participant id*

Many answers contained multiple different themes by one participant. The most frequent themes in 19 of the open question responses were voice assistant feature preferences, option for the users to choose the voice assistant they want, expansion of harmful gender stereotypes and how the gender of the voice assistant doesn't matter. See appendix 2 for the theme analysis.

## 4 Results

The questionnaire results are presented in this chapter by using the methodologies and data analysis mentioned in the previous chapter. Results describe students' perceptions and attitudes towards voice assistants and their gendered design.

### 4.1 Background information of participants

Out of 142 people who opened the survey link, 67 participants (48 % (n=32) female, 51 % (n=34) male, 1,5 % (n=1) other) answered the questionnaire. 27 % of degree students at LUT university are women (LUT 2021), so the survey reached more female students than what their percentage in LUT university is. The gender theme of the survey might have appealed to more women to answer the survey, or the questionnaire reached more women. Participants were between the age of 19 and 42. Most participants were born between 2000-2004 (60 %) and 1995-1999 (33 %). Average age of the participants was 23 years old. There was no significant age difference of the participants, so it was not expedient to compare the results to the age of the participants.

Apple's Siri and Google's Google assistant were the most familiar voice assistants to the participants, but even they were not used much on weekly or daily basis. Only 1,5 % used Siri daily and 3 % weekly. For Google assistant 4,5 % of participants used it daily and 1,5 % weekly. One third (33 %) of the participants have tried Siri once and 28 % have tried Google assistant once. 57 % had never tried Siri and 55 % had never tried Google assistant. Usage percentages can be seen in table 1. Participants don't have a lot of experience with different voice assistants, so their lack of experience on voice assistants may be reflected on the results and their perceptions about voice assistants. According to the study by PwC, 18–24-year-olds are most likely to adapt new voice technologies, but they use the appliances less than older consumers (McCaffrey et al. 2018). This could also be case with the participants, since they have tried the different voice assistants, but don't use them regularly.

Amazon's Alexa, Microsoft's Cortana and Samsung's Bixby were used the least by the participants (table 1). Almost no one (96 %) had never tried Alexa. For Cortana, the percentage of participants who had never used it was 93 % and for Bixby 90 %. These voice assistants had been tried once by 1,5 % (Alexa), 7,5 % (Cortana) and 7,5 % (Bixby) of the participants. The low percentage of uses for these voice assistants could be because Alexa, Cortana and Bixby don't have Finnish language version available.

Some other voice assistants that the participants mentioned they had used, were not actually voice assistants. Two of the other answers were not voice assistants, for example self-checkout automats and Google maps. Alice, which is Russian voice assistant by Yandex, was mentioned as other voice assistants besides the ones mentioned earlier. Another mention of different voice assistants was various models of systems in cars. Car voice assistants allow hands-free communication to the system while driving. In that case, Google maps could also be included as voice assistant. It's possible that not every participant recognized what a voice assistant is and what isn't. Among the participants the idea of what is a voice assistant can be a variety of systems that use voice to function, such as self-checkout automats.

*Table 1: Usage percentages of market-leading voice assistants*

	Never	Tried once	Monthly	Weekly	Daily
Apple's Siri	56.7%	32.8%	6.0%	3.0%	1.5%
Amazon's Alexa	95.5%	1.5%	3.0%	0.0%	0.0%
Google's Google assistant	55.2%	28.4%	10.4%	1.5%	4.5%
Microsoft's Cortana	92.5%	7.5%	0.0%	0.0%	0.0%
Samsung's Bixby	89.5%	7.5%	3.0%	0.0%	0.0%
Some other, which one:	91.0%	6.0%	1.5%	0.0%	1.5%

60 % of participants were aware that majority of voice assistants on the market are primarily or exclusively projected as female in character. One fourth (25 %) of participants were somewhat aware and 15 % were not aware of this. Questionnaire was targeted at students and shared within technology students, which can be why majority of the participants were aware of how common the female gendering of the voice assistants is, even though the participants hadn't used that many voice assistants by themselves before. There was no significant difference between the gender of participants and the knowledge of primarily female gendered voice assistants ( $p=0,311$ ), which means that knowledge of gendered voice assistants is not related to the gender of the participants. Some participants also discussed the topic of if they knew the voice assistants to be commonly female gendered in the open



question as seen below. Not having previously thought about the gendering of voice assistants was also one of the themes found in the open question theme analysis (appendix 2).

*"I haven't thought before why the female voice assistants are more common but I understand why female voice might seem more friendly" -P15*

*"I have never thought of this before, but it may be that I have a slight preference for female gendered voice assistants." -P18*

#### 4.2 Preferences on voice assistant characteristics

The stereotypical gender traits for women are affectionate, empathetic, friendly, sincere, sensitive, and cooperative. Male stereotypical traits include authoritative, assertive, determined, organized, confident and dominant. (Eyssel and Hegel 2012) Preferences the participants choose for voice assistants are presented in table 2. Participants most preferred characteristics out of the previously mentioned traits for voice assistants were friendly (63 % agree, 24 % strongly agree), organized (43 % agree, 46 % strongly agree), and cooperative (42 % agree, 45 % strongly agree). Most disliked feature for voice assistant was dominant (48 % disagree, 22 % strongly disagree) and authoritative (37 % disagree, 10 % strongly disagree). Sensitivity split options, which can indicate that sensitivity is a somewhat important for taking emotional aspects into account, but it can also be seen as a weakness for a voice assistant if it means that the voice assistant would act too delicate or shy. Participants were more open for traditionally female features and characteristics, like friendliness and cooperativeness than for stereotypically male traits such as authoritative and dominant. Stereotypical male traits that the participants admired the most on voice assistant were determined and organized. Determination would help to make sure that the voice assistant finishes the required tasks and organization helps to trust the voice assistant to keep all the personal schedules and information on track.

Table 2: Preferred characteristics on voice assistants

	Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
Authoritative	1.5%	17.9%	32.8%	37.3%	10.5%
Affectionate	3.0%	22.4%	35.8%	31.3%	7.5%
Assertive	6.0%	22.4%	43.3%	19.4%	8.9%
Empathetic	9.0%	35.8%	32.8%	19.4%	3.0%
Determined	13.4%	43.3%	29.9%	10.4%	3.0%
Friendly	23.9%	62.7%	8.9%	4.5%	0.0%
Sincere	17.9%	50.7%	29.9%	1.5%	0.0%
Organized	46.3%	43.3%	10.4%	0.0%	0.0%
Sensitive	4.5%	20.9%	34.3%	32.8%	7.5%
Confident	17.9%	53.7%	26.9%	1.5%	0.0%
Cooperative	44.8%	41.8%	13.4%	0.0%	0.0%
Dominant	0.0%	8.9%	20.9%	47.8%	22.4%

There were no strong ( $r > 0,5$  or  $r < -0,5$ ) correlations between the preferences of all the features. Medium correlations between the preferences are presented in table 3. Female characteristics might fit the personal assistant role better than the male characteristics, as they are seen in positive light. Positive stereotypical traits confident and organized support each other, they have a positive correlation. The stereotypically male characteristics can also be seen as dangerous for technology, such as being authoritative or determined. Humans want to be in control of the technology we create and not the other way around. Dominance is not associated with being friendly or sincere, which could make the voice assistant feel untrustworthy.

Table 3: Positive and negative correlations of preferences on voice assistants

Positive correlations	Negative correlations
Sensitive & affectionate (p = 0,000) r = 0,44	Dominant & friendly (p=0,023) r = -0,27
Confident & organized (p = 0,000) r = 0,46	Dominant & sincere (p=0,027) r = -0,27
Cooperative & friendly (p = 0,002) r = 0,39	
Authoritative & dominant (p=0,001) r = 0,39	

In other question, when asked what makes companies prefer female characteristics in voice assistants (multiple choices were possible to choose), 59 participants answered because female voice is seen as friendly (figure 1). The same theme also appeared in the open responses.

*“It is easier to understand female voice assistant as the voice is higher. I sometimes have trouble hearing male voices as it feels like low voice fade into background. Also female voice makes me feel safer.” -P4*

*”I have personally gotten used to the female voice and I find it very is pleasing.” -P2*

41 participants selected to the multiple option question that stereotypically women fit the assistant role better, because the nature of women is nurturing, as seen in the participants’ comments. 26 women, 14 men and 1 other chose the option (figure 2). The responses align with the related studies that argue that the gender stereotypical features are preferred when performed by the gendered design that the stereotype is associated with (Tay et al. 2014).

*“Females are more often associated to be “helpers”, assistants, work in support functions than men, therefore it might feel natural to have female as voice assistant.” -P11*

*“It’s fairly basic psychology to prefer female voice, as female voices are perceived as being more nurturing and caring, which can make people feel more at ease and comfortable when interacting with a voice assistant, for a multitude of psychological reasons.” -P16*

Preference for female voice is also one reason for the popularity of female voice assistants, total of 28 answers (8 women and 20 men). 15 participants selected the option “female characteristics increase the user satisfaction”. As it has been noted in related studies, the female gendering increases the feeling that the user’s unique needs will be taken into more consideration than they would be with male gendered system (Borau et al. 2021). Female characteristics bringing profit for the company was selected by 13 participants. Participants might see profit as the general success of the product, not just one feature of it, such gender it is projected as. As mentioned in the open question answers, the comprehension skills, and tone of the voice assistants and user experience are seen as important features that make the voice assistant pleasurable to use and that are not defined by gender of the assistant.

*“Given that tech is more male dominant it's interesting that the assistants are female, but as a user experience it wouldn't have effect.” -P17*

For the other reasons beyond the ones that were listed as options in the question, open responses included a viewpoint that currently technologically oriented people are mostly men that may prefer woman voice, which is why companies prefer to use a female voice in voice assistants. Both men and women prefer the voice of the opposite sex (Jones et al. 2010)

but the intended target user group of voice assistants is not only men. It is hard for companies to please every user unless companies could offer more voice options to let the users customize the voice assistant as they wish. Other reasons that the participants thought why companies select female characteristics is that the companies make the decision without much thought behind it and that the options are listed in alphabetical order, so female comes before male and other options. This can imply that the participants think companies don't see gender as priority or something that should be given much thought about and that the genders are just listed in alphabetical order just as everything else, as seen in the open answer response as well.

*“At least Siri has options for both, they are in alphabetical order and that's why female comes first. It doesn't fully mean that female is preferred. Otherwise, it's people's choice and I wouldn't put blame on the software developers for putting choices in alphabetical order.” -P14*

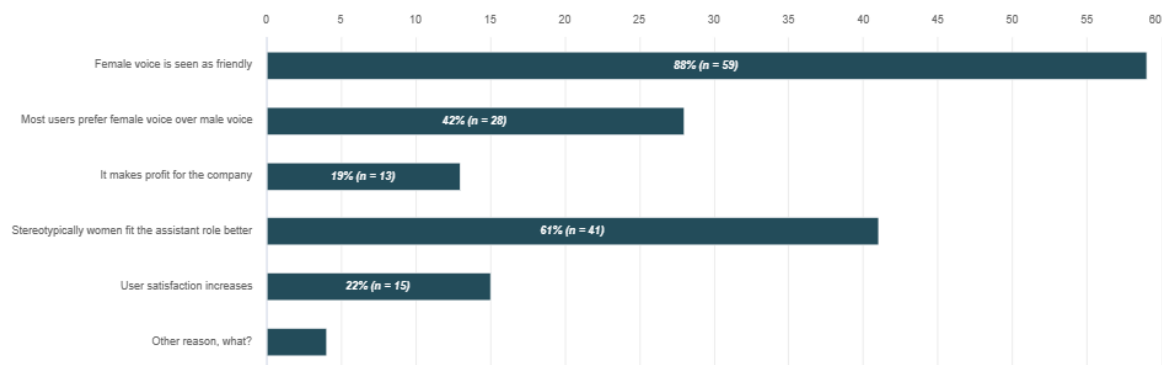


Figure 1: Female features participants think that make companies prefer female voice assistants (could choose multiple options)

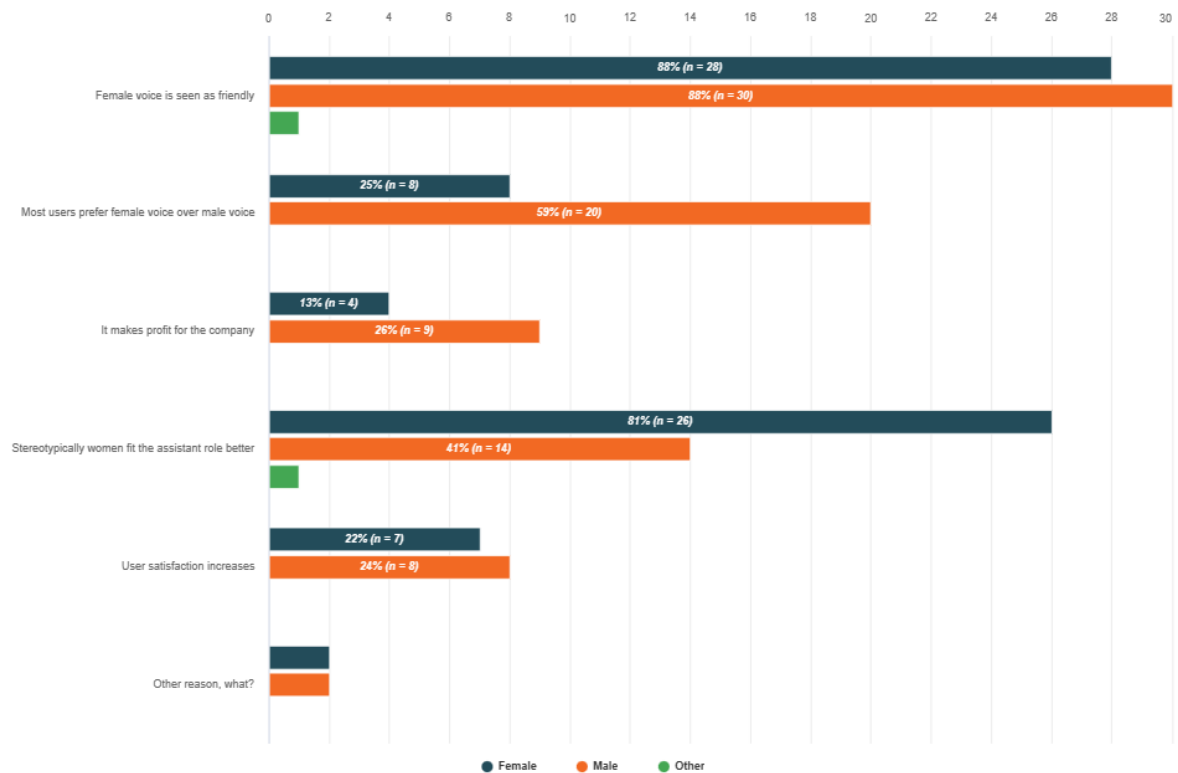


Figure 2: Female features participants think that make companies prefer female voice assistants divided by the gender of the participants (could choose multiple options)

Furthermore, in another question on the survey “female characteristics make voice assistants seem more helpful than male characteristics would”, the respondents would 39 % agree, 30 % neither agree nor disagree, 24 % disagree, 7 % strongly disagree. There is a significant positive correlation between female characteristics improving the helpfulness and female voice improving the user experience ( $p=0,000$ ;  $r=0,49$ ). Participants who agree that the female characteristics make the voice assistant helpful, also agree that the female voice improves the user experience of voice assistants. It could be that the participants don’t think that female characteristics automatically make the voice assistant more helpful, but the pleasing female voice makes the experience somewhat better. The context in which the voice assistant is used can be more relevant to the helpfulness. The gender of the assistant is determined by the developers also for the context in which it will be used (West et al. 2019). For example, will the voice assistant be used in more stereotypically masculine tasks like finance or science, or in more stereotypically feminine tasks like personal assistance and nursing. P19 talked about how the preference of the gender would depend on the context.

*“Female voice sounds nice. However it’s true that female voice shows more affection, but male sound may sound more professional. So in everyday*

*questions I would prefer female but in scientific questions I would prefer male.” -P19*

### 4.3 Significance of gender in voice assistants

Almost half (46 %) of the participants didn't care about the voice option of the voice assistant when they could choose which one (female, male, gender neutral, robotic or doesn't matter) they would prefer (table 4). 31 % would prefer a female voice, 15 % gender neutral voice and only 4,5 % would choose male voice and 3 % robotic voice for their voice assistant (table 4). Robotic voice might sound too distant and irritating. The indifference to the gender of the voice used in voice assistant may be because most of the users had only little personal experience with voice assistants so the participants had no personal experiences to compare the options to each other.

*Table 4: Preference for voice types on voice assistants*

	<b>n</b>	<b>Percent</b>
Female voice	21	31.3%
Male voice	3	4.5%
Gender neutral voice	10	14.9%
Robotic voice	2	3.0%
Doesn't matter	31	46.3%

For 47 % of the men the voice option doesn't matter and 38 % of men would prefer female voice. Women prefer “doesn't matter” (44 %), female voice (25 %) or a gender-neutral voice (22 %). Percentages on preferred voice options by the gender of the participants are shown in table 5. Male voice and robotic voice are not preferred, which can be because female voice is seen as more friendly, or the participants don't particularly care what the voice would be. Female voice is default in many voice assistants, so the users might prefer it because they have tried female voice assistants or because they expect it to be good because it's common choice. Robotic voice might sound too unnatural to listen to in daily basis. Preference for gender neutral voice (15 % for all participants) can also mean that the participants don't care if the voice is either feminine or masculine. There was no statistical significance between gender of the participants and the responses on what voice option are preferred ( $p=0,596$ ).

Gender of the participants doesn't influence which voice option they prefer on voice assistants.

Table 5: Preference for different voice assistant voice types divided by gender of participants

	Female		Male		Other		Total
	n	Percent	n	Percent	n	Percent	
Female voice	8	25.0%	13	38.2%	0	0.0%	21
Male voice	1	3.1%	2	5.9%	0	0.0%	3
Gender neutral voice	7	21.9%	3	8.8%	0	0.0%	10
Robotic voice	2	6.2%	0	0.0%	0	0.0%	2
Doesn't matter	14	43.8%	16	47.1%	1	100.0%	31
<b>Total</b>	<b>32</b>		<b>34</b>		<b>1</b>		<b>67</b>

Over half (57 %) of participants find that using female voice for voice assistants neither improves nor reduces the user experience. 18 % disagree and 12 % strongly disagree that the female voice would increase the user experience. Female voice is not seen as so relevant for user experience. There are many other important factors besides gender of the voice assistant that play into successful user experience, such as tone and intonation. There is a significant positive correlation between finding female voice to increase the user experience and that voice assistant should be primarily projected as female ( $p=0,000$ ;  $r=0,56$ ). As noted in the related studies, the gender stereotypical traits and behavior are even more preferred, when they are displayed by the same gender that the stereotypes are associated with (Tay et al. 2014). This can be because participants also preferred traditionally feminine traits for voice assistants. The participants discussed the user experience of voice assistants in the open question, but the most important thing about the voice was that it works properly, not that it's certain gender.

*“I feel the more important thing than gender is the way the assistant uses intonation in their speech. The current choice of intonation sparks anger in myself when the voice assistant does not understand a command. The intonation sometimes feels condescending.” -P9*

*“Tone of the voice probably is more important than the gender. If it affects how they're seen, I don't think it's conscious difference but it's also what people who use them are used to.” -P17*

*“All that matters is that the voice is pleasant and not clearly a robotic voice.” -P5*

Only fifth of the participants (21 %) think that the gender of the voice assistant matters (figure 3). For the rest, it doesn't seem to matter, or they don't know whether to agree or disagree to the statement "gender of the voice assistant does not matter to me". Altogether, the participants don't seem to mind what the gender of the voice assistant is. It could be that if the participants were tested to use voice assistants, the unconscious preference could differ, but nothing cannot be said of it for sure, because many of the participants lack the personal user experience with voice assistants.

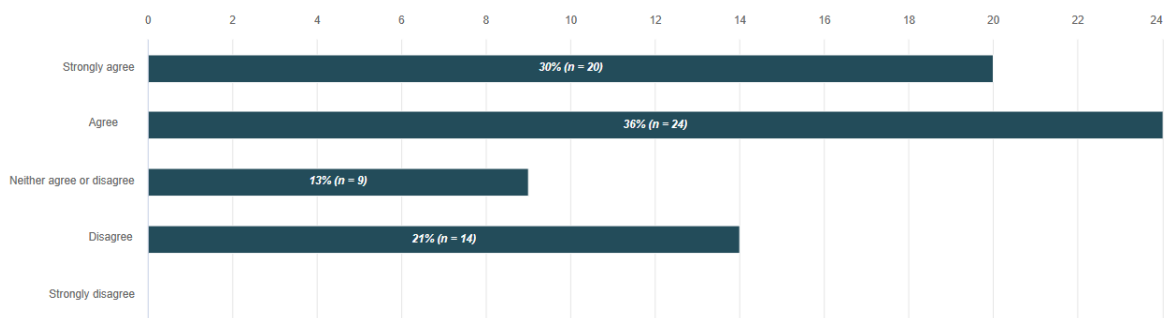


Figure 3: Gender of the voice assistant does not matter to the participants

#### 4.4 Possibility to choose the preferred voice assistant

39 % of participants agree and 28 % of participants strongly agree that companies should provide more gender options for their voice assistants (figure 4). The participants discussed about the possibility of having more diverse options also in the open question, which lead to a theme "voice options for voice assistants" (see appendix 2). There is a negative correlation between wanting companies to provide more gender options for the voice assistants and that voice assistants should be primarily projected as female ( $p=0,045$ ;  $r= -0,25$ ;  $N=67$ ). The correlation is not quite strong, because it's closer to null than -1, but it's still interesting. Participants who want more diverse options for voice assistants also don't think the female option should be the primary one that the companies offer.

*"We should expand the choices." -P6*



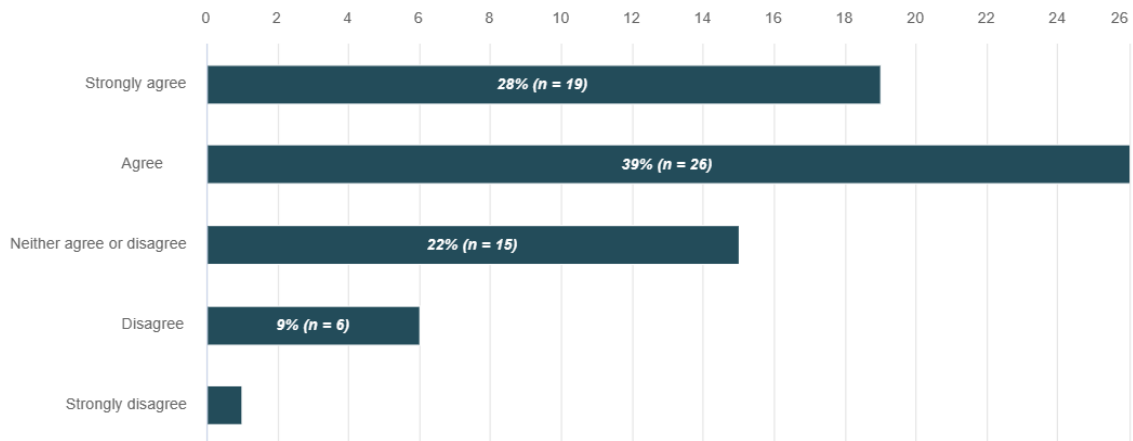


Figure 4: Companies should provide more voice options

In the figure 5, participants agree that the user should be the one who gets to select the gender of the voice assistant they will be using (37 % strongly agree, 39 % agree). There is a significant and a strong positive correlation between the variables companies should provide more voice options and the users should be able to select the gender they want to use by themselves ( $p=0,000$ ;  $r=0,75$ ). These two go together, because if no more options were wanted, then companies would not be expected to provide more options for the users to choose from. Option to be able to choose the preferred voice option the user wants was also discussed in the open question and was one of the main themes that was found in the theme analysis (appendix 2).

*“[...] there should definitely be an option to choose which voice you want the assistant to have.” -P1*

*“In my opinion, the software should ask the user the wanted gender of voice assistant before initialization.” -P2*

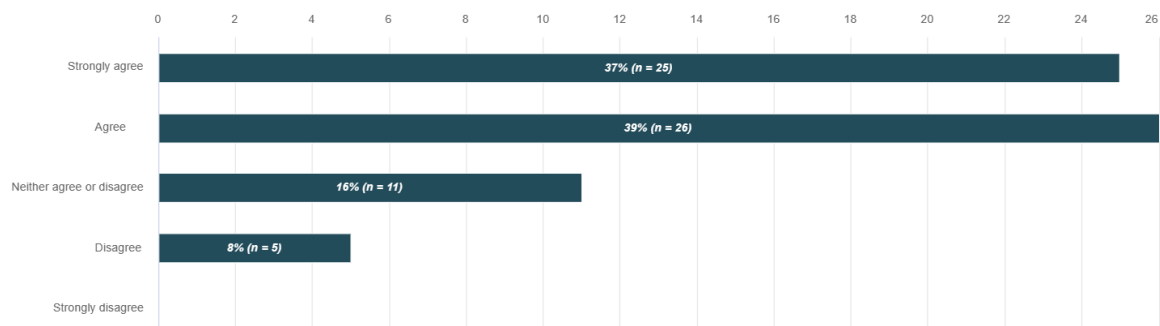


Figure 5: Users should be able to select the gender of the voice assistant they want to use

The participants had quite a positive attitude towards diversifying the voice options and genders of voice assistants as well as to let the user customize the voice assistant's gender

and voice as they wish. Providing more gender options for voice assistants is a long process. As noted in the study by Hwang et. al, the design and the script of a female voice assistant is gender stereotyped (Hwang et al. 2019), so changing the gender of completed female voice assistant to male, would take a lot of work, since people prefer the gendered voice assistant to act in their expected gender roles (Tay et al. 2014). If companies leave the choice of what gender to use for the user to decide, the companies could wash off their hands on making the decision themselves and not having to think about how the exclusive or primary design choices affect the human-computer interactions. All in all, the option for more than one gender is important, because not everyone likes the same voice. The customization of the voice assistant could also make it feel more personal and unique to the user. One participant commented about how the option to choose the preferred voice could also possibly help avoid traumatic experiences.

*“What if the only voice available sounds like someone who abused you and hearing that voice triggers all that trauma? You might not be able to use voice assistant even if it was crucial for your independence if you cannot use your phone etc. in other ways.” -P13*

Half of participants (52 %) neither agree nor disagree that the female voice should not be the default voice option for all voice assistants (figure 6). This could either imply that the gender is not seen as significant or that options are good, but female voice assistant could still be the first option. One fifth (22 %) of women strongly agree with the statement that female voice should not be the default option, whereas for men the same percentage is only 3 %. Women might care more for how women are presented in technology. Siri is no longer female by default in English version (Panzarino 2021). Change has already happened on this area, but not with all other voice assistants such as Alexa, which is still only exclusively female voiced.

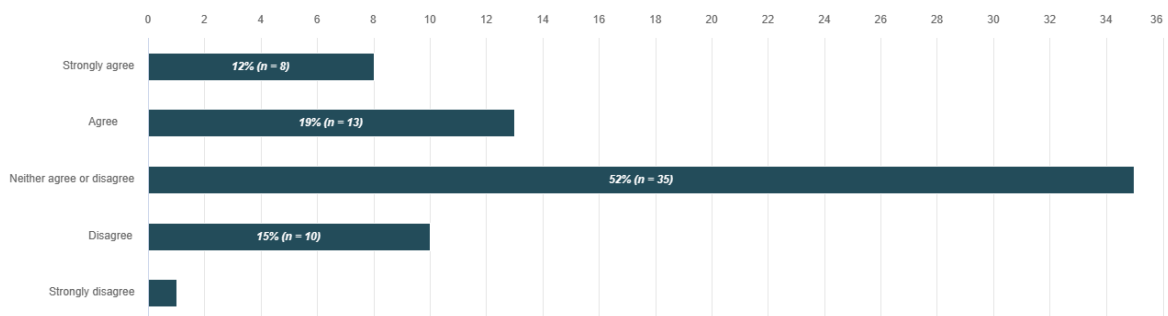


Figure 6: Female voice should not be default for all voice assistants

## 4.5 Challenges of gendered voice assistants

Half of the participants (51 %) think that the voice assistants should not primarily be projected as female (table 6). One third neither agree nor disagree (31 %), so they may have not thought about the gender of the voice assistants or its impact much before, or the gender is seen as irrelevant feature to the success of voice assistants. The positive correlation ( $p=0,000$ ;  $r=0,56$ ) between thinking voice assistants should be primarily projected as female and that female voice improves the user experience was discussed earlier (see chapter 4.3.).

Table 6: Voice assistants should be primarily projected as female

	n	Percent
Strongly agree	0	0.0%
Agree	5	7.5%
Neither agree or disagree	21	31.3%
Disagree	34	50.7%
Strongly disagree	7	10.5%

Opinions on whether there should be more discussion about the gender of the voice assistants are not unanimous as seen in figure 7. There is a significant and strong positive correlation between thinking that there should be more discussion on the gendering of voice assistants and that companies should provide more gender options ( $p=0,000$ ;  $r=55$ ). Relevant discussion could be about the design choices the companies have made for gendered voice assistants. The report by UNESCO (West et al. 2019) about the harms of gendering voice assistants has opened a lot of discussion on how to prevent the gendering of voice assistants from increasing harmful gender stereotypes. The report also offers a guide for developers on how to prevent the negative side-effects of female gendering technology. The participants might not see discussion relevant to them, depending on their field of study and interests.

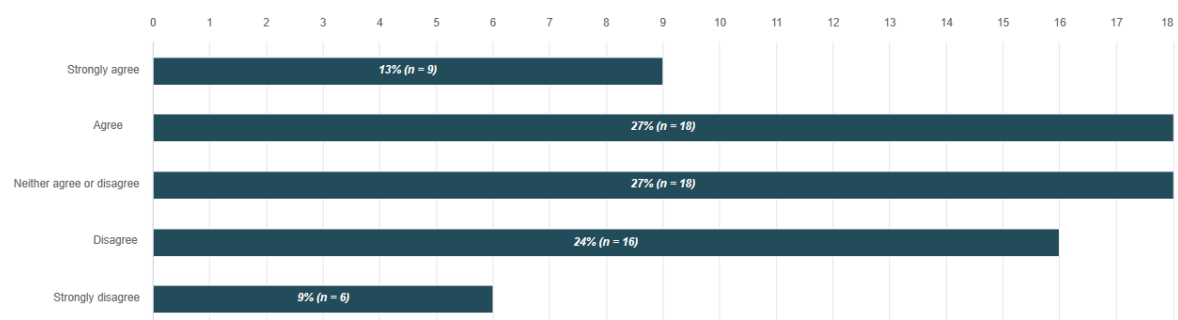


Figure 7: There should be more discussion about gender of voice assistants

Challenges that the users found of the commonly limitedly gendered design of voice assistants was investigated with the question “What do you see as challenges of only having female gendered voice assistants” which had multiple options and more than one option could be selected. Results are in the figure 8. The most popular challenges of only having female gendered voice assistants were expansion of harmful stereotypes (N=31), lack of diversity in technology (N=30), and that because of the gendering of voice assistants, women are made into servant in technology (N=31). In the open question, many participants expressed their thoughts about the harmful stereotypes that the exclusively female gendering might cause. Expansion of harmful stereotypes was also one theme in the open question theme analysis (appendix 2). The students seemed to be well-informed about the challenges of the female gendered voice assistants.

*“In some languages voice assistants work worse than in others, which also might brainwash users into thinking that women are simple or stupid because they (in this case the voice assistant) don't understand even simple commands.” -P9*

*“While the use of female voice assistants doesn't have any immediate and clear negative effects on its own, they're a small part of a larger system that supports female stereotypes and unnecessarily strict gender roles. (In my opinion) there are very few explicit problems in how women are portrayed, but all the little things (like female voice assistants, female objectification in marketing being more common than male objectification, etc...) add up to uphold harmful stereotypes” -P10*

*“Females are more often associate to be "helpers", assistants, work in support functions, etc. than men. However, it keeps the old fashioned way of thinking alive, and tech companies should not do that, but do their best to remove that kind of thinking and help to make the culture and norms to support that men and women are equal and that they are the same in this sense.” -P11*

*“I am afraid that some people become more controlling and submissive when commanding a female voice assistant. Also stereotypical "blond girl (voice) doesn't know anything" attitude can weaken the message or help given by the assistant.” -P12*

17 participants didn't see any challenges with only having female gendered voice assistants. 16 of these responses were from men and one from a woman (figure 9). The reason or not seeing challenges may also be because the challenges are not seen to be related to the gender aspect of voice assistant, but other parts of them, such as speech recognition and initiation. Many of the participants didn't feel like there were any harms of challenges of female gendering of voice assistants, which also was one theme that was found in the theme analysis in appendix 2.

*“I don't really see any harm in it [...]” -P1*

*“I strongly feel like that gender doesn't affect my real life thoughts about stereotypes mentioned [in the survey]” -P2*

*“I don't really notice gender in voice assistants or anything.” -P3*

*“I don't really care about the gender of the assistant.” -P5*

*“I don't think this is so much of a big deal. I wouldn't really care about the gendering of voice assistants as long as they functioned properly. [...] like I said, this doesn't seem like a huge problem to me:” -P7*

*“I don't like voice assistants in daily basics. Of course it's a different story if a user has disabilities but otherwise there is no need for voice assistants.” -P12*

*“I wouldn't care about this issue but that all are female makes it interesting.” -P17*

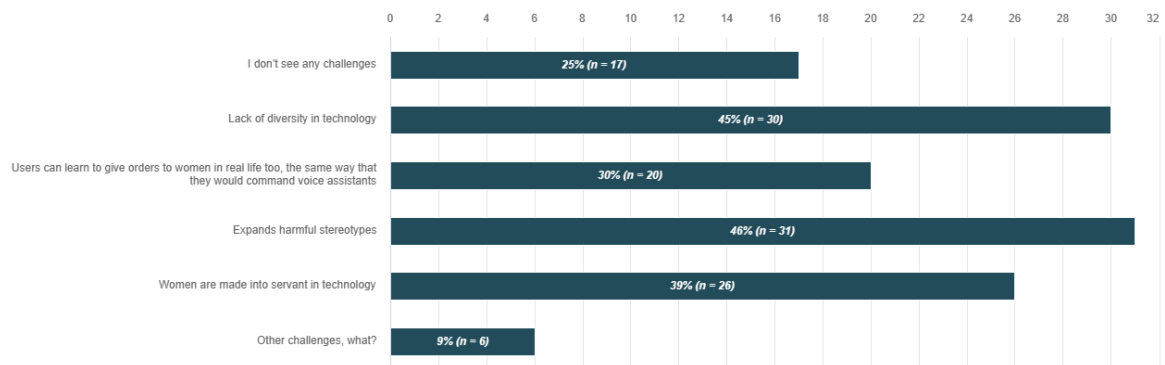


Figure 8: Biggest challenges of only having female voice assistants (could choose multiple options)

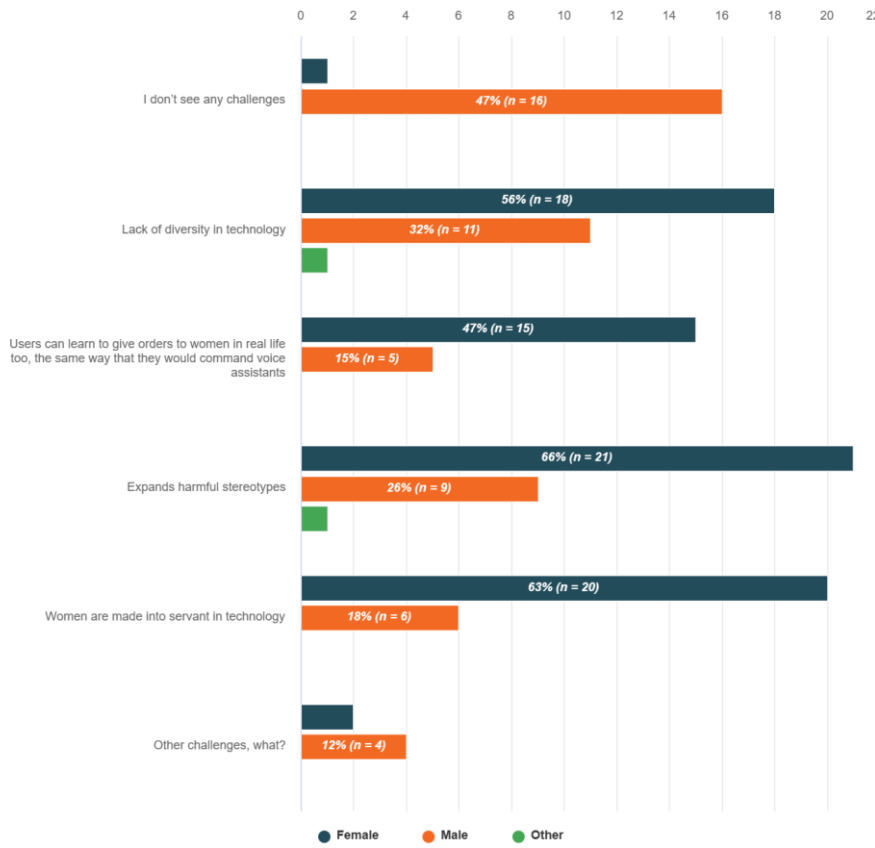


Figure 9: Biggest challenges of only having female voice assistants by the gender of participants (could choose multiple options)

Other reasons that the participants had listed as challenges of female voice assistants was lack of option for users who would want to use other than just the female voice assistant, sexualization of voice assistants being common and that the female gendered voice assistants annoy feminists. Lack of options can be a challenge because the preferences of individuals might not always be what the designers think the certain target groups would prefer. The companies should think about the users' needs more specifically, not just researching if women or men prefer certain design choices (Schulenberg et al. 2023). Sexualization of voice assistants was found as a harmful design choice to women in related studies discussed earlier (Fessler 2017; Hwang et al. 2019). Feminists being annoyed by female gendered voice assistants might mean that feminists might not like the current design of voice assistants which in some cases includes harmful gender stereotypes and is not using mindful HCI design choices that align with feminist principles. Someone understood the question of the challenges of only having female voice assistants as if there were now only female voice assistants, but it's true as the participants said that now there is options for male and female voices, so the question formatting might have confused some participants to think that as of

now, there is only exclusively female gendered voice assistants, not what if there were only female gendered voice assistants.

#### 4.6 Limitations and future research

Limitations to the survey is that it only includes students mostly in their twenties, so the age distribution was not examined. Different age groups might have had different views and perceptions of gender and voice assistants. Limitations of the questionnaire is that it only got 67 responses. A larger number of data and a bigger sample size would offer more validity and reliability to the results (Heikkilä 1998). The study would also be interesting to conduct with a more diverse group of young people, not just university students, which limits the results to perceptions of people who are highly educated. The survey also didn't ask participants to specify their field of study, so nothing can be said of the type of education the participants have.

A possible limitation of the questionnaire was that the questions and the options might be leading the participants to answer in a certain way. The idea of the questionnaire would be interesting to create as a future study with test group and a control group in controlled experimental environment. Further studies on the subject could be done to figure out that even when the gender of the voice assistant would be seen as insignificant, would the result be different, if the participants were to use a voice assistant with different kind of voice assistant genders. The unconscious bias and preferences could lead to different results when participants would have personal experience with using voice assistants. The conscious attitudes from the questionnaire can also be significant for companies when they are building voice assistants, but it cannot be taken as completely accurate representation of students' attitudes and perceptions for the low number of participants. Attitudes and perceptions could be further studied by their standard measures that have been previously created in related research. Interviews could be an interesting method to approach the perception of gendered design to get more profound points of view from targeted groups.

## 5 Discussion

In this bachelor's thesis the reasonings for the gendered design of voice assistants were found in the related studies. Advantages and challenges of female gendered voice assistants were discovered extensively, but the method was unsystematic, so it does not necessarily give a wider insight on the researched topic. The results of the questionnaire answered to the research questions on how the students perceive voice assistants. The participants didn't seem to mind what the gender of the voice assistant is and expressed their opinions that other things like the tone and intonation of the voice assistant increase the user experience more than just the gender of the voice assistant. Although the gender didn't matter to the participants to a great extent, they still preferred voice assistants with stereotypically female traits.

The questionnaire results can be useful for service design when designing new voice assistants, but it must be noted that the participants had little hands-on experience with voice assistants, which is why the results are in many cases based on just perceptions and attitudes of voice assistants instead of personal experience. Perceptions are useful for companies when they develop new technologies and to investigate what possible end-users think of the product. The results indicate that the students don't seem to consciously care what the gender of the voice assistant is, even though mostly female characteristics are preferred over male characteristics. More studies should be conducted to get more profound and accurate results that could be used to analyze perceptions in service design.

The results are mostly in line with related studies, but the participants' lack of care for the voice assistant gender was not found in other studies when doing this work. Participants prefer characteristics for voice assistant that are stereotypically female, which is in line with the previous studies showing that the users prefer gendered software that display the gender stereotypes of the chosen gender (Tay et al. 2014).



## 6 Conclusions

The first research question was why female gendering of voice assistants is so common and the reasons in favor and against the female gendering of voice assistants. The reason why the female gendering of the voice assistants was researched was to find out how the gendered design choices affect HCI and possible end users. The related studies answered the reasons for why female gendered voice assistants are common. Warmth, friendliness (Eyssel and Hegel 2012), and acknowledgement of users' unique needs are associated with female characteristics (Borau et al. 2021). Human stereotypes are also applied to computers (Nass et al. 1994), and gendered software are preferred when the gender stereotypes match the gender that they are associated with in humans (Tay et al. 2014). The female voice assistants are a reasonable choice for companies because the female gendering improves the perceived humanness of voice assistants (Borau et al. 2021) but the negative effects of the female gendering should be taken into consideration as well. Harms of the female gendering of voice assistants includes for example sexualization of female voice assistants (Fessler 2017; Hwang et al. 2019) and expansion of harmful stereotypes (Schulenberg et al. 2023). The harms could be reduced by following the suggestions given in the related studies to improve the design of voice assistants include for example feminist HCI principles (Bardzell 2010) and gender inclusive design methods (Vorvoreanu et al. 2019; Schulenberg et al. 2023).

The second research question was what students' perception of gendered voice assistants are, which was investigated by conducting an online questionnaire. The questionnaire implied that participants didn't find much relevance of the gender of the voice assistants. The usage of voice assistants was low among the participants, so the perceptions are based on attitudes and general ideas of voice assistants, not on personal experiences. Increasing of more options is seen as important and the participants found harmful gender stereotypes in the gendered design of voice assistants. Participants preferred mostly female traits on voice assistants and thought that companies choose the female gendered design on voice assistants mostly because female voice is seen as friendly, women stereotypically fit the assistant role and most users prefer female voice over male voice. Participants who agree that the female

characteristics make the voice assistant helpful, also agree that the female voice improves the user experience of voice assistants.

Even though female traits are preferred, the gender of the voice assistant doesn't have much importance to participants. Female gendering of voice assistants doesn't seem to improve the user experience, but there is a significant positive correlation between finding female voice to increase the user experience and that voice assistant should be primarily projected as female ( $p=0,000$ ;  $r=0,56$ ) implementing that the preferred stereotypical female traits are preferred even more when they are implemented by the same gender the stereotype is associated with. The participants discussed that instead of the gender of the voice assistant, tone and initiation are more important for a pleasant user experience. Although the gender of the voice assistant didn't mostly matter to the participants, there was a positive correlation between wanting the users to be able to choose the gender of the voice assistant by themselves and that companies should offer more than one voice option ( $p=0,000$ ;  $r=0,75$ ). This means that more options are wanted, and companies are also asked to provide more diverse options for voice assistants. The change has already happened in the industry, as more voice assistants offer more options than just the exclusively female option.

Altogether, the participants seem to prefer voice assistants whose traits are in line with each other. Other options besides just the female version should be available. The results could be implemented in service design of voice assistants to see how possible end users perceive the gendered design choices, but the participants had only little personal experience on using voice assistants, so for more accurate results a better method would be to conduct an experiment where the participants subconsciously rate features of voice assistants after using different voice assistants.

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## Appendix 1. Questionnaire

## Appendix 1. Questionnaire

## 1. Select your gender \*

- Female  
 Male  
 Other  
 Prefer not to say

## 2. Select your birthyear \*

## 3. How often do you use these voice assistants? \*

	Never	Tried once	Monthly	Weekly	Daily
Apple's Siri	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Amazon's Alexa	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Google's Google assistant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Microsoft's Cortana	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Samsung's Bixby	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Some other, which one: <input type="text"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## 4. I would like my voice assistant to have following features \*

	Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
Confident	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sincere	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Friendly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dominant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Empathetic	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cooperative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Determined	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Organized	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Authoritative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Assertive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sensitive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Affectionate	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Appendix 1. Questionnaire

**5. Which voice option would you prefer on your voice assistant? \***

- Female voice
- Male voice
- Gender neutral voice
- Robotic voice
- Doesn't matter

**6. Majority of voice assistants on market are primarily or exclusively projected as female in character. Were you aware of this? \***

- Yes
- Somewhat aware
- No

**7. Companies should provide more than one gender option for their voice assistant \***

- Strongly agree
- Agree
- Neither agree or disagree
- Disagree
- Strongly disagree

**8. Users should be able to select the gender of the voice assistant they use \***

- Strongly agree
- Agree
- Neither agree or disagree
- Disagree
- Strongly disagree

## Appendix 1. Questionnaire

**9. Female voice should not be default voice option for all voice assistants \***

- Strongly agree
- Agree
- Neither agree or disagree
- Disagree
- Strongly disagree

**10. Using female voice for voice assistants improves the user experience \***

- Strongly agree
- Agree
- Neither agree or disagree
- Disagree
- Strongly disagree

**11. Female characteristics make voice assistants seem more helpful than male characteristics would \***

- Strongly agree
- Agree
- Neither agree or disagree
- Disagree
- Strongly disagree

**12. Voice assistants should be primarily projected as female \***

- Strongly agree
- Agree
- Neither agree or disagree
- Disagree
- Strongly disagree

**13. Gender of the voice assistant does not matter to me \***

- Strongly agree
- Agree
- Neither agree or disagree
- Disagree
- Strongly disagree



## Appendix 1. Questionnaire

**14. There should be more discussion about the gender of voice assistants (e.g. general discussion, discussion within technology companies...)\***

- Strongly agree
- Agree
- Neither agree or disagree
- Disagree
- Strongly disagree

**15. Why do you think companies prefer female characteristics in voice assistants? Can choose more than one option \***

- Female voice is seen as friendly
- Most users prefer female voice over male voice
- It makes profit for the company
- Stereotypically women fit the assistant role better
- User satisfaction increases
- Other reason, what?

**16. What do you see as challenges of only having female gendered voice assistants? Can choose more than one option \***

- I don't see any challenges
- Lack of diversity in technology
- Users can learn to give orders to women in real life too, the same way that they would command voice assistants
- Expands harmful stereotypes
- Women are made into servant in technology
- Other challenges, what?

**17. What thoughts do you have about the female gendering of voice assistants? Please add any comments you have about gendering of voice assistants. (e.g. have you ever thought about why female voice assistants are more common than male voice assistants, does the gendering of voice assistants impact how users see them...)**

## Appendix 2. Theme analysis of open question answers

Theme	Codes
Voice options for voice assistants	<p>P1: "[...] but there should definitely be an option to choose which voice you want the assistant to have."</p> <p>P2: "In my opinion, the software should ask the user the wanted gender of voice assistant before initialization."</p> <p>P6: "We should expand the choices."</p> <p>P7: "I only agree that it should be rearrangeable in our devices so people can use it as they prefer [...]"</p> <p>P14: "At least Siri has options for both, they are in alphabetical order and that's why female comes first. It doesn't fully mean that female is preferred. Otherwise, its people's choice and I wouldn't put blame on the software developers for putting choices in alphabetical order."</p> <p>P15: "However, it would be good if the user was given option to choose between female, male or gender-neutral voice if that matters to them. Personally, I haven't used voice assistants that much that I would know which option I prefer."</p> <p>P16: "Options are of course always great, undoubtedly. However, to take extra steps towards acting against our basic psychology is foolish"</p> <p>P19: "[...] in everyday question I would prefer a female but in scientific questions I would prefer male."</p>
Voice assistant feature preferences	<p>P2: "I have personally gotten used to the female voice and I find it very is pleasing [...]"</p> <p>P4: "For myself it is easier to understand female voice as the voice is higher. I sometimes have trouble hearing male voices as it feels like a low voice fade into background. Also female voice makes me feel more safe."</p> <p>P11: "Females are more often associate to be "helpers", assistants, work in support functions, etc. than men. Therefore, it might feel natural to have female voice as voice assistant."</p> <p>P15: "[...] but I understand why female voice might seem more friendly."</p> <p>P16: "Its fairly basic psychology to prefer female voice, as female voices are perceived as being more nurturing and caring, which can make people feel more at ease and comfortable when interacting with a voice assistant, for a multitude of psychological reasons. Its more akin to asking help from a mother figure than an assistant as a real life analogy. [...] However, to take extra steps towards acting against our basic psychology is foolish "</p> <p>P18: "[...] but it may be that I have a slight preference for female gendered voice assistants. Females should consider this as an advantage. "</p> <p>P19: "Female voice sounds nice. However it's true that female voice shows more affection but male sound may sound more professional. So in everyday questions I would prefer female but in scientific questions I would prefer male."</p>

## Appendix 2. Theme analysis of open question answers

Gender doesn't have much importance	<p>P1: "I don't really see any harm in it, [...]"</p> <p>P2: "I strongly feel like that gender doesn't affect my real life thoughts about stereotypes mentioned [in the survey]"</p> <p>P3: "I don't really notice gender in voice assistants or anything."</p> <p>P5: "I don't really care about the gender of the assistant."</p> <p>P7: "I don't think this is so much of a big deal. I wouldn't really care about the gendering of voice assistants as long as they functioned properly. [...] like I said, this doesn't seem like a huge problem to me:"</p> <p>P12: "I don't like voice assistants in daily basics. Of course it's a different story if a user has disabilities but otherwise there is no need for voice assistants."</p> <p>P17: "I wouldn't care about this issue but that all are female makes it interesting."</p>
Voice assistants and disabilities	<p>P12: "[...] Of course it's a different story if a user has disabilities but otherwise there is no need for voice assistants."</p> <p>P13: "What if the only voice available sounds like someone who abused you and hearing that voice triggers all that trauma? You might not be able to use voice assistant even if it was crucial for your independence if you cannot use your phone etc. in other ways."</p>
User experience should not be affected by the gender of the voice assistant	<p>P15: "I think in general that the gender of voice assistant should not have impact on the user experience. "</p> <p>P17: "Given that tech is more male dominant it's interesting that the assistants are female, but as a user experience it wouldn't have effect. "</p>
No thoughts about gendering of voice assistants before the questionnaire	<p>P5: "Never really thought about it. [...] This questionnaire sure provoked some thoughts!"</p> <p>P8: "Alexa and Siri are usually used as female names. Because of this I have fleetingly thought about the chosen assistant voice."</p> <p>P15: "I haven't thought before why the female voice assistants are more common but I understand why female voice might seem more friendly"</p> <p>P18: "I have never thought of this before, but it may be that I have a slight preference for female gendered voice assistants."</p>
Intonation is more important than gender of the voice in voice assistants	<p>P5: "All that matters is that the voice is pleasant and not clearly a robotic voice."</p> <p>P9: "I feel the more important thing than gender is the way the assistant uses intonation in their speech. The current choice of intonation sparks anger in myself when the voice assistant does not understand a command. The intonation sometimes feels condescending."</p> <p>P17: "Tone of the voice probably is more important than the gender. If it affects how they're seen, I don't think it's conscious difference but it's also what people who use them are used to. "</p>

## Appendix 2. Theme analysis of open question answers

Expansion of harmful stereotypes	<p>P9: “In some languages voice assistants work worse than in others, which also might brainwash users into thinking that women are simple or stupid because they (in this case the voice assistant) don't understand even simple commands.”</p> <p>P10: “While the use of female voice assistants doesn't have any immediate and clear negative effects on its own, they're a small part of a larger system that supports female stereotypes and unnecessarily strict gender roles. (In my opinion) there are very few explicit problems in how women are portrayed, but all the little things (like female voice assistants, female objectification in marketing being more common than male objectification, etc...) add up to uphold harmful stereotypes”</p> <p>P11: “Females are more often associate to be "helpers", assistants, work in support functions, etc. than men. However, it keeps the old fashioned way of thinking alive, and tech companies should not do that, but do their best to remove that kind of thinking and help to make the culture and norms to support that men and women are equal and that they are the same in this sense.”</p> <p>P12: “I am afraid that some people become more controlling and submissive when commanding a female voice assistant. Also stereotypical "blond girl (voice) doesn't know anything" attitude can weaken the message or help given by the assistant.”</p>
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