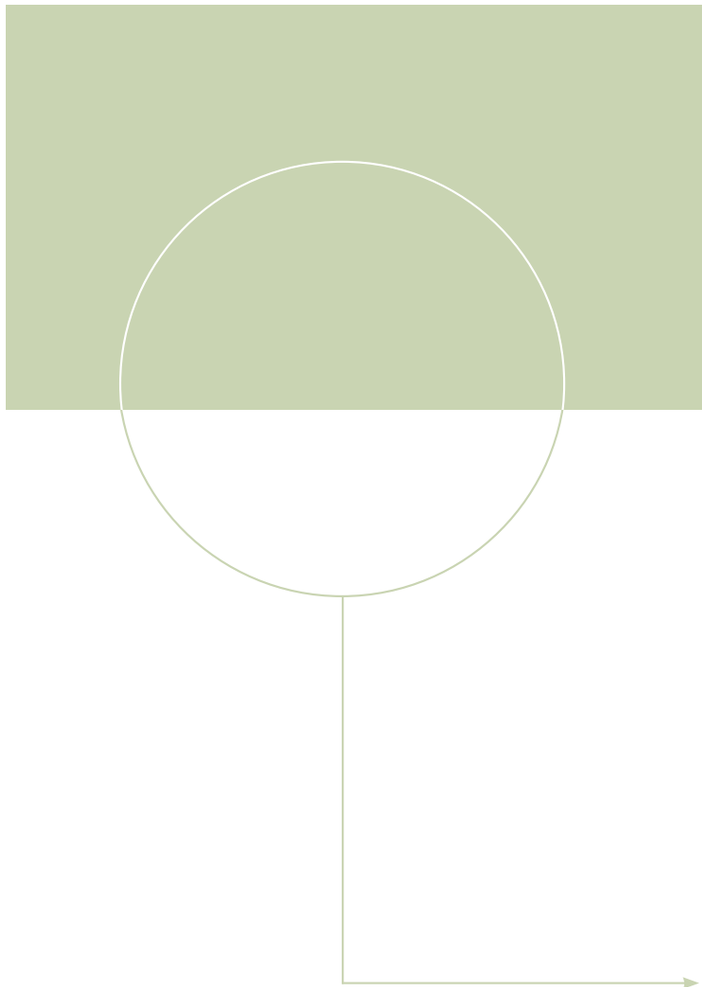

Master's thesis

2020

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Submission date: July 2020
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Gatekeepers by Design? Gender HCI for Audio and Music Hardware

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A thesis submitted in fulfillment of the requirements for the degree of Master of Philosophy

Music, Communication and technology

02.07.2020

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Declaration of Authorship

I, Karolina JAWAD, declare that this thesis titled, "Gatekeepers by Design? Gender HCI for Audio and Music Hardware" and the work presented in it are my own. I confirm that:

- This work was done wholly or mainly while in candidature for a research degree at this University.
- Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.
- Where I have consulted the published work of others, this is always clearly attributed.
- Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work.
- I have acknowledged all main sources of help.
- Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself.

Signed: Karolina Jawad 

Date: July 3, 2020

NTNU & UIO

Abstract

Department of Music (NTNU), Department of Musicology (UiO)

Master of Philosophy

Gatekeepers by Design? Gender HCI for Audio and Music Hardware

by Karolina JAWAD

Hardware for audio and music is subject to inscribed social processes and can bring them to appearance through visual cues and language. This dissertation investigates how established hardware for audio and music can communicate issues related to gender. In particular, it looks into (1) how language of live interfaces in music can inform about whether and how gender shapes musical tools; and (2) to what extent can gender bias in the design of musical interfaces be detected through visual cues. With a mixed methods approach, this thesis aims to create a richer picture on potential gender identities in hardware for music. Two studies are presented: an interview analysis with expert women from music technology and a quantitative study on gender reception of audio and music hardware. The findings and results suggest that gender perception for established hardware in audio and music exists. To follow up, design recommendations are proposed on how to approach the development of interfaces under the notion of pluralism. This implicates to involve people with different backgrounds in musical hardware and DMI design processes, with implications for academia and industry in order to make musical hardware more accessible.

See below a link to a blog post on this dissertation in a less detailed version.
Gatekeepers by Design? Gender HCI for Audio and Music Hardware:
https://mct-master.github.io/masters/2020/07/04/GenderHCI-For-Music.html

Acknowledgements

Thanks to all the people who have supported me emotionally, with friendship and loyalty, with inspiration and guidance, with the safeguarding of my sanity and financially. I'm very thankful to have Anna Xambó Sedó as a supervisor and constant supporter. This work would have been impossible without you. I'm very proud on what we could achieve together and I'm thankful to all your initiations without whom Trondheim would have been a different place. I'm especially very thankful to my mother Biserka, my father Jawad and Günther. Without you, this work would not have been possible. Thanks to all my friends, in alphabetical order - especially Dana, Jana, Kara and Sylvie. Thanks also to Claudia, Ditte, Tici, Thomas and Victoria. Thanks to my fellow students, especially Jørgen Nygård Varpe and Mari Lesteberg. Thanks also to the teachers at MCT - Stefano Fasciani, Alexander Refsum Jensenius and thanks to Robin Støckert for the constant support. Thanks to all the nice people at Fjordgata 1 from the third floor. Thanks Eric for teaching me SPSS. Thanks to all the anonymous participants of the online survey! Thanks to all collaborators and supporters that made it possible to finish this work in Trondheim and Berlin....

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List of Abbreviations

DMI	**D**igital **M**usic **I**nstrument
HCD	**H**uman **C**entered **D**esign
HCI	**H**uman **C**omputer **I**nteraction
ICAD	**I**nternational **C**ommunity for **A**uditory **D**isplay
ICLI	**I**nternational **C**onference for **L**ive **I**nterfaces
ID	**I**nteraction **D**esign
IT	**I**nformation **T**echnology
MCT	**M**usic **C**ommunication and **T**echnology
MT	**M**usic **T**echnology
NIME	**N**ew **I**nterfaces for **M**usical **E**xpression
NTNU	**N**orges **T**eknisk **N**aturvitenskaplige **U**niversitet
SMC	**S**ound and **M**usic **C**omputing Conference
STEM	**S**ience **T**echnology, **E**ngineering and **M**athematics
STS	**S**cience and **T**echnology **S**tudies
WoNoMute	**Wo**men **No**rdic **Mu**sic **Te**chnology

To Adam and Adel...

Preface

In the initial phase of the dissertation preparation, the sudden restriction imposed on our lifes, caused by the measures of the COVID-19 pandemic, changed societies and shaped horizons on what we consider as human. Not only psychological, but also many collective concerns dispersed the focus and left many questions unanswered. Therefore I dedicate this work also to all the people who never give up to make this world a better place, by seeking truth, equality and justice. I'm presenting my thesis as an interim record, that evolved under challenging circumstances. The position of the author here is one of an observer that intersects different disciplines and is in none of them really at home.

Chapter 1

Introduction

1.1 Problem Space

The design of musical hardware, as well as of electronic or digital music instruments (DMIs), can communicate a variety of diversity issues. These issues can be studied, for example, with regard to gender relations in academic programmes or in industry. Whether academic or industrial, the music technology field is known as a field that needs more gender diversity (Frid, 2019; Gadir, 2017; Xambó, 2018). People from various cultural and economic backgrounds, ethnicities, gender identities and diverse abilities are little represented (Frid, 2019) when designing audio and music hardware. The question is to what extent are these circumstances reflected in the language of musical live interfaces, the visual semantics of music technological artefacts and in its interaction design (ID)?

Humans have always been making music using objects and artefacts (Bongers, 2000). Academically speaking, a music technology artefact is any mechanical device that generates musical sound (Essl, 2003). This dissertation looks into investigating the design of hardware for audio and music which is commonly associated with the term 'music technology'.

In a narrow sense, a hardware can be, according to Magnusson and Mendieta (2007), a computer, a soundcard, controllers and sensors. Although there has been a vivid development in instrument design with electric components in the last two decades (Bongers, 2000), the look of the interfaces that are available to the mass market usually have very similar shapes, dominated by edgy forms and knob type controllers (Jensenius and Voldsund, 2012). Susann Vihma adheres in "On Design Semiotics" (Vihma, 2010) that entire cultures can be recognised on the basis of its product environment, as humans are capable of constructing meaning through the form of artefacts. Different academic disciplines have ascertained that artefacts communicate non-verbalized human values (Berg and Lie, 1995; MacKenzie and Wajcman, 1999; Vihma, 2010). However, it is an open question to what extent can these artefacts communicate on the environment in which they have been designed and by whom.

1.2 Research Question

In the program of Music, Communication and Technology (MCT),[1] we have tested, developed and reflected upon music technological methods and tools to find out how technology influences human communication and the way we experience music and sound.

[1] https://www.ntnu.edu/studies/mmct

This research aims to contribute to a critical reflection of current technological practises in the field of digital music instrument design. Informed by my previous research (Jawad and Xambó, 2020), the focus of this investigation is to enquire the following main research question:

> ***To what extent established hardware for audio and music can communicate issues related to gender?***

This main research question is tackled by the following two research sub-questions:

- ***How can language of live interfaces in music inform about whether and how gender shapes musical tools?***
- ***To what extent can gender bias in the design of musical interfaces be detected through visual cues?***

1.3 Motivation - Relevance of the Thesis

Inspired by the literature review and own observations in my study environment, but also through the published paper "How to Talk of Music Technology" (Jawad and Xambó, 2020), this master thesis investigates technical artefacts in music under the light of design research, inspired by Gender Human Computer Interaction (Gender HCI) principles and Science and Technology Studies (STS).

This dissertation builds on our previous qualitative research on the insights of music technology from expert women in the field (Jawad and Xambó, 2020). From this previous research, it was possible to find out that the language of interfaces for musical performance can communicate issues related to gender. Moving from language to the realm of material artefacts that do not articulate by speech but act meaningfully by design, this thesis seeks to research musical hardware available to the mass market.

Investigating gender issues of musical hardware and digital musical instruments (DMIs) using both quantitative an qualitative methods is of interest here. The goal is to inform how to develop more pluralistic interaction design principles that promote gender inclusive design. It is out of the scope of this dissertation to address female-biased design.

The design principles presented here are tools to continue the reflection on diversity in Human-Computer Interaction (HCI), specifically on balancing the gender imbalance in the field of technology design for musical purpose. Design and language of music technology might have chilling or inhibiting effects on diverse groups. The focus will remain on visual and language cues of the items rather than on the sound producing qualities.

1.4 Structure of the Thesis

This dissertation is structured as follows. First, the background chapter (Chapter 2) gives on overview on the merging fields of research that need to be acquired. The methods chapter (Chapter 3) shows how mixed methods have been applied. In Chapter 4, a summary of the findings is presented from the paper "How to talk of music technology" (Jawad and Xambó, 2020) and how they have informed the second study presented in this dissertation. In Chapter 5, the second study is presented, with design recommendations in the following Chapter 6. It is then discussed how

the findings and results meet the research question, which is contrasted with other scholars' opinions. Chapter 7 concludes this dissertation with an outline of the implications and prospects for future work.

Chapter 2

Background

In this chapter, the multifaceted discourse and practises that come together when discussing gendered artifacts in the field of music technology is shortly introduced. A general summary is presented as well as the points that can be addressed when aiming to novelise interaction design in music technology are discussed, drawing upon Gender HCI, product semantics and innovative research communities, such as NIME.

2.1 Gendered Artefacts in Music Technology

There is an ascending awareness about the correlation of technology design and diversity, which is often investigated by design critics through Gender HCI and STS research.

MacKenzie and Wajcman (1999) wrote that technologies can be designed, consciously or unconsciously, to open certain social options and close others. Interaction of the user's world is more and more incorporated, with its social setting in which the user is embedded, into the machine (Dourish, 2001). Particular design features up to entire technologies can be and act politically (MacKenzie and Wajcman, 1999). Therefore, music technology and musical instruments, like any other technology, do as well act as cultural and symbolic artefacts that absorb political content around access to, respectively, physical ability, gender, socio-economic status, class and cultural hierarchies (Morreale et al., 2020; Zeiner-Henriksen, 2014).

As gender is the lens of the political in this dissertation, it is the aim to assess whether these power relations are materialised in non-verbalized values that potentially act as gatekeepers by design. On a lower level, according to Vorvoreanu et al. (2019), the person's construction and expression of their gender identity would often intimately be intertwined with how they feel about and interact with technology.

The look and usability of DMIs can impose or remove chilling and inhibiting effects on people with diverse abilities (Oost, 2003), who would like, for instance, to explore music technology or express themselves musically, with or without prior professional musical education. The way to investigate these non-verbal values, the semantics attached to the artefacts, and the quality of its user interaction can enable a profound discord.

This thesis focuses on the visual semantics of commercially produced hardware for music, how much it can say on "gender script" (Oost, 2003) or "persona" (Lucas, Ortiz, and Schroeder, 2019), while still reflecting on HCI and language. According to Lucas, Ortiz, and Schroeder (2019), in commercial DMI production the product designers would often encapsulate the goals, behaviours and abilities of a broad target user group into a fictional archetype known as persona when designing DMIs. This approach implicates that commercial forces bypass large parts of the population

as the persona development or gender script assumes. This dissertation aims at diversifying the target user group to underrepresented groups such as women and non-binary, and ideally can inform other underrepresented groups in the design and use of hardware for audio and music (Xambó, 2018; Frid, 2019).

2.2 Gender Inclusive Design in Technology

> *"How do colour, layouts, and language affect our impression of an interface?"* (Barth, 2012, p.12)

It is an open question how much male-biased environments are being reflected in musical hardware beyond cultural colour coding and product placement in online marketing. In information technology (IT), for example, there has been concrete empirical studies about how websites design or software can be biased by gender, which have proved to advantage the usability in favour of one gender group (Vorvoreanu et al., 2019). Accordinly, the results of Vorvoreanu et al. (2019)'s studies were positive in terms of usability and affirming the necessity of what is called, gender inclusive design. Derrick Ryan Barth (2012) investigated if it is possible to produce an interface that is pleasing to all users regardless of gender. According to Barth (2012), the current interface trends are predominantly biased towards male users as they have been considered the 'default' gender in computing for decades.

These type of investigations belong to the matter of Gender HCI (Cassell, 2002) or feminist HCI (Bardzell, 2010), which were established in the last decade under the influence of HCI, design research (Demirbilek and Sener, 2003), STS, gender studies and psychology. This approach is a tool to deconstruct how gender identities shape the design and use of technological items (Bardzell, 2010). This dissertation draws upon these theoretical and methodological approaches.

As we will discuss in Chapters 3 and 5, the survey that has been conducted in the second study of this dissertation is inspired by a research from Livingstone (1992), which shows that the sovereignty of interpretation of what technology is tends to be subject to societal shaping processes as well, or as MacKenzie and Wajcman (1999) say, is co-constructed. Livingstone (1992) examined the ratings of participants that were asked to assign a symbolic gender to domestic technologies in brown goods (e.g. TV components, stereos and PCs) and in white goods (e.g. kitchen and laundry appliances). According to Rode (2011), Fiesler, Morrison, and Bruckman (2016), and Light (1999), technologies that are femininely gendered, however, gradually lose their status as technology. Another inspiration for the survey design was given by Demirbilek and Sener (2003), who theoretically investigated how "meaning" could be designed into a product in order to "communicate" with the user at an emotional level. Finally the research that has been undertaken around software by Vorvoreanu et al. (2019) showed that:

> *"[. . .] software cannot be made "better" by having a "pink" version and a "blue" version [. . .] to improve software's usability across genders, software needs inclusivity across the cognitive diversity that arises not only among different genders, but also within them."* (Vorvoreanu et al., 2019, p.11)

.

According to Dourish (2001), any software system introduces some kind of formalization of the world. Therefore, HCI would deal with the formalisation's of human cognition and activity (Dourish, 2001). In this sense, the need for diversity in

the development of audio interfaces and commercial DMIs, among others, is striking in order to diversify the perception of the world in technology. The first encounter with music technological items can have a major impact in how novices and people with diverse abilities and genders will continue (or not) interacting with them. In the next section, New Interfaces for Musical Expression (NIME) is discussed as a pool of diverse possibilities to give materials sound and sound shape.

2.3 NIMEs in the Light of Gender HCI, STS and Design Research

The academic community of NIME[1] focuses on designing new instruments for musical performance with both artistic and research purposes. NIME is described by its own practitioners as a community of musicians, researchers and technologists that develop new musical interfaces. Any real-world action could be translated into electrical energy and serve as a control signal for an electronic sound source (Bongers, 2000). Hence, among the available multiple options to give artefacts the shape to produce sound, there is now also a growing self-critical debate within this community on diversity (Reid, Sithi-Amnuai, and Kapur, 2018; Xambó, 2018), upon the tools themselves (Jensenius and Voldsund, 2012; Schedel, Ho, and Blessing, 2019) and on a social agenda, with little or no interaction to the world of mass produced items for music (Morreale et al., 2020).

Zeiner-Henriksen bespoke subcultural capital in terms of analogue synthesizers, citing Thornton (1996) in which a smaller cultural group deviates from a dominant culture within which it would exist (Zeiner-Henriksen, 2014). It is an open question who or what is this larger group: the commercial mass production, the classical music education, or traditional concepts of (audio) engineering? There are a number of resources to draw upon enabling to make DMIs more accessible and gender inclusive, as it is discussed throughout this dissertation. The democratization of electronic music production has been a key entry point:

> *"This deliberate dissociation from the mass-produced and mass-consumed represents a means of maintaining certain power relations within a subculture. Electronic music instruments and production tools have become much more accessible since the early 1980s, and this democratization of music production has narrowed the distance between the professional music producer and the amateur." (Zeiner-Henriksen, 2014, p.34)*

Following up on this citation, the agenda of democratisation and NIME's direction, it seems that the design of these instruments is becoming more inclusive and interdisciplinary, an approach that this dissertation contributes to.

2.4 Summary

In this chapter, we have seen that there is a growing discussion on accessibility of DMIs and NIMEs. We have also seen how closely technology and gender are intertwined. This will inform the methods of this dissertation that will be introduced in the next chapter.

[1] http://nime.org

Chapter 3

Research Methods

In this chapter, the methodology is outlaid. The chapter starts explaining the benefits of applying mixed methods in this dissertation. First, the qualitative study methods are presented related to the interview analysis from expert women. Then, the online survey on hardware and its quantitative approach is introduced in terms of the study design, pilot study, data collection and data analysis.

3.1 Introduction

The question whether musical hardware can communicate issues related to gender is complex. To address the first question "How can language of live interfaces in music inform about whether and how gender shapes musical tools?" a qualitative approach is taken, which is explained in Section 3.2. For addressing the second question "To what extent can gender bias in the design of musical interfaces be detected through visual cues?", a quantitative approach is taken instead, as explained in Section 3.3.

3.2 Mixed Methods

In order to explore the impact of technologies, direct feedback from its interested individuals is fundamental to HCI research (Lazar, 2017). Accordingly, Lazar (2017) points out that surveys can be very useful in this regard as many individuals can be reached. The downside of surveying a phenomena is that questionnaires cannot be not deep enough. Therefore a mixed methods approach with qualitative studies can provide perspectives and useful data that surveys might miss. A mixed methods approach aims to create a balanced account of the observed phenomena and helps to expose existing research under this light. The results from the quantitative study should ideally give the qualitative observations more facets. In the qualitative interviews, for example, there were also informal talks with the interviewees that were also important as part of sharing their valuable insights, which is difficult to achieve with online questionnaires.

In particular, the two research sub-questions (see Section "Research Question" in 1) are addressed with a mixed methods approach (Lazar, 2017) of combining qualitative and quantitative research methods. According to Adams, Lunt, and Cairns (2008), using mixed methods is helpful for understanding how technology is subjectively and collectively experienced and perceived by different user groups. Beyond that, mixed methods can provide a balanced reflection of an issue. It will give a more differentiated account on the objectives as mixed methods serve both to gain deep insights from experts in one field and to contrast their impressions with a wide

range of experiences The participants of both the interviews and the online survey share overall similar backgrounds and interests as it is shown in Chapters 4 and 5.

3.3 Study 1: Interviews

The interviews were semi-structured with the following main topics: background, path in music technology and career advice. The interview questions can be found in Appendix B. The published interviews can be found online (http://wonomute.no). In order to address the first research sub-question "How can language of live interfaces in music inform about whether and how gender shapes musical tools?", the findings of this qualitative study will be presented in Chapter 4.

Studying the language on technological artefacts in the qualitative part through the analysis of interviews proved valid. According to Kvale (2007), interviews are particularly suited for studying people's understanding of topics in their lived world. It enables access to data that would otherwise be very hard to capture (Lazar, 2017). In the interview process there was a semi-structured exchange of information around the term 'music technology'. Through the informant's description of their experiences and self-understanding, by means of "clarifying and elaborating their own perspective on their lived world" (Kvale, 2007, p.15) there was no need for more quantity in interviewees to attain new valuable insights, but subjecting fewer interviews with penetrating interpretations (Kvale, 2007).

3.3.1 Context

The organization WoNoMute has been founded in August 2018 together with the launching of the MCT master's program. The initiative is a Norwegian collaboration between the NTNU in Trondheim and UiO in Oslo. This initiative aligns with the agendas of the Department of Music at NTNU and the University of Oslo's Faculty of Humanities in order to improve the representation of women in techno-scientific fields. The organisation evolved as an horizontal network to promote the work of those identifying as women in the interdisciplinary field of music technology on a local, national and international level. A series of regular events were organised during the first year, including a seminar series of women expert in the field of music technology and their respective interviews.

3.3.2 Data Collection

The interviews were audio recorded and transcribed. For the transcription, oTranscribe[1] was used. During the interviews, a video recording was also produced with 3 questions about the interviewees' background, related to that their favourite activity and their perspectives for women in music technology (see Appendix B). The purpose of these video recordings was to produce a short video sketch about the interviewee. These videoed interviews were also transcribed for data analysis. The full collection of video sketches can be found online (http://wonomute.no/interviews). When analysing the interviews, the following nomenclature is arranged: for the written interviews, the name of the interviewee and the reference number is provided (e.g.,"Miranda Moen, Reference 1"), and for the videos we give the timecode and distinguish between the presentations (e.g.,"Miranda Moen, Presentation Video, 01:12") and the biosketch videos (e.g.,"Miranda Moen, Video Interview, 01:12").

[1] https://otranscribe.com

3.3.3 Data Analysis

The transcribed interviews where reorganised in the software for qualitative research (Jackson and Bazeley, 2019) NVIVO[2]. The statements have been sorted by a method from psychology called thematic analysis (Braun and Clarke, 2006). It has been applied in order to recognize thematic clusters. The most prevalent theme according to the informants from the artistic field were verbalized on the terminology of music technology. The data has been discussed and contrasted with literature review, as shown in Chapter 4.

3.4 Study 2: Online Survey

In order to address the second research sub-question "To what extent can gender bias in the design of musical interfaces be detected through visual cues?", a quantitative study was done based on an online survey, which was informed by the findings of the previous study. From these observations it was possible to design a survey that would query unknown recipient and confront them with the implications of these observed phenomena. Inspired by feminist technology studies and feminist HCI, the survey has been designed to test whether musical hardware can be perceived gendered.

3.4.1 Study Design

Prior to the study design, there was an extensive literature review and observations of how musical hardware brands present their products on social media platforms. On this basis, a catalogue of items was drawn up, which can be consulted in the Appendix C. The selection of the nine instruments presented in the online survey was based mainly on cultural colour coding and aesthetics, staging and wording of the products. The aim was to have three instrument groups (neutral, and with binary genders, female and male), each with three instruments. The survey was build with Nettskjema[3], a website for survey creation services provided by the University of Oslo.

Prior to the main survey questions, the participants could voluntarily provide information on their professional background, native language and gender. The online questionnaire had three parts. Nine items were presented and each item was followed by three questions. In part 1, the participant had to assign a gender category to the item ranging from 'female', 'male', 'neutral' or 'other'. The participants could chose up to two items. In part two, within a scale from one 'not at all', three 'neutral' and five 'very strong', the decision on the gender category had to be related to the shape, colour and wording. In part three, the participants were presented with 13 attributes and the extent to which they saw these attributes associated with the subject, which had to be expressed within a scale from one 'not at all', three 'neutral' and five 'very strong'. The full questionnaire can be found in Appendix D.

The participants could voluntarily comment or express their views and thoughts at the end of the online survey. The list of comments can be found in Appendix E. Although large data has been collected, this dissertation focuses on a subset to provide a more integrated approach, investigating conspicuous patterns and values on the basis of selected instruments.

[2]https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home
[3]https://nettskjema.no

3.4.2 Pilot study

In order to test the usability of the survey in terms of logic and comprehensiveness, but also spelling and grammar, three fellow students were asked to participate in a pilot study. The participants were free in how to give feedback and what they wanted to address. The first person gave advice on the order of the questions to make them more graspable and helped with spelling. As 'neutral' is not a gender category the category 'genderfluid' should suggest a state of all containing genders. But the participant did not understand the category immediately therefore it seemed better to give the participants the option to not chose any gender category at all. Therefore 'genderfluid' was replaced with 'neutral' assuming that not everyone is familiar with the possibilities to name a gender e.g. the different categories and their meaning. It would have potentially created insecurity while answering the questions. The second person commented that it would have been the first time to think about gendered items in music technology and that the first intention was to assign every instrument the attribute neutral.

The third person also said to have never considered artefacts in gendered ways before and expressed concern about the lengths of the questions respectively the amount of the attributes. The participant also commented that she is not sure if the perception of the headphones as male is due to the fact that they are worn by men only or if it is the design. If it had been presented in pink, the reaction might have been different.

All participants gave the exact time they needed to answer the questions. After iterating again through the survey, by taking into account the remarks and feedback of the participants in the first pilot study, the survey was sent out.

3.4.3 Call for Participation

The survey was open to everyone who listens to music on a regular basis and/or produces, composes music. The questions on demographic information like gender, field of profession and native language were voluntary. The call for participation was sent to several local, national and international mailing lists and also to relevant people, such as fellow MCT students, research communities like New Interfaces for Musical Expression (https://nime.org), the Sound and Music Computing network (http://www.smcnetwork.org) and the the International Community for Auditory Display (https://icad.org) as well as to the NTNU Music Technology student group on Facebook. But also to the female safe space community female:pressure http://www.femalepressure.net and to the WoNoMute mailing list. Beyond that, 5 to 10 people were asked to participate with a personal note to fill out the survey. These people could not be reached through mailing lists or "social media" groups, but they are personal contacts that relate to music production with electronic instruments, such as DJs, sound editors but also designers and film makers. The survey was online for 10 days at Nettskjema.

3.4.4 Data Collection

Nine instruments were presented and had to be assigned with attributes (see Appendix C). The participants were asked to iterate with each of the nine items through the same questions. In the first part, the participants were working with gender categories like 'male' and 'female' or with attributes that are casually not associated with gender like 'neutral' or 'other', as presented earlier in this chapter. In the second part, the participants were asked to determine, by means of 5-point Likert items, to

what extent form, colour or wording was related to their decision. In the third part, a list of attributes was given and the participants could choose which of them would strongly resonate to the presented item.

3.4.5 Data Analysis

In order to carry out frequency analysis, the document had to be sanitised in a format readable in statistical packages. When preparing the data files, some columns had to be combined to allow for correct calculations in the SPSS statistic program. With the subsequent frequency analysis, the identification on general patterns and significant features were possible. The data was plotted in Excel.

Different attributes of the 9 artefacts have been evaluated to see whether the results of the sample can be transferred to the overall population. For this dissertation, we looked only into the cases and attributes where numbers in terms of gender perception of instruments where more striking to check whether the characteristics of the associated instrument are assessed equally or if their perception clusters by gender.

3.5 Summary

In this chapter, we have seen how a mixed methods approach can address the research questions in a complementary way. Qualitative analysis has enabled profound insights amidst the experience of experts that could inform the design of the online survey, while quantitative analysis has enabled to get the opinion of a large group of participants on their perception of gender on music and audio hardware. Both interviewing and surveying included conducting literature research and data sanitation once the data was collected. In the next chapter,the findings from the first qualitative study is presented.

Chapter 4

Interviews with Expert Women on Music Technology

In this chapter, a qualitative approach will be shown by means of analysing the interviews with women experts in the field of musical interface design, music technology research and artistic practise, who expressed themselves about the terminology of music technology.

4.1 Introduction

This chapter summarises the research published in the conference article "How to talk about music technology" (Jawad and Xambó, 2020), which can be found in Appendix A. The interview questions were inspired by previous experience from the paper's second author in conducting similar interviews at the organization Women in Music Tech at Georgia Tech.[1] The whole process involving interview conduction, transcription and analysis of the WoNoMute interviews discussed in this chapter has been led by the paper's first author and author of this dissertation.

Due to the underrepresentation of women in the field of music technology (Gadir, 2017; Xambó, 2018), the all-female community WoNoMute[2] has been founded at the Department of Music at NTNU in Trondheim, together with the Department of Musicology at UiO in Oslo, in 2018. Expert women from music technology-related fields, ranging from theorists, to practitioners and to artists have been invited in a monthly event to lecture on their field of expertise. Organised around the cross-campus master Music Communication and Technology (MCT) these events have been streamed into the World Wide Web and are now available as an online archive on the WoNoMute website.[3] As part of the social gatherings, interviews with the guest speakers have been also conducted.[4] For the International Conference on Live Interfaces 2020 (ICLI 2020) in Trondheim, a paper has been published in which we made qualitative research on 7 interviews. The interviews have been transcribed and analysed, as well as contrasted with literature on STS and gender studies.

During the process of identifying different emerging thematic patterns, the usage of language around the music technology terminology offered profound interpretations, that have not only been presented at ICLI, but informed the research for this thesis.

[1] https://womeninmusictech.gatech.edu
[2] `http://wonomute.no`
[3] `http://wonomute.no/seminars`
[4] `http://wonomute.no/interviews`

Live interfaces for musical performance can communicate issues related to gender. In this chapter, we investigate the potential issues related to the following research question:

> *"How can language of live interfaces in music inform about whether and how gender shapes musical tools?"*

The research question is addressed by qualitative analysis of the interviewees' statements when asked questions related to music technology topics.

4.2 Qualitative Data Analysis

Through thematic clustering it could be revealed that the term music technology was partly received with unease when the interviewees had to relate themselves or their work to the term. However, their work included explicitly technological practise in music, which can be retraced in the vignettes: *"I don't like to describe what I do as music technology, for me, that's more the system behind the instruments."* (Alexandra Murray-Leslie, Reference 1) and *"There is an introduction of technology into the arsenal of tools that I'm using but I don't think of it as the technology part being the prominent thing"* (Pamela Z, Reference 1).

In the question "What advice would you give to women interested in pursuing a career in music technology?", the term become even more an external artefact: *"Again, to me 'career in music technology' sounds a little bit like you're talking about circuit benders or that they are writing and designing software. I see myself as an artist and so I can only speak from that, what my advice is about trying to be an artist. Then it doesn't matter rather you are using technology, and what kind of technology you're using."* (Pamela Z, Reference 2). The discussion has shown that music technology as a term must resonate with associations of audio engineering or the 'nature' of the technological or engineering part in music, which might not be appealing to some. Sofia Dahl, who holds an engineering degree, said: *"Now I can say I am an engineer, but I am not a typical engineer. I wouldn't feel comfortable working as an engineer in a company."* (Sofia Dahl, Reference 1).

4.3 Findings

Through initial exploration, different thematic patterns emerged that could potentially be explored. However, the most profound thematic cluster emerged when analysing statements in relation to music technology and engineering.

We could analyse that the language of music technology, especially the term 'music technology' in academia carries ideas of activities that are stereotypically gendered. The interviews with women who work in music technology-related fields combined with the literature review showed that the written or verbalized context in which science, technology, engineering and mathematics (STEM) practises appear can relate to the presence or absence of women. The forum for public debate generated with the seminars and interviews was crucial to promote these initial conversations.

4.4 Discussion

Regarding the first research sub-question of this dissertation (see Section 1.2), from the presented findings and discussion it is clear that the terminology still resonates with STEM disciplines, which bypasses the practises that would potentially attract more people from underrepresented groups. The interviewed practitioners with artistic backgrounds reported that they were designing their technological artistic items to fit their own musical agenda. Therefore, associations of the implicated attributes of engineering and programming could be transformed and reversed. Consequently, music technological practices can be 're-written', can alter the perception of technology itself and has the potential for a 'female narrative' (Armitage, 2018) in engineering. The context in which STEM methods are applied is crucial for the presence or absence of women. In the moment a gendered tool can act as an excluding mechanism ("Ambient Belonging: How Stereotypical Cues Impact Gender Participation in Computer Science" 2009), a gendered tool can become inclusive as well (Stewart, Skach, and Bin, 2018). And this is also reflected in the statements of the expert women in our interviews, who do not like to describe what they do as 'music technology'.

Interfaces for music performance are not only artefacts, but ideas which the term 'music technology' alone is not capable to address. The existing diversity of practices do, most likely, not resonate to people outside the community. As the literature review showed, the notion of 'music technology' carries ideas of activities related to the term that are stereotypically gendered. The context in which women work with topics related to music technology and with STEM methods is crucial for their presence or absence. As future work the second part of this dissertation researches how music-technological artefacts materialise gender. But mainly this research has focused on rethinking the term 'music technology' in academia, education and industry. It has the potential, as the artistic practitioners showed to become more inclusive and, as the discussion has showed, more environment-aware. Gender is only one diversity issue, this research should also encourage to reflect new perspectives on the techno-scientific terminology in general.

4.5 Summary

In this chapter, we have addressed the first research question of this dissertation and have seen that the language of live interfaces for music can communicate gender issues. In the next chapter, we will address the second research question of this dissertation by reporting the results of the online survey on the gender perception in musical hardware.

Chapter 5

Online Survey on The Gender Perception of Hardware in Music

In this chapter, the second study of this dissertation is presented. This study investigates the gender perception of hardware in music and audio. Hundred and eleven participants took part in an online survey with questions on colour, shape and wording of 9 exemplary artefacts of music hardware. In this study, the results of the responses are introduced and discussed.

5.1 Introduction

The findings from our first study discussed in Chapter 4 informed a second study, which is presented here. This chapter outlines the results of an online survey designed to identify the gender perception of hardware in music and audio. In particular, the following research question is investigated:

> *"To what extent can gender bias in the design of musical interfaces be detected through visual cues?"*

The research question is addressed through an online questionnaire on DMIs focusing on music technological hardware. In the next section, the results are presented using descriptive statistics. As numerous data were collected, here we focus on providing an overview of the most salient trends. In the aforementioned analysis, the intensities of the attributes for the respective instruments are outlined. It is then discussed whether the perception of the attributes as well as the assigned gender differs among the gender groups. An exemplary instrument for each category is provided: 'male', 'neutral' and 'neutral - female'.

5.2 Data Analysis

5.2.1 The Participants

Hundred and eleven participants took part in the online survey. The participants could voluntarily provide information about their gender, professional background and native language. More than 20 different languages were indicated, it points out that the participants were from international backgrounds. English and Norwegian native speakers were the two largest language groups. The gender distribution is shown in Figure 5.1. The majority were representatives from those indicated as males with 54 participants. Those identified as females had 47 participants and other genders were represented by 10 participants. From here on we will talk about

two groups: 'male' and 'FAGTCGGP'. The latter is an acronym that refers to *Female-Agender / Androgyn-Genderfluid / Transgender / Cisgender / Genderqueer / Gender Non-Conforming / Prefer not to Say*. Each of the two groups had a representation of 49% and 51%, respectively, which is close to a realistic representation of the population.

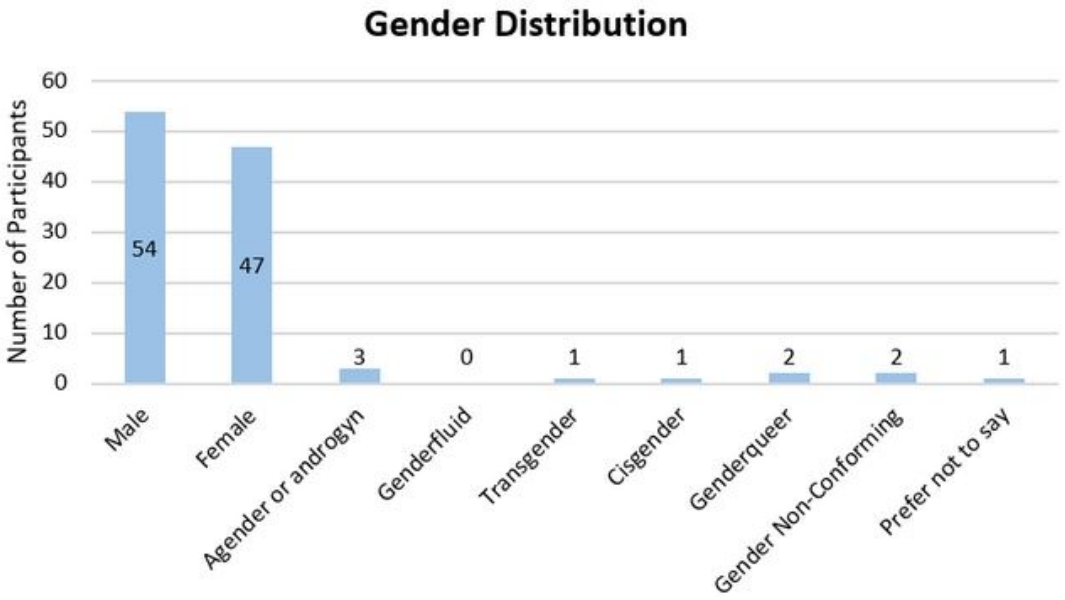

FIGURE 5.1: Bar plot of the number of participation by gender

Hundred and ten out of 111 participants provided information on their field of profession. The professions "Music Technology and/or Sonic Arts", with 71 persons, as well as "Music (performance, improvisation, jazz)", with 44 persons, were the largest groups of participants. See Figure 5.2 for a detailed report on the different profiles.

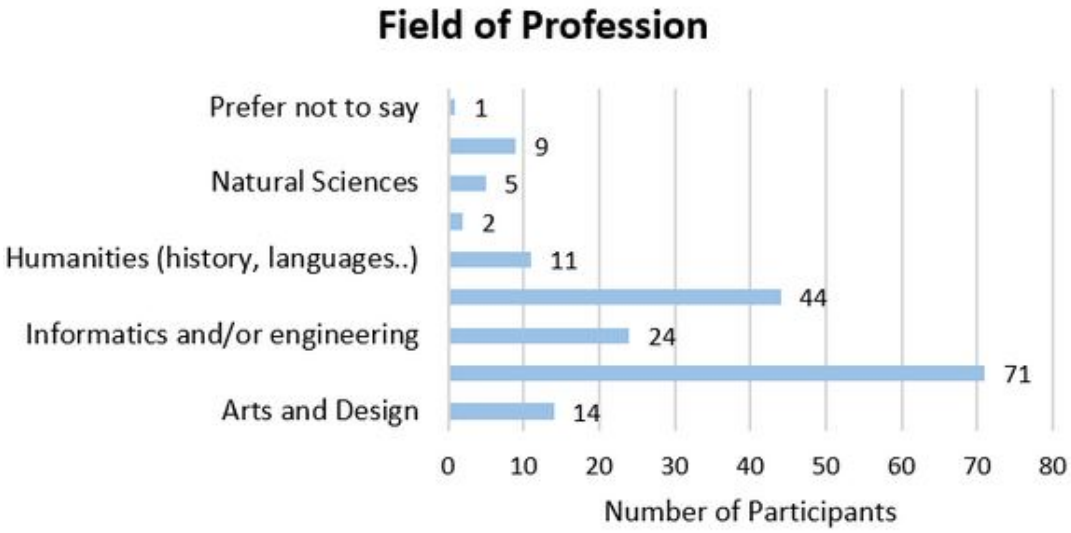

FIGURE 5.2: Bar plot of fields of professional background by participants (non-exclusive categories)

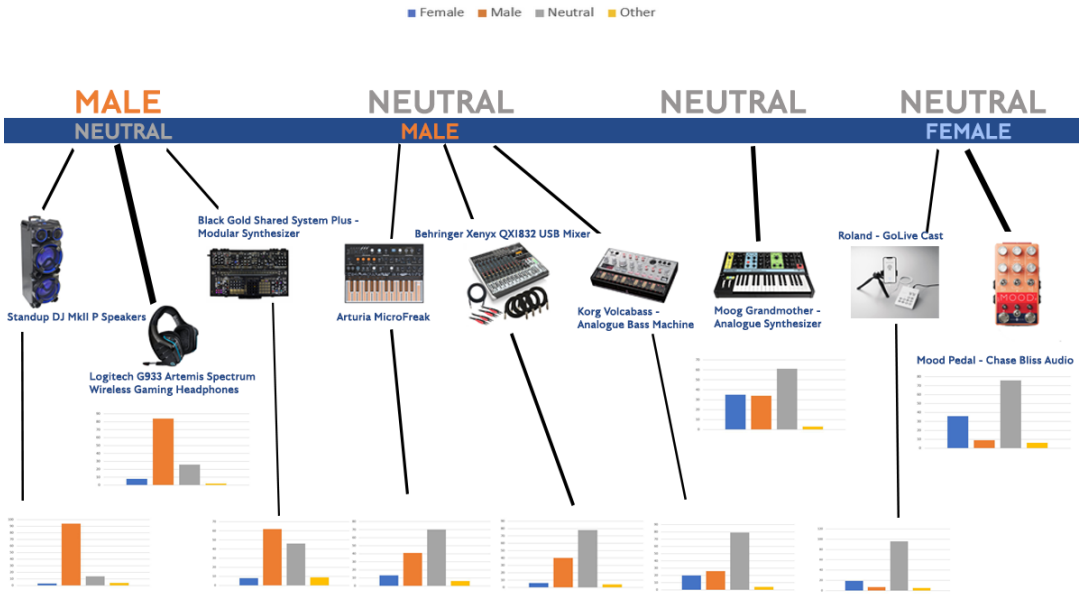

FIGURE 5.3: Continuum of instrument perception based on participants' gender assignments. The stroke width indicates the level of expressions of gender assignments.

5.2.2 General Patterns

As shown in the continuum (Figure 5.3), there was a tendency to rate the artefacts rather neutral and gendered in the second place, except for three items (Logitech headphones, Standup speakers, Black Gold modular synthesizer), which were rated male in the first place. From all the seven items that were rated neutral in the first place (Arturia MicroFreak, Mood Pedal, Roland GoLive Cast, Moog analogue synthesizer, Behringer Mixer, Volca Bassmachine), only two were perceived predominantly female in the second place (Mood Pedal, Roland GoLive Cast). Hence, there is not a single instrument from this selection that was classified as a female-biased artefact.

This confirms that there exists a perception of gender in artefacts, with varying degrees of expression, which is the subject of this dissertation. Overall, this indicates that there are differences occurring in the perception of the items' gender among the gender groups. The same goes for the perception of the attributes, but to a much smaller degree, and with differences among the gender groups only in a few cases. This will be discussed in the next section.

5.2.3 Instrument Analysis

This section focuses on analysing the results from an exemplary example of a 'male' instrument, a 'neutral' instrument and a 'neutral - female' instrument in terms of gender categories, perception by gender, ratings of attributes and relation of shape, colour and wording to gender perception.

'Male' Instrument: Logitech Gaming Headphones

Out of the 9 instruments, we selected the Logitech G933 Artemis Spectrum Wireless Gaming Headphones (Figure 5.4) to exemplify a 'male' instrument because it was rated among all gender groups over 50 percent as male by all gender groups. Figure 5.5 shows how the gaming headphones were mostly perceived 'male' by all gender groups.

FIGURE 5.4: Logitech G933 Artemis Spectrum Wireless Gaming Headphones (Image source: Logitechg.com)

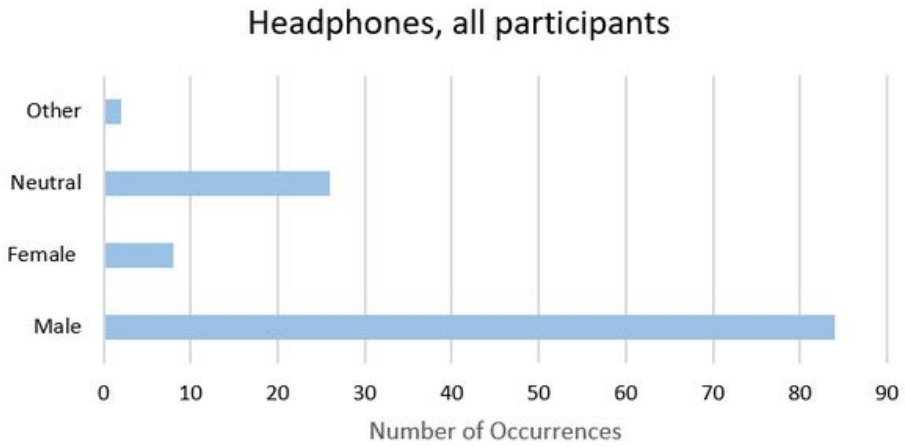

FIGURE 5.5: Bar plot of the Logitech Gaming Headphones by gender categories: male, female, neutral and other (non-exclusive categories, two options possible).

The gaming headphones were perceived rather masculine. This descriptive assessment is based on the fact that 84 of all the participants assigned the gender category 'male' to the item. There is a notable difference on how the different gender groups perceived the 'masculinity' in respect to 'femininity' of the item. Of the 'FAGTCGGP' group, 84 percent perceived the headset as male, while only 67 percent of the men surveyed perceived the headset as male. While 32 percent of the male group classified the item to the category neutral, only 16 percent of the other group classified it as neutral, which indicates a noticeable difference in the gender perception between groups. It can be stated that all genders except for men were inclined to classify the headset as male. However, the conditions are much closer in the category female with almost no difference in the perception between the two groups, although it had little representation compared to the the male or neutral categories. Figure 5.6 summarises these results.

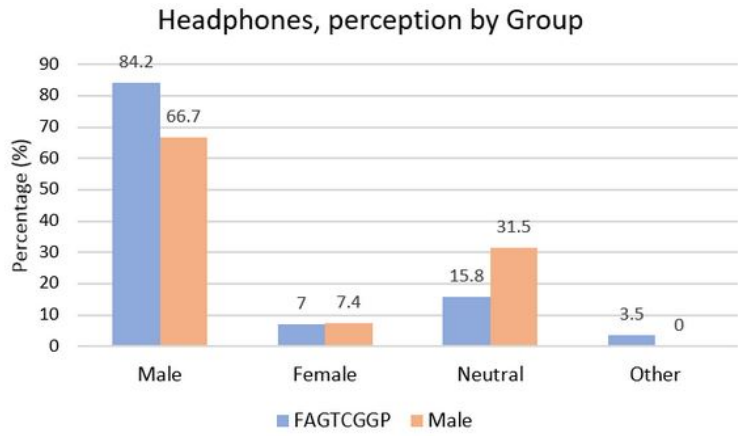

FIGURE 5.6: Stacked bar chart of the rating percentage (%) of each gender category by gender groups for the gaming headphones

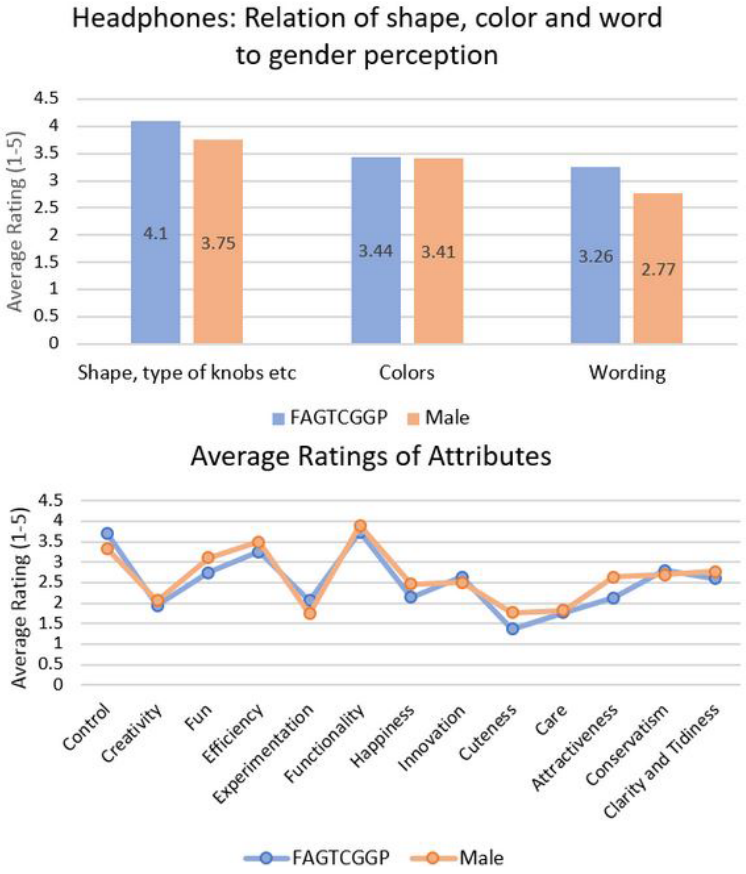

FIGURE 5.7: (Top) Bar plot of average ratings (1 not at all, 3 neutral, 5 very strong) of shape, colours and wording by gender group. (Bottom) Average of ratings (1 not at all, 3 neutral, 5 very strong) of the 13 attributes that are seen in the gaming headphones.

The extent to which the participants saw the object's gender associated with the attributes, shape, colours or wording can be observed in Figure 5.7. The most related attribute is 'shape', where men agreed less than the 'FAGTCGGP' group as can be observed. From the other attributes that were assessed, 'functionality' also scored high. The headphones' lowest-scored features were 'cuteness', 'experimentation' and 'care'. Men rated the 'cuteness' of the headphones higher than the 'FAGTCGGP'

respondents, the same for 'attractiveness', where men rated the attractiveness of these gaming headphones higher than the other group, although those attributes do not stand out compared to the highest and the lowest value.

'Neutral' Instrument: Moog Synthesizer

Out of the 9 instruments, we selected the Moog Grandmother Analogue Synthesizer (Figure 5.8) to exemplify the neutral instrument because it performed best in being perceived as neutral artefact in the first place (see Figure 5.9).

Around 35 respondents assigned the instrument to be female and 34 respondents classified it as male, but none of those values are above 50 percent. Therefore, neutral remains the most frequent evaluation. Splitting the classification in gender groups, as shown in Figure 5.10, reveals some slight differences. The male classification of the instrument is rated by the male group with 22 percent while the 'FAGTCGGP' group rated it with 39 percent male, descriptively a clear difference, but both not over 50 percent reach.

FIGURE 5.8: Moog Grandmother, analogue semi modular, 32 key synthesizer (Image source: Moogmusic.com)

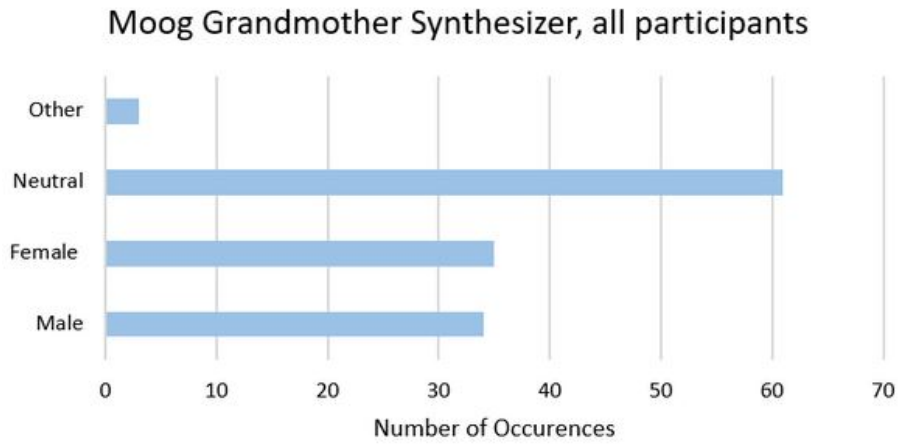

FIGURE 5.9: Bar plot of the Moog Synthesizer by gender categories: male, female, neutral and other (non-exclusive, two options possible)

The attribute assessment can be inspected in Figure 5.11. Comparing all features, 'care' is the lowest value while 'fun' is the highest value. Together with 'fun', 'control', 'creativity', and 'experimentation' are the highly rated characteristics. Whereas 'conservatism', 'attractiveness' and the aforementioned 'care', as well as 'clarity and tidiness' are rated rather poorly. Concerning the attributes, shape is being perceived as much more connected by the 'FAGTCGGP' group than for the male group.

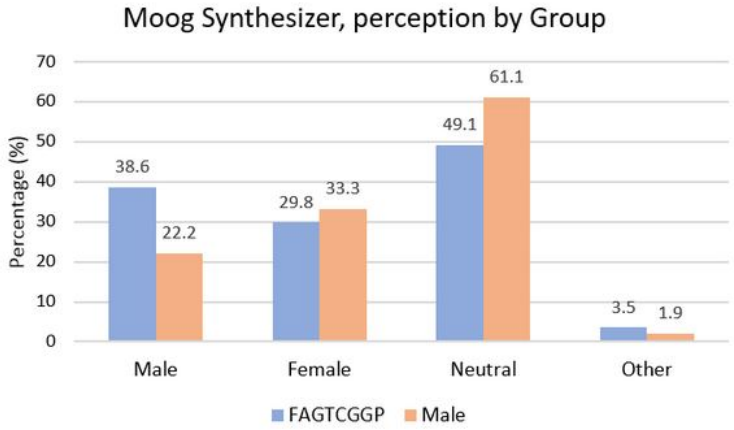

FIGURE 5.10: Stacked bar chart of the rating percentage (%) of each gender category by gender groups for the Moog Grandmother Synthesizer

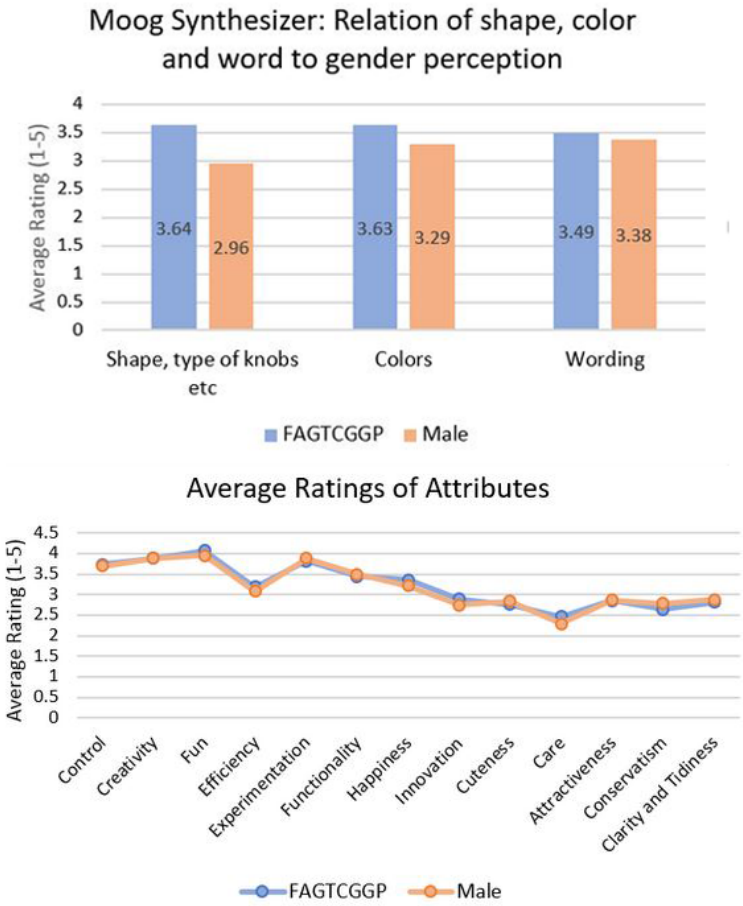

FIGURE 5.11: (Top) Bar plot of average ratings (1 not at all, 3 neutral, 5 very strong) of shape, colours and wording by gender group. (Bottom) Average of ratings (1 not at all, 3 neutral, 5 very strong) of the 13 attributes that are seen in the Moog Grandmother Synthesizer.

'Neutral - Female' Instrument: Mood Pedal

Out of the 9 instruments, we selected the Mood Pedal Chase Bliss Audio (Figure 5.12) to exemplify the 'neutral - female' instrument because it got with 36 responds

the highest female scores in total, after being perceived as neutral in the first place with 76 responds as to observe in Figure 5.13.

As shown in Figure 5.14, the gender classification for the Mood Pedal is close to equal for both genders. Except for the category other, the ratings are very similar and only differ slightly. As the category female scored second highest, it is interesting that especially the 'FAGTCGGP' group rated it as neutral, the more connotated the item is towards one gender category, the more the represented of that category would score it as neutral, similar patterns were also observed with the headphone evaluation.

As shown in Figure 5.15, none of the attributes stand out particularly positively nor negatively in terms of the average ratings of the 5-point Likert items. This is different for the lowest-score attributes, with 'conservatism' being the lowest rated attribute while fun is the most positive measured average.

FIGURE 5.12: Chase Bliss, Audio Pedal MOOD (Image source: Chase-blissaudio.com)

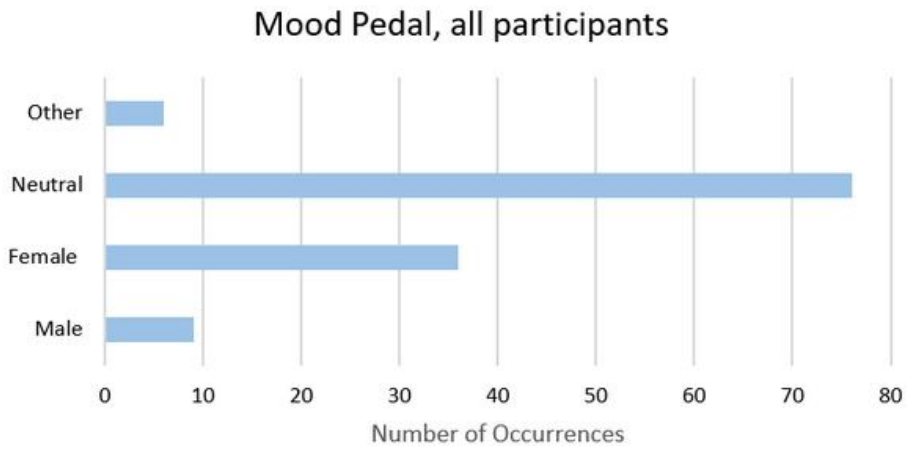

FIGURE 5.13: Bar plot of the Mood Pedal by gender categories: male, female, neutral and other (non-exclusive, two options possible)

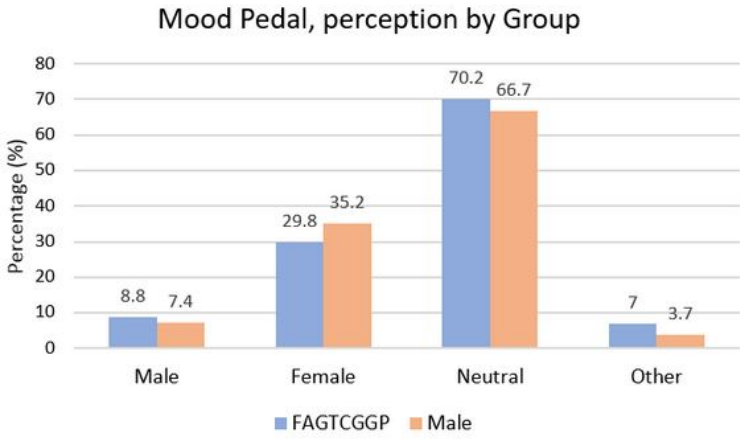

FIGURE 5.14: Stacked bar chart of the rating percentage (%) of each gender category by gender groups for the Mood Pedal

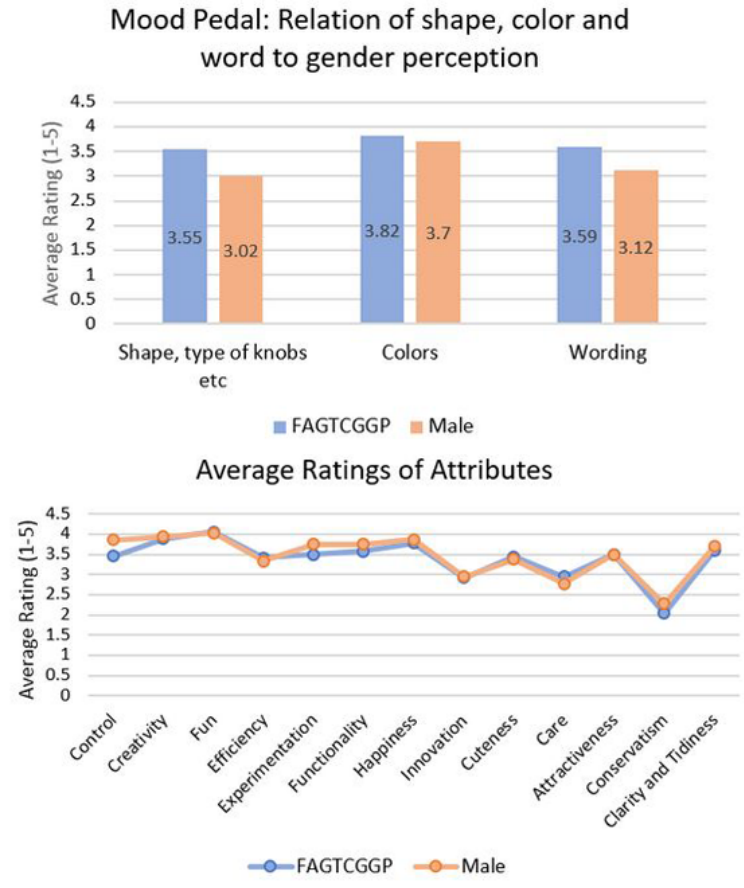

FIGURE 5.15: (Top) Bar plot of average ratings (1 not at all, 3 neutral, 5 very strong) of shape, colours and wording by gender group. (Bottom) Average of ratings (1 not at all, 3 neutral, 5 very strong) of the 13 attributes that are seen with the Mood Pedal.

5.3 Discussion

Regarding the second research sub-question of this dissertation (see Section 1.2), from the presented analysis of the results it seems that there exists gender perception in DMIs and hardware for music and audio. With a few exceptions, this gender

perception is overall male biased, an impression that only differs slightly among the two large gender groups. The evaluations of the items prior to the conduction of the study were overly very similar to the results of the study and ca be consulted in the Appendix C.

The gender assignment of the items in this study was assessed through the predominant binary gender models, male and female, in order to measure how participants applied attributes and if this can reflect gender stereotyping. The results of the survey showed that most of the attributes for each instrument would be assessed almost similarly among the gender groups. From all the presented items only two had a feminine connotation. An explanation by Oost (2003) indicates that this could be due to designers and engineers are mostly men and would see themselves as the potential user, thus creating a gender bias toward male-dominated symbols and competencies, unable to envision the diversity of the user group (Oost, 2003).

5.4 Summary

In this chapter, an online survey has been analysed. The gender assignments and intensities of the attributes for the respective instruments were briefly outlined. Three instruments were chosen for in-depth analysis with the aim at representing a 'male' instrument, a 'neutral' instrument and a 'neutral - female' instrument. It has been shown that there is a tendency to perceive most of the items as neutral and/or male. In the gender assignments there were differences occurring among the gender groups, but they were of minor degrees. When relating the artefacts to shape, colour and wording, there was a similar pattern among the groups, although the 'FAGTCGGP' group communicated in all the presented cases more intensity in their answers than the male group. The perception of attributes in connection to the items was close to identical with a few cases in which the assessment was slightly more dispersed. In the next chapter, it will be discussed what strategies can be taken in order to counter these tendencies, which will be contrasted with other scholars' opinions.

Chapter 6

Discussion

In this chapter, the findings and results from the two studies presented in this dissertation are merged and contrasted with other scholars' opinions by revisiting the research questions and proposing a set of design recommendations.

6.1 Research Questions Revisited

This dissertation aimed to answer the large research question:

- ***To what extent established hardware for audio and music can communicate issues related to gender?***

In particular, this dissertation aimed to answer the research questions:

- ***How can language of live interfaces in music inform about whether and how gender shapes musical tools?***
- ***To what extent can gender bias in the design of musical interfaces be detected through visual cues?***

The notion of 'gendered artefacts' in musical hardware or DMIs has been subjected to qualitative and quantitative investigation. Music technology's terminology resonates with STEM disciplines in a way that does not represent its diverse practises. This observation is based on the statements from the interviews that have been analysed in Chapter 4. The next step was to assess if music technological items can communicate a gender and how the participants relate it to colour, wording and shape, just by the look of the presented items, which has been investigated by quantitative means in Chapter 5. After all, it can be concluded that gender perception for established hardware in audio and music exists.

The two studies presented here indicate that before interacting with items, just by the way they look, they are communicating gender identities. But they do not seem to imply specific attributes nor do they differ remarkably in their expression among the inquired groups. This argues strongly for the point that wants to be stressed with this contribution, which is that it is possible to create interfaces that are being received similarly "positively" among different genders. Although emotional response, or reaction to meaning, triggered by a product, varies for people with different backgrounds, e.g. social class, educational level, religion, and so on (Demirbilek and Sener, 2003), with respect to the assessest items in this thesis the semantic features that trigger similar responses have been similarly perceived. The Moog Grandmother Synthesizer, for example, has been rated almost equally in the category neutral and close to equal as masculine and feminine. We can see also in Figure 5.11 that explicitly positive attributes as 'happiness', 'experimentation' and

'fun' are rated equally high by both groups. Although it has to be acknowledged that there is a certain homogeneity in the professional backgrounds of the participants followed by dominant language groups.

6.2 Design Recommendations

If the use of interfaces not only clusters by gender, but also differs within gender in cognitive styles (Vorvoreanu et al., 2019), personas have to be developed by designers of diverse groups. Since the objects studied in this dissertation were considered overly masculine, the conclusion is that the designers of these objects might not be from diverse backgrounds. In this section, we discuss what an ideal design approach for audio and music hardware would involve in terms of design recommendations.

The design recommendations are open, i.e., they are less about giving advice on detailed semantic design and appearance of an interface (although the survey mainly worked with visual cues), but rather about emphasising the need for participatory design processes. As long as the gender imbalance in engineering and hardware design in academia and industry for DMIs is little addressed, it is important to highlight that potential users with different backgrounds need to be more present in the development process.

6.2.1 Participatory Design - In Favour of Inclusive Design

Direct feedback from affected and interested persons is of fundamental importance for HCI research (Lazar, 2017). Bardzell (2017) argues that the best platforms are built by people who use these platforms, whose service offered would be better. Marsden, Hermann, and Pröbster (2017) write that this could be possible in the so-called "third room", a common room where future users work with the development team. Accordingly, it is also argued that, in order to identify problematic gendering, reflection must be integrated from the initial research and development phase onwards. The often subtle, invisible ways and forces by which women are included or excluded in the design and use practice should be reflected upon (Marsden, Hermann, and Pröbster, 2017).

6.2.2 Universal, Pluralistic or Neutral interfaces?

As noted in Oost (2003), many objects and artefacts designed for "everyone" without a specific user group in mind are based, often unconsciously, on a one-sided user image. This could possibly be reflected in its semantics. Colour, shape, form and texture of the designed objects are sent as messages that are part of our language structures that deal with meaning, as Demirbilek and Sener (2003) explain. These attributes would communicate with users and can therefore never be contextually neutral. Vorvoreanu et al. (2019) stress, while leaning on Bardzell (2010), that attention to individual differences within genders can be emphasised by the notion of pluralism rather than universality. This approach supports individual differences and non-binary notions of gender identification, which can embrace also other underrepresented groups.

This dialectic between universality and pluralism also applies to the world of music/audio hardware and DMIs, next to the musical function of the items. Neutrality here is as constructed as gender identities are, which implies that the interfaces should offer the possibility to be either more suitable for a variety of uses which

could be addressed by the term universality, but preferably by pluralism. This preference for the notion of pluralism is because it is much closer to the reality of the variety of gender identities, abilities, social settings, cultural and economic backgrounds, and ethnicities.

6.2.3 Limitations

Although this contribution seeks for pluralistic interfaces, the gender attributes for the machines were only available as binary options. Clearly gender is not a fixed concept and both femininity and masculinity are socially constructed and undergo constant, subtle redefinition and reinscription (Rode, 2011). Therefore the goal is to move away from binary gendering at least in the sphere that is, according to Frid (2019), considered an essential part of human rights and freedom of expression like the artistic practice of music-making from which Frid says, many people are still largely excluded from. Another limitation is that the second study works with pure visual cues that rely on shape, wording and colours but cannot draw upon tactile impressions and musical affordances. Therefore the assessment remains on the surface of cultural colour coding and wording. In the online survey that assessed these objects, the information about whether the participants have used the item by themselves or not might have enabled a broader picture about what kind of attributes the actual users connect in opposition to those who have not used the item before, and just decided from a visual impression.

6.3 Summary

In this chapter, the research questions of this dissertation were revised. This was reflected in terms of design recommendations and related to inclusive audio and music hardware as well as DMI development. The forces that make a more likely biased interface design and how this can be reflected in non-verbally semantic cues were highlighted. Therefore, it has been elaborated how language of interfaces can shape its material and semantic. In the next chapter this dissertation is finalising with some prospect future work and methodological, practical and theoretical implications.

Chapter 7

Conclusion

In this chapter, the discussion of the findings and results from the two studies presented in this dissertation are revised to consider their prospective implications in regard to theory, methodologies and practise. To conclude, future work and final remarks are provided.

7.1 Theoretical, Methodological, and Practical Implications

The combination of different methodologies brought by the two studies presented in this dissertation aimed to create a richer picture of whether and how hardware for audio and music is being perceived with visual cues and language related to a specific gender identity.

Inspired by the insights of the ICLI 2020 paper, the contribution of this work is mainly to push the idea of Gender HCI further into the realm of music technology. This is of special interest since the items that are available to the mass market communicate numerous diversity issues. The analysis of hardware is an echo on the existing environments and social relations surrounding music technology and computer music (Frid, 2019). Addressing this issue cannot be tackled by just changing semantics into female biased musical hardware and DMIs but requires constructive and active debate at different levels of technology development.

7.2 Future Work and Final Remarks

The limitations presented in Section 6.2.3 implicate future opportunities. The results of the second study presented in this dissertation could not be fully evaluated due to time constraints, as numerous data was gathered. Future work includes a more in-depth data analysis. It could be beneficial to collaborate on the evaluation with different actors, and develop profound design strategies involving organisational structures and design cues to investigate how to rewrite gender scripts and personas. The aim is to include more diversity in the interface design process. The intersection of disciplines exploring our material world with Gender HCI, STS and design research is only one step towards more inclusive interfaces. Further research is needed together with musicians, engineers and product designers to inform and collaborate with academia and industry.

Appendix A

ICLI 2020 Paper

A.1 How to Talk of Music Technology: An Interview Analysis Study of Live Interfaces for Music Performance among Expert Women

Jawad, K., Xambó, A. (2020) "How to Talk of Music Technology: An Interview Analysis Study of Live Interfaces for Music Performance among Expert Women". In *Proceedings of the International Conference on Live Interfaces* (ICLI 2020). Trondheim, Norway. pp. 41-47.

How to Talk of Music Technology: An Interview Analysis Study of Live Interfaces for Music Performance among Expert Women

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Abstract. With the aim of making women's work in music technology more visible, the organization Women Nordic Music Technology (WoNoMute) has originated conversations with expert women in the form of seminar talks and interviews that are archived digitally. This paper analyses the first seven interviews and seminar talks with women from this online archive using thematic analysis. We explore whether and how their gender determines the shape of their tools focusing on *live interfaces*. From our findings, we propose to investigate alternative usage of the technical term 'music technology' to accommodate more diversity and fluidity into the field. This can inform the revision of the language used in education and human-computer interaction in order to be more inclusive but also to become more conscious about the creation of professional and academic environments that involve music technology.

Keywords: Human-Computer Interaction, live interfaces, physical virtual communication, interviews, digital archive, performance, women in music technology, gender

Introduction

As studied in previous research, women are underrepresented in the field of music technology (Gadir, 2017; Xambó, 2018), which aligns with the broader issue of the underrepresentation of women in science, technology, engineering and math (STEM) fields (Nimmesgern, 2016; Sax, 2012). It has been highlighted the importance of creating all-female communities of learning, mentoring, and the promotion of women role models in music technology related fields as strategies to raise awareness and broaden participation (Armitage, 2018; Dobson, 2018; Xambó, 2018). Beyond that, it is important to investigate and discuss the mechanisms and reasons behind the absence of women in these fields.

With the aim of making women's work in music technology more visible, the organization WoNoMute has originated a series of seminar talks and interviews with expert women in the form of live events and a digital archive (http://wonomute.no). The events are organised around the cross-campus master program Music, Communication and Technology (MCT), a co-joint master between the Norwegian University of Science and Technology (NTNU) and University of Oslo (UiO). The master's activities are located in an audiovisual networked space, the Portal, which connects the two universities and has streaming facilities to also communicate with online viewers. WoNoMute is reimagining the *cyberspace*—a term that refers to interconnected digital and physical spaces that promote other ways of participation and communal life (Schwartz, 1999)—by creating a forum where women in music technology are visible and discuss about their work and experiences with technology.

This article addresses the following research question: *How can interview analysis with women who work with live interfaces in music inform about whether and how their gender determines the shape of their tools?*

We analysed the first seven interviews published in this online archive using thematic analysis. One of the themes identified is the use of the term 'music technology' in their work, and how gender shapes their tools, particularly live interfaces. Thus, the research question includes gender as a key factor. However, it is noteworthy that we adopt a stance as descriptive and ethnographic as possible in regards of how we approach the term of 'music technology'. The term is defined by the interviewees' voices and then linked to

the literature, which we found especially connected to the notion of musical interface as a gendered metaphor (Essl, 2003). From this perspective, this research contributes to rethink the term of 'music technology', which can inform future steps in education and human-computer interaction. Although music technology received such a prominent place in the discussion through the thematic analysis, it is out of the scope of this research to provide a more profound historical overview on the terminology.

Interface as a Gendered Metaphor

> *"Knowing how interface structures our relation to knowledge and behaviour is essential... today we perceive our environment through interfaces."*
> Monteiro (2017, p.7)

In order to stress live interfaces as possibly gendered artefacts, we highlight the communicative aspects of interfaces in general. Monteiro (2017) is describing interfaces as a cultural moment in which a specific relationship between human user and technological artifact is being established. Accordingly, its connotations of advanced technology and contemporary forms would suggest both immediacy and engagement. Further on, interfaces would represent and convey ideological meanings, therefore capable to produce false consciousness. Monteiro expresses the notion of interface as a series of actions between human and machine in time and space: *"embed choices, conduct, languages, and ultimately values, worldviews and aesthetics into technical infrastructures."* (Monteiro, 2017, p.8)

Georg Essl (2003) regarded new music interface technology as concerned with using technology for musical performance and highlighted how women authored gender as an issue in their performances. Essl describes *new music interface design* as an academic field involving electrical components for musical performance, and *music technology* as any mechanical device that generates musical sound. Georg Essl's definition of new musical interface technology involves usually electrical components and sensors, a workable definition in this paper because it echoes with our findings.

Along other practises, often summarised as 'music technology', the design of live interfaces has multi-disciplinary dimensions. Historically it has been a little diverse subject, especially women were rarely involved in interactive audio design with traditional engineering tools such as microprocessors (Stewart et al., 2018). However, there is enough evidence that indicates strongly that gender imbalance exists in creating interfaces for music and performance. This can be traced to external factors in the practise environment rather than in the technological subject itself, which has been addressed and showcased by several authors and practitioners with different methodologies (Cheryan et al., 2009; Stewart et al., 2018; Sørensen, 1992). The analysis of the interviews presented in this paper is done from the perspective of using the term 'music technology' as an interface that can communicate gender issues.

The Interview Process

In this section, we present the context of this research in terms of the MCT master and Portal, the organization Women Nordic Music Technology (WoNoMute) and the interview analysis process.

The MCT Master and Portal

The NTNU-funded project Student Active Learning in a Two Campuses Organization (SALTO) aims to promote cross-campus teaching and learning as an open laboratory (Støckert et al., 2017). A new international master has been launched within this educational scheme: Music, Communication, and Technology (MCT), which is a master's program in collaboration between the NTNU in Trondheim, Norway, and UiO in Oslo, Norway. The master's program centres around the field of music technology from a research perspective in a cross-campus setting. The students have interdisciplinary backgrounds and work in teams. The master has a dedicated physical space in both sites, the Portal, with a real-time low-latency audiovisual network and audiovisual technologies.

Women Nordic Music Technology (WoNoMute)

The organization Women Nordic Music Technology (WoNoMute) has been founded by the second author in August 2018 at NTNU, in partnership with UiO, and in alignment with the NTNU Department of Music's and Faculty of Humanities's will to improve the underrepresentation of women in techno-scientific fields. WoNoMute

is an horizontal network that promotes the work of those identifying as women in the interdisciplinary field of music technology. The organization aims to promote and connect the work of women in music technology at local, national and international levels. During the first year of the organization, a small group has constituted the core WoNoMute team, with the help of a number of contributors and advisors, in particular with invaluable contributions from the MCT students and teachers.[1]

WoNoMute is an open space defined and discussed by its members and produces content that is publicly available. During the first year, the organization has coordinated seminar series,[2] which is a monthly series of lectures by women who work around music technology and who present their work in the MCT portal, connecting the two campuses of NTNU in Trondheim and UiO in Oslo and streaming to the world. The seminar series have been curated by the second author in conversation with the organization's advisors. In connection with the seminar series, WoNoMute has also conducted interviews,[3] mostly led by the first author. The interviews have been conducted typically in the form of both a short biosketch interview video and a written interview, which are published on the organization's website.

Interview Analysis

Over the period of 8 months, WoNoMute invited 7 women figures active in music technology related fields, to give a lecture in the Portal, in chronological order: Miranda Moen, Alexandra Murray-Leslie, Tone Åse, Tami Gadir, Angela Brennecke, Pamela Z and Sofia Dahl. The live streams of the presentations and interviews are stored in the online archive. The interviews are semi-structured and have been conducted by the first author (except for the interview with Pamela Z where Tone Åse was also an interviewer). The interviews had questions related to the interviewees' background, mentors and role models, their work, and advice to women interested in pursuing their careers in music technology. The questions were inspired by the previous experience of the second author while conducting and supervising similar interviews when she was at the organization Women in Music Tech at Georgia Tech.[4]

Both seminars and interviews were generally programmed in the Portal. While the seminars were open to public and accessed from two cities and online viewers, the interviews were captured in a more intimate ambience. Driven by the interview questions, we applied thematic analysis (Braun and Clarke, 2006) to identify emerging patterns on the WoNoMute's published online material i.e. the short biosketch interview videos, the written transcribed interviews and the video recordings of the presentations. We used the software NVivo (Bazeley and Jackson, 2013) to unfold themes from this material, annotating the text snippets from each interviewee. For the written interviews, the nomenclature used includes the name of the interviewee and the reference number (e.g., *"Miranda Moen, Reference 1"*), and for the videos we give the timecode and distinguish between the presentations (e.g., *"Miranda Moen, Presentation Video, 01:12"*) and the biosketch videos (e.g., *"Miranda Moen, Video Interview, 01:12"*). In the next section, we discuss in detail the main findings from this interview analysis process, focusing on how the term 'music technology' is used.

Live Interfaces, Sonic Arts, Circuit Bending... Is Everything 'Music Technology'?

In this section, the musical interface is being inspected, based on the statements of four of our seven interviewees, when discussing about their backgrounds and experiences. In particular, we explore how the term 'music technology' is used when talking about instruments and applications. We sketch a casual frame in order to understand in what way the term is genderised according to Essl's (2003) definition. We seek for reasons and come up with interpretations, which indicate that there does not seem to be a universal statement.

According to Tami Gadir's presentation "The Music Technological Body", every form of musical expression, including all forms of bodily, classical and computer engineered instruments, are declared as 'music technology':

> *"Music is always technological. And music is always affected by gender. Or sometimes it helps to use negative formulations, we can say that there is no music that is non-technological and no music that is unaffected by gender."* (Tami Gadir, Presentation Video, 04:42)

[1] http://wonomute.no/committee
[2] http://wonomute.no/seminars
[3] http://wonomute.no/interviews
[4] http://womeninmusictech.gatech.edu

Asking what kind of images would rise when thinking about the "music technological body", Tami Gadir presented different photos and video excerpts with content that is distantly or closely related to the term. In her interview, she would affirm this position, based on her own practice:

> *"The piano was my first music technology. [. . .] I tried to teach myself that people have different skills with various types of technologies."* (Tami Gadir, References 1, 2)

Independent from that, another interviewee stated in her interview that everything is 'music technology' as well:

> *"Because it is all technology. Even somebody who just plays a concert grand piano, that is probably one of the most technologically sophisticated instruments that you can imagine. It is all about the well balanced and designed mechanical thing."* (Pamela Z, Reference 1)

In Tami Gadir's presentation, she also states that technology would not be an item that exists apart from music in a pure, pre-technological form (Tami Gadir, Presentation Video, 17:46). A number of the answers to the question "What brought you to the field of music technology?" are able to reveal preconceptions that come along with the term 'music technology' and show that the intended detachment notion between music and technology is quite strong. The term evoked partly discontinuous reactions when two of the interviewees expressed their disconnection with 'music technology' when referring to their own work, even though their musical practice included several technical layers and items. An indication for this can be inspected in the following vignettes:

> *"I don't like to describe what I do as music technology, for me, that's more the system behind the instruments."* (Alexandra Murray-Leslie, Reference 1)

To the same question, Pamela Z answered:

> *"There is an introduction of technology into the arsenal of tools that I'm using but I don't think of it as the technology part being the prominent thing. The aesthetic and the adventurousness of the work is more important to me than whether or not there is technology involved."* (Pamela Z, Reference 1)

Although Pamela Z stated earlier that the exposure to technology provoked a change in her artistic voice, when we asked her "What advice would you give to women interested in pursuing a career in music technology?", the term music technology seems to become a detached and irrelevant artefact:

> *"Again, to me 'career in music technology' sounds a little bit like you're talking about circuit benders or that they are writing and designing software. I see myself as an artist and so I can only speak from that, what my advice is about trying to be an artist. Then it doesn't matter rather you are using technology, and what kind of technology you're using."* (Pamela Z, Reference 2)

There seems to be an echo between these statements and the approaches to music technology regarding the nature of the technological or engineering part in music. Sofia Dahl, who holds an engineering degree, distances herself from the role of the engineer even though she applies engineering methods in her research:

> *"Now I can say I am an engineer, but I am not a typical engineer. I wouldn't feel comfortable working as an engineer in a company."* (Sofia Dahl, Reference 1)

Alexandra Murray-Leslie mentions international conferences on music technologies such as the New Interfaces for Musical Expression (NIME),[5] which namely fuse music and technological practice. Although her music instrument *Computer Enhanced Footwear* is mentioned in relation to it, 'music technology' is not present in the language:

> *"[T]o 3d print the prototype instruments, creating a live costuming on stage that could be actuated through gesture led my group [. . .] to new interfaces for musical expression. When I started my PhD I suddenly realised this whole incredible world of people working with their digital DMI [digital musical interface/instrument] controller or connecting virtual with classical instruments."* (Alexandra Murray-Leslie, Reference 2)

[5] https://www.nime.org

Discussion

Here, we analyse how the term 'music technology' should be reimagined to include the missing plurality and fluidity revealed by our interviewees, which is beyond the acknowledged interdisciplinarity of the field.

According to the above conversations, the interviewees with the strongest artistic practice see their work not necessarily regarded as part of music technology. The attributed expressions like "circuit bending" and "designing software" (Pamela Z, Reference 2), and "the system behind the instruments" (Alexandra Murray-Leslie, Reference 1) suggest that the *ambient belonging* (Cheryan et al., 2009) that accompanies the term 'music technology' rather associates with stereotypical environments and characteristics of engineered products.

The scholars that we discuss next propose ideas that are part of our agenda on how to reveal the stereotypical biases of technology in the academic field of music technology. For example, Sørensen introduces in "Towards a Feminised Technology?" (1992) the notion of *translation problems* from values to technology, for example values such as usefulness and efficiency. Human practice would be difficult to relate with these concepts. Similarly, Sørensen explains how humans and their activities would be gradually removed from the vocabulary in technological texts. Accordingly, Sørensen wonders whether there is the possibility that the aforementioned values could be seen as a translation into physical characteristics of an artefact (Sørensen, 1992, p.13). This could explain why many of the interviewees, even those with engineering background, do not seem to see themselves aligned with 'music technology' or engineering.

Cheryan et al. (2009) examined how material objects in environments can communicate characteristics of the inhabitant group. Environments could therefore act like gatekeepers by preventing people who do not feel they fit into those environments, from joining them. The goal of their paper was *"to demonstrate that stereotypes of a domain should be taken into account when attempting to diversify that domain"* (Cheryan et al., 2009, p.2). In Stewart et al. (2018), the researchers demonstrated that women and girls want to learn how to work with electronics and code to build audio interfaces of their own design (Stewart et al., 2018). However, they are underrepresented within established audio and music technology communities and academia (Stewart et al., 2018, p.8). Accordingly, by introducing e-textiles to audio technology women would persistently outnumber men in the gender representation.

Even though the design of interfaces in all its artistic and sonic nuances might be seen as inherent to the academic field of music technology, 'audio and music technology' terminology still resonates with STEM disciplines, as we learned from interviewing diverse practitioners, in a way that cannot resemble those practices. By designing their artistic items and technically tailoring them to their own needs, the idea of the implicated attributes that come along with the imagery of engineering and programming is transformed and often reversed. Consequently, music technological practices can be 're-written' and, in doing so, can alter our perception of technology itself. This has the potential for a 'female narrative' (Armitage, 2018) in engineering or what Sørensen calls 'feminised technology' (Sørensen, 1992).

All the above examples show that the context in which STEM methods are applied is crucial for the presence or absence of women. In the moment a gendered tool can act excluding, termed as *ambient belonging* in Cheryan et al. (2009), a gendered tool can become inclusive as well, as seen with the e-textiles. And this is also reflected in the statements of the expert women in our interviews, who do not like to describe what they do as 'music technology'.

Implications and Future Work

This article sought to answer the research question *How can interview analysis with women who work with live interfaces in music inform about whether and how their gender determines the shape of their tools?*

From our analysis we observed that the established terminology in the academic environment of music technology fails to address the diversity of practices, especially with gendered tools that can act as gatekeepers for women. We thus propose to investigate alternative terminology that is suitable to accommodate a diversity of uses and practices. This is an important finding that was possible through the analysis of the publicly available material from the WoNoMute online digital archive. In turn, it has been crucial the creation of both a public and a private cyberspace for forum debate and dissemination of a variety of women's work in music technology in a connected and modular venue, the Portal, in order to promote these initial conversations. When attempting to diversify the music technology domain in academia, education and industry, it should be taken into account that not only language but the design of the environment are relevant factors to be considered (Cheryan et al., 2009).

We acknowledge that this research is limited to a specific group of practitioners, academics and professionals who identify as women, and that more research needs to be done in order to provide a more generalisable representation. For example, it is an open question whether similar reflections could be found among practitioners, academics and professionals who identify as men or non-binary. Here we focused instead on an in-depth qualitative analysis of a small but diverse group in terms of backgrounds and experiences to initiate this debate. As future work, we foresee the need of establishing working groups, where multiple stakeholders take part into discussions with the aim at revising the terminology in order to be more inclusive and move the field forward.

Conclusion

In this article, we noticed that interfaces for music performance are not only artefacts, but ideas. The term 'music technology' alone is not capable to encompass the existing diversity of practices as it carries ideas of activities related to the term that are stereotypically gendered. The discussion showed, with a number of examples from women who work with topics related to music technology, that the context in which STEM methods are applied is crucial for the presence or absence of women. Finally, we discussed the implications and future work of this research, namely rethinking the terminology in academia, education and industry, related to the term 'music technology', so that it becomes more inclusive and environment-aware. We acknowledge that gender is one of the dimensions in diversity, and we hope that this research can encourage to reflect new perspectives on the techno-scientific terminology.

Additional Information

The following list includes the links to the written interviews, biosketch video interviews and presentation videos discussed in this paper, which are part of the WoNoMute online digital archive:

Miranda Moen
– **Written interview**: http://wonomute.no/interviews/miranda-moen
– **Biosketch interview video**: https://youtu.be/xdMMQiUG7mU
– **Presentation video**: https://youtu.be/QJBmbiEb8dc

Alexandra Murray-Leslie
– **Written interview**: http://wonomute.no/interviews/alexandra-murray-leslie
– **Biosketch interview video**: https://youtu.be/VPpy01W0fAw

Tone Åse
– **Written interview**: http://wonomute.no/interviews/tone-aase
– **Biosketch interview video**: https://youtu.be/SRX81BHTWbc
– **Presentation video**: https://youtu.be/y8PI-E0o6Wc

Tami Gadir
– **Written interview**: http://wonomute.no/interviews/tami-gadir
– **Biosketch interview video**: https://youtu.be/DoO9mq3khGQ
– **Presentation video**: https://youtu.be/okEgjIjpJkY

Angela Brennecke
– **Written interview**: http://wonomute.no/interviews/angela-brennecke
– **Biosketch interview video**: https://youtu.be/OV8A98-HRIk
– **Presentation video**: https://youtu.be/mpFSF2PHcFo

Pamela Z
– **Written interview**: http://wonomute.no/interviews/pamela-z
– **Biosketch interview video**: https://youtu.be/DQMF2ABrJvs
– **Presentation video**: https://youtu.be/v3ql6QMNi4U

Sofia Dahl
– **Written interview**: http://wonomute.no/interviews/sofia-dahl
– **Biosketch interview video**: https://youtu.be/SV42EZF3Gx0

Acknowledgements. The interviews and seminars were held and recorded at NTNU in Trondheim, Norway. We are thankful to the interviewees cited in this paper, without whom this work would not be possible: Miranda Moen, Alexandra Murray-Leslie, Tone Åse, Tami Gadir, Angela Brennecke, Pamela Z and Sofia Dahl. We are also thankful to the rest of interviewees from the WoNoMute seminar series 1st edition: Natasha Barrett, Liz Dobson and Sølvi Ystad. We thank the help and support of the MCT students, teachers, and administrators. Special thanks to the students Sepehr Haghighi, Eigil Aandahl, Jørgen Varpe, Shreejay Shrestha and Ulrik Antoniussen Hamøy for their technical support in Trondheim and Jarle Folkeson Steinhovden, Espen Wik, Elias Andersen and Guy Sion in Oslo. Thanks to the teachers Robin Støckert, Anders Tveit, Daniel Formo, Sigurd Saue and Alexander Refsum Jensenius for their technical advice. Also thanks to Maj Vester Larsen, Øystein Marker and Ellen Karlsen Holmås for their executive help. We are very thankful to Mari Lesteberg and Ane Bjerkan for their support as part of WoNoMute Oslo. Thanks also to Kara Ayla Wolf for her help in proofreading. The seminar series have been supported by the Faculty of Humanities and Department of Music at NTNU with the collaboration of University of Oslo. The data collection and analysis of this research was carried out while the second author was at NTNU. This work was partially supported by the NTNU SALTO project (80340480).

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Appendix B

Interview Questions

B.1 Video Questions

B.1.1 Looking at the present

- Introduce yourself and what you're working on at the moment.
- What is your favourite part in that?
- How do you see your role as a woman in music technology?

B.2 Long Audio-recorded Interview

- What is your background?
- What brought you to the field of music technology?
- How do you see your role as a woman in music technology?
- What are your experiences being a woman in the music technology field?
- Did you had a role model or mentor?
- What is your background?
- Please introduce more closely your piece of work/research.
- What motivated you to do this piece of work/researches?
- If theoretical: how did you design the study or data analyses? What research methods did you use to conduct the study?
- If practical or engineering: How does the system work (and why)?
- What is the follow up of this piece of work/research?
- What advice would you give to women interested in pursuing a career in music technology?
- Do you want to add anything else or have a comment?

Appendix C

Item Catalogue, Pre-Study

Catalogue of Music technological Items/DMI’s

(with associative tagging)

MicroFreak

Arturia MicroFreak

Gender: Male

Persona: Young male adult

Wording: Freak, male connotated word, micro - X; micro: suggests something tiny, small seized,

Colors: Orange in combination with black,

Shape: Tiny, handy

Attributes: Creativity, cuteness, experimentation, fun

Logitech Artemis Gaming Headphones

Gender: Male

Persona: Male adult, domiciled

Wording: Artemis (myth of greek hunting goddess) and Gaming Headphones suggests a solitary state of immersion in a dark room with rough games

Colors: Black, with turquoise

Shape: Bulky, heavy

Attributes: Control

Chess Bliss Pedal, MOOD

Gender: Genderfluid

Persona: Universal, female of any age

Colors: Apricot, red, dark blue

Shape: Handy

Wording: ‘Mood' suggests a state of creativity that is 'bodiless'

Attributes: Experimentation, Creativity, Control

Black Gold Shared System Plus

Gender: Male

Persona: Universal, well educated and technical versatile, rather young-middle aged

Colors: Black

Shape: Bulky, but the bunch of colourful knobs and lights are expressing curiosity, communicating an openness towards different forms of expression that is in itself is nearly pluralistic, there is no predetermined way on how to handle the instrument

Wording: Rather dry functional wording, terming colors, indicating abstract, technical features (plus)

Attributes: Control, logic, efficiency, fun

Roland GoLive Cast

Gender: Female

Persona: Universal

Colors: White, grey

Shape: Handy, flaty - simple interface to the extent that it doesn't seem like a technology at all

Wording: Functional wording, indicating concrete, technical features

Attributes: Control, functional, conservative, tidy

Moog Grandmother Semi-Analogue Synthesizer

Gender: Genderfluid

Persona: Universal, rather young

Colors: Fresh, colourful design, (spring, childish) colours

Shape: Knobs are clearly arranged and highlighted through colored bars,, like in a sandbox

Wording: Plays with old technology that comes in 'outdated' analogue together with new technology

Attributes: State of fun, creativity, experimentation and cuteness

Stand-up DJ Speakers

Gender: Male

Persona: Young-middle aged

Colors: Black with shimmering purple/blue

Shape: The shape of the membranes instantly creates an atmosphere, very targeted on one group, not very diverse in expressions.

Wording: ‘DJ’ suggests a dark space, rather closed than open

Attributes: Control, fun

Behringer Xenyx USB Mixer

Gender: Male

Persona: Middle-, adult aged

Colors: Grey in different shades

Shape: Square, controllerism e.g. many buttons

Wording: ‘DJ’ suggests a dark space, rather closed than open

Attributes: Control, functionality, logic, positivism

Korg Volcabass – Analog Bass machine

Gender: Genderfluid

Persona: Universal

Colors: Silver, rosa, gold and black, weak expression

Shape: Small, elegant through its materials

Wording: Bass suggests something more masculine

Attributes: Control, experimentation, fun

Appendix D

Online Survey

D.1 Demographic Questions

D.1.1 What is your professional background/field of study?

Up to two crosses possible.

- Arts and/or Design
- Music Technology and/or Sonic Arts
- Informatics and/or engineering
- Music (performance, improvization, jazz..)
- Humanities (history, languages..)
- Film
- Natural Sciences
- Other
- Prefer not to say

D.1.2 What is your native language?

- English
- Norwegian
- German
- Italian
- Catalan
- Spanish
- Danish
- Swedish
- Hungarian
- S/B/C
- Cech

- Dutch
- Portugese
- Russian
- Arabic
- Mandarin
- Japanese
- Hindi
- French
- Suomi/Finnish
- Sami
- Polish
- Persian
- Rumanian
- Hebrew
- Turkish
- Urdu
- Other
- Prefer not to say

D.1.3 What is your gender?

- Male
- Female
- Agender or androgyn
- Genderfluid
- Transgender
- Cisgender
- Genderqueer
- Gender Non-Conforming
- Other
- Prefer not to say

D.2 Main Questionnaire

D.2.1 Which gender characterizes this object most closely?

You can chose up to two genders.

- Female
- Male
- Neutral
- Other

D.2.2 To what extent you think this is related to the shape (form, type of knobs, seize.. etc.)?

(1 not at all, 3 neutral, 5 very strong)

- 1
- 2
- 3
- 4
- 5

D.2.3 To what extent you think this is related to the colors?

(1 not at all, 3 neutral, 5 very strong)

- 1
- 2
- 3
- 4
- 5

D.2.4 To what extent you think this is related to the wording?

(1 not at all, 3 neutral, 5 very strong)

- 1
- 2
- 3
- 4
- 5

D.2.5 To what extent you consider the item is communicating..

(1 not at all, 3 neutral, 5 very strong)

- Control
- Creativity
- Fun
- Efficiency
- Experimentation
- Functionality
- Happiness
- Innovation
- Cuteness
- Care
- Attractiveness
- Conservatism
- Clarity and Tidiness

Appendix E

Online Survey's Comments

- This was a super weird study and I think much more care should be taken to see if the questions even made sense...
- I think many of these are considered male by me because from my experience, males are more likely than females to be using and buying them.
- I think this is a very important field of study. What I noticed in my own way of thinking about gender perception of electronic hardware was that I was asked to view attributes of gender in things I never have tied any gender to before. I think much of my own (and probably others) perception of gender in electronic hardware is tied to being asked the questions themselves. I didn't really see gender in many of these examples before, but after being asked about it I now will probably think more about this in regard to other hardware from this day on. I have yet to see any specific examples of gendered advertising of electronic hardware, and I hope I never will. Good job spotlighting this issue! I think your work is a good indicator that this is something we should care about.
- -I noticed that the attributes on electronics that struck me as most masculine (and that I tend to have a less favourable opinion of) were ones that I associate with military hardware, for examples some styles of knobs, or the handles on your speaker example. -I noticed that I was biased by my personal opinions of the companies. -I also was shaped by my knowledge of the synths, for example the MicroFreak I view quite neutrally, partly because its design avoids the militaristic ideas of masculinity I mentioned above, but also because I know that it includes code developed by people of multiple genders, including women like Émilie Gillet from Mutable. -I noticed that most of the designs I like don't seem particularly gendered. I notice gendering when it conforms to what I perceive as unhealthy societal ideas of gender.
- Wonderful topic you have picked. Thank you!
- I cannot classify technical gear as "male" or "female". This means to me, that we fall back into older gender roles like many knobs and black = male, no knobs but colorful = female, I think we are already beyond that stage.
- Shape and color is definitely what defines the gender of the hardware, for me.
- Hey, really cool research project! It will be very interesting to read your findings. How techology integrates with and shapes our notions of gender is to my mind a very important part of human culture, and it is way too often overlooked. So kudos to you for delving into this! So cool. Feedback, just two things. Firstly, I was a bit unsure of whether to describe the items from my own viewpoint (*I* think this is cute, or efficient or whatever) or based on my

perception of general gender norms (*society* would in general find this cute, efficient). In the end I opted for the former. The ramifications here would be that had I answered in the latter way, you could have interpreted my understanding of societal norms as my personal opinion. (*He* thinks that this is cute, when what I actually mean is that I think other people probably would.) If many of your respondents are confused about this, I guess this could make it hard to interpret the results, and at worst you could end up just confirming general gender norms as they are understood by your respondents. Secondly, as a gay artist living in Berlin in a sexually and genderwise nonconformist environment, I might think it could be a good idea to include sexual identity in your questionaire. Sexual identity is of course distinct from gender identity, but the two are integrated in so many ways that, at least for me and a lot of people I know, my notions of gender are very much influnced by my sexuality. Just a couple of thoughts. Again, I really love this - good luck with your work and I am looking forward to reading you finished thesis!

- Might be an idea to make the survey a bit shorter? I found myself breezing through the last three items, sadly.
- Wooooaaahhhh
- I don't find any correlation of the design of equipment as a reflection on the creative abilities of Women. My field of work includes the long time awareness, work and influence of Artists like Laurie Spiegel, Elaine Radigue, Delia Derbyshire and many others who worked with Room size Harware. On the other hand, who knows what the Design Department, responsible for visual design of the hardware, do, in terms of who they cater there designs to. Nice project and well designed questionnaire, well done!
- Some of the items were not shown in perspective or with their casing (MicroFreak, Mood Pedal, Black Gold, Grandmother), and the size of some items wasn't obvious since there weren't other objects in the image. I think those factors could affect gender perception. (Sharp vs curved edges, texture, depth/size; a smaller item could be perceived as "cuter" and possibly more feminine.)
- I find it a bit hard at first to assign genders to objects. But then, since my native language is German, I noticed already many years ago that drum machines are shes and synthesizers are hes ;) - die Maschine, der Synthesizer. So my answers are quite free associations without much reasoning. If I were to reason, I'd assign them all per se gender neutrality. Even if, telling from the design, one can assume certain gender related target groups.
- Interesting study, would like to hear more about the results once it is finished. Sometimes I have felt that some objects might initially look as stereotypically male, but I could easily imagine people that identify themselves as female appropriating them and ascribe female qualities to them. There is a certain fluidity there I suppose, perhaps tied with artistic practice, cultural identity, etc. Good luck!
- I have done my very best to give some feedback
- I think shape is the most important thing in feeling that something belongs to a gender, second is color. The two are triggering certain emotions in me. Certain shapes are making ne feel disgusted...and i wouldn't buy them bc of the shape.

I definitely prefer neutral shapes. Squares and everything that has 4 corners without some extra shapes...

- I was able to select several levels from 1-5, so please be aware that some people might misclick on several options. I didn't like that when asked to identify myself there were many options, but when asked about the objects there were only 4 options.
- Very interesting study!
- Very difficult for me to associate gender with hardware out of context in which it is used.
- Curious study, makes me curious about the use of the knowledge/results of it!
- Great work!
- why do I give my gender with six or seven options, but machines are binary?
- I often had problems deciding whether I was judging the represented gender of the object or the gender of the target buyer. The gender association seems to be influenced by established clichés. In a field such as music I would hope they are continuously challenged and subverted
- I would be interested in seeing the variation between genders of neural natures and outside other cultural norms. Please, keep me posted on what you discover! Friendly A(n)g(n)., Marcel P.S. Curious, you put agender and androgyne together. I've always thought them a bit opposite. But, perhaps I can be called both .
- I found it very hard to relate the human quality of gender to manufactured objects/tools. To me, gender is an expression of one's phsyical and cultural awareness in relation to other humans; a machine cannot embody this.
- I got more interested as to "what is actually going on here" as I went through your examples. I think we are talking here about what Daniel Kahneman (Thinking fast and slow, Nobel Prize) refers to as system 1 and 2 — our responses are unconscious and coming from system 1, then use system 2 to "justify" them, as I was going down your detailed ratings. Happy to discuss further, and also connect you with the CEO of AffectiveMarkets.com that is working on an AI that I think could give a lot of insight into what you are trying to do (he has a personal interest in music). That is with a strong warning — don't let this loose your focus on completing your thesis! You can reach me at: xxx and happy to discuss in more detail. You can check me in xxx
- As I look through these images, I realise that what affects my association with gender most strongly is social context rather than appearance of the object. As I work in sonic arts and sound, and as almost all my colleagues are men, I generally associate almost any piece of hardware that is clearly for sound purposes as something aimed at men.
- This was a very interesting survey! While I have used many different kinds of gear before, it never really occurred to me to think of them in a gendered manner. I'd love to hear or read about the results! All the best with your study :)

- There's so much more to gender identity than the questions I've just been asked about mucal instruments. Fascinating.
- I am biased because I use MakeNoise modules.
- HARD to find a feminine instrument. Surely there must be something, beyond what was shown. My first thought is of Imogen Heap's magic gloves, but that's mainly because of Imogen Heap I guess. There's nothing inherently masculine to something like the mixer, but I still picked "male" due to dudes mostly manning mixing consoles. So beyond shape, name, colour, I thing what conveys gender the most is the people we're used to seeing with the respective tool. Interesting study!
- I noticed my perceptions on gender were mostly influenced by my perceptions & associations of use - for example, headphones are gender neutral to me but gaming gear is not since I have a perception of the gaming world as being extremely male-centric male dominated. The other strong association with male gender was if something looked like military gear.
- I noticed that throughout the questionnaire, my initial impressions of the hardware was compounded as I was asked to provide explanations. I also became aware that the factors that contributed to my impression of the object's gender was based on stereotypes of masculinity/femininity. While I feel I do not value a particular orientation as part of myself, I can see the significance of marketing in music technology, especially knowing that the majority of the market is male.
- At times my decisions were based on color, form and appeal, but often it was based on whether or not I use gendered terms when speaking of an object. I often find myself referring to more complex electronics (such as synthesisers) as her/she, and simpler electronics (such as headsets or speakers) as he/him. I have no clue why this is. Interesting work!
- I never thought about this before; thank you for bringing it up!
- Often very difficult to assign gender to the different aspects of the devices when there are no clear stereotypes in play.
- Very interesting research, I would love to know about the results!
- Thank you!

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