

# Deaf Tech Worth Wanting

## A Participatory Speculative Investigation

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zur Erlangung des akademischen Grades

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eingereicht von

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Wien, 7. Mai 2024

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Katta Spiel



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# Deaf Tech Worth Wanting

## A Participatory Speculative Investigation

DIPLOMA THESIS

submitted in partial fulfillment of the requirements for the degree of

**Diplom-Ingenieur**

in

**MSc Media and Human-Centered Computing**

by

**Robin Angelini, BSc**

Registration Number 12113471

to the Faculty of Informatics

at the TU Wien

Advisor: Ass. Prof. Dr. Katta Spiel, BA BSc

Assistance: Dr. Maartje de Meulder (*University of Applied Sciences Utrecht*)

Vienna, May 7, 2024

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# Erklärung zur Verfassung der Arbeit

Robin Angelini, BSc

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Wien, 7. Mai 2024

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Robin Angelini



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**Namen der Teilnehmenden, die einen wesentlichen Beitrag zu dieser Masterarbeit geleistet haben:**

**Nombres de los participantes que han contribuido significativamente a esta tesis:**

**Names of the participants who made a significant contribution to this thesis:**

Belén Navas • Caroline Obermaier • Clara Eva Fernández Delgado • Daniel Lesovsky  
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other persons!





# Kurzfassung

Die deaf-led Diplomarbeit hinterfragt die vorherrschenden Ideologien in Bezug auf Technologien für taube Menschen im Bereich der barrierefreien und assistiven Technologien und setzt sich für einen Wechsel zu einem deaf-centered Paradigma ein. Unter Verwendung der Grounded-Theory-Methodologie untersucht die Arbeit Deaf Tech und den deaf-centered Designansatz. Durch partizipatives, spekulatives Design mit tauben Teilnehmenden aus drei verschiedenen europäischen Ländern erforscht die Arbeit ihre Visionen einer idealen Technologi Landschaft - eine, die sich nicht nur auf Barrierefreiheit fokussiert, sondern eine breitere Erforschung von Technologien umfasst, die auf ihre Neugierden zugeschnitten ist. Die anschließenden partizipativen Interviews spiegeln die Relevanz der Deaf Community für die Gestaltung der Technologie wider. Die Ergebnisse dieser Arbeit befassen sich mit Fragen der technologischen Forschung und Entwicklung für taube Menschen und überbrücken die Lücke in der Literatur an der Schnittstelle zwischen Deaf Studies und Human-Computer-Interaction-Forschung. Darüber hinaus bieten die Ergebnisse Einblicke in alternative sozio-technische Narrative von tauben Menschen und Konzepte von Deaf Tech, die sich auf identitätsbezogene, kulturelle und erfahrungsbezogene Aspekte konzentrieren. Schließlich bietet die Arbeit einen Beitrag zu einem offenen Dialog über die Bedeutung von deaf-led und deaf-centered Ansätzen in der Technologieforschung und -entwicklung, die die Bedürfnisse, Wünsche und Erfahrungen von tauben Menschen hervorheben und in den Mittelpunkt stellen.



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# Abstract

This deaf-led thesis challenges prevailing ideologies surrounding technologies for deaf people within the field of accessible and assistive technologies, advocating for a shift toward a deaf-centered paradigm. Employing Grounded Theory methodology, the study investigates Deaf Tech and the deaf-centered design approach. Through Participatory Speculative design involving deaf participants from three different European countries, the thesis explores their visions of an ideal technological landscape — one that not only focuses on accessibility, but encompasses a broader exploration of technologies tailored to their curiosities. The subsequent participatory interviews reflect the relevance of the deaf community in shaping technology. The findings of this study address the issues within technological research and development for deaf people, bridging the gap in the literature at the intersection of Deaf Studies and Human-Computer Interaction research. Furthermore, the findings offer insights into alternative socio-technical narratives by deaf people and conceptions of Deaf Tech, focusing on identity, cultural, and experiential aspects. Lastly, the work contributes to an open dialogue about the importance of deaf-led and deaf-centered approaches to technology research and development, emphasizing and centering the needs, desires, and experiences of deaf people.



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# Resúmen

Esta tesis, dirigida por una persona sorda, cuestiona las ideologías predominantes en torno a las tecnologías ‘para personas sordas’, dentro del área de las tecnologías de accesibilidad y de asistencia, abogando por un cambio hacia un paradigma centrado en las propias personas sordas. Empleando la metodología de la Teoría Fundamentada, el estudio investiga tanto la ‘Tecnología Sorda’ como un enfoque de diseño centrado en las personas sordas. Aplicando un método participativo y especulativo, en el que intervienen participantes sordos de tres países europeos diferentes, la tesis explora sus visiones de un panorama tecnológico ideal; uno que no sólo se centre en la idea de accesibilidad, sino que abarque una exploración más amplia de tecnologías a la medida de su curiosidad. Las entrevistas participativas posteriores reflejan la relevancia de la comunidad sorda en el diseño tecnológico. Las conclusiones de este estudio abordan la problemática en torno a la investigación y el desarrollo tecnológico para las personas sordas, acercando distancias ante la actual carencia de bibliografía en el cruce entre los Estudios sobre Personas Sordas y la investigación en torno a la Interacción Persona-Ordenador. Además, las conclusiones ofrecen una perspectiva de las narrativas socio-técnicas alternativas propuestas por las personas sordas y una aproximación al concepto de ‘Tecnología Sorda’, centrándose en aspectos identitarios, culturales y vivenciales. Por último, este trabajo contribuye a generar un diálogo abierto sobre la importancia de un enfoque diseñado por las personas sordas y centrado en las personas sordas dentro de la investigación y el desarrollo tecnológico, haciendo hincapié y centrándose en las necesidades, los deseos y las experiencias de las propias personas sordas.



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# Introduction

Technologies are an integral part of deaf people's lives. From the introduction of the teletypewriter and video telephones, which facilitated communication over distance between deaf communities in the early years, to the widespread adoption of internet-based communication platforms that enable instant messaging and video calling, and the advent of smartphones and social media, the landscape of connectivity has transformed. Beyond communication, accessibility technologies such as captioning, visual alerting systems and video relay services are also developing. More recently, the integration of AI (Artificial Intelligence) technologies has been offering promising solutions to the challenges of accessibility.

Notwithstanding these advances, the design and development of accessibility technologies for the deaf community have largely been driven by hearing people who have occupied various roles such as researchers, developers and designers. Their approaches are often based on the needs of the deaf community without taking into account cultural and linguistic nuances. Yet, as the deaf community is marginalized in the development process, the ideologies of audism are embedded and reinforced in the design of these technologies, perpetuating solutions that prioritize adaptation for deaf people rather than focusing on their identity, cultural and language perspectives, and desires. As a consequence, these technologies may not be centered on the actual needs and desires of deaf people.

## 1.1 Motivation

The recent work *Criptopias* [6], which was written by diverse disabled researchers including myself, shows how they envision technologies by telling narratives that are centering their experiences. In our vision, technologies for disabled people do not have to be advanced, high-tech or super - as they are often advertised by companies, government institutes and academics [5]. Thus, the *Criptopias* inspired this thesis to go further through the lens of deaf people by actively engaging the deaf communities in visioning their ideal

world, and from there, exploring the technologies developed that put their desires at the center. In this way, it seeks to understand how a deaf-led and deaf-centered approach is relevant to technological development.

### 1.2 Objectives

The objectives of this thesis are threefold:

- (a) Through a state-of-the-art review, this study examines the **intersection of deaf people and technologies**, specifically examining the extent to which ideologies are embedded in the research and development of accessible and assistive technologies, potentially hindering the shaping of technologies that adequately address the desires of the deaf people.
- (b) Using a Grounded Theory approach, this qualitative research adopts an inductive approach, focusing on the interpretation of data to understand phenomena. Through Participatory Speculative design as part of workshops for data collection, the thesis explores the **potential for engaging deaf people** in a dialogue that not only encourages their creative exploration of technology but also gives them the opportunity to envision alternative ideologies.
- (c) Through interviews, the work aims to reflect together with participants to **understand the needs and desires of deaf people in the technological landscape**, their experiences in research contexts and their aspirations for the future, moving to a deaf-centered approach that places deaf people at the heart of design development.

### 1.3 Questions

In particular, the thesis addresses the following research questions which will be divided into three dimensions of expected results.

**R<sub>1</sub> Addressing State-of-the-Art:** To what extent have recent user-centered approaches to accessible and assistive technology considered the needs and desires of deaf people?

**R<sub>2</sub> Exploring Deaf Tech:** Which alternative socio-technical narratives do deaf people envision by using Participatory Speculative design methods to create technologies tailored to their curiosities and desires?

**R<sub>3</sub> Towards Deaf-Centered Design Approach:** How does collaboration with deaf communities affect the research process and technology design to ensure its relevance and impact?

## 1.4 Scope

This thesis aims to initiate dialogue and contribute to theorizing issues such as technology for the deaf, Deaf Tech, and deaf-centered design approaches. Due to its explorative nature, it does not seek to generalize, but rather to provide initial insights, narratives, and reflections to stimulate further discourse.

The research will focus primarily on deaf signers in the European context, specifically in Austria, Spain and Germany, to collaborate with various deaf communities to capture various data samples.

## 1.5 Structure

The work is divided into 6 sections:

**Background** This chapter begins with an introduction to the definition of deafness and continues by explaining the complexity of its multifaceted aspects. The chapter then presents a selection of technologies for the deaf and the problems they pose. Furthermore, the chapter goes through the accessibility research landscape and the related ideologies that arise in the development of technologies for the deaf. It then presents two cases that describe the constellation between the deaf community and the acceptance of technology. Finally, the chapter discusses the significance of Crip Computing in the context of putting disabled people at the center of development for this thesis.

**Methodology** The chapter provides a comprehensive overview of the author's positionality in this thesis, the employed methodology of Grounded Theory, the research methods of Participatory Speculative design, and the semi-structured interviews. The chapter details the process of data collection and analysis. Finally, it shows the extent to which ethical aspects were ensured.

**Results I: Speculative Stories** The first part of the results presents alternative socio-technical narratives generated from workshops with deaf participants. These include different aspects of humankind, society, design of media landscapes, spaces and technologies. Ultimately, this serves as a foundation for Deaf Tech.

**Results II: Participatory Reflection** The second part of the results came from interviews and it focuses on participatory reflections from the participants, including the workshop process, their lessons learned from the workshop, the importance of Deaf Space, as well as the mutual exchange between researchers and participants and the outlook on collaboration in research. These reflections serve as the basis for deaf-centered Design.

**Discussion** The discussion section expands on various aspects stemming from the findings of the state-of-the-art review, speculative stories, and participatory reflections.

It highlights the significance of deaf research settings and their importance in providing a platform for deaf people, both presently and in the future as part of the pipeline. Further, Eyeth serves as an alternative socio-technical entity allowing to generate narratives that align with participants' visions. Also, it examines the components of Deaf Tech and their distinct relevance to technologies for the deaf. The discussion also elaborates on the potential of a deaf-centered approach, emphasizing not only the inclusion of deaf people in technology development but also the incorporation of identity and cultural elements into the technology itself.

**Conclusion and Future Work** This chapter answers the research question in a summarized form, discusses the limitations of this research, and emphasizes the open-dialogue nature of this work for future discourses in HCI, but also the need to collaborate with Deaf Studies scholars. In this way, a deaf-centered design will be developed that centers deaf people and puts them at the forefront of technological design.

### 1.6 Relevance

In this section, I will outline the relevance of the research, which is divided into three main areas: the current state of research ( $\mathbf{R}_1$ ), the exploration of Deaf Tech ( $\mathbf{R}_2$ ) and the development of a deaf-centered approach ( $\mathbf{R}_3$ ).

#### **$\mathbf{R}_1$ : Background $\Rightarrow$ Ideologies behind Technologies for the Deaf and Recent Issues on Research and Development**

The work brings state-of-the-art research in Deaf Studies up to date in HCI fields. It goes beyond the complexity of the definition of deafness and considers different constellations of deaf communities. This contributes to bridging the gap between HCI and Deaf Studies. Further, by addressing the issues and ideologies behind technologies developed for deaf people, particularly in the research domains of accessibility technologies, the work opens discussion about technoaudism and raises awareness of the need for a shift from a user-centered design paradigm to a deaf-centered design approach that emphasizes the expertise and experience of deaf people in technology development.

#### **$\mathbf{R}_2$ : Speculative Stories $\Rightarrow$ Understanding Deaf Tech**

Through the employment of Participatory Speculative design with deaf participants within a deaf-led research context, the work shows how the method contributes to generating alternative socio-technical narratives. In doing so, it not only presents the understanding of technologies within a broader, social context, but also provides insights that serve as a foundation for understanding what Deaf Tech might mean.

### **R<sub>3</sub>: Participatory Reflection ⇒ Discussing deaf-led and deaf-centered Approaches**

For the integral part of the analysis in terms of participatory reflection, the work shows the articulations of deaf people, particularly on the importance of deaf-led research and reciprocity, and the need for a pipeline that provides deaf people access to the design of technology landscapes, both in research and development. These aspects ultimately provide an initial foundation for understanding a deaf-centered design approach that can be discussed further to create a framework that places deaf people at the heart of technology research and development.



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# Background

## 2.1 Defining Deaf

The definition of *deafness* extends beyond its rigid notion, as it encompasses various aspects (medical, social, cultural and linguistic) that are subject to dynamic transformation concerning political and social dynamics as well as academic discourse.

In the medical context, deafness is a spectrum of hearing *impairment* ranging from moderate to profound loss, focusing on (in)ability to hear. The loss of hearing ability is then linked to the derivation of the human norm, associated with personal tragedy [106] as “*a condition to be cured*” [90]. Hearing loss is often associated with language development disorders and, therefore, therapeutic interventions such as early cochlear implantation and hearing and speech training rehabilitation are considered. [46] These aspects are inherent in the medical modal of disability, which addresses issues of the human body in a broader aspect of different disabilities, aiming to restore “normal life” via medical or technological interventions. [37]

In the social<sup>1</sup> context, *deafness* refers to a non-normative hearing status and the (social) barriers inherent in the systems instead of the deficits of deaf persons.

However, the social context regarding being deaf comes with nuances, as shown in the discourse of Deaf Studies scholars:

While Lane (2002) argues that deaf people do not view themselves as disabled [70], Ladd (2003) nuances that social context is to be expanded by a culturo-linguistic perspective, which means that deaf people perceive themselves as a part of cultural and linguistic minorities, where the deaf community, deaf culture, and sign language have their special significance. [69]

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<sup>1</sup>The social model of disability is the response to the prevailing medical model of disability, which addresses a person’s deficits, while socially addressing the barrier of the environment that disables the person to access. [97]

Recent scholars such as De Meulder (2017) postulate the dual category status of deaf people, hence “*being seen as both a linguistic minority and a group of people with a disability.*” [23] The aspect of disability is particularly relevant in the context of legal rights, as it provides (a certain degree of) access.

The identification with disability can also be understood as “*strategic essentialism*” [41], as the deaf person can only access legal resources by declaring themselves as disabled. [108]

It is important to acknowledge that there are differences in how deaf people define themselves (instead of assuming collectivity) and may adapt to the situation (or not even at all). Being deaf can also be understood through different identities (e.g. hearing disability, hard of hearing, deafened, cochlear implant user, D/deaf<sup>2</sup>); however, these are not necessarily assumed by all deaf individuals. [108]

This paper focuses on deaf signers who consider themselves culturally deaf and identify as part of the deaf community. It is important to note that this represents only a portion of the spectrum of hearing disabilities, as not all individuals who are (medically) deaf identify as culturally deaf or see themselves as part of the deaf community.

### 2.1.1 Deaf People

When it comes to the consensus on how many deaf people/DHH exist, it is a complex matter.

For example, in the case of Germany, it is assumed that there are 83,000 (medically) deaf people living in Germany. The number is based on the assumption that one per thousand of the population is deaf. The German Federation of the Deaf [18] investigated the issues through a critical lens: firstly, disabled people are not obliged to register and therefore data is only collected from registered persons, which may bias the number. Secondly, the government statistics distinguish in their collection of data the degree of hearing loss, like hard of hearing (hearing loss of 20-80 dB), profoundly hard of hearing<sup>3</sup> (hearing loss below 80-95 dB) and deafness (hearing loss below 90 dB). Finally, since the government statistics only collect medical data, the data do not take into account deaf people who use sign language and/or their belonging to deaf cultures. In Austria, it is also assumed that around one per thousand of the population is deaf, corresponding to around 10,000 (medically) deaf people [118]. According to Spanish statistics [56], there are 27,300 deaf signers. Lastly, the World Federation of the Deaf (WFD) estimates that

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<sup>2</sup>In this paper, I use *deaf* - unless explicitly stated otherwise - to refer to people who are deaf, use sign language and identify as part of the community, without making a dichotomous distinction between d/Deaf, as this term has been critically discussed in Deaf Studies [68]. d/Deaf differs, for example, in that deaf people are biologically deaf and neither use sign language nor engage in the deaf community. Deaf (with a capital D) is then identified as culturally deaf and as part of the Deaf community(ies). Accordingly, I use DHH inclusively for all deaf people (regardless of their hearing status, sign language, and community belonging) and Deaf for sociocultural entities and concepts.

<sup>3</sup>An Taubheit grenzend schwerhörig

there are 70 million *deaf* people worldwide [120] without stating any information about data collection methods.

### 2.1.2 Sign Languages

Deaf signers refer to deaf people who use sign language(s) as one of their languages. While 90% of deaf children are born to hearing parents, access to sign language is often denied - often through supposed medical and pedagogical recommendation [110] or the acquisition of sign language is acquired late through a deaf school or deaf peers [65]. This particular sociolinguistic situation of deaf signers is characterized by very different degrees of access to sign languages and, therefore, linguistic competence. While distinctions are often classified as Native Signers, Early Learners (L1) and Late Learners (L2) [126], this classification is controversial in linguistics and Deaf Studies. For instance, Hochgesagt et al. [53] highlight the ideological selection of native signers for compiling ASL corpora, overlooking the diversity of deaf communities. De Meulder [81] proposes a novel lens by diving into *traditional signers* and *new signers*, especially in the context of revitalization of sign languages.

The WFD states that there are over 200 sign languages worldwide [120]. Sign language is a complete, natural language with its own grammar, syntax, and vocabulary. [58] While in Germany, Austria and Spain the respective national sign language is officially recognized as an independent language, they are subject to different legislation: In Germany, it is part of the “Act on Equality for People with Disabilities” (Behindertengleichstellungsgesetz), in Austria it is written into the constitution and Spain has its own “Sign Language Act,” which includes Catalan Sign Language.[117]

Sign language is widely recognized as the preferred form of communication for deaf people [17], often referring to their primary and accessible language [87], although access to sign language is not always given. However, it is also important to recognize that there is more to deaf communication than just sign language. Deaf people do have multimodal and multi/translingual capabilities, which is often referred to as a linguistic repertoire [3]. These repertoires enable deaf people to switch fluently between modalities such as sign language, written language, fingerspelling, gestures and/or accompanied by multimedia artifacts [67].

### 2.1.3 Audism

In society, DHH are severely faced with structural discrimination, which happens in various domains, including barriers and oppression to education [36], which are still present today [43]; employment discrimination [19], limited access to healthcare [66], and barriers in justice [33] to mention a few. In addition, DHH are often externally determined and controlled by hearing people. For instance, access to sign language is often controlled or even denied [96]. This type of oppression is also referred to as *audism*, coined by T. Humphries [54], rooted in the belief in the superiority of hearing and speech

[9, 64]. These decades of oppression of DHH led to their exclusion from society. Audism is embedded in different layers: (i) *individual*, (ii) *institutional*, (iii) *metaphysical* [9, 32].

The impact of audism has severe consequences on both deaf individuals and the community, especially language deprivation (denying access to sign language), which has a grave impact on cognitive progress, mental health, and may induce trauma, to mention only a few consequences. [47] In the context of (European) education, the prohibition of the use of sign language and the dismissal of deaf teachers decided in the Milan Congress of 1880<sup>4</sup>, the worsening in the education of the deaf (on behalf of oralism<sup>5</sup> in education) has intensified and to date has been of severe consequence. [119].

## 2.2 Technology for the Deaf

Technology plays a vital role in the daily lives of deaf people as technology has not only influenced the intercommunication of deaf people but also accessing information. However, there are few studies investigating the use of technologies in the deaf population [76, 101] and the influences and impact of technology on deaf people in general as well.

Key milestones of “technology for the deaf” (TFD) include the inventions of text and video telecommunications in 1964 and closed captioning on television in 1979. With the advent of mobile devices that allowed text messaging in 1992 [92], the internet has further expanded communication options, with features such as video calling on computers and smartphones offering new ways to communicate. [60] In recent years, with the rapid development of AI technologies, there have been promising prospects for improving the accessibility for DHH.

### 2.2.1 Examples of TFD

In the following, I describe some of the TFD in context of (i) communication (direct communication between deaf people), (ii) assistance (devices that work as aids for deaf people, e.g. to notify users) and (iii) accessibility (the design of technologies that provide access (to somewhat extend) for deaf people). The categorization is not intended to draw a clear dividing line, but rather represents the main aspect of each topic.

- (i) One work from 2007 [91] studies deaf people using technologies and highlights the use of early technologies, including the use of Short Message Service (SMS) used by 96% of deaf people (in the survey), followed by 56% who owned a fax and 23% who used teletypewriter (TTY). According to the 2014 paper [14], deaf people are opening up communication opportunities in line with trends such as social networking services and smartphones (video call, instant messaging). In my observation, since COVID-19 (although videoconferencing has always played

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<sup>4</sup>often referred to as Dark Ages of the Deaf Education [51]

<sup>5</sup>Oralism refers to the education for deaf people through spoken language, e.g. speech and lip reading in combination with the rejection of using sign language [96]

an important role), there has been an exacerbated online video communication, triggering the expansion of virtual networks of national and international deaf people. Various (scientific and non-scientific) presentations are now more accessible; debates take place on Instagram in Stories (by tagging users) or directly live on Instagram; this dynamic of deaf intercommunication has shifted.

- (ii) In the assistive context, based on visual and haptic elements, there are, for example, light signals in the houses when the doorbell rings and alarm clocks which are supplemented with additional vibration pads [24]. The option of integrated alarms from smartphones has partially replaced these. Furthermore, hearing aids fall under the category of assistance [20], as the device can amplify sounds.
- (iii) A common example, understood in the context of accessibility, is subtitling to convey information from spoken content to text [85]. There are also Video Relay Services (VRS), which enable communication between deaf and hearing people through sign language interpreters during telephone calls [112]. Further, in a more narrow sense of accessibility, there is a transfer of hearing experiences to deaf people: In the context of music, for example, sound shirts have been made for deaf people to feel instead of hear music. [16]

With the rise of AI-driven technologies such as speech-to-text, auto-captions have become prevalent. They fall in the category of accessibility technologies as they aim to provide access for deaf people (and “breaking barriers” [21]). Further examples of AI technologies for the deaf are Signing Avatars [5], Sign Language Recognition [88] and Sound Recognition (alarms, door bells, etc.) [8]

### 2.2.2 Issues on TFD

Technological development has not always centered around deaf people (neither the social model nor the design). It has also been embedded with ideologies aimed at addressing hearing deficits (e.g., the development of hearing aids and cochlear implants) and “solving” barriers. As the paper [76] referring to a “*one step forward, two steps back*” dynamic in this regard, the development of these technologies has the power to either include or exclude deaf people. Specifically, this dynamic means, among other things, that Alexander Graham Bell’s telephone isolated deaf people because it favored spoken communication, while Robert Weitbrecht improved long-distance communication for deaf people via TTY, which in turn has limitations for deaf users who only have TTY devices. In addition, recent deaf scholars [81, 7, 27] as well as deaf organizations [62, 127, 121] have raised awareness of the ideologies behind AI developments, also regarding sign language and the demand for a ethical and responsible development. The tension between deaf communities and technology stemming from this dynamic, among other things, is then discussed deeply in the section on Techno-Solutionism. Yet, deaf people do have a positive attitude towards technology and readily adopt it, except the obsolete technologies and/or if the technologies use sound-based alerts only. [101, 7].

Below, I will illustrate the issues on technologies for the deaf in relation to the categories discussed in Technology for the Deaf:

### **Communication Technology**

In the case of written communication formats, they can open up access for deaf people who are able to connect and communicate through text. While this approach provides access to a certain extent, it is not deaf-centered because deaf signers still rely on written language to communicate.

Video conferencing platforms like FaceTime or Zoom enable direct communication in sign language, seemingly applying a deaf-centered approach. However, from a design perspective, the platforms mentioned are not centered on the deaf user. For instance, features like FaceTime's gesture animations, such as thumbs-up or peace signs, may be visually appealing but are not in harmony with communication in sign language, as these effects disrupt the flow of communication. [25] This aspect is also at the forefront of Zoom's lack of a spotlight function for people who sign, which means that they have to be activated manually. [125] In addition, notifications that are not necessary are constantly displayed, such as that one is not connected to audio.

This limitation of deaf-centered aspects can also be observed in social media platforms like Instagram, where video formats are restricted to portrait orientation, based on smartphone designs. However, this vertical alignment does not accommodate the three-dimensional space required by sign languages, leading to spatial constraints. [59]

### **Assistive Technologies**

When it comes to assistive technologies specifically designed for disabled people, such as the deaf, limitations often arise from: (a) policy, namely the right to access and/or the accessibility of devices in the first place; (b) the pricing of assistive technologies, as they are often expensive and pose a significant burden for marginalized groups, who are frequently associated with precarious work conditions; (c) the restriction to low-quality assistive devices; for example, low-cost hearing aids are only accepted as a health insurance benefit - higher-quality hearing aids are not covered by (German) health insurance, even though they make a significant contribution to the deaf. (d) Funding for assistive technologies remains insufficient overall; and, lastly (e) there is a lack of product selection and often only selective options are available that do not truly cater to one's needs. [115]

### **Accessibility Technology**

Captions are part of accessibility that addresses DHH. Specifically, they transcribe audio speech and cues to text, while subtitles translate speech to text for (hearing) non-speakers. However, there are issues with captions, namely the very availability of captions in different languages and the limitation to English captions only, while other

languages are provided in subtitles, excluding deaf non-English speakers from access. [105]

For communication between hearing and deaf people in the context of the relay service, access is tangential, whereby this is to be understood with the additional aspect of quick-fix issues through the use of interpreters, see De Meulder’s work [22]. Deaf customers in Germany have to pay for this service, even if they are called by hearing end-users. This ideology reinforces that the responsibility for accessibility is assumed to lie with the deaf person.

With the rise of AI technologies, it has become an experimental landscape on how accessibility may benefit deaf people. However, this results in low-quality or even unnecessary technology. The issues in this matter raise questions that are discussed in further sections.

## 2.3 Introduction to Accessibility Technologies

Accessibility technologies encompass the design of technologies aimed to accommodate diverse users, often advocating for a universal design approach. In contrast, assistive technologies are specifically designed to assist specific users in performing tasks. [1]

In relation to accessibility technologies, *deafness* is commonly perceived through the lens of disability within the medical model framework. Consequently, it falls under the category of “Accessibility Technology” where the term *accessibility* often implies adaptations aimed at bridging gaps for deaf people. It is worth noting that there is no distinct field of research focused specifically on Deaf Technology. For sign language, there is a growing number of scholarly works on sign language machine translation (SLMT), a section in machine translation.

In the context of developing accessible technologies, user-centered design (UCD), fostered by the rise of e-commerce [78], has gained considerable prominence in academic research and for-profit business development in the technology sector. The emphasis on user-centered paradigms has also extended to the field of accessible and assistive technologies [95].

One of the most critical aspects of UCD is the active involvement of users in the design process, which is based on the user’s experience. It is part of the iterative nature of UCD, alongside the interdisciplinary team, that users have an essential role in the evaluation. In this way, UCD enables solving complex problems by responding to continuous user feedback. [57] However, the following section presents the problems of UCD that arise when working with disabled (including deaf) people.

## 2.4 Assessment of Recent Development

Acknowledging the predominance of able-bodied people in developing solutions for disabled communities is crucial. In the field of accessible technology, there is a prevalent yet



misguided ideology of creating solutions for all. In contrast, in the field of assistive technologies, there is a notable shift towards a “fixing-centered” paradigm [38], also termed as *technosolutionism* [52]. These misconceptions often lead to more harm than good by failing to provide meaningful, inclusive access(ability) [48].

In the context of accessibility technologies, existing challenges and limitations associated with the user-centered design (UCD) perspective are shown: While the advent of the World Wide Web (WWW) has promised to connect people globally, it has also revealed significant *roadblocks* for the disabled community within the web space [71]. The issues are not limited to this, but also extend to current developments of UCD relating to disabled people. [99] Moreover, the prevailing approach to accessible design often fails to include disabled people as equal participants in the UCD process, perpetuating a vision of design that is harmful to the disabled community [75].

These issues within the UCD paradigms become apparent especially when involving deaf participants, as the following significant pitfalls show.

### 2.4.1 Prevalence of Ideologies

When it comes to TFD or sign-language-related technologies, the increasing research on the combination of sign language and technology has unfortunately been accompanied by the use of ableist terminologies, such as the obsolete term “impairment” and derogatory phrases like “deaf and dumb”, in publications [13]. These terms are derogatory and reproduce stereotypes and negative perceptions of deaf people that are long past-due. This stresses that there is an excessive focus on “technological solutions” without addressing the backgrounds of deaf people.

Further ideological misconceptions about the needs of the deaf community and “helping” them can lead to the creation of technologically advanced but ultimately meaningless products, such as sign gloves. These products fail to address the needs and challenges faced by deaf people [74] - instead of bringing them to the center as innovators and creators, as they are experts of their disability [48].

### 2.4.2 Existence of Power Imbalance

Another issue emerges from the power imbalance in the relationship between the hearing researchers/developers and the deaf community. This imbalance results not only from ideologies and a lack of prior knowledge of sign language within the research team, hindering meaningful participation of deaf people, but also from epistemic exploitation [5]. For instance, the development of the Signing Avatar has raised concerns about ethics, as they may have grave consequences for the deaf community by bypassing deaf participation. As a result, the Signing Avatar is low-quality; these technologies hinder rather than enable the deaf community from accessing it. Therefore, [21] emphasizes the urgent need for the active participation of deaf individuals in such projects to minimize harm.



Furthermore, with regards to the rising of AI playing into the field of accessibility technologies, the work of Desai [27] raises issues not only on framing the problem of communication with deaf people, but also on the lack of critical examination and reflection of the complexities of deafness and sign language, leading to technologies that hinder than contribute to accessibility.

### 2.4.3 Absence of Practical Guidelines

The adoption of standardized guidelines often overlooks the diverse needs of disabled communities, such as the deaf community, leading to a disconnect between imposed norms and practical realities. For example, a common misconception is that providing a survey in sign language is sufficient to collect data from deaf participants. In practice, however, this approach fails to address the complexities of communication within the deaf community. In reality, deaf participants may find it challenging to provide their answers in sign language, as they have to respond in written language (which they may not be comfortable with) since there is no tool for their direct response in video format, requiring them to use alternative methods such as uploading video links [103].

### 2.4.4 Lack of Direct Involvement

In the era of AI technologies, which is the next wave of Human-Computer Interaction (HCI), there is a growing demand for the participation of disability/deaf communities in technology development. This demand challenges the established “norms” [82] that define anything outside the norm as deviant. Furthermore, deaf people are often not involved in the whole design process, rather than in a one-off feedback session [21] (akin deaf users are only used for the data extraction [7], but labeled those as co-creation [27]). Further, deaf researchers are also underrepresented in research [61] and have little, if any, decision-making power in the research team [5]. Also, the very terms “deaf-led research” as well as co-design with deaf people have been misused by recent scholars: De Meulder [30] critiques that deaf-led research has been labeled so only on the fact that deaf researchers were collecting data, but still did not have any role with decisive power.

Consequently, the failure to include the deaf communities in the design of these technologies has a serious impact on the user experience that rather excludes than includes them. Thus, the mentioned issues underline the urgent need to shift the paradigm towards a *deaf-centered design* that places deaf people in the foreground on matters of deaf and sign-language-related technologies.

### 2.4.5 Techno-Solutionism

The prevailing paradigm of “just fixing solutions”, particularly in the context of disabled people, has gained ground in the technology fields. [52] coined the term *Techno-Solutionism*, which approaches problems by oversimplifying complex (societal) problems to be solved by technology, overlooking the critical issues.

While the problem has been persistent, among other things, externally determined technologies, embedded ideologies and thus disparity of acceptance by end users. This may be driven by the era of AI technologies, especially AI presumably offers a landscape of “unlimited possibility” to solve all problems.

### 2.5 Use Cases

In the following, I would like to present two examples that show a particular tension within the deaf community in order to broaden the understanding of the issue. The concrete focus is on (a) hearing in the sense of restoring hearing and (b) sign language in the sense of bridging the communication.

#### 2.5.1 Case Deafness: Cochlear Implants

To comprehend the underlying issues inherent in the dichotomy between the medical and the social model, the case of cochlear implants serves as an illustrative example. This technology highlights the tension between the advancement of sophisticated solutions aiming to potentially *cure* deafness from medical standpoints (akin to being the object of a cure) and contrasts to the deaf community’s rejection of being labeled as disabled. Consequently, cochlear implants were often perceived within the deaf community as a threat to their cultural identity, akin to a form of cultural genocide [26, 102], whereas both positive and less positive attitudes and acceptance of deaf people - in terms of their identities - vary toward cochlear implants [84]

Nevertheless, it is crucial to acknowledge that cochlear implants can offer significant benefits to individuals reliant on such technology. However, within the discourse surrounding these technologies, it is imperative to recognize the prevailing medical ideologies that have historically positioned doctors as arbiters of “normalcy”. For example, the Youth Welfare Office in Germany wanted to withdraw custody from parents if the child was not implanted, which led to a court case and thus sparked the concern of forced implantation [42, 29]. These issues overshadow the complex socio-linguistic dynamics of the deaf community and the importance of linguistic accessibility (hence sign language). Furthermore, while cochlear implants are often portrayed as symbols of progress and innovation, their actual implementation is far from seamless; success often demands rigorous auditory and language training rather than a simple “plug-and-hear” solution [86].

There are initiatives, such as those advocated by the Deutscher Gehörlosen Bund, which promote dialogue [28] including bilingual communication for individuals with cochlear implants and their families, integrating spoken language and sign language. This approach is now scientifically endorsed, though its adoption remains uneven across medical and educational institutions.

Consequently, the questions remain: Firstly, how can the self-determination of deaf people, particularly deaf infants and children, be ensured in the face of technological

interventions? And secondly, how can the autonomy of those within the deaf community who reject cochlear implants be respected on individual, social, and medical levels? These questions highlight the complexities involved in understanding the intersection of medical advancements, cultural identity, and individual autonomy within deafness.

### 2.5.2 Case Sign Language: Signing Avatars

The case of Signing Avatars provides a lens through which to examine issues beyond auditory restoration and highlights the oversimplification and underestimation of the complexity of sign languages and the embedded ideological understanding of *one-way* accessibility [5].

Although Signing Avatars are praised as innovative (AI) solutions, especially by government agencies and businesses, they are often seen as the ultimate accessible solution for the deaf community. However, this view does not necessarily reflect the views of the deaf community itself. Various national and international deaf associations have raised concerns [62, 127, 34, 121]. One such concern is, for instance, the underrepresentation of deaf people in decision-making processes and the poor quality of translation, which is reported to be as low as 15% [89].

In the context of accessibility “for the deaf”, the development of Signing Avatars is often experimented with using AI technologies. Deaf people are then framed by “their one-sided” communication barriers, which can be “overcome” with AI technologies such as Signing Avatars. The excessive focus of Signing Avatars as the “one-way” translation solution from spoken language to sign language instead of the “two-way” solution, as the communication barriers are to be understood two-way, is therefore criticized, among other things. [21, 7]

This example demonstrates how technologies such as Signing Avatars may provide seemingly automated solutions to complex social and linguistic problems that are supposedly solved by AI. However, they overlook the profound complexity of discrimination against deaf people. Furthermore, the emphasis on misunderstood benefits and cost savings risks overshadowing the potential negative impact on deaf communities, exacerbating existing barriers.

To conclude, this discrepancy raises intriguing questions: What are the perceptions and intentions behind the technologies? Non-disabled people may see them as a means of curing disabled bodies (and thus improving quality of life), while the disabled community may see them as a means of social participation and empowerment. Therefore, it is important to understand that each individual has a different idea of the meaning of the *good life*, which should be acknowledged.

## 2.6 Towards Techno-Audism

As audism is embedded in different areas (as described in the introduction), the term *Ableism* as an umbrella term referring to all disabled people, i.e. to the ideology of the superiority of the able-bodied and the prevailing “*normality*” that leads to discrimination against disabled people [73].

While ableism and audism have similarities in terms of social discrimination and systematic barriers, audism focuses specifically on hearing, namely the ideologies of the importance of hearing and speaking [54, 64].

In the context of technology, there is a concept called *Technoableism*, which addresses issues within the disability community that arise in this combination of ableism in technologies. Technoableism [98], is defined by Ashley Shew as follows:

*“Technoableism is a term I have coined to describe a rhetoric of disability that at once talks about empowering disabled people through technologies while at the same time reinforcing ableist tropes about what body-minds are good to have and who counts as worthy.”*

This definition reflects the above mentioned issues of the cochlear implant and Signing Avatar cases. Since the Signing Avatar affects the deaf community due to sign language being a part of the deaf people’s language, the issues of the Signing Avatar are to be seen in relation to linguisticism/linguagism. Linguicism (also known as linguistic discrimination) refers to a concept of inferiority and rejection towards other languages [50]. In the following, I would like to address my thoughts about the constellation between technoableism, audism and linguisticism/linguagism (towards deaf signers).

There is literature discussing the impact of AI-driven technologies such as NLP (natural language processing) in the context of minority languages pointing to the need to pay more attention to these languages in NLP research. The issues in this context are complex; for example, the corpora often lack coverage due to insufficient resources and expertise [123]. Furthermore, the prevailing “*consumerist approach to language data reinforces a vicious cycle*” [114] that further marginalizes minority communities technologically. Robinson’s article [94] provides further insight and illustrates how platforms such as Duolingo pausing Welsh language courses can significantly affect the vitality of languages, which highlights the problem of neglecting minority languages. However, technologies may potentially contribute to language revitalization within a complex social and political context.

These problems often stem from embedded ideologies of linguistics that favor dominant languages with a large user base due to their perceived profitability and consequently neglect low-resource languages, including sign languages.

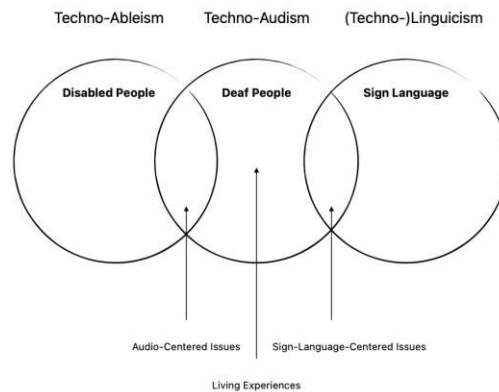


Figure 2.1: Distinction between technoaudism, technoableism, and technolinguicism: The graph visualizes the overlap between technoableism and audism in terms of reinforcing the ideology of disability on the left, while the overlap on the right focuses on audio-centered issues. Since sign language is a part of deafness, it comes with additional issues, namely sign language-centered issues. Thus, technoaudism aims to focus on the lived experiences of deaf people as the center of the ideologies reinforced in the technological landscapes.

Therefore, I propose a more nuanced view, as deaf signers have a particular situation that refers to *-ism* as well as auditory (audism) and linguistic aspects (linguicism), as illustrated in the constellation in the figure below.

The idea of technoaudism can also refer to sign language when initiated in projects that affect deaf people, such as a Signing Avatar. The idea of technoaudism can encompass a range of issues discussed in various works, for example the underrepresentation of deaf people in research projects, the lack of direct participation of deaf communities, epistemic exploitation and sign language simplification [7]. Essentially, I define *technoaudism* as the imposition of auditive ideology throughout the technological process - from design to user testing to distribution - with the aim of “helping” the deaf community without fully considering their needs and desires, thereby neglecting their culture and expertise.

The concept of technoaudism should serve, in particular, to explore sign language as a new research landscape, especially in the age of AI technology. The coining of the term technoaudism is therefore intended to nuance the constellation between deafness and sign language.

Above that, it is crucial to recognize that it is not only the technologies themselves that are susceptible to technoaudism, but also the discourse and societal attitudes surrounding them contribute to it, e.g. in the cases of cochlear implants and Signing Avatars. Acknowledging the experiences of the deaf communities, particularly those who primarily use sign language, is essential for a more nuanced understanding. Although there is an overlap with other disability communities, a deaf-centered approach is relevant to this study.

Given the limited scope of this master’s thesis, further discourse and exploration of these topics is encouraged to solidify the definition of *technoaudism*.

## 2.7 Towards Deaf Tech

### 2.7.1 Crip Computing

Disabled people have been pioneers in shaping technology, even though they are often overlooked in public discourse and research [122]. For instance, the incandescent light bulb was invented by a deaf man [107], auto-pilot and cruise control were developed by a blind man, as cited in [122], among other examples. The term “Crip” used to be a slur describing disabled people, but it has been reclaimed by the disabled community to express pride, disability rights, or activism [79].

As mentioned in the introduction, Wu [122] discusses the problematic interaction between disabled people and technology, highlighting the tendency to objectify disabled people by viewing disability as (i) a problem to be solved, (ii) a resource for experimentation, or (iii) an afterthought, resulting in technological exclusion or harm.

The “Crip Technoscience Manifesto” by Hamraie and Fritsch advocates for placing disabled people at the center of technology development, challenging traditional able-bodied notions of technology aimed at “fixing” or “improving” disabled bodies [48].

Furthermore, in the context of working with disabled people, the approach of participatory research has found its place in HCI but is not yet fully established. Participatory research is understood as research driven by participants themselves, directly involving them in the research process [100]. However, recent scholars, as discussed in [27], have pointed out instances where co-designing with deaf people has been misused: deaf individuals have been used merely for data extraction without truly influencing the research. This is also discussed in [7].

An important approach, as seen in the following papers, to working with the disability community is the “Do-It-Yourself” (DIY) approach presented by Meißner et al. [80], which leaves room for the creation, inspiration, and participation of marginalized groups. Another method is the expressive bodies approach introduced by Spiel and Angelini [103], which provides space for participants to articulate their expressions and needs by adapting them without having them to adapt the research settings.

One aspect of critical design is speculative design [31, 83], which allows for speculation about alternative inspirations, putting alternative narratives, desires, and visions of marginalized groups at the forefront. This approach has also arrived in the HCI research field in very recent years [35]. An example of this is the collective speculation of disabled HCI researchers in the work called “Criptopias” [6], which highlights that technologies do not necessarily need to be specialized but should, at the very least, center around the disabled communities themselves. However, the integration of participatory research,

working with disabled people and critical design, remains scarce and is only done by a few researchers in the HCI research landscape [104].

### 2.7.2 Rethinking Deaf Tech

The concept of *Deaf Tech* often intersects with discussions of accessibility or assistive technologies, where they serve as components but need their own distinct space, one that centers around deaf signers.

However, a substantial gap in the literature exists in addressing these issues - namely, the prevalence of ideologies, power imbalance, the absence of practical guidelines, and the lack of direct involvement of the deaf community. These factors collectively hinder the deaf community from actively shaping the technological landscape, resulting in technologies that do not center the deaf people (see mentioned issues on TFD in 2.2.2).

For this reason, this thesis seeks to explore the possibilities of engaging deaf individuals in a dialogue that not only fosters their imaginative exploration of technology but also transcends the traditional boundaries of accessibility concerns. The focus shifts towards adopting a deaf-centered approach to technology development, offering novel perspectives that detach from the above-mentioned ideologies. Also, the literature in HCI reveals gaps about centering deaf people in the design development; among others, the co-design has often been limited to a single session which also lacked direct communication with the deaf participants.

The overarching goal of this research is, therefore, to reimagine the landscape of Deaf Tech through a deaf lens. By addressing the prevailing gaps in current discourse and practice, this study aims to develop a deeper understanding of deaf people's technological needs and desires. By employing a Speculative Participatory design approach, the research aims to envision Deaf Tech that is not only functionally accessible but also culturally resonant and desirable for deaf signers. By placing deaf people at the forefront of the research process as active participants and co-creators, the aim is to foster a collaborative environment that puts deaf voices and perspectives in the foreground. In doing so, the research seeks to contribute an example of a deaf-led and deaf-centered approach in HCI.



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# Methodology

This section comprehensively explains the methodologies and the study design used in this thesis. The research's epistemological approach is based on constructivism, which emphasizes the importance of subjective interpretations and social constructions for understanding phenomena. Within this framework, the thesis employs Grounded Theory as its research methodology. The research methods used include Participatory Speculative design and semi-structured interviews. Before going into the methodological details, it is important to first outline the position of the researcher and explain the contextual factors and personal perspectives that shape the study. Subsequently, the implementation of the workshops as part of the data collection is explained in detail and the ethical considerations that were taken into account in this research are reflected upon.

## 3.1 Positionality

In this section, I introduce my positionality that guides my research and analysis. I am a deaf signer, white, cis-male graduate student at the TU Wien in Vienna, Austria, whereby this thesis was written as part of my stay abroad in Madrid, Spain. Raised in a deaf family, I am a first-generation student and may (to my knowledge) be the first deaf HCI scholar in Europe. My primary languages are German Sign Language (DGS) and German as primary languages, with English and International Sign (IS) as secondary languages. In addition, I have proficient knowledge in Austrian Sign Language (ÖGS), intermediate knowledge of Spanish Sign Language (LSE) and a basic knowledge of Spanish - those languages are part of this thesis.

My research interests revolve around the convergence of deaf technology, critical access, and emerging technologies. Influenced by my lifelong exposure to technology, I identify myself as a digital native. My first encounter with technologies such as computers and smartphones began in early adolescence and they continue to play a crucial role in my life today, among various other technologies.

My educational path was shaped by attending deaf schools and access to universities through sign language interpreters. However, it is important to recognize that deaf students make up only a fraction (up to 0.1%) of the deaf population in Austria [63]; status of 2006.

In conclusion, I acknowledge my privileges, including European citizenship, literacy and mobility. This position may not represent the diversity within the deaf communities, since many DHH *globally* face educational barriers due to systemic audism, underlining the importance of recognizing these inequalities.

This thesis does not intend to generalize, but rather to provide initial stories of how the deaf participants envision contributing and building further perspectives and therefore discourse within diverse deaf communities. Thus, the stories presented in the following can only show a piece of the deaf communities, as each deaf community brings not only different life experiences, but also their background such as country, nationality, access, culture, education, etc. on the table.

## 3.2 Grounded Theory

The methodology employed in this thesis is Grounded Theory (GT), guided by Charmaz [15], which is an adapted version of Glaser’s pioneering work in the field. Grounded Theory is a qualitative research methodology characterized by its systematic yet flexible approach to collecting and analyzing qualitative data.

It involves constructing theories directly from the data itself, emphasizing an inductive approach and employing iterative strategies between data collection and analysis. By doing so, the iterative approach allows for generating theories based on an iterative analysis of data. Following the mentioned iterations, the thesis employs inductive reasoning from observational data to generate phenomena. This methodology is comparative in nature, facilitating the emerging analysis through constant comparison of data.

At the heart of GT is the concept of dialogue with the data, in which researchers engage intensively with the information collected and allow insights and themes to emerge from the data rather than imposing rigid theoretical frameworks.

The employment of GT methodology in this study is based on the following key factors:

First, there is a difference between Charmaz’ and Glaser’s approaches to GT. Charmaz’ “Constructivist Grounded Theory” differs from Glaser’s origin framework by emphasizing the role of subjective interpretation and meaning construction of the data by researchers and participants alike. [93] I, therefore, chose Charmaz’ approach because it is aligned with my research objectives and methods (hence co-creation in workshops and interviews), which emphasize understanding participants’ subjective experiences within a constructivist paradigm.

Moreover, the limited existing literature in HCI on participatory research with deaf participants necessitates the exploratory nature of this study. By using the GT methodology,

I aim to engage deeply with the data to draw themes and insights directly from the participants' narratives. This in-depth engagement with the data is essential to develop a deep understanding of the phenomena, particularly in the context of the experiences and perspectives of deaf people.

In addition, the in-depth nature of GT is aligned with the Participatory Speculative design that I incorporate into the research process. By actively involving participants in the research process, I aim to encourage collaboration and co-creation and ensure that the resulting theories are grounded in the lived experiences of deaf people.

Given the lack of previous literature and knowledge in the specific area of participatory research with deaf people, flexibility in the application of analysis is essential. The GT methodology allows for adaptability and openness to new findings, so that new concepts and themes that may emerge during the research process can be explored.

Moreover, this thesis aims to collect alternative socio-technical narratives developing emergent theories. This is realized by collecting and analyzing narratives shared by participants. In doing so, I aim to foster dialogue about data and theory to facilitate future research efforts in establishing a foundation for a deaf-centered approach.

In summary, the adoption of GT methodology in this study is driven by the choice for deep engagement with the data, collaboration with participants, and the exploration of novel concepts within the context of Participatory Speculative research with deaf people.

### 3.3 Participatory Speculative Design

In the following, I will outline the context of Speculative Participatory design, which is the primary relevant method in this thesis.

Participatory design is essentially about empowering marginalized participants by involving them directly in the design process. It recognizes the importance of including diverse perspectives and lived experiences in the design process. [100]

Speculative design is a creative and imaginative approach that explores alternative futures and challenges existing assumptions. [31, 83] Speculative design serves as a tool to change narratives and provides a platform to challenge existing power structures and imagine a more equitable future. [35] In combination with participatory design, this allows us to imagine possibilities beyond current norms, stimulate critical reflection and engage in conversations about societal values and aspirations.

Specifically, this thesis aims to use Participatory Speculative design to create a dynamic framework for the empowerment of marginalized participants, in this case, deaf people. Through participatory engagement, deaf participants have the opportunity to contribute their stories and perspectives and ensure that their voices are foregrounded throughout the design process. They also have the opportunity to shape the outcomes to a greater or lesser extent. This means that in this context, as a researcher, I have the task of facilitating rather than directing the collaboration with participants. This ensures that

the resulting narratives are based on their lived experiences rather than pre-constructed views of the researcher.

Simultaneously, Speculative Participatory approach provides a platform for envisioning and exploring possibilities beyond existing norms, allowing for the creation of deaf-centered narratives that challenge audio-centricity, also in the context of access(ibility) and embedded ideologies. By engaging in speculative thinking, participants can co-create narratives that not only reflect the needs and desires of the deaf community but also envision an environment that meets deaf-centered design.

## 3.4 Workshops

### 3.4.1 Objectives

To foster Participatory Speculative design within the deaf community, this study incorporated workshops as a central component. The workshops aimed to engage with deaf people from three different countries (Austria, Germany and Spain) with the interest of capturing various data samples, allowing creative co-creation to collect stories. The table below provides a detailed outline of the workshop process, including the agenda, types of data to be collected, and specific research objectives.

### 3.4.2 Participants and Recruitment

The participants were recruited through personal contacts within the deaf communities of three countries: Austria, Germany, and Spain, albeit one German and one Austrian participant each brought along another workshop participant who was not previously known to me - as I provided the option to bring further persons. The choice of these countries was based on personal mobility as part of the study, as well as personal relationships with the deaf communities in the mentioned countries. The workshops were conducted on-site in the respective countries. A total of 16 deaf individuals participated in the workshops: four in Vienna, Austria, in 09/2023; nine in Madrid, Spain (five in one workshop in 11/2023 and four in another in 01/2024); and three in Hamburg, Germany in 01/2024. Following the workshops, the same participants were invited to interviews (see Semi-Structured Interview), which they conducted either via Zoom (due to physical distance) or on-site.

The selection criteria included participants identifying themselves as deaf and using sign language. The languages used in the conducted workshops were each country's respective national sign language: Austrian Sign Language (ÖGS), German Sign Language (DGS) and Spanish Sign Language (LSE). The interviews were conducted likewise, except for some Spanish participants who used International Sign (IS) instead. Participants' ages ranged from 21 to 45 years; there were ten female and six male participants. Their educational background ranges from secondary school leaving certificate to Bachelor's degree.

While factors such as age, gender, nationality, linguistic and educational background within deaf communities were considered to account for variety among participants, it is important to recognize that the sample does not fully represent the diversity of deaf communities (see [68]) due to the limited scope of the work, recruitment methods and sample size.

### 3.4.3 Implementation

The workshop plan was detailed in advance during feedback sessions with supervisors, as summarized in the following table 3.1. Workshops were conducted in participants' homes and one venue provided by the club from *Asociación de Personas Sordas de Coslada*<sup>1</sup>. On average, each workshop lasted three hours. For each workshop, the following materials were available in a moderation kit: board markers, felt-tip pens, colored cards, adhesive dots, stickers, scissors, and glue. In addition to the materials, snacks and beverages were provided.

**Ice-Breaking** The workshop began with an ice-breaking session. Participants gathered together, many of whom might have known each other already. Before the actual workshop started, an introduction was given regarding the objectives of the master's thesis and the workshop. Any general questions about the project and consent were clarified, and participants were provided with a consent form to digitally sign on my iPad. Further details regarding ethical considerations are elaborated in section Ethical Considerations.

**Warm-Up: Magic Machine** The first activity of the workshop was the “Magic Machine Workshop”, inspired by the concept introduced in the work by Andersen [4]. This activity aimed to detach participants from conventional thinking (in the context of ideologies of accessibility) and immerse them in a new world of possibilities. To achieve this, I began the workshop with storytelling to introduce the fictional deaf mythology called *Eyeth*. Eyeth [49] is a deaf mythology referring to a fictional planet where most or all inhabitants are deaf and speak sign language. The name derives from the pun *Ear*-th, as the current world is *phono-centric*, making the *Eye*-th an alternative *ocular-centric* planet.<sup>2</sup>

The storytelling unfolded as follows:

<sup>1</sup>[https://www.instagram.com/aps\\_coslada/](https://www.instagram.com/aps_coslada/)

<sup>2</sup>Eyeth can also be understood as an inverted planet of Earth; i.e., the hearing people are a minority group and the deaf people are a majority, known as the “people of the eyes”. As the origin of the Eyeth remains unknown, it is rather a folklore story passed down through generations of deaf people. [49] There are more or less Eyeth-related stories such as critical novel [124], art [113] and movie [55].

*Years of research in space led us to a remarkable moment - an invitation aboard a mysterious spacecraft that wanted to accompany us on its journey to a habitable planet called **Eyeth**. At breathtaking speeds, we traversed the infinite expanses of the cosmos, gradually revealing information about Eyeth. Eyeth, a planet known only to the initiated, hosted a unique community of deaf residents whose world was shaped by sign language. This fascinating culture had existed for centuries and was renowned for its technological advancements that far surpassed our imagination on Earth.*

*As we approach the mysterious planet Eyeth in our story, I'd like to see your creative imaginations! How do you all envision this extraordinary world? What comes to mind as we get closer to Eyeth? Share your thoughts and let's create a vivid picture together!*

The narrative of the story about Eyeth was structured to include broader aspects, as I did not intend to ask for specific technology-related stories. In this way, the narrative of an ideal world became possible, since technologies need to be understood in a broader, social context regardless. Moreover, the specific technology-related questions may run the risk of reducing the stories to these aspects and reproducing existing ideologies, as there is no reflection on the whole picture (namely Eyeth as an ideal of the landscape of possibilities). In doing so, I intended to use stories to analyze aspects of Deaf Tech, rather than asking to generate them.

The warm-up session (which lasted about 60 minutes) aimed to facilitate individual ideation, allowing each participant to gather as many cards as possible and express them in their preferred format (text, sketches, graphics, etc) with markers or felt-tip pens on the cards. Their expressions on the cards varied among them: While some participants listed different stories on a card, others used separate cards for each story. Some of them wrote down only keywords, others expressed themselves with sketches that illustrate concepts, partly supplemented with keywords or detailed descriptions of objects, which were then explained in sign language.

The goal was for each participant to immerse themselves in the world and construct their own narrative. There were no limits, and a diverse range of stories beyond technologies were collected for the analysis.

**Futuring: Focusing on Selected Themes** After individually generating a variety of ideas (in the form of stories), the next session was inspired by the work of Vidal [111], lasting about 60 to 75 minutes. The participants were provided a large blank white or red poster so they could come together to share and explain their visions to the group in rounds and put their cards on the paper. Other participants could ask questions or build upon these ideas. If they had additional comments or new ideas, they took either a new card or just wrote it down on the poster. Following this sharing round, participants were encouraged to engage in discussions to identify common themes on the poster and further develop ideas by adding on it. They could use the sticker to highlight the stories. As participants interacted, I was taking note of observations for documentation purposes. The aim was to collect concepts that envision the Eyeth.

**Role Play: Participatory Film Making** The last part of the workshop (for about 45 - 60 minutes) was role play in the framework of Participatory Film Making - inspired by

the work of Manni [77]. The aim was for participants to develop a short film (maximum 5 minutes) using existing materials and creative approaches. The idea was once again after the *Futuring*, where they have discussed various concepts and ideas, to actually implement some selected ideas in a creative way. This aimed not only to strengthen the collaboration and experience of the participants but also to allow them to express themselves in the form of acting to reflect on living experiences.

**Group Reflection and Feedback** The workshop wraps up with a reflection and feedback session. Participants have the opportunity to share their impressions and give feedback on the workshop.

Table 3.1: Summary Workshop Process

| Topic                                | Average Duration | Reference                                                      | Data Source               | Goal                                                                   |
|--------------------------------------|------------------|----------------------------------------------------------------|---------------------------|------------------------------------------------------------------------|
| Ice-Breaking                         | 10 min           |                                                                |                           | Introduction of the thesis, today's agenda, expectation, etc.          |
| Warm-Up: Magic Workshop *            | 30 min           | The Magic Machine Workshops [4]                                | Sketches/Art + Discussion | Creative Imagination/ Exploration + Collection of many stories / ideas |
| <i>Break</i>                         | <i>15 min</i>    |                                                                |                           |                                                                        |
| Futuring Workshop                    | 60 min           | Future Workshop [111]                                          | Concept + Notes           | Focusing on selected themes                                            |
| <i>Break</i>                         | <i>15 min</i>    |                                                                |                           |                                                                        |
| Role Play: Participatory Film Making | 45 min           | Designing structural participation in an interactive film [77] | Video                     | Expressive Bodies + Living Experiences                                 |
| <i>Break</i>                         | <i>15 min</i>    |                                                                |                           |                                                                        |
| Group reflection and feedback        | 10 min           |                                                                | Notes                     | Conclusion                                                             |

### 3.4.4 Personal Reflection on Workshop Process

In the following, I will illustrate my reflections on the workshop and my role as a researcher: The workshop was designed to be participant-driven, so I aimed to ensure a non-formal space to avoid the disparity of science, including avoiding framing the workshop as a



formal scientific project and using technical jargon. In doing so, I embodied myself as a moderator to guide the workshop in such a way that allows the participants to shape their space; in case of significant thematic deviations or ambiguities, I provided some assistance. It was also crucial for me to make sure that all ideas from participants were valuable and to emphasize that there were no right or wrong ideas and that they could always ask me for support. This approach has led to a comfortable space for the participants since every idea was valuable, and solidarity was based on the shared experience.

Speaking of arriving on Eyeth, the introductory story has been beneficial in detaching from existing ideologies/concepts and immersing into new territory of their vision. The unlimited potential for material usage, various ways of expression (keywords, text, drawing, sketches, sign language), and encouragement of discussion have fostered creative ideas.

While in three workshops, participants immediately engaged in idea generation after the Eyeth story, one workshop group faced uncertainties: Instead of developing Eyeth and its narrative, questions arose about whether hearing individuals were included, if they would be discriminated against (reversed Earth), and what role hearing individuals play. To mitigate the uncertainties, I encouraged them to develop their ideal narrative, which helped them to detach further and work on it.

Generally, participants, especially in the first 30 minutes, brought forth many ideas without hindrance; only afterward did some ask for further ideas. To assist with this, I offered topics such as: What does communication look like? How do you envision city life? Where do you like to meet?

Additionally, the advantage of smaller groups lies in their dynamic; everyone can participate without feeling more or less excluded. Furthermore, in the second phase of the workshops (Futuring), everyone was allowed to contribute their narrative, encouraging everyone to participate.

In retrospect, the workshop offers a unique opportunity for people to come together and for participants to create a space that allows them to develop themselves.

### 3.5 Semi-Structured Interview

Approximately two to four weeks after the workshop, a series of semi-structured interviews (applying the framework by [11] lasting 20 to 45 minutes each) are conducted with individual participants. These interviews are intended to provide an opportunity to reflect on the workshop experiences and insights. With a total of [13/16] workshop participants, eleven interviews were conducted via Zoom, two on-site. The interviews were conducted in the participants' preferred language, with five of the Spanish participants (one of which does not have Spanish nationality) choosing International Sign. While the aim of the workshop is to collect and present stories (alternative narratives), the interview aims to reflect on the workshop itself in order to understand not only how the Speculative Participatory Workshop can be included as part of a deaf-centered method, but also the participants' own experiences of this format.



The guidelines as an orientation for the interviews are based on the following key questions, which do not, however, have to be followed strictly, but rather allow for a natural and genuine dialog, giving the participants space to articulate and express themselves freely.

- **Preparation**

- Warm welcome
- Clarification of informed consent
- Start of the recording

- **General reflection on the workshop**

- How was the workshop experience for you?
- What moments or activities during the workshop left an impression on you?
- Which activity did you like the most and why?

- **Lessons learned from the workshop**

- What important insights did you take away from the workshop?
- To what extent do you think the workshop has influenced your views on technology?
- Did the topic *Eyeth* concern you after the workshop and if so, how?

- **Favorite artifact**

- Can you tell me your favorite artifact that was created during the workshop?
- What makes this artifact your favorite?

- **Wrapping up**

- What does *Eyeth* mean to you?
- Do you have anything to share?
- Do you have any feedback for the workshop or interview?
- Thank you very much for your participation and your time.

## 3.6 Data Analysis

I used the Grounded Theory approach in this study, as described in section Grounded Theory. This included iterative strategies between data collection and analysis, which enabled a comprehensive understanding of the phenomena under study. Furthermore, the process of data analysis was not strictly sequential but rather dynamic, allowing for continuous refinement and adaptation.

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The data analysis focused mainly on two distinct but interrelated areas: speculative stories from the workshops and participatory reflection from the interviews, as these areas provided complementary perspectives. In addition, the Situational Analysis [12] method was used as a supporting technique for the analysis of the speculative stories to facilitate the situational understanding of the findings.

The Miro<sup>3</sup> collaboration board was used as an essential tool for data analysis. With its post-it notes and mind map function, Miro supported the organization and visualization of the collected data. In particular, the stories from the workshops were mapped to the board, where they were categorized into thematic clusters (coding) using a mind map format. This structured approach supported the subsequent analysis, especially when applying the situation analysis method to speculative stories.

The data analysis process took place in several iterative phases 3.1:

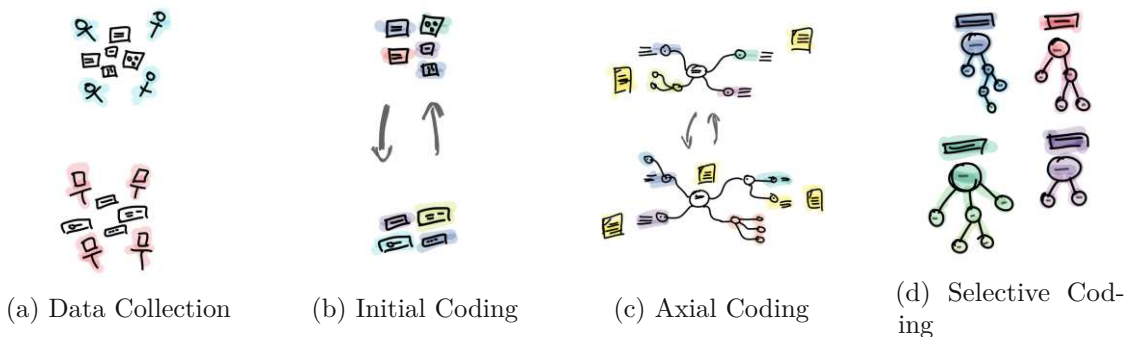


Figure 3.1: Process of the Analysis of the Stories

- (a) **Data collection:** During the workshops, participants used cards to write down their stories in a variety of formats, from keywords and descriptions to sketches and concepts. In addition, the discussion phase generated conceptual frameworks that provided initial structuring cues for the narratives, in which the participants may group the stories into themes.
- (b) **Initial coding:** I analyzed each story thoroughly to understand its context and meaning. This involved creating a mind map for each workshop, segmenting the stories and transferring them to the Miro board. Each story was then coded.
- (c) **Axial Coding:** Building on the initial codes, I conducted a deeper analysis to identify fundamental axial codes. Similar codes were grouped into overarching themes to highlight the underlying patterns and connections within the data.
- (d) **Selective Coding:** In the subsequent step, the analysis was expanded to include broader areas or categories (selective coding). This phase enabled a comprehensive understanding of the study topic, capturing its multidimensional aspects.

<sup>3</sup><http://miro.com>

It is crucial to underline that the data analysis process was characterized by a dynamic interplay of data, both within and across workshops. The iterative nature of the analysis facilitated continuous refinement and synthesis of insights, ensuring a nuanced and comprehensive interpretation of the data.

The analyzing process for the results from the interviews differed slightly from that of the prior process. This will be illustrated in the following section.

I used MAXQDA, a computer-aided qualitative data and text analysis software tailored for interviews, texts, and media analysis.<sup>4</sup> This tool facilitated the application of Grounded Theory methodology guided in the documentation from MAXQDA [44].

The following figures illustrate the process of video recording of the interviews to transcripts.

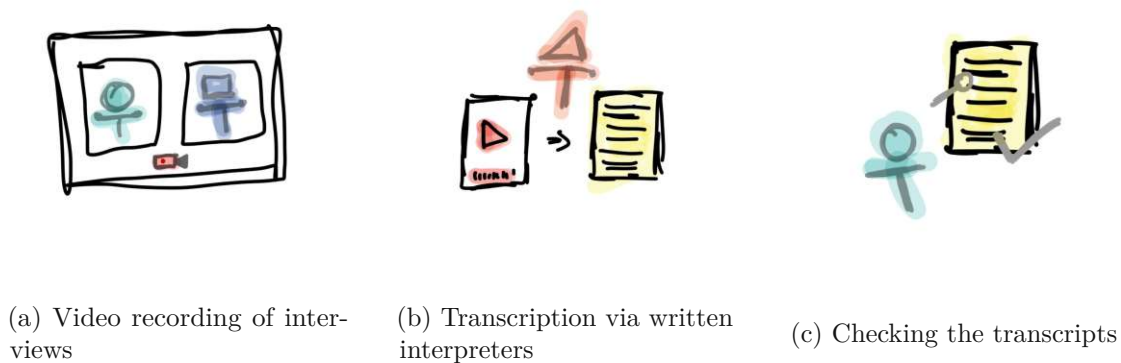


Figure 3.2: Process of Data Collection and Transcript

- (a) **Video recording of interviews:** The interviews are conducted with the participants' consent and recorded either via Zoom (for online sessions) or camera (for in-person sessions).
- (b) **Transcription by written interpreters:** The video files of the interviews are sent to interpreters (6 of the transcripts were translated by hearing, 7 ones by deaf interpreters), who provide translations of the respective sign languages into written English.
- (c) **Checking the transcripts:** Finally, I review the translations alongside the video files and make any necessary corrections.

The figures below outline the analysis process utilizing MAXQDA and applying the Grounded Theory approach.

<sup>4</sup><https://www.maxqda.com>

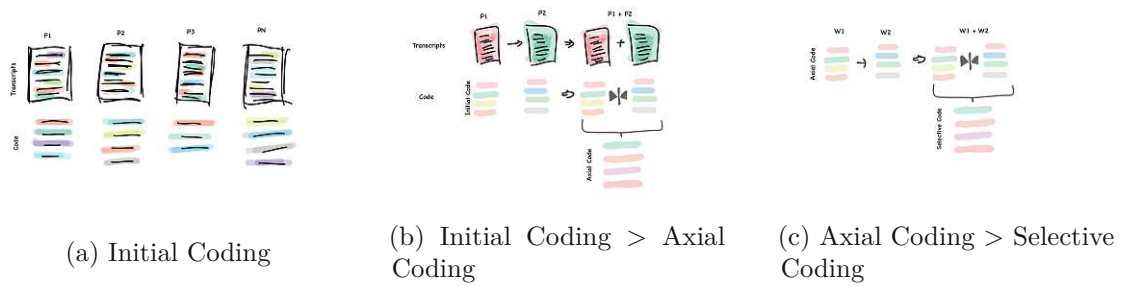


Figure 3.3: Process of Data Analysis of the Interviews

- (a) **Initial coding:** Each transcript is carefully coded line by line using MAXQDA’s coding feature. Herewith, I am assigning code to the corresponding interpretation of the content. I also outline memos with the Memo features in MAXQDA to reflect my interpretation and reason for the assignment. Codes are then sorted and organized to establish a systematic code list over time.
- (b) **Axial coding:** Codes from different transcripts are compared and analyzed using MAXQDA’s Creative Coding feature. Applying the “select-and-drag” feature allows for re-organizing the codes and therefore establishing the relationships between codes. The codes may be merged, split or grouped (in color-coded) to further understand patterns and connections between data.
- (c) **Selective coding:** Categories are developed through comparing and consolidating themes across transcripts. Concepts are reinforced by applying codes selectively. MAXMaps are utilized to visualize and conceptualize the emerging themes and relationships.

It is worth noting that throughout the analysis process, there is a continuous reflection on the process, with references made across stories and reflections. While each story may have its focus, there is mutual referencing between them to ensure a comprehensive understanding of the data.

The results from the narratives as stories are presented in the following chapter as Speculative Stories and results from the interviews are then presented in Participatory Reflection.

### 3.7 Software Tools

In this section, I will present the various software tools that were used for this work. MAXQDA and Miro were utilized for data analysis. Additionally, Miro was also employed for graphical representation purposes. GoodNote was used for reading and annotating literature, taking notes during the workshop, signing documents, and sketching. Overleaf

was used as an editor for this work, including synchronization with Zotero for literature management.

Additionally, I also experimented with AI Assistive Tools (by arrangement with advisors), namely ChatGPT from OpenAI, for providing suggestions on structure, clarity and tone and DeepL Write for suggesting refinements. However, the results were critically evaluated and adapted to fit my own words and expressions. I also used Grammarly for proofreading purposes.

### 3.8 Ethical Considerations

In my master's thesis, my institution, Vienna University of Technology, does not require an ethical review. However, I adhere strictly to the guidelines for ethical principles and the Code of Ethics from TU Wien Informatics. Participants will receive advance notice about the thesis project, the handling of their data, and their rights as participants. Specifically, participation is completely voluntary and participants can withdraw at any time without providing a reason. To ensure transparency, participants receive three documents in both German (for German and Austrian participants) and Castilian (Spanish) (for Spanish participants): an information sheet, a privacy policy, and a consent sheet. Although participants were offered a translated version of the documents into sign language, this was not requested by any study participants.

The information sheet provides details about the master's thesis project, which involves Speculative Participatory Design for deaf-centered technology. The sheet explains the aim of actively involving the deaf community in the design process and conceptualizing technologies that meet their desires and needs. Participants are invited to a 2-3 hour workshop, followed by a brief interview. There are no right or wrong ideas, and all input is valued. Collaboration can be terminated at any time, the participation is voluntary and free of charge. Participants can also contact the supervisor if they have any questions or encounter any issues.

The privacy policy emphasizes the significance of data protection and compliance with the Austrian Data Protection Act and the General Data Protection Regulation. Participants are informed that data collection involves qualitative research methods such as workshops and interviews with deaf participants. Various data will be collected, including participants' artifacts, notes, interview recordings, and observations. The interview that has been recorded will be transcribed by interpreters whom the participants are informed of and approved. The interpreters will adhere to their code of conduct while carrying out the transcription. The data will be used for the master's thesis as well as for possible further scientific analysis and publications. The duration of data storage depends on the statutory retention periods and the research purpose. Participants have the right to access information, rectify inaccuracies, request erasure, restrict processing, and object to data usage. If participants have any questions or concerns about data processing, they can contact the project supervisors or the data protection officer at the TU Wien.

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Finally, the consent form is where participants sign to declare their informed decision. Additionally, participants have the option to not anonymize their names, as marginalized groups often remain invisible in projects, and this work aims to highlight the importance of deaf voices. Participants can also choose whether or not they want to be photographed and published.

## Results I: Speculative Stories

This chapter aims to explore the different narratives (i.e. the stories) from the Participatory Speculative workshops. Using a Grounded Theory approach as part of this study, I analyzed and identified several key themes to solidify a structured framework for understanding the rich narratives that were generated during the workshop discussions. The themes provide insights into different aspects of the speculative world of Eyeth, illustrating the multi-layered nature of Eyeth, ranging from architectural and technological design to social transformation.

While my primary focus in this thesis is on Deaf Tech, it is essential to emphasize that the study goes beyond technological concepts. By placing Deaf Tech in the context of the broader Eyeth landscape, I aim to unpack its interconnectedness with other domain areas. This holistic approach allows drawing a comprehensive picture of the speculative world of Eyeth and highlights the importance of understanding technology in its broader social, cultural, and environmental context.

The findings contain vignettes [45], quotes and sketches that provide a nuanced understanding of Eyeth by capturing subjective interpretations and lived experiences, enriching the discussions with different perspectives and narratives. The vignette is also storytelling from the participants' point of view (POV) to allow the reader to be immersed in their perception. This narrative-oriented approach facilitates the exploration of the subtleties of participants' perceptions in the context of Eyeth. By foregrounding their voices and experiences, the study aims to enhance understanding and interpretation of the phenomenon as part of the explorative approach.

The legends for the quotes from workshops as well as interviews are as follows:

**Workshop:** W(orkshop)*Number / Country*      W1 W2 W3 W4

**Interview:** P(articipant)*Number / Country*, Pos. *Line\_In\_Transcript*

### 4.1 Welcome to Eyeth

The following vignettes illustrate the participants' first impressions after learning about the landing on a planet called Eyeth (an alternative planet Earth, which is ocular-centric instead of phono-centric) in the workshop's storytelling (see 3.4).

As the spaceship touched down with force on the surface of Eyeth, we could not grasp the planet with our own eyes. On the planet Eyeth, under the unknown skies, we felt a sense of belonging - a feeling that was as real as if the planet itself was signing: "Welcome home". The atmosphere here was like the warmth of a summer's day - a gentle breeze of tranquility.

As we took our first footsteps on the surface of Eyeth, we were struck by the beauty of our new surroundings. The Eyeth and its deaf inhabitants from various interstellar planets welcomed us with open arms. In these initial moments of uncertainty, we considered the question of communication. How would we be able to communicate between our different languages? But as soon as we started signing, these worries melted away and we just sensed the ease and understanding. Because sign language is magic itself - a seamless flow of visual communication that connects across languages.

As we gazed at the horizon, filled with the endless possibilities that lay before us, we couldn't help but wonder: Could this be our Neverland? A place where we can finally embrace a future of limitless possibilities?

With each passing moment, we were immersed in a sense of peace that we longed for but had never really found on Earth. Here, amidst the beauty of Eyeth, we felt a deep sense of freedom - the freedom to be ourselves, without fear or inhibition. It was a moment of deep realization - the realization that Earth, with all its chaos and audism, was never really our home.

The following sketch 4.1, which was created by a participant (in W4/S) to illustrate his experiences of landing on Eyeth, summarizes his very first impressions, which are shared by most other participants (also across workshops):

#### Visual

As I lay in bed on my first night in Eyeth, I could barely sleep as I grappled with the number of impressions of Eyeth. One thought echoed continuously: "Everything is so VISUAL".

VISUAL (in this case as a sign glossary) is to be understood as a term that describes the eyes and their function as a whole in visually-centered matters as a basis (in the life



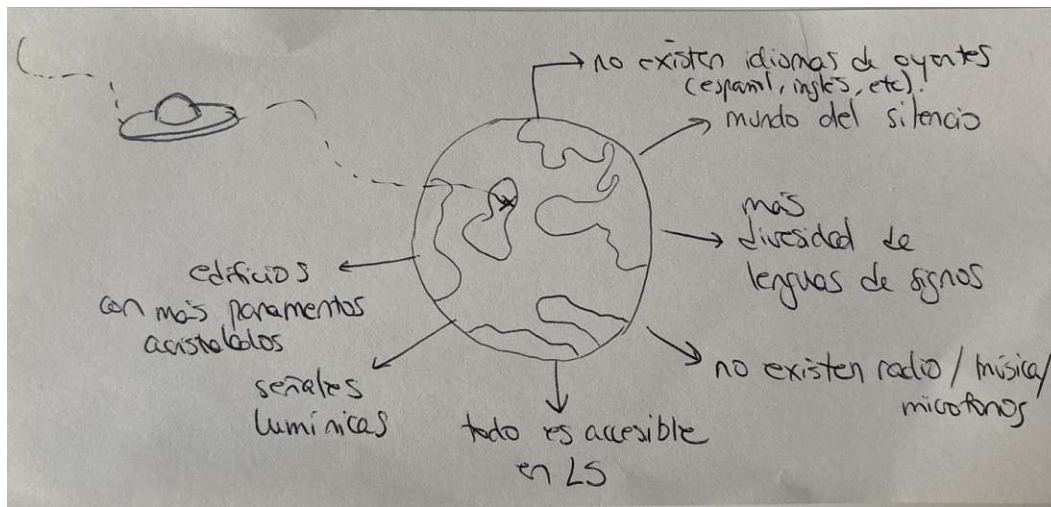


Figure 4.1: First impressions of Eyeth *Translation clockwise*: (a) no hearing languages (English, Spanish, etc.) (b) world of silence (c) more diversity of sign languages (d) no radio/music/microphones (e) everything is accessible in sign language (f) light signals (g) buildings with more glass faces

of the deaf *sighted* person). In principle, stimulus processing in deaf people is strongly dominated by visual perception, resulting in a sensory dominance of the sense of sight. This influences the entire life of a deaf person, as they react primarily to visual stimuli in addition to the other three senses of taste, touch and smell. These stimuli can be present in different forms, but are also processed differently than in the hearing environment. This is particularly the case when visual communication takes place, when people react particularly quickly to light signals or simply when the visual appearance of a person leaves a particularly lasting impression.

During the discussion in the workshops (W1 W2 W3 W4), VISUAL comes up frequently in any domain, such as environment, communication, design of the spaces, personal devices. In this context, one participant signed (in W2/S): “As the ‘VISUAL’ simply follows the eyes”.

Conclusively, the concept of the VISUAL also encompasses the idea that every piece of information conveyed is visual. This stands in contrast to auditory information on Earth, which becomes obsolete on Eyeth. This concept links to the deaf-centered approach, including the fact that information can be conveyed through pictorial representations, sign language or signal lights inside and outside the visual field of the individual.

### Access

When I was exploring the concept of accessibility on Eyeth, I found myself in a paradigm where the term “Accessibility” had no meaning. Here, accessibility was not a concept associated with barriers and challenges, as it often the case on Earth. Instead, it was an integral part of daily life.

The term *Accessibility* is mentioned and discussed in all workshops W1 W2 W3 W4, although different workshop groups applied various lenses on the concepts of *Access* and *Accessibility*, which I will outline below in detail:

W1/A as well as W3/G define accessibility as access to sign language on all levels (which can also be found in the discussion regarding Deaf Rights). Among others, the following key points are mentioned: “24/7 and Everywhere is Accessible” (W1/A), live information is also supplemented with sign language avatars (W1/A), (W3/G) emphasizes the political debate in sign language, but also access to the social domains; specifically to different social networks. W4/S supplements accessibility with (a) non-audio visual information and (b) universal design, but also (c) design elements of DeafSpace.

W2/S refers to the obsolescence of accessibility in the sense of obviousness. In concrete terms, accessibility would be a description of problems that are a relic of Earth, because access on Eyeth is seamless and effortless. As one participant explained in the interview about the concept of accessibility on Earth:

*We don't just need to make it accessible. In this world [Eyeth], we don't even know what 'accessible' means [because it's already there].*

– Interview P5/S, Pos. 27

In context, this sentiment is shared by participants (in all workshop groups W1 W2 W3 W4), associating Eyeth with a sense of liberation and joy. There is no struggle for rights here, because access is not just a privilege but a fundamental aspect of human rights for deaf people. Being deaf is not just about being part of the majority, it is something ordinary. The deaf-centered aspects of Eyeth are no longer a desire, but a norm.

### Sign Languages

The topic and the spread of sign languages were discussed in all workshops W1 W2 W3 W4, which is linked strongly to Access (in 4.1) and Deaf Rights (in 4.1) as well. In concrete terms, accessibility, direct communication and sign languages are closely linked; when the participants talk about accessibility, they mean that sign language is used everywhere (e.g. live information in sign language (W1/A), political debates and participation in SL (W3/G) and in the news (W4/S). Whereby - especially in W4/S - accessibility also means visual information (see VISUAL in 4.1) and deaf-centered design (see Deaf Space).

**W2/S** discusses particularly the evolution of sign languages, which takes place on the national and international, but also interstellar levels. Concretely, this means that the sign languages on Eyeth are not static, but evolve within its communities and across interstellar planets. While sign languages evolve naturally, each community still preserves its cultural heritage. Over time (also discussed by **W4/S**), a universal sign language develops as the central language (as the official language), contributing to the high literacy levels among Eyeth's population through the given language acquisition and access. Furthermore, each interstellar immigrant on Eyeth is treated with respect for their original sign language, and opportunities are provided to learn the universal sign language as part of the integration.

**W1/A** also emphasized the importance of sign names, as they are part of the identification in govermental registers and other places. In doing so, each person has their own sign name and once the sign name is changed, the person must register with the government. Names in written form - in turn - may become obsolete.

## Deaf Rights

Deaf rights encompass the social movement within both the disability rights and cultural diversity movements, advocating for the equality of deaf and hard of hearing (DHH) individuals in society. [72]

These rights include, among other things, the right to Deaf Education (focused on sign language-centered education rather than oralism), recognition and equality of sign language(s), resulting in accessibility, and the preservation of deaf culture and the development of deaf identity. These aspects are emphasized in all workshops **W1** **W2** **W3** **W4**, particularly in recognizing and appreciating sign languages and ensuring linguistic accessibility at all levels, thereby making audism obsolete.

Different workshops placed focal points on various aspects: **W1/A** mainly discussed self-determination and independence of deaf individuals, fostering peace within communities; **W2/S** emphasized the importance of deaf-centered education as given; **W3/G** focused on achieving a harmonious society with equality and non-hierarchical structures; and finally, **W4/S** centered on providing linguistic input for children. The struggle for deaf rights, especially within this sample group, is integral to their identity and daily lives. Following the workshops, it can be interpreted that Eyeth fundamentally upholds the rights of its population based on three foundational pillars (as main issues).

### (I)

The first commandment is the recognition and appreciation of each individual's dignity, equality, and freedom.

### (II)

Another pillar is the recognition of linguistic and cultural rights. All sign languages, naturally evolving within communities, are preserved as cultural heritage. Deaf people have the right to express themselves through their native sign language.

### (III)

Lastly, the right to education is not just an entitlement but a guarantee that all deaf people have access to education. Language barriers and deprivations, especially among children, remain unknown phenomena in Eyeth compared to Earth.

### Science and Research

Due to these peculiarities, Eyeth - especially in W4/S is driven by science and research that centers a visual-manual-first approach as sign language is the primary, fundamental communication form.

Thanks to the drive for science and research, society, linguists, health, and technology sectors have flourished. The health care system understands deafness as a natural phenomenon - in contrast to the earthly controversy that sees deafness as a deficit requiring accommodation. The system on Eyeth rejects these ideologies. Instead, the focus lies on hands and eyes (also emphasized in W1/A and W2/S) - the primary means of communication. Due to scientific breakthroughs on Eyeth, innovations such as different creams are available for hand-related issues, reflecting their importance, and the same attention is given to eye care (W2/S).

In addition to technological developments, due to the importance of visual-manual-first design, there has been rapid progress (compared to Earth, skipping the radio era) with cutting-edge technologies taking advantage. (W2/S)

## 4.2 The People of Eyes

### Introduction

When discussing in the context of society, W1/A focused on the collective, healthy deaf community, W3/G and W4/S describe more precisely the definition and dynamics of society on Eyeth.

In concrete terms, Eyeth is built upon the foundation of a community-based (W4/S), non-hierarchical (W3/G) society. Multi-generational households (W1/A and W3/G) are prevalent, reflecting the belief in the reciprocal benefits between the elderly and the younger generation. The multi-generational and public representation of various deaf people allows deaf children to have diverse role models. As part of a community-based society (W4/S), each community, shaped by its different interest groups, forms a network with other communities, facilitating the exchange of knowledge. Cultures emerge naturally through this interconnectedness. In addition, the critical pillar of society is active participation in communal activities (W4/S), politics (W3/G), and public debate (W1/A). Individuals on Eyeth tend to be less lonely due to being an active part of various communities that correspond to their interests. The mentioned sphere is accessible to its people, allowing them to shape the Eyeth as an ongoing project (W4/S).

## Collective Society

The **W1/A** describes - especially with regard to society - the special characteristics of Eyeth celebrating individual success by fostering a society rooted in respect, acceptance, openness, and freedom. Communities thrive in a healthy atmosphere, free from the “crab theory” [2] prevalent on Earth, where deaf individuals tend to criticize or undermine each other’s accomplishments. This issue stems from a part of audism, specifically the ideology that “deaf people can’t do it”, which leads to further self-oppression with each other. Since there is no such thing as audism on Eyeth, this very root issue is resolved in the first place.

## Self-Development

In stark contrast to Earth’s on-going oppression issues, Eyeth empowers its inhabitants with freedom of choice, eliminating external determinations and controls (**W1/A**). This freedom extends to career choices and the pursuit of hobbies, emphasizing personal self-development (especially in **W4/S** but also in **W1 W2 W3**). The enjoyment of hobbies takes precedence over constant advocacy for rights, providing increased personal time that may be spent free from concerns about audism. Deafness is not seen as inferiority, but instead as an integral part of being human on Eyeth.

## Education and Job

Access to education has a particular significance on Eyeth and is therefore discussed in all workshop groups **W1 W2 W3 W4**, intensively discussed in **W2/S** and **W4/S**. It begins at an early age and offers various stages up to graduation. The educational facilities focus on individual support and the needs of the students. The schools and universities are also structured in such a way that they address the concepts and methodology of deaf education (**W2/S** and **W4/S**), which have been exceptionally researched and improved. Individual aspects, such as whether certain lighting conditions would lead to better learning success, are also considered (**W4/S**). Research on Earth has primarily concentrated on oralism, often described as a dark age associated with a regression of deaf education and a consequent focus on research on language deprivation, etc., also relating to the ideologies of Eugenics [109]. Meanwhile, research on Eyeth specializes in methodologies of deaf education and on deaf pedagogy.

In addition, Eyeth promotes free choice of employment for all (emphasized in **W1/A**), regardless of deafness. All residents, including professionals such as deaf students, engineers, politicians, doctors, professors, etc., are given career opportunities that they can choose to pursue according to their interests and abilities - independent of their deafness.

### 4.3 Media and Communication

On Eyeth, sign language is the heartbeat of communication, and its integration into various forms of media is, for instance, reflected by the transmission of visual information. Signed content is central to Eyeth's media landscape, covering digital billboards, screens, and social media platforms, where visual language conveys information and stories through sign language.

In the following subsections, I first introduce the different media formats - which were generated through all workshops **W1/A** **W2/S** **W3/G** **W4/S** and therefore the interconnectedness of this subject, then I explain the understanding of the screen as a particularly important medium, and lastly, I present different media from the entertainment cues.

#### 4.3.1 Modes

There are various ways in which sign language content is transmitted through the media, which are explained below.

**Human Signers** Human signers deliver content through various expressive forms, catering to diverse purposes. These include professional signing for business communication, neutral signing for conveying governmental and non-governmental information, and performative signing for marketing presentations.

**Signing Avatar** Cutting-edge technology on Eyeth contributes to the development of avatars that can sign and interact proficiently on a human level. The unique features of signing avatars are the provision of a higher level of privacy for users and end-to-end encrypted communication (**W2/S**).

Due to signing avatars being so widespread on Eyeth, each person can produce their own version of one, design it as they like and finally create videos with their avatar. The quality is preserved during replication and is used for anonymization and entertainment, among other things. (**W1/A** **W2/S**)

**Hologram** Holographic technology plays a vital role, allowing real-time communication through holographic projections. This enhances conversations' immersive and interactive nature, especially in video chat scenarios.

**Symbolic** Eyeth introduces a unique form of written symbolic language based on handshapes and objects 4.2. The visual symbolic language (in the form of written signs) provides insight into the rich cultural expressions of Eyeth. The symbolic language was first used to display information and traffic signs, among other things, and is gradually being replaced by more dynamic forms such as GIFs (animated images). GIF enables the animating of images used to present signed content for short and repetitive sequences. While the symbolic languages are less present on Eyeth due to technological



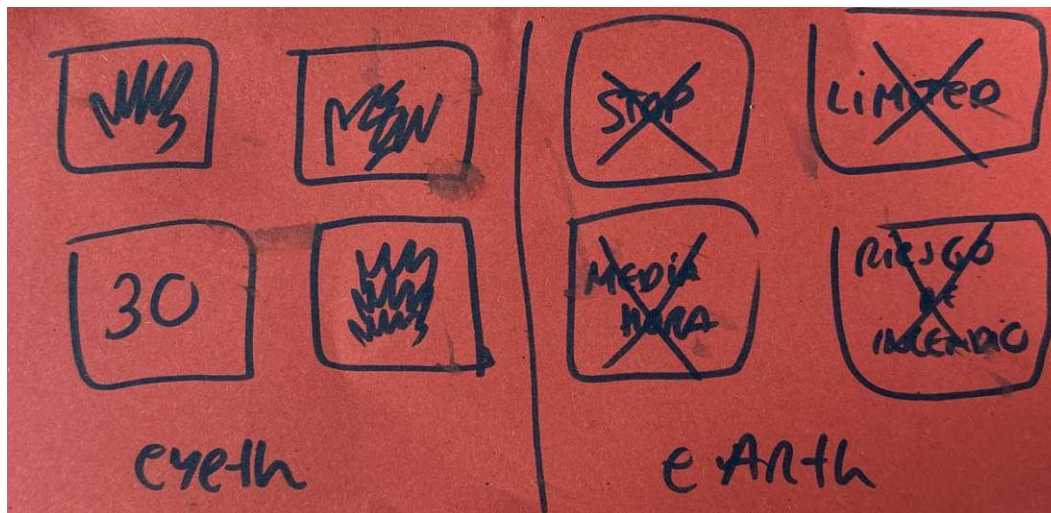


Figure 4.2: Comparison of the information signs between Eyeth and Earth. In the context of visual representation, it was also discussed whether pictorial representation is based on the hand shapes of the signs or objects. (W4/S)

developments, this symbolic language is found in the academic institutions that study the symbolic language on Eyeth for historical roots and is used for the permanent storage of information.

#### 4.3.2 Screens

When talking about the visual environment, the *billboard* plays a special role. The visual information shown on billboards can encompass various forms of visual content such as images or graphical information, as well as sign-language-based content, which will be introduced in the following sections.

Public spaces on Eyeth feature information screens displaying vital information through signed content. Digital billboards on Eyeth are dynamic, serving as media for visual announcements, artistic expressions, and community engagement.

When a person approaches a screen containing information presented in sign language as sequences, W3/G is suggesting the video starts automatically when the person makes eye contact with the screen. If eye contact is interrupted, the screen automatically stops and resumes as soon as the eye contact is re-established. This method eliminates the need to wait for the video to start or for one to re-watch the entire sequence, as the video automatically resumes when eye contact is returned. Furthermore, each person gets an individual representation of the sequence based on their corresponding eye contact time stamp.

### 4.3.3 Entertainments

The area of entertainment - which was particularly speculated in **W1/A** and **W2/S** - is a dynamic landscape that predominantly engages the visual and tactile senses through technologies presented below.

**360° Dome Cinema** The 360° dome cinema on Eyeth is a form of immersive entertainment. The integration of visual storytelling in sign language and visual vernacular nourishes the *eyediencies* with an alternative, immersive cinema experience (**W2/S**).

**Interactive Books** In the Eyeth's literature landscapes, interactive books, inspired by elements from the Harry Potter movies, offer readers a new perspective on traditional literature (as usual on Eyeth). By incorporating dynamic imagery, signed narratives and interactive features offer an engaging and immersive way to explore storytelling (**W2/S**).

**BASS Technology** Eyeth's music emphasizes a tactile experience through BASS (here as sign gloss) technology, which allows people to feel vibrations and rhythms. This approach creates a unique experience that adds a new dimension to artistic expression when combined with VV, Deaf Slam and other creative forms of visual expression, offering a novel multi-sensory art experience (**W1/A**).

## 4.4 Space

### Introduction to DeafSpace

When discussing the spaces on the Eyeth, the participants (**W1 W2 W3 W4**) refer to the concept of DeafSpace. DeafSpace is a deaf-centered architectural approach that creates environments that bring deaf people to the center. Key components are the visual range (everything must be within one's visual range), walkways (providing enough space for walking side-by-side while having a visual conversation), and group spaces (e.g., u-shaped seat arrangements). [40]

### Public Space

Concerning public spaces, the participants (**W1 W2 W3 W4**) emphasized the importance of spacious streets to facilitate comfortable, natural communication for deaf pedestrians. Narrow paths and obstacles like poles are eliminated to prevent discomforts that could otherwise arise in side-by-side walking while having sign language conversations. In addition, the wide, obstacle-free pathways ensure unhindered navigation, while the absence of poles reduces the risk of accidental collisions or disruptions in communication. Therefore, information signs are strategically placed: suspended over the ground or even floating, to maintain clear, unobstructed paths for deaf people.

As a participant from **W1** explains her figure 4.3:



When I think about the spaces in Eyeth, I visualize how the information is presented. There just have to be floating objects like floating signs and billboards. My idea comes from the fact that deaf people tend to bump into each other at the bar, which refers to the nature of conversation in sign language between two or more people. A floating sign could solve this problem. In addition, the floating sign is more likely to provide “short” information, such as a signal, direction, etc. It can be encoded in symbols (as in the current Earth) or in sign language in repetitive sequences like a GIF. On the right side, a larger billboard will be used for important announcements or commercials in sign language, with additional visual effects. I imagine the whole thing to be very lively.

– Interview P2/A, Pos. 60



Figure 4.3: Floating signs and billboard (W1/A)

The figure 4.4 illustrates how the pedestrian traffic lights incorporate floor lights and vibration planes for tactile indication, eliminating the need for color checking (W1/A W2/S). A participant from W1/A highlights this by sharing his experience on a vacation in Lisbon:

*I just recently traveled to Lisbon with my [hearing] father, and we were walking around the city, and we were chatting, and suddenly the traffic light turned green, and my dad didn't realize. And then he told me that in Austria, there is a noise as well that indicates that the traffic light is green now, but in Lisbon, it wasn't the case, so my dad didn't realize.*

– Interview P4/A, Pos. 62



Figure 4.4: Traffic light with vibration plane when the light is shifting to green (W1/A)

In addition, there is an implementation of mirrors (entire reflection, partial reflection for detection of movement), mainly placed in corners to provide additional environmental information to the person's visual range (W2/S).

In conclusion, one participant from W2/S described the scene depicted in figure 4.5 as akin to walking through Times Square in New York, where every piece of information shines brightly right into the eyes. In addition to the billboards, the passageway presents numerous lights, screens displaying signing people, and mirrors, facilitating the immersive visual environment.

### Building Design

Building designs on Eyeth (W1 W2 W3 W4) include features that enable visual communication through windows, mainly glass buildings. To add privacy options, the glass can be obscured as well as unobscured, while the obscured option is used for recognizing movement.

In addition, there are various uniquely shaped buildings, which are highlighted in W1/A. For example, some buildings contain the representation of the ILY sign as part of the construction (see 4.6). The ILY sign holds symbolic value for the deaf community and includes the hand sign consisting of the following letters: I - I, L - LOVE, Y - YOU. This particular architectural style shows a nuance of reflection from the deaf communities.

Circular buildings (speculated in W4/S) are found in workplaces, educational institutions, and sometimes homes. The circular style allows the division of spaces in the view center.



Figure 4.5: Lively visual-centered environment, inspired by New York's Time Square (W2/S)

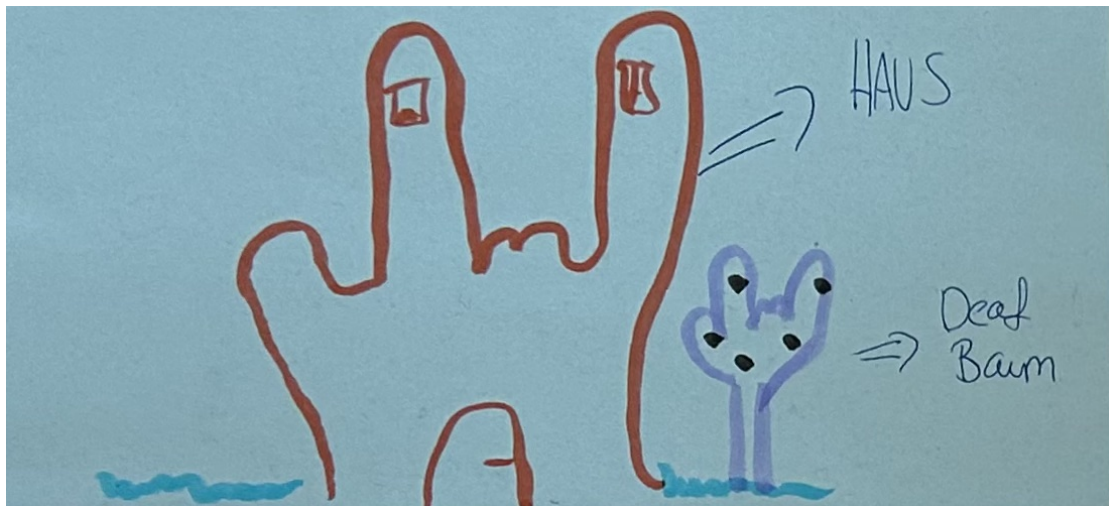


Figure 4.6: ILY house and tree (W1/A)

This makes the rooms accessible “through the eyes”.

In educational and work settings (W2/S), live self-spatial POV recording videos enhance communication - as the students and colleagues can still understand the person from the back. See-through screens and boards make conventional blackboards redundant and improve direct communication and teaching.

Cafes are designed with rounded tables and touch-displayed desks; glass windows create environments for social interaction (W1/A).

### Lighting system

The lighting system plays a critical role in all buildings and is developed not only to prevent eye damage caused by overused lighting but also to comfort the eyes. The features include better (W3/G), non-harmful light (W2/S), visual signals for various activities (W3/G), integration of natural light through luminous windows, and adaptable, high-quality lighting for different scenarios, such as spotlighting in debates (W4/S).

## 4.5 Transport

Eyeth's transportation system is like the body's circulatory system. Every node is connected, you get from A to B via C. Whether it is cars or trains: everything is circular and swings over roads and rails. You can explore every corner of your surroundings thanks to the panorama windows and mirrors. Seats are arranged in a circle, and therefore each journey allows you to communicate directly with other passengers. The streetlights are not just lamps, but dynamic indicators: if it is raining heavily, they light up blue; if an ambulance is approaching, they light up red. The light signals can be found everywhere, even on the platforms of the railroads. When a train arrives, the ground lights switch from red to green. All visual elements are synchronized with each other.

In the following, I will present aspects of the transportation systems on Eyeth. The W2/S focuses more on both individual (car) and public transportation, especially their design as well as streets. The two other workshops (W1/A and W4/S) mainly discuss the design of information given in public transportation.

### 4.5.1 Individual Vehicles

**Cars** The design of cars on Eyeth is centered around enhancing visibility, a key aspect emphasized in the earlier VISUAL section (see Figure 4.7). Cars are equipped with expansive windows, while rear-view mirrors are enlarged to ensure optimal visibility in traffic, aiming to eliminate blind spots and provide drivers with a comprehensive view of their surroundings.

Advanced autonomous cars (in W4/S) feature rounded vehicle designs that prioritize visual elements. The seats are adjustable and arranged in a circular fashion, offering a 360° panoramic view of the surroundings. This design accommodates the natural preservation of conversation in sign language and therefore enhances both communication and the overall driving experience.

**Notification system** Eyeth's cars (W2/S) feature various signals on the amateur dashboard, including a warning light for approaching ambulances, designed to keep drivers extra alert (see figure 4.7). Furthermore, a notification system displays real-time data on car windows, conveying information about traffic conditions, warning signals, and

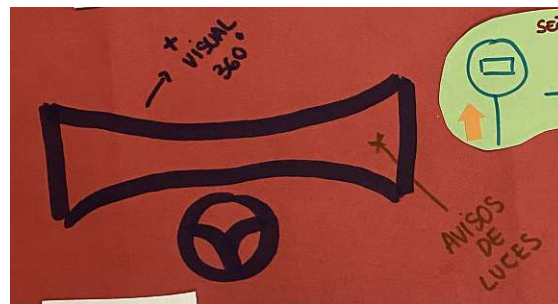


Figure 4.7: Description of the information in the cockpit (W2/S)

other updates. These visualizations, presented in sign language or symbols, contribute to drivers' constant awareness of their surroundings.

**Dynamic streetlight signaling** A distinctive feature of Eyeth's road systems (from (W1/A W2/S)) is the utilization of streetlights as a dynamic signaling system. Different colored lights indicate various situations, such as red indicating an approaching ambulance, complete with animated light chains to denote the direction (see figure 4.8). Yellow lights indicate accidents, while blue lights signal heavy rain.

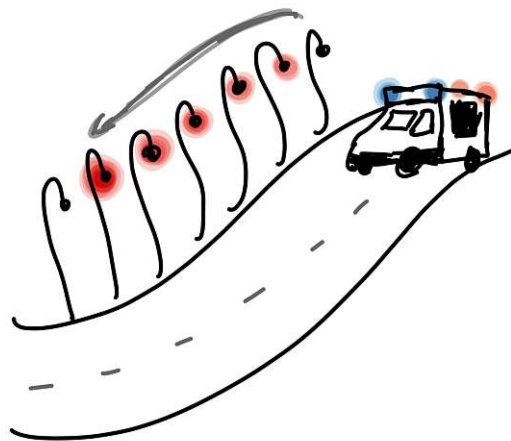


Figure 4.8: Representation of the direction of dynamic streetlight signaling while an ambulance is approaching

#### 4.5.2 Public Transport

The rounded design seen in cars extends to trains on Eyeth, featuring circular, reclining seats that enable direct communication between passengers. Metro cars have wide 360° panorama windows, offering passengers a view of their surroundings (see figure 4.9).





Figure 4.9: Visual illustration of the 360° panorama window (W2/S)

**Visual information on the platforms** Metro platforms (see figure 4.10) incorporate visual elements, such as a red light indicating waiting and a green light signaling the arrival of trains. These design elements draw inspiration from the metro systems in Washington, D.C., and Tokyo.

**Information display** Screens on metro platforms present information, including station names, in sign language, performed either by a signing human or an avatar. Additionally, screens offer comprehensive sign language information about each train's status, including time details, delays, and explanations for any issues. Each station name has its own sign.

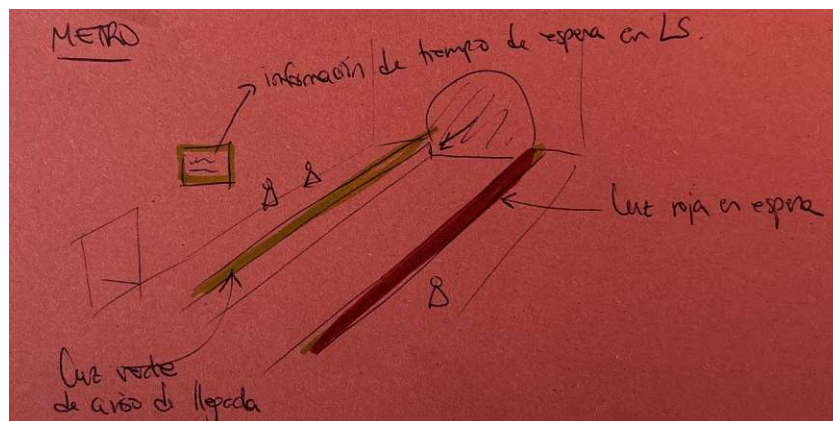


Figure 4.10: Description of the metro platform, including (a) information in sign language, (b) signal lights that are green when the train is arriving or red when waiting for the train (W4/S)



(a) Deaf animals such as a dog (that is signing), fish and duck



(b) Deaf Eye-raffe (Eye-raffe as a pun derived from Eyeth and Giraffe) with the face shaped by the ILY sign

Figure 4.11: Representation of deaf animals on Eyeth from W1/A

## 4.6 Environment

Eyeth is home to a vibrant and diverse natural environment, including flora and fauna, which stands out particularly in the German-language workshops (W1/A and W3/G). Due to the evolutionary conditions that prevail on Eyeth, the animal world is also deaf. They influence the shaping of the visual environment. Instead of acoustic perception as on Earth, visual perception on Eyeth is invigorating. One example is biofluorescence (W3/G), which is used to recognize communication between animals. The biofluorescence is not only located on the ground, but the weather is also visually shaped with colors that indicate the future weather situation.

*“Once I start thinking about what nature might look like on the Eyeth, I find myself in a rabbit hole: What would actually happen if everything had no acoustic relevance: What would predators look like? How do prey defend themselves from predators? What emerges on Eyeth and disappears from Earth? It must be totally different because we are really living in an audistic-centered world.”*

– Interview P5/G, Pos. 13

In a more humorous setting, the participants in W1/A (see figure 4.11) discussed how the deaf animals would look like and one participant suggested an ILY-shaped giraffe (or rather Eye-raffe) and other deaf animals. (W1/A)

In the interview, the participant explains as follows:

*“The giraffe- I do not know why, but I feel like when I think about this world I see that there might be deaf animals as well in that way, so that’s why I associated the*

*ILY-sign and that was just a natural process, even though, of course, in our existing world, there are deaf animals as well, but we can't really imagine because it's not visible. So with the I love you sign the giraffe is visibly deaf so it stands out. This is a deaf giraffe and I really like this idea."*

– Interview P1/A, Pos. 40

This is also reflected in the *Deaf Tree* in the figure 4.6.

### 4.7 Personal Devices

In the following sections, I will present stories that go beyond personal devices to include not only gadgets such as phones and smartwatches but also expand into smart clothing and the tools present on Eyeth.

#### 4.7.1 Phone

As I walk through the wide street, my senses attuned to my surroundings, I feel a subtle pulsing in my pocket. I reach for my phone, flip it open, and a holographic projection appears, displaying the caller's presence with sharp clarity. The three-dimensional space allows communication in sign language to appear seamless. The caller signs, I sign, as if there was no physical distance at all.

On Eyeth, personal devices such as phones (W1/A) and smartwatches (W2/S) are essential. The design line of the phone is embedded in the flip phone style 4.12, so that form and function are seamlessly combined.

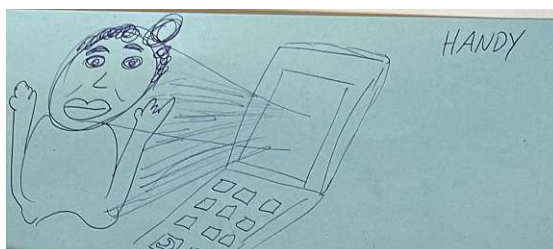


Figure 4.12: Display of the flip phone with a pop-up display showing the avatar (W1/A)

In the interview with the participant, the reasons for choosing the flip phone design are highlighted. The participant describes her considerations for the design element:

*I think we chose the flip function because that would place the webcam in the perfect spot as is. Like now the Samsung flip phone that came out, it is also very easy to just place and put somewhere and you can videocall somebody because otherwise you always have to place something behind the phone to put your phone up, for it not to fall down! For right now, of course, I have my laptop which is easier and this is also*



*something that I flip open so this might be the association of this as being used to having something to place vertically if we want to FaceTime with somebody.*

– Interview P2/A, Pos. 90

The phone is primarily designed to facilitate communication by integrating features such as video calls similar to FaceTime and hologram functions. Inspired by the conversations in the Star Wars movies, the inhabitants of Eyeth define interpersonal communication via hologram as natural. One participant (W1/A) describes the feeling of participating in “realistic” conversations, especially due to the three-dimensional view of the conversation party.

Participants describe the purpose of using the phone’s signing avatars and thus the experience:

*I feel the hologram/avatar appearing from the flip-phone [may be useful] if something comes up where you would need to call somebody, for example problems with electricity or something at the authorities, if you have to pick up a new passport, then it would be really practical for this feature with the avatar to be possible, as opposed to the relay service or having to communicate via email. I feel like this would be a way faster way for things to get done more quickly. Also, if an unknown number were to call me in an audio call, I can just pick up the phone and have the signing avatar appear and translate for me. That’s the one thing I can think of that I would need right now.*

– Interview P1/A, Pos. 58

#### 4.7.2 Smartwatch

As I am strolling through the busy streets of the city, my smartwatch accompanies me. With a simple tap of my finger, a holographic dashboard appears before my eyes, providing me with real-time information on the state of things. Amidst the countless stands, I come across a fascinating store where I encounter a vendor whose sign language is different from mine. With a simple gesture, I activate the translation service on my smartwatch and summon a sign language avatar that effortlessly translates our conversation. Finally, I decide to make a purchase and reach for the item, when my old friend appears in the marketplace. So I hand the bag with my purchase to my hovering smartwatch, relieving myself of the burden. Now that my hands are free, I greet my friend warmly and chat with him without being distracted by carrying the bag.

The presentation of a smartwatch (W2/S) on Eyeth offers, in addition to the classic functions (notification of information in the form of visual and haptic signals), the integration of a hover function for a hands-free experience.

Specifically, the design of the smartwatch goes beyond the touchscreen: the hover function allows the user to interact with the device without physical contact, offering a hands-free experience. The smartwatch's sensors recognize and respond to hand gestures, creating an intuitive user interface.

As the smartwatch is based on the concept of hands-free operation, it offers a holographic display that emanates from the wrist. The holographic display is triggered by a button on the wrist, allowing the user to control and position the hologram at will. This design ensures that users can interact with the holographic interface while using their hands for communication or other tasks.

The participants explain the inspiration for the idea that, in addition to the smartwatch, there is a personal hover carrier:

*So, when we do groceries, the bags are carried by a hover carrier because we need our hands to be free to be able to communicate. Sign language is our language, we need the hands to communicate but we also need them to grab things. If our hands always get busy, how can we communicate? That's how our idea emerged.*

– Interview P5/S, Pos. 36

In addition to the visual communication option, the holographic display offers a dashboard that provides a range of functions. Users can navigate through a virtual dashboard projected by the holographic display. The interface offers a menu system that makes it easy to read and select different options. This provides various information at a glance. The users can customize the holographic display to show a variety of data, including notifications, open messages, weather data and much more. In addition, the smartwatch features a real-time translation service. For example, regional sign language is translated into the corresponding user's language by avatars.

### 4.7.3 Visual Augmentation

As I make myself comfortable on the sofa to watch my favorite show, I am notified by a vivid projection in front of me showing that a sign language message from a friend has arrived. It's the smart contact lenses that allow me to augment my surroundings. So I follow the narrative on the screen and my friend's real-time communication in parallel and respond effortlessly in sign language. The room around me seamlessly recognizes my signs and converts them into a short message that I send with a single glance.

When it comes to personal devices, the *VISUAL* is once again at the center of idea generation. Personal devices in particular offer the opportunity to augment the visual environment.

Augmented reality contact lenses (speculated in [W3/G](#)) are one of the most advanced technologies on Eyeth. Originally, the technology was intended to improve visual acuity.

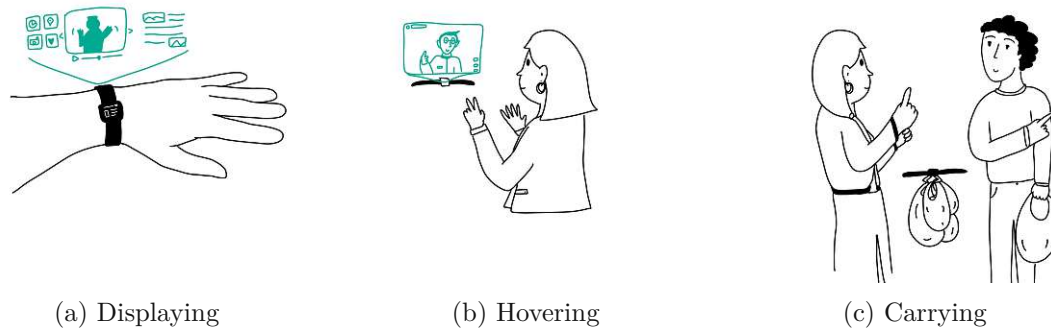


Figure 4.13: Description of various application contexts for the smartwatch. Figure (a) shows a possible smartwatch with a holographic display, enabling the user to interact with information. (b) The smartwatch can be hovered and aligned in front of the person to enable communication via sign language with both hands. (c) The smartwatch serves a butler function, namely it can carry things and follow the user to provide them with a hands-free user experience. All of these figures are illustrated with special thanks to Belen Navas Serana.

Glasses, while widely used on Earth, posed discomfort due to the nature of sign language, which necessitated some facial contact and frequently led to collisions, resulting in the glasses slipping off. This has led to interruptions in communication and damage to the glasses.

Thanks to technological research, contact lenses on Eyeth, in [W3/G](#), are becoming intelligent and not only improve visual acuity but also enhance the visual environment. The elements of the vision enhancement concept are outlined to align with the hands-free experience. In scenarios where hands are required (e.g. food preparation, operation of machines, etc.), augmentation is enabled to provide an additional form of communication with the person on the other end. Tasks can be performed smoothly while maintaining communication without interrupting ongoing activities. This hands-free user experience is in line with advances in smartwatch design.

Furthermore, the contact lenses provide additional information about the environment such as news, weather and navigation.

### 4.7.4 Smart Clothes

I stand in front of the mirror and put on my favorite jacket, which has just been fully charged. It feels light, clings to my skin, and vibrates slightly to signal that it is ready for use as soon as I close the fasteners.

This is no ordinary jacket, but a synthesizer of communication. The smart clothing is equipped with a vibration function to transmit information through tactile feedback on the user's body. Every movement and approach sends different vibration signals to my skin. For example, if someone approaches me from behind, the vibrations pulse gently against my back, so I don't have to turn around. This is the way the jacket provides me with information about my surroundings.

But my jacket can do much more than just describe my surroundings. In an emergency, it warns me of danger with a high-pitched, pulsating vibration that sends an urgent message.

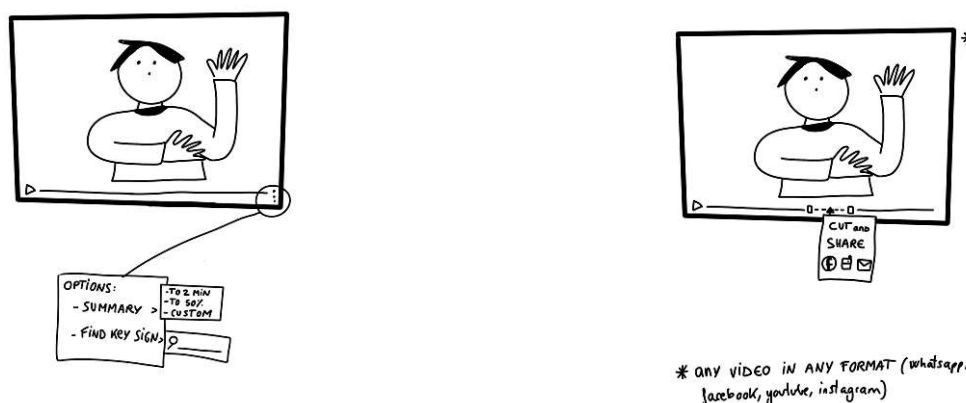
As it is getting dark in the alleys, I am on my way to the pub to meet my friends. To match the mood, my jacket pulsates with flashing LEDs and rhythmic pulses. It embodies the integration of performance and artistic dynamism.

The smart jacket from [W3/G](#) provides spatial information to the user via tactile feedback, such as vibration signals, for various contexts like notifications, movement, and emergencies. It also features aesthetic functions allowing for creative design freedom, including LED integration, such as flashing LEDs in multiple colors. Above that, it's designed to seamlessly integrate artistic expressions, like aligning colors during visual vernacular.

### 4.7.5 Software Tools

As I am in my home office working on my to-do list, I notice the warm light of the signal lamp, which tells me that a letter from the government is in my inbox. I switch on my computer and open the mailbox, where I am greeted by a preview of the video message. Alongside the video, key information gives me a quick overview of the content. I can adjust the playback speed and the system recognizes when my attention is interrupted - it pauses the video automatically to maintain eye contact with me. When it's time to respond, the RecordNow feature simplifies the process. With one click, I can seamlessly sign my answer and edit out any mistakes without interrupting the flow. With one final click, my response is sent and I can move on to the next task on my to-do list.

The following description of various software tools are developed by [W4/S](#).



(a) Selection options of a video player including summary and finding key sign features

(b) Trimming feature to share on social media platform

Figure 4.14: Design of the video player on Eyeth (W4/S). The figures are illustrated with special thanks to Belen Navas Serana.

On Eyeth, sign language is the primary language of communication. Therefore, the transmission of videos containing data in sign language is of utmost importance. To enable easy and seamless transmission of video data, numerous video tools are available on Eyeth. Users can view, download and upload data in sign language and even fill out forms in sign language with a simple click. To ensure privacy, users can represent themselves via an avatar and all communication is encrypted.

One of the most frequently used video tools on Eyeth is easily cutting and inserting video clips as shown in the figure 4.14. A specific tool also automatically generates relevant key characters that result in a summarized video. Managing the data is simple and requires just a few clicks. Due to the advanced storage utilization of the videos, all users get unlimited storage space and there are no problems with reaching storage capacity limits.

## 4.8 Summary

The findings for the alternative socio-technical narratives generated by the deaf participants in the participatory speculation workshops as part of the deaf-led research are summed up in the following.

Eyeth sees itself as a visual-centered planet that is deaf and its inhabitants use sign language by nature. The establishment of sign language and the rights of deaf people are therefore a given, which ultimately means access to education, work and hobbies for everyone. Furthermore, the media landscape on Eyeth is one where sign language is of importance in the presentation of information. In addition, the visual elements in the spaces are central, including glasses, reflections, and visual dynamic light signals.

Finally, various technological tools are presented, including a flip phone with holograms, a smartwatch that can move, visual augmentation to expand information, haptic feedback on the bodies from smart clothes and software tools that center the video aspect.

Eyeth, my heart beats when I think of you. You are not just another place, you are a sanctuary where my eyes and my hands find their center. In your presence, I feel the assurance that my rights and access to you remain unshakable.

Your realm is surrounded by luminous light, translucent glass and reflective mirrors that make the rooms seem larger. Objects hover above you, displays full of signing people, gliding through the air.

Every corner of Eyeth is on guard, signaling red, yellow, green and blue lights when something is informing me. The personal devices just blend seamlessly into the environment, enriching the world around us.

Eyeth, I am asking myself: Are you just a dream of my longing? Or do you exist somewhere beyond my imagination?

## Results II: Participatory Reflection

This chapter centers on the participatory reflections drawn from the interviews conducted with participants from the workshops. The interviews do not only aim to discuss the participants' experiences but also to reflect on their relationship with Eyeth, their perception of Deaf Tech, the workshop process and their desires for deaf-centered approaches. While the previous chapter focused on the outcomes of the workshop and the subsequent discussions about alternative sociotechnical narratives (hence stories), partly on *Deaf Tech*, this chapter is about reflecting on what a *deaf-centered approach* might mean.

Using the Grounded Theory approach, akin to the approach used in Results I: Speculative Stories, I have rigorously analyzed and identified key themes, focusing on reflective and interpretative clues. Through this analysis, I aim to (a) understand participants' perceptions of the dynamic workshop experiences and their learning outcomes, (b) explore changes in attitudes towards technology during the workshop, (c) discuss the importance of deaf-led research in a Deaf Space, (d) underline the frustrations arising from previous predominantly hearing-led research settings, and (e) prospect participants' desires and outlook (hence the pipeline) and (f) to conclude the importance of reciprocity.

It is crucial to recognize the interconnectedness of areas rather than relying solely on categorization. The categories serve to illustrate the dominant issues, highlighting the initial cues of the areas and their links to other relevant areas. This approach allows for a more profound understanding of interconnectedness.

The graph 5.1 illustrates the connection between categories, indicating the meta-level of issues. Each category is the result of the participants' reflections. The workshop experience opens opportunities for personal reflection due to its non-formal setting, since the participants do not only engage in the workshop, but also engage and learn from the workshop. This leads them to shape their attitudes towards the technology as well

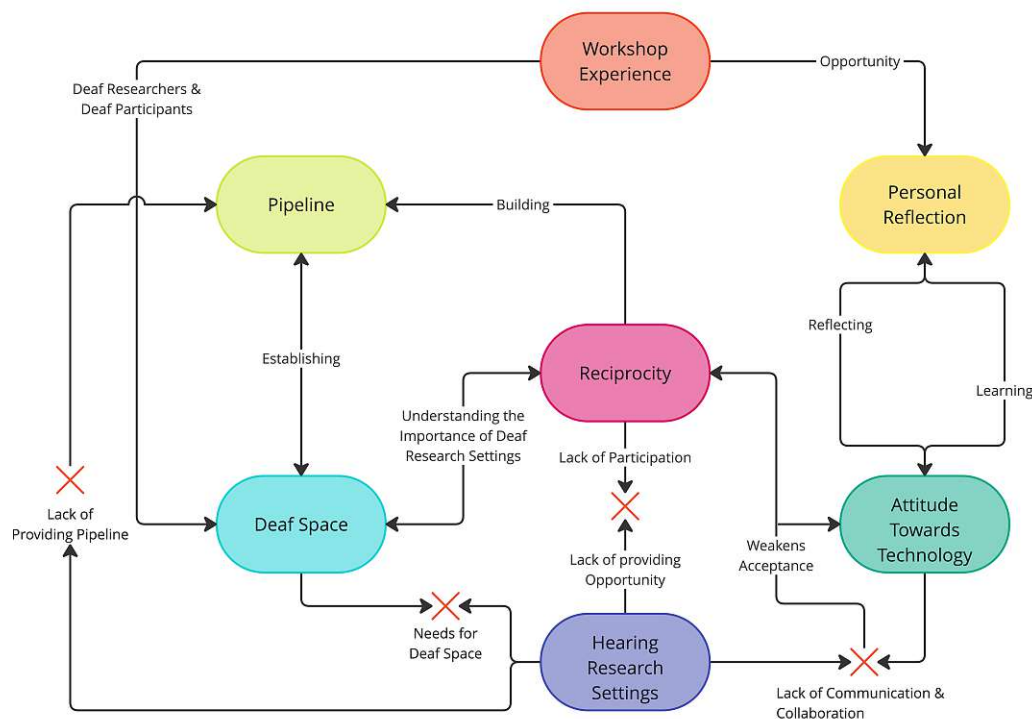


Figure 5.1: Overview of the Interconnectedness between Categories

as question the ideologies behind accessibility, which supports personal learning and reflection.

Due to the design of the technological landscape being dominated by hearing-led research, which is based on a lack of direct communication and failing to provide opportunities to deaf people, this has a serious impact on the reciprocity and attitude towards technology, but also the pipeline is taken from deaf people.

For this reason, the importance and relevance of the Deaf Space is emphasized. It enables the participants to develop within the framework of direct communication and peer relationships, thus strengthening reciprocity. In this way, the pipeline is to be built up to ensure that deaf people can participate at all levels, ultimately shaping the technological landscape.

### 5.1 Dynamic Workshop Experience

In this section, I address two important aspects related to the dynamic workshop experience: (a) the non-formal settings, which allow participants to freely create ideas without being bound by structured settings, and (b) the freedom of shaping discussions



without consequences, enabling participants to engage freely.

### 5.1.1 Non-formal settings

In contrast to hearing, non-signing, structured and rigid research settings (surveys, structured interviews, one-time feedback sessions) experienced by deaf participants (which is also linked strongly to Issues of Hearing-dominated Research Settings), a Speculative Participatory workshop (SPW) provides a dynamic platform for non-formal education, encouraging active participant engagement. Rather than adhering to a rigid structure, SPWs allow participants to actively shape the discussion and bring ideas to fruition through their contributions. As a researcher, my role is that of a moderator, encouraging rather than directing the dialogue.

In the interviews, I asked about the participants' expectations of the workshop at the time of the invitation. It was about understanding what expectations they had before the workshop and to what extent these expectations were in line with the workshop experience. The following statements were made:

*[...] I thought that was a typical survey from universities, with rigid questions like “Do you feel hospitals are accessible?”, “Did you get an accessible education?” etc. Because I had one project and it had this kind of question. But your workshop was so different, it was like playing a game with friends in our own space. You did well by giving us this space, it was nice. It was not what I expected.*

– Interview P5/S, Pos. 39

*I thought it would be like you throw one question and we discuss it. Then the same with the next questions, not in a free way. For example, you ask us “What technologies would we use if there was no hearing person in the world?” and we reply to you. I thought the questions were related to technology and in a strict order. But then in your workshop, I was amazed that we can express ourselves freely and not just about technology. I didn't expect the workshop would have three parts, even more, when we got to film.*

– Interview P6/S, Pos. 41

As these quotes highlight issues with the format of above-mentioned research settings, which will be discussed further in Issues of Hearing-dominated Research Settings in detail, the SPW designed in this thesis transforms the “Questions-Answer” format into a “playing format” where free expression is allowed and encouraged.

### 5.1.2 Shape everything!

Participant P12 describes the unique opportunity of the free workshop, emphasizing that participants can generate ideas and discussions without limitations on responsibility, feasibility, budgeting, etc.

*I enjoyed the whole experience and it was an uncommon activity that I never experienced before. I have participated in different workshops for deaf youth where we brainstormed ideas that were about how to do politics or how to set up a camp. Those kinds of workshops tended to end with some actions that we just expected to happen or tasks to distribute between us. But your workshop was not like that, it was a nice experience to remember. Until your workshop, I hadn't experienced a workshop where I just had to share and leave without tasks or responsibilities. It wasn't just that, you also allowed us to think of another world apart from the Earth.*

– Interview P12/S, Pos. 5

Participant P13 adds that all ideas were validated, and there was a detachment from real meetings, allowing for playful and creative developments within the workshop.

*I liked from the discussion that we never disapproved of any idea any of us shared. In real meetings, some ideas would be dismissed because they are impossible, because of budget, or because the technology is not that advanced yet, etc. We didn't experience it in the workshop and we took all the ideas as good and possible.*

– Interview P13/S, Pos. 7

Hence, the SPW can be understood as a dynamic and living space, emphasizing the importance of Deaf Space, which will be discussed in the corresponding section Deaf Space. This setting provides an opportunity for participants to gather, occupy space, and shape their discussion collectively. The research setting focuses on collective participation rather than one-on-one interactions between a researcher and participants answering questions.

### 5.2 Eyeth as Alternative Narrative

Through SPWs, deaf participants have the potential opportunity to engage with their vision of the world within Eyeth. These workshops not only challenge participants to imagine Eyeth but also empower them to shape their vision. Consequently, participants have the opportunity to explore their imaginations and articulate their ideas. Simultaneously, Eyeth provides a sandbox to be shaped. However, this process can be challenging, as participants must first detach themselves from entrenched ideologies associated with Earth and then construct an ideal world that reflects their desires.

*I have never really thought about the kinds of questions that were asked, especially about this kind of inverted world which was hard for me to imagine because, of course, we are used to living in the world as it is, and I had to just get out of this way of thinking and imagine myself in a different kind of world.*

– Interview P1/A, Pos. 2

As the participants make their initial ideas fruitful and share them with others, a multiplicity of individual and group ideas emerge - a shift to actively engaging with the topic.

*I thought I would struggle to imagine a whole different world because it is too fantastical for me. But, in the end, I could imagine different situations. I imagined so many possible situations that I felt myself out of reality.*

– Interview P12/S, Pos. 4

The basic idea of Eyeth is to transcend ideologies and thus expand one’s own horizons by opening up a new landscape of unlimited possibilities. It is about creating space for new visions and moving away from conventional concepts.

*I enjoyed the most the first one: thinking. Your questions made me think of things that I wouldn’t think in daily life. After the workshop, while I was working, I realized that I could give even more answers. It was nice to bring those ideas to action in the filming part, after discussing and agreeing on our different ideas.*

– Interview P7/S, Pos. 13

This quote from P7 highlights the participant’s enjoyment of the thinking process impulsed by the workshop, leading to reflections they wouldn’t typically consider in their daily routine.

Furthermore, the concept of “Eyeth” encourages reflection on the fact that the earth (referring to the “ear”) is inherently designed for hearing people as well as further imagination on what it would mean if Eyeth (referring to the “eye”) was specifically designed for deaf people. Based on Eyeth, participants are encouraged to develop ideas.

*I never really thought about the connection between Ear-th and Eye-th. Of course, it’s a wordplay, but somehow it’s so true that I feel I would find Eye-th like my home, and that’s why I had so many ideas.*

– Interview P12/S, Pos 5

Furthermore, Eyeth encourages the participants to question what it would be like if their surroundings and beyond are deaf, which contributes to reflecting on the narratives they are creating.

*[...] I think, in school or growing up, I have never really talked about this topic. Even though we discuss society and issues within society, how we treat each other, we never really talked about a society that would just consist of deaf people. We always think about the deaf community being added onto the hearing world and adapting to the hearing world. But thinking about a world with just deaf people, that was really nice and I really enjoyed it. Also, afterward I felt stronger, or I don’t know how to say it- It was just so interesting to discuss these subjects, and I could take a lot of thoughts with me.*

In conclusion, Eyeth serves as an alternative socio-technical narrative, enabling participants to break free from current narratives, question the current system, and explore alternatives that meet their desires. It thereby provides room for reflection and imagination, allowing participants to explore alternative ways as part of self-development, which will be explained in the following section.

### 5.3 Personal Reflection

Below I will outline personal reflections of the participants that were shared in the interview. These include participants' experiences of how the workshop contributed to their personal growth, what they learned from the workshop and how they challenge the current systems associated with Earth, and therefore Eyeth as an alternative narrative.

#### 5.3.1 Influences from Personal Experiences

Navigating a world not designed for them, deaf individuals possess a profound understanding of what inaccessibility entails for their lives, leading to ideas and inspirations for change. Thus, the workshops provide the participants with the opportunity to articulate their experiences and imaginations dynamically. By having a peer group, they may not only exchange their experiences but also discuss how to deconstruct the barriers in their ideal way.

*I think accessibility is combined with the ideas of the deaf community. Exactly that from the barriers that we experience in our daily lives, we can really learn from internalizing this experience, and then draw from our experiences how we imagine things. Because within our experiences that we collect, we can try to change something. And we might come up with a way how things would be easier for us. Of course, we have always encountered barriers in our lives that we have internalized, and if we think about a different world that would be our world we know how we could do it another way, how we could do it in an easier way for us as a community.*

– Interview P4/A, Pos. 18

#### 5.3.2 Appreciating the Variety of Perspectives

While the participants initially assume the similarity of their visions due to having similar profiles within the group, the workshops allow them to reflect on the bias of assuming similar experiences, as each deaf person has different experiences, perceptions of the environment and therefore their ideal, and ultimately, how to navigate through the world. The setting of the workshop helps to recognize the different perspectives within the group and thus the nature of the workshop is to share and learn from each other.

*We had such different perspectives, which also made me realize – coming from the expectation that we would all have similar opinions, and then realizing that it was not at all like that made me see that our needs are so different as well.*

– Interview P2/A, Pos. 36

Instead of assuming the same perception (which may have been biased by the similar profiles within the workshop), it was very important for the participants to experience different perspectives, leading to discussion through exchange.

*The most interesting thing for me was when we put our different opinions together and exchanged ideas. Everyone had a different perspective on the topics, different ideas, and that was great fun to see.*

– Interview P11/G, Pos. 9

### 5.3.3 Questioning the Accessibility

Furthermore, SPWs engage in open dialogue and demystify issues that are prevalent in today’s world. They help to challenge audism as they emphasize the fact that the world was not designed for deaf people and remains largely inaccessible to them. The focus shifts from understanding individual “issues” to systemic problems. This aspect of personal reflection can be seen as a form of growth, as the workshop offers the individuals the opportunity to empower themselves.

The following quote underlines the importance of the project for the deaf people, particularly in terms of challenging the prevailing ideologies around accessibility and shifting the perception of systematic problems rather than individual problems. The workshop has the side effect of encouraging people to question the current system, to confront prevailing social norms, to change perspectives and to recognize their own values:

*[...] I feel the project is important for us deaf people. Because we do know that the actual world, the earth, is not accessible to us. While imagining the ‘other’ world, we were surprised to realize that we are not responsible for this problem. The problem is them. Until now, we thought we were just wrong because we could not reach their level and we try to be at their level. But we are good, the problem is them. [...] I feel the workshop helped us realize this.*

– Interview P4/S, Pos. 24

P13 questions the notion of a perfect world and what contribution the concept of Eyeth makes in questioning one’s own perception, namely in terms of the perception of accessibility, which in the end run still means adaptation. While Eyeth offers an imagination of alternative narratives, P13 also feels confronted with the existential question of the “current world”.

*The workshop made me start thinking about what is meant by a perfect world. I always understood the world from an accessibility perspective, that was more about how we can adapt ourselves to hearing people. It was amazing to imagine how to be ourselves, without adapting to others, and at the same time, it was sad to see that we will never have the world that we want. Thus, the workshop made me think if the world that we have now is good enough for us.*

– Interview P13/S, Pos. 2

Finally, P9 reflects that since technology has been an important part of deaf people's lives, but it's still embedded in the accessibility issue, questions arise about developing technologies that center around being deaf:

*For the last 20 years, technology has become important in our lives, like subtitles, the whole accessibility, the smartphone, we can videocall. It is not the same as it was in our parents' time. It made me realize that I forgot that we can develop technology without the usual purpose of accessibility for the deaf. It hit me. Why can we not just develop technology? Why should we always look for accessibility adaptations for the technology they developed previously? We can use just technology designed for us.*

– Interview P9/S, Pos. 14

### 5.4 Attitude Towards Technology

The participants' attitudes towards technology vary: while some participants are tech-savvy, seeing technology as an important part of their daily lives, others take a less tech-savvy stance. Some are also skeptical about technologies, especially due to the rapid development and its consequences.

The SPW provided the opportunity to engage with technologies, expand perspectives on possible implementations, and transfer them to various domains. Participant 3 (P3) shared this experience:

*I feel that I learned a lot more about technologies, so yes. For example, the traffic light with vibrations or some other things that we came up with for possibilities. I wouldn't have thought of so many options! For example the flying stop sign would not be bad, so there are a lot of technologies that I wouldn't have thought of before.*

– Interview P3/A, Pos. 29

The following quote (especially the bold parts) illustrates how P1 reflects and changes her attitude towards technology during the workshop and in dialogue. In particular, she acknowledges that technologies actually offer opportunities and possibilities to change things:

*Through the workshop, I think that I was able to become **a bit more open towards technology**, because I realized what opportunities there might be, and what solutions there might be, so it does not always have to stay the same.*

– Interview P1/A, Pos. 24

Regarding the discussion of sign language avatars, P1 initially withholds her opinion on these technologies:

*I had not really thought about the avatar that much until I came in contact with you. Then I realized there is such a thing as a signing avatar. Also in the workshop, talking about it, **I do not feel like I have a fixed opinion on signing avatars**, because I have not really been concerned with it much, but as I said before, it really depends on how the avatar works and if it makes sense to put it to use in many different contexts; which I do not think, there are always pros and cons.*

– Interview P1/A, Pos. 28

However, her position evolves over time through conversation, leading her to articulate a clearer opinion and express it:

***And in my opinion, signing avatars would be more useful in public transport, like having them appear and signing where the exact location is at the moment, which is nice. Of course, you would still need the information in written text too, otherwise there might be misunderstandings. Of course, there can always be misunderstandings, but yes. I think the avatar does not make sense for social situations and interactions, for example. . . It just doesn't make sense, I cannot imagine replacing a sign language interpreter with a signing avatar because you cannot build any kind of relationship with this avatar, so this just does not feel right. The avatar is, of course, neutral in its behavior at all times so this just does not feel right to me.***

– Interview P1/A, Pos. 30

This change in attitude towards technologies highlights the importance of engaging in dialogue, confronting participants with examples, and discussing possible applications. These opportunities for exploring technology need to be facilitated, as otherwise, there would be no means to address the topic effectively.

## 5.5 Issues of Hearing-dominated Research Settings

The participants shared issues associated with hearing researchers as well as hearing-dominated research settings based on their experiences. Concretely, deaf participants shared that they feel treated as a disability group to be researched about within formal settings, rather than being provided with true participation, making them feel like they are merely ticking boxes for the researcher's agenda.



For example, P6 expressed concerns about trust and understanding in workshops led by hearing researchers. They stress the importance of having a deaf researcher who shares a similar identity and can better comprehend the participants' needs:

*It might impact the trust. [...] It wouldn't make sense if the workshop leader was a hearing person. We wouldn't know if they understand what we want. If the leader person was a deaf person, we wouldn't have to expand the answers because he/she understands what we mean as they live as a deaf person every day too. We share the same deaf identity and he/she understands us better. It would be different if the leader was a hearing person.*

– Interview P6/S, Pos. 60

Adding to the issues regarding a hearing-led research environment, P6 highlighted the discomfort that may arise when a hearing facilitator attempts to follow discussions, emphasizing the importance of shared experience. Failure of setting a safe space may lead to distortion of the results:

*If during the workshop we feel blocked with one idea, how would the leader orient us as a hearing person? He/she can get the idea wrong and we would feel uncomfortable. You, as a deaf person, can give us examples that we feel resonated with. A hearing person couldn't do it. That is why it would be different, the results would definitely be different.*

– Interview P6/S, Pos. 59-60

Finally - a common feeling among the participants - P11 describes the mentioned research environment as depicted in the movie “*Trueman Show*”, where the life of the protagonist is constantly observed by the others:

*There's this movie called 'Trueman Show'. [...] A person lives his life normally and everyone else watches. That's how I always feel as a deaf person. Like an animal show of monkeys at the zoo. You are observed from above. Oddities are noted down. You are observed and someone else notices things and makes a note of them. That makes me feel very uncomfortable.*

– Interview P11/G, pos. 23-24

This analogy illustrates the sense of scrutiny and discomfort that deaf people experience when they feel constantly observed and judged by hearing researchers.

### 5.6 Deaf Space

This section aims to discuss the importance of Deaf Space, which can be understood as a safe space for deaf people gathering in research settings. In the context of my thesis



work, Deaf Space means deaf-led research and deaf participants, where the participants can shape the workshop process.

P10 argues that a hearing and non-signing environment brings the risk of language barriers as well as conflicts of cultures within the research environment and therefore emphasizes the importance of direct communication and the needs of the Deaf Space. For example, P10 shares her experiences of communicating different ideas and assessing their feasibility and the resulting problems.

Specifically, in the context of hearing environments, deaf participants have to explain the background of their ideas in detail while constantly assessing the rationale for the ideas chosen, and the nuances of feasibility (degree of viability of ideas from “joke idea” to “serious idea”) as well as making sure that the priorities of ideas (from must-have to good-to-have) are not lost in translation due to cultural differences between hearing and deaf people. Another aspect is the lack of collective nuances gathered from background experiences.

Furthermore, regarding the translation process in unstructured sessions, the lag becomes significant again to the disadvantage of deaf people when they have to explain to the hearing person (through sign language interpreters) while other hearing people are already continuing discussions on the next topic.

The need for a deaf-centered research setting not only relates to the above points, but within a Deaf Space there is not only direct communication, but also a higher level of contextual as well as nuanced understanding that is often inherent to the deaf experience. A hearing researcher may not be able to grasp these nuances.

*If they take the time to explain to a single person that the other participants are already continuing their discussion and they are left behind again. This takes up almost ten times as much time, explaining all the background. When you're among deaf people, you don't need to do that. You also think differently: 'Is this important now?', 'Do I want to say something about it?', 'Oh, maybe later.' Then the hearing people ask: 'Really, that's how it is with deaf people? Aha.' But that didn't happen at your workshop, I made completely different decisions. That would be 'nice to have' now, the atmosphere is different. You don't say it out loud. You don't pay so much attention to the nuances. You immediately recognize that something great is developing and everyone feels the same way. Hearing people always say 'Aha, oh, really?' This confusion is eliminated with completely deaf participants, you don't have to explain yourself all the time. It's much easier to differentiate between what is being discussed and how it is meant. So whether it's a joke or a dream. You don't have to explain so much extra stuff to deaf people.*

– Interview P10/G, Pos. 29

Moreover, P9 illustrates the pressure on deaf participants to represent the deaf community positively in the presence of hearing researchers to avoid possible outcomes that do not represent the deaf community, or represent it in a negative or stigmatizing way.

*Deaf people have few opportunities of having their own space. Now that we have that, would it be a good idea if a hearing person joins us and researches us? In the end, just the hearing people can benefit from our answers. When a hearing person is with us, I feel accountable to explain to him/her about our answers and show him/her that we as deaf people are skilled and our good things as deaf people. We are always prepared to do so when we see a hearing person, in order to make him/her trust the deaf community and support sign language. We wouldn't have this kind of mental load if the leader wasn't hearing.*

– Interview P9/S, Pos. 50-51

Participant P5 reflected on the importance of creating deaf spaces, where deaf people can explore freely without the presence of hearing people.

*No, it is definitely better for all people involved to be deaf. Hearing people do not know how it feels to be deaf and they don't know the situations we are in. Growing up, every single second of every day, we know how it feels to be deaf and hearing people don't know it. They can learn about it, but they never know how it really feels, they can't empathize.*

– Interview P4/A, Pos. 32

P9 shares his experiences in another deaf setting and format:

*I have good memories of Frontrunners when we shared ideas or when we experienced teamwork. I didn't have a lot of opportunities to do similar things since then. I liked having this opportunity again with your workshop as everyone was deaf and led by a deaf person like you. It took me back to my Frontrunners time as daily I don't think of the topics discussed there. With your workshop, we had our own space and I didn't have to be cautious about saying what was in my mind because I knew everyone will understand what I mean and I won't be judged. It felt great.*

– Interview P9/S, Pos. 6

Finally, participants shared their fatigue of participating in different studies that end with negative feelings, such as studies that are often focused on barrier issues but in themselves are also barriers. For example, the lack of direct communication is mentioned by P13.

*That is the problem. Deaf people get tired of it. If it wasn't you but another hearing-led research, I wouldn't participate because I don't see any point. Many hearing researchers keep asking me to participate and I end up fed up with it. [...] I would have to bear their attitude and communicate through a sign language interpreter and so on.*

– Interview P13/S, Pos. 31

In conclusion, the quotes show how the Deaf Space serves as a safe space where deaf people can communicate freely, share experiences and see their ideal world without the limitations imposed by hearing environments. In this case, access is understood through direct communication (shared language) between deaf people and collaboration in terms of exchange.

## 5.7 Importance of Reciprocity

The following quote from P6 highlights the link to other areas: Firstly, the problems of the hearing-led settings, as discussed above, that made P6 feel like a guinea pig (analogous to the Trueman show). In addition, it highlights the importance of deaf space as discussed above as well.

However, deaf research environment and reciprocity, as underlined in the following quote, in this case was achieved by having an introductory explanation of the goals of the work, how they can participate and shape the results and what their contribution means to me as a deaf researcher and therefore to the research community. This is the way to understand the importance of conscious participation as well as feeling valued and informed.

*In the other research project, [...] I felt it was long and I ended with a headache. I felt they treated me as a guinea pig. Nothing was explained, and no results were shared. The authorization was signed by my parents, and then in the school, they came to interrupt my class and asked me to go with them. Now with your workshop, it is different because I know what it is about and the aims. So, I can be more conscious of what I can give with my perspective as a deaf participant, and that my contribution is important. Some actions will be influenced by the opinions of deaf people because it is a real representation.*

– Interview P6/S, Pos. 48

The participant P5 illustrates her experience similar to P6.

*After replying [to a classic survey] to what obstacles I experience in my everyday life, like having no access to sign language interpreters or sharing that sometimes I don't feel safe in the world out, I leave the room a bit disgusted because I am even more aware of the obstacles I live with. In addition, I never know what they do with all the answers I shared. The information I gave might help them, or their project. What about me? I still don't know what happens after I share with you my answers; [in contrast to other research,] I felt good doing it [for your master's project]. It is a good exchange: you get information for your work and I enjoy doing it.*

– Interview P5/S, Pos. 117

To link to the prior importance of deaf research settings, P13 emphasizes not only the indispensable role of deaf researchers in conducting research within the deaf community,

but also the importance of reciprocity in research relationships and advocates for a continuous cycle of learning and sharing between researchers and the community.

*With deaf researchers, they are peers and they understand what we mean by our answers or with our experiences because they experienced it too. Hearing researchers will never be the same as deaf researchers. They would never say they don't understand or miss certain information and they cannot be emphatic like deaf researchers. I believe there is only one good way to do this: with deaf researchers, if it is the deaf community. Plus communication must be direct and open. Also teach the deaf community about things, instead of only extracting information for the researchers' own benefit. You must give back to the deaf people, so they can learn and they feel they also get something. This way ideas build up very fast, because when people understand something better, they can give you better ideas and responses too. [...]*

*It must be a continuous cycle, not one-way. That is important.*

– Interview P13/S, Pos. 29

Furthermore, P9 stresses the importance of accessibility of academic publications as part of the reciprocity. He also emphasizes the importance of closing the gap between academic and deaf communities.

*The papers should be published with a video in sign language. The academic people should bring themselves closer to us. They shouldn't feel superior to us and we should be treated equally with more exchange of information. The academic world has many resources that we can use. We can build this bridge between communities. Deaf people, who work in federations, services, and deaf schools, can profit from their resources because they work with deaf people daily and academic people don't.*

– Interview P9/S, Pos. 95

The quote should be understood as a call to academic institutions to value and work with the insights and resources available within the deaf community.

Furthermore, insight into the research leads to positive experiences as well:

*I feel that I could get an insight into your world and get to know the issues you touch on in your research. Otherwise, there are not really opportunities for me to get an insight into your work and into your field, so that was something that I think I could take from the workshop. Also, the knowledge about these issues that they exist which I knew, but I wouldn't have seen an opportunity to get an insight into your work in any other way. This is a positive for me.*

– Interview P1/A, Pos. 34

## 5.8 Needs of Pipeline

Throughout the workshop, participants' attitudes towards technology have shifted, leading to a stronger sense of appreciation for their own ideas. However, it has become evident that the intended pipeline for realizing these ideas is lacking. In addition, many participants shared their frustration about the lack of resources, budget and access to materialize their ideas.

The following quote highlights the importance of centering deaf people in the design process and development rather than simply being a passive consumer:

*I can see it from the discussion we had in the group. We just need the resources, the budget, the experts, the researchers, etc. But we already know what we need, who knows better than the deaf about what the deaf need? They shouldn't work "for us", but "with us". As I said before, who knows better than us? They can bring our ideas to action.*

– Interview P9/S, Pos. 74

In addition, P9 desires to learn how to transform ideas into actionable steps, describing the challenge of taking concrete actions due to a lack of knowledge or support system.

*I want to learn how to take action. We tend to not know how to take action about the ideas we have, who to contact, which kind of support we can get, etc. I feel we are stuck because of it and not because we have any problem with brainstorming. We just have to figure out how to do the next step.*

– Interview P9/S, Pos. 103

In the following section, I will illustrate some aspects that influence the understanding of how developing ideas contributes to a positive perception of one's own value:

*I feel proud of ourselves as deaf people that we can get very good ideas even though we are not scientists or engineers. We always know how to deal with challenges in our lives. [...] For example, if we see a light in the wrong place, we think about how to improve it by moving it to another place. We always come up with ideas, even if we are not designers or architects. [...] Nevertheless, we are always ready to come up with ideas and it is a pity when they are not taken on by the technology experts because of the gap between both communities. Precisely because of this gap, we often don't take our potential ideas seriously while the hearing experts work on really bad quality products.*

– Interview P12/S, Pos. 40

However, this sentiment does not apply to all participants, as some feel that the ideas of Eyeth remain to be desired:

*I think that is because... It is never possible for these imaginations to be realized anyway. Of course, it was great to think about it but I know that this will never happen in real life, so that is a little bit of a shame and that might be the reason.*

– Interview P3/A, Pos. 11

Some participants view Eyeth as a place to dwell on a pessimistic perspective:

*I was thinking strongly about Eyeth of course, this might be a little bit of a pessimist thinking but I think we would never reach this kind of goals that we were talking about in the workshop. We can imagine things, but in general, there might not be an outcome, because that is so far away for us. And we are only doing tiny baby steps, right? So that is something that I think about which might be a little bit of a negative point of view.*

– Interview P1/A, Pos. 16

This highlights the issue that there is actually little to no opportunity for deaf people to implement their ideas or even have the resources to do so.

However, Eyeth can also figure as hope, as P4 explained in the workshop and interview:

*[...] In this world we have many things that we just accept, barriers that we just accept. We talk about it with our friends and stuff, but we take it, it is normal for us to just accept and take it. And in the discussion, in the end we came to reach the state of hope. Hope that it does not have to be like this for good. Maybe we can slowly but steadily change some things and add new things, one at a time- for in the end there is a big change that happened.*

– Interview P3/A, Pos. 84

Thus, the following quotes emphasize the need for more deaf researchers in tech fields and therefore more awareness and information about the potential of technology. In combination with these factors, a strong pipeline can be provided, allowing deaf people to be at the center of technology development.

*So it would be really cool if more [deaf] people would be involved in this area of work and study [in technology], then it would be easier to develop actual artifacts, too - for this process to be accelerated.*

– Interview P1/A, Pos. 70

P1 adds that this type of pipeline also provides opportunities for deaf people to learn more about technology and therefore change their attitudes towards technology by learning the potential of technologies in the context of Deaf research settings.

*And it would be really cool for these [workshop] opportunities to arise more often in the community, for spreading the notion of the technologies a little more because in general, the deaf community is very negative about the avatar, which I was too, so this would be a possibility to countersteer against that and change that narrative*

– Interview P1/A, Pos. 70



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# CHAPTER 6

## Discussion

The objective of this study is to explore novel socio-technical narratives of the deaf community and to investigate the integration of deaf-centered design principles into technology development processes.

As introduced in the chapter Background, technology plays an essential role in the daily lives of deaf people. However, it is important to recognize that existing technologies are shaped by prevailing ideologies that focus primarily on addressing deficits, or even through accessibility paradigms without considering the needs and desires of deaf people. As a result, issues of self-determination and the desire for technology that puts the deaf community at the center come to the forefront.

In response to the growing awareness of the importance of user-centered design, which is present in the field of assistive and accessible technologies, this research introduces a novel lens: a deaf-centered design approach. This approach does not only place deaf people at the heart of the design process, but also gives them the opportunity to actively shape the technology landscapes. This means that the approach goes beyond “involving users early in the design process” and builds a bridge of mutual exchanges as this study is led by a deaf HCI researcher (myself), which emphasizes the combination of community belonging and the perspective through a technology lens.

In the following sections, I will discuss several key aspects: (a) the role of participatory design in fostering the generation of alternative socio-technical narratives and the notion of research participation as a personal experience (b) the significance and implications of deaf-led research (c) the conceptual framework of Eyeth for speculative storytelling (d) an exploration of the concept of Deaf Tech and (e) potential challenges and limitations that may impact future directions.

### 6.1 Meaning of Deaf Research Settings

#### 6.1.1 From Participation to Space

In the context of this research, the Participatory Speculative approach enables the initiation of a *Space* that differs from (traditional) research approaches characterized by rigid formats, face-to-face feedback sessions and structured question-and-answer situations (see Dynamic Workshop Experience) and therefore tends to restrict the space. However, the problems do not only remain limited to the rigid formats. There is a lack of dynamic participation of deaf people, which highlights the need for creating a space for multiple deaf participants which is led by the deaf researcher.

Specifically, the workshops are designed in such a way that the space is transferred to the participants, so that they can take over the space and thus generate and shape the stories according to their own approaches (to a certain extent). This means that the potential deaf end-users can not only actively contribute, but also come together to share ideas and participate in the design (see also Non-formal settings).

This space of engagement goes beyond mere participation; it promotes meaningful exchange and contributions. It transforms the research environment from a formal setting into a dynamic space of non-formal learning – a learning space. Here, participants have the opportunity to learn directly or indirectly through the exchange of ideas. The researchers take on a moderating role and enable the participants to actively shape the environment.

Through interactions on a peer-to-peer level (i.e. deaf to deaf) and the dynamic nature of the workshops, this space enables the gathering of rich and diverse insights. It serves as a meeting place for both researchers and participants, offering data to the researcher on the one hand and an introduction the world of academics to the participants on the other hand.

The extensive exchange and contributions within this space create valuable experiences for participants. Workshops do not only generate ideas, but also encourage participants to understand and reflect on the intentions of others behind those ideas, which promotes transformative learning (see Personal Reflection). In addition, indirect team building reinforces a sense of belonging and ownership of ideas, i.e. in the context of discussing their ideas retrospectively after the workshop.

Positive experiences within this participatory framework lead to reciprocity (see interview in 5.7), which is crucial for sustained participation and acceptance of research process. This includes activities such as the exchange of ideas, reflection, the discussion of systemic issues and the collective development of goals, meanings and impacts of research.

Instead of retaining the space on behalf of the researcher, they let the participants create freely, which not only achieves effects such as the generation of stories, but also relevant side effects such as creating a collective (learning) experience, building knowledge and reflection, exploration of research concepts and joyful moments.

### 6.1.2 Importance of Deaf-led Research

Deaf-led research in this thesis means that I, as a deaf researcher, am leading the entire research process with deaf participants. The research process includes developing the project, conducting the research with deaf participants, and evaluating the research. The advisors of this thesis are a hearing researcher who is proficient in ÖGS (B2 level) and a deaf researcher.

Deaf-led research, in the context of this thesis, also means that I adapt and shape the methods to the needs of the deaf participants and try to detach existing concepts from a hearing perspective. In doing so (as discussed in Positionality), I actively bring my background influences into the research. When working with deaf participants, my approach involves adapting to the dynamic situation. This includes adjusting schedules for DST<sup>1</sup>, organizing spaces into arrangements such as U or O form to facilitate discussion, providing materials and possibilities for expression through various means such as writing, drawing, or signing and filming. In addition, I incorporate Eyeth mythology to foster relational connections and identification. I also reflect on my methods, such as reflecting during the interview process, maintaining camera posture, and taking notes while signing without breaking eye contact. I also consider the translation process through interpreters and the interpretation of data from complex cultural and social perspectives. I am aware that deaf-led research involves an interplay of existing methods and interactions with deaf participants. The “re-evaluation” of the application of methods - especially in the context of working with deaf people - highlights the importance of reducing the risk of deaf people having to adapt to the existing system (e.g. as discussed in the issues of signed video on survey in Absence of Practical Guidelines). Reflection on existing methods facilitates shaping the methodological design that meets the needs of deaf people.

In the context of working with deaf people, there are two key points to consider: being deaf (identity and culture) and using sign language.

- (a) As part of the deaf community (and Deaf culture), I may have a deeper understanding of lived experiences, leading to nuanced interpretations of dynamic issues brought up in the workshops and the data generated from it.
- (b) I have a profound knowledge of sign languages since they are my primary mode of communication, which means that discussions can take place directly without intermediaries (i.e. sign language interpreters), enabling direct communication and understanding of linguistic nuances. However, this proficiency only applies to German and Austrian sign languages, as I have only intermediate knowledge of Spanish sign language.

As observed in the interviews, there is an emphasis on the importance of (i) Deaf Space (5.6) which refers to the space of deaf people only and (ii) Reciprocity (5.7 reflecting on the importance of mutual exchange).

<sup>1</sup>Deaf Standard Time, describing the culture of deaf people regarding the perception of time [116]

Fundamentally, it is important to acknowledge the lack of deaf-centered research in the field of human-computer interaction (HCI). Furthermore, deaf people often feel like test subjects (see “guinea pigs” quote in section Importance of Reciprocity) of hearing researchers; this is not limited to HCI research as highlighted in the interviews (5.5). Deaf-centered research - in contrast - may allow to contribute meaningful interactions within the deaf community and create space that allows for direct communication where participants may feel comfortable.

In this setting, direct interaction (especially knowledge of sign language) allows not only the participants but also the researcher a certain contextual and high-level understanding that creates a communicative level for everyone. This may be limited in the context of hearing researchers; it includes knowledge of (a) sign language (b) deaf community / Deaf culture, and (c) acknowledging one’s own privileges). However, the assumption of shared experiences in the context of DEAF-SAME may lead to overlooking inherent inequalities within deaf communities [39]. Addressing these inequalities (as discussed in Positionality), including issues of access to education, socio-economic status and social position within and outside the deaf community, is essential.

Finally, within the scope of my work, deaf-led research in combination with Deaf Space emphasizes the critical role of communication, covering key aspects:

**Building Trust** Deaf-led research may address previous negative experiences in hearing-centered research environments, as reported by participants in the interview, by providing clear research goals, objectives, and methods, as the issues around hearing-centered settings may be connected with the lack of direct and clear communication as well as explanation. However, not only clear and direct communication is essential to build participants’ trust and improve understanding of the meaning and results of their contributions, but the subtle need for a certain relationship with the deaf researcher (in the sense of being deaf peers) is also significant. Finally, trust should be critically considered and reflected upon, especially for (deaf) researchers, given the predominance of hearing audiences in the academic world. It is important to recognize the value of collecting data in an environment of trust. So, when presenting research findings to a predominantly hearing audience, it is essential to acknowledge the contributions of deaf participants and to emphasize the need for sensitivity and care in sharing those research findings.

**Reciprocity** Deaf-led research in combination with a participatory approach encourages a culture of mutual support and exchanges where participants feel valued and empowered to make a meaningful contribution. This sense of reciprocity encourages active engagement in the research process. This, however, should not automatically be considered based on deaf research settings, but rather critically understand how to communicate to the participants what their contribution means to the research, applicability of research objectives and potential benefits of outcomes.

**Community** Deaf people tend to have strong connections within their community, which means a special characterization and responsibility of deaf researchers which requires continuous engagement and communication. While belonging to the community can reduce the discrepancies between participants and researchers due to mutual exchange, this may be overestimated if not adequately considered by the researcher. Furthermore, the responsibility of the deaf researcher may have an impact on the results of the research and how the results can then be reflected to the community. These issues are also discussed in the work of [7] about *double-bind* between hearing developer and deaf leader in signing avatar, an issue applicable to hearing audiences in academia as well.

## 6.2 Exploring Eyeth

Deaf-led research (belonging) and the dynamic workshop (living workshop experience) foster a space for creativity and the generation of speculative narratives (i.e. stories). In this context, speculation, particularly in the realm of *Eyeth*, provides an opportunity to break free from current ideologies and immerse oneself in a new landscape to create freely. Eyeth can be understood as a sandbox for the free exploration and creation of one's own vision. This approach challenges participants to go beyond traditional concepts of accessibility, for the following three reasons.

- (a) It shifts the focus from traditional questions about accessibility to a focus on the experiences of access of deaf people in a different context, as indicated by the findings from the participant interviews. Deaf participants used to deal with issues of accessibility (*needs*) rather than what they want (*desire*).
- (b) Even though the workshop offers the opportunity to freely shape the new landscape, some participants face the challenge of working with ideologies. These are reflected in the discussions in the workshop and include, for instance, internalized audism. Leaving these ideologies behind is encouraged through the opportunity for self-reflection and discussion with other participants.
- (c) Eyeth introduces the idea of free creation and expression, where sign language is at the center and deafness is not a limiting issue. The dynamic workshop facilitates the introduction and discussion of ideas and allows free speculation without professional, technical or financial constraints.

In this way, Eyeth's narratives can be understood as socio-technical phenomena. Consequently, researchers have the task of analyzing and developing components: (a) exploring the understanding of deaf technology, (b) assessing technical feasibility and prototyping, (c) understanding systematic issues and pipeline needs and, finally, (d) the relevance of ongoing collaboration with the deaf community.

## 6.3 Meaning of Deaf Tech

### 6.3.1 Components of Deaf Tech

In the speculative workshop, I do not aim at asking for specific technology in a manner of extraction but rather to collect stories from their vision of the Eyeth. By collecting these stories, I seek to investigate the intertwined technological ideas in the context of Eyeth and, as a consequence, which technological realizations and their feasibility can be investigated further. In this section, I want to provide an understanding of the components of Deaf Tech gathered from the workshops and thereby provide the foundation for further research on Deaf Tech.

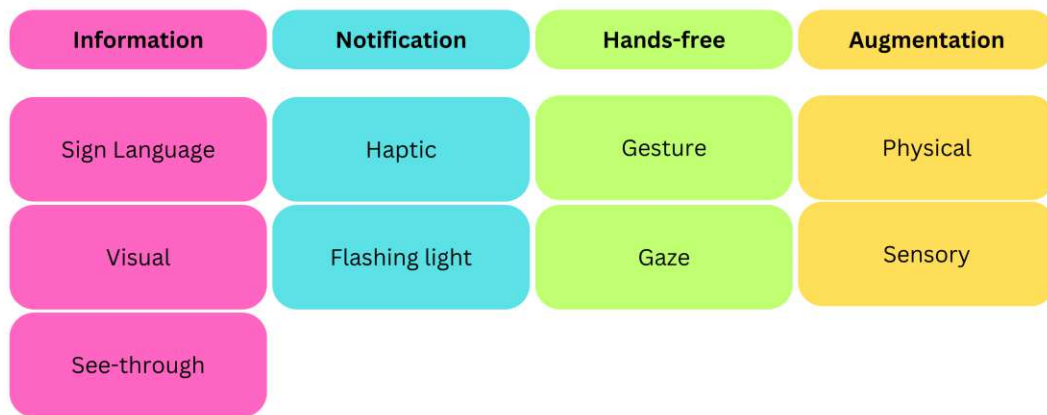


Figure 6.1: Components of Deaf Tech

#### Information

In the context of technological design, providing seamless information is one of the fundamental aspects. Hence, sign language (4.1) as the main language of communication is the central element of the design. In order to send and receive sign language files (e.g., through screens with signers, video calls via hologram, etc.), there is a need for a central representation of sign language on various levels (2D screens 4.3.2 or 3D holograms 4.3.1, as well as representation by human 4.3.1 or computer-generated avatars 4.3.1). Additionally, there is a need for the recognition and capturing of sign language in order to provide sign language information.

Furthermore, the visual aspect is central, as explained in the stories 4.1. The concept of the visual would therefore involve how design technology is structured to correspond to the visual perception of deaf individuals. For example, as shown in the dashboard of the SmartWatch 4.13, the center is the signing content, while the surroundings add more information. In addition, the study [10] shows that deaf people perform better at

peripheral attention in comparison to hearing people, which may also influence design considerations.

Lastly, see-through is an aspect that appears in various contexts such as glass buildings 4.4, direct eye contact 5.6, holographic displays in smartwatches 4.7.2, including discussions of privacy 4.4. See-through is a translucent element that allows for increased visibility of spatiality, which not only serves the purpose of allowing communication, but also provides information about the spatial surroundings.

### Notification

Notification, in this context, describes the feature of alerting the user to general information or emergencies with heightened attention. This could involve visual flash signals, for example, dynamic street lighting 4.8 or haptic signals such as vibrations in a smart jacket 4.7.4 and vibration plates at traffic lights 4.4. However, notifications may not be limited to either visual or haptic, but provide haptic-visual information as a combination of these modes: For instance, a flashing light alarm clock with a vibration plate.

### Hands-free

The hands-free experience (on Earth only known from auditory-based hands-free interaction), allows users on Eyeth to navigate devices without the need for physical contact. This can apply to gaze-based interactions, as demonstrated by the example of video auto-stop-and-return 4.3.2. This allows a smooth switch between watching and pausing the video. For gesture-based interaction, as shown with the example of the smartwatch in 4.13, this allows switching between contexts smoothly because signing is never interrupted.

### Augmentation

Augmentation allows for the enhancement of human capabilities by providing additional information or actions. In the context of sensory augmentation, the focus is on visual augmentation, such as through contact lenses 4.7.3 which provide additional visual information. Physical augmentation is evident in the importance of having both hands free for communication, as shown in 4.13. However, augmentation may not be limited by those senses, but also apply to other senses (olfaction, haptic, etc.)

#### 6.3.2 It's more than just Deaf Tech

The components of Deaf Tech are not intended as a checklist of features that technology ought to have in order to cover deaf-centered aspects. Rather, they serve to initiate a dialog regarding the understanding of Deaf Tech and its most relevant components in order to build a solid framework. Nevertheless, the experience of being deaf remains of utmost importance in this context. The emphasis lies on the “joyful experiences with technologies” of deaf people. Deaf Tech also aims to challenge the ideologies discussed



in the background of “technology for the deaf”, not only in terms of accessibility, but through a lens that focuses on the experience of being deaf. By furthering an alternative socio-technical narrative, the question becomes: *What if* the development of technology centered deaf people right from the start? Ultimately, Deaf Tech critically examines existing “technologies for the deaf” (TFD) and the ideologies that drive them: (i) instead of seeing TFD as problem solving, Deaf Tech focuses on deaf people as beings (ii) instead of seeing TFD as a resource for experimentation, Deaf Tech pivots on experience and self-determination and, finally, (iii) instead of TFD as an afterthought, Deaf Tech as a forethought.

It is also important to emphasize that Deaf Tech does not have to be fancy or cutting-edge. Sometimes what is necessary are practical solutions that meet the needs and desires and that are part of everyday devices without necessarily raising awareness (as discussed in a broader aspect in *Criptomias* [6]). In concrete terms, Deaf Tech means that the needs and desires of the deaf are the first priority, so that no effort is required to adapt the technology, but conversely, the technology places the deaf at the center, in the sense of being adapted without realizing it.

This does not mean that Deaf Tech rejects technologies “for the deaf”, but rather offers an expansion that is at the center of the deaf. This allows DHH to choose technologies that preserve their autonomy. Technologies for the deaf, despite the ideologies embedded in them, are still valuable as they enable decent degrees of access(ibility).

Yet, there is little to no research on Deaf Tech, which underlines the need for projects to raise awareness of the gap in research and encourage discourse. Ultimately, Deaf Tech may contribute to the optimization of the TFD based on the resulting understanding drawn from Deaf Tech, as it can respond to the needs of deaf-centric aspects.

### 6.4 What’s next?

#### 6.4.1 Rethinking Accessibility

In discussions about accessibility and design, the perspective of the non-disabled is often taken on and considered as the normative basis. These manifest ideologies in turn exclude marginalized people who have to find their way around systems on their own. In the context of deafness, this also includes the question of identity, among other things. However, deaf people do not necessarily describe themselves as disabled but view themselves as a socio-linguistic minority. This perspective may seem alien to those who are rooted in a hearing ideology that sees deafness as a deficit.

Consequently, deaf people may have a distinctly different understanding of accessibility, as is evident in stories about deaf animals and interviews on accessibility issues. This is the crux of the matter: Accessibility as it is traditionally understood does not align with the differentiated experiences of various people, a concept that is discussed within *Criptomias* [6]. In concrete terms, we must consider accessibility beyond functionality, putting lived experience in the foreground.



This leads to reflecting on the concept of universal design as part of accessibility technologies. Universal design does not aim at “adding” accessibility features, but rather to provide “one-size-fits-all” solutions. However, the feasibility of this approach is challenged by the inherent diversity of people, as each person has unique needs, experiences and desires. Furthermore, universal design often fails to challenge the normative status quo. The attempt to make everything accessible to everyone risks homogenizing experiences and neglecting the specificity of individual life experiences.

At its core, technology should be about empowering and responding to lived experiences and gaining insights from different narratives and stories. For this reason, Deaf Tech deserves its place, which addresses the needs and desires of deaf people and emphasizes experiencing access with technology, instead of solutions in the sense of the “to be fixed” label on issues. So the question is: How can we, as a society, envision inclusive, embodied technologies that cater to individuals?

### 6.4.2 Establishing A Pipeline

The results of the workshop as well as the discussions in the interviews with the participants show a strong desire not only to participate in research processes, but also to develop technologies independently, both individually and as a community. Specifically, deaf people do have ideas, but lack a platform and pipeline for their implementation.

Even though the economic system is usually geared towards profit, which is often measured in terms of user numbers and revenue, these measurements cannot be applied to the deaf community. However, this situation has a significant impact on gaining and securing funding, particularly for research purposes or to support start-ups.

It is important to understand the problem systematically and comprehensively: Many deaf people do not have access to sign language by birth and suffer the severe consequences of language deprivation as a result. There are significant problems in the school system, such as in Austria, where in 2021, only 1-3% of deaf people have obtained a school-leaving certificate (Matura) compared to 35% of hearing people [63]. There is a lack of opportunities for deaf people, especially in the technical field. Even highly qualified deaf people encounter limited opportunities for further development. [7].

When discussing the pipeline, I would like to link Criptopias [6] once again: Establishing a pipeline would not just mean providing access to settings, but also to provide ones in which deaf people can actively learn: “*We need to recognize that functional accessibility does not automatically indicate cultural and social accessibility.*” In doing so, the work [87] provides and reflects an initial example of how this can be put into practice: by providing opportunity led by deaf people a space to deaf people to experiment and learn. So, there are five key points about establishing the pipeline:

- (a) The pipeline is understood from the beginning to be accessed and continues this journey to achieve the goals.

- (b) The pipeline means the possibility to enter at any time and to acquire technical skills in this context.
- (c) The pipeline questions existing educational systems that hinder the deaf from gaining qualifications.
- (d) The pipeline also means to put effort into offering opportunities to the deaf to participate.
- (e) Finally, the pipeline means reflecting on own privileges and giving space to deaf people.

### 6.5 Towards Deaf-Centered Design

In this section, I will reflect on the concept of deaf-centered design and describe the contributions that this work makes to this novel framework. This thesis emphasizes the importance of deaf-led research as the foundation for an in-depth understanding of the phenomena, while participatory design places deaf people at the forefront of the creation process through co-creation.

Deaf-led research contributes significantly by drawing on the expertise of the deaf researcher, adapting the methodological approaches to the deaf participants and understanding the nuances of the socio-cultural context. This approach provides a high level of contextual understanding that may be limited in a hearing-led research.

Participatory research places deaf people at the center of the design process through co-creation. In doing so, they actively engage in the workshop process to shape the landscapes of the technology through their visions.

These two aspects are closely intertwined; one cannot be fully understood without the other. Deaf-led research without participatory elements may not be sufficient to generate speculative stories, and without deaf-led research, participatory research may lack the necessary depth for speculation and nuanced interpretation.

Furthermore, I argue that the deaf-led research (in the thesis' context) serves as an initial foundation for understanding and shaping the deaf-centered framework. Based on the deaf researcher's background, they do not only bring their expertise as deaf beings but also draw upon their lived experiences with embedded ideologies of technologies. As discussed in the participatory reflection, there is a power imbalance between deaf and hearing people due to systemic discrimination against deaf people. This dynamic happens in academia, where research aimed at *helping* deaf communities often results in a passive supply of data rather than an active role in shaping it. In addition, there is a significant discrepancy in the number of requests deaf people receive, from undergraduate students to professors, all focused on identifying barriers and solutions. This repetitive cycle fosters a sense of otherness and fatigue. For this reason, deaf researchers may have a deeper understanding of previous problems (as they are affected, too) as well as

belonging to the deaf community, which then serves as the basis for trust and exchange that may not be achieved by hearing researchers.

However, while deaf researchers may facilitate direct communication and contextual understanding, it is important to acknowledge that solely the fact that it is deaf-led does not automatically result in high-quality data collection or more validity of research outcomes. Additional factors, such as methodological rigor, participant engagement strategies, positional and ethical reflexivity, also play key roles in shaping research findings and maintaining the importance of reciprocity.

In conclusion, deaf-centered design, as explored in this thesis, is a multi-faceted approach that requires the symbiotic integration of deaf-led research and participatory design methods. However, this approach does not intend to be the only option and should be discussed and sophisticated further to guide the development the deaf-centered approaches.



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## Conclusion and Future Work

The thesis investigated the theme of Deaf Tech, focusing on technologies that center the experience of deaf people. The stages included (R1) understanding the recent issues on technology and research, (R2) collecting alternative socio-technical narratives, and (R3) reflecting with the deaf community.

In doing so, this investigation unfolded through three research questions introduced in the section on Background as follows:

**R<sub>1</sub>: To what extent have recent user-centered approaches to accessible and assistive technology considered the needs and desires of deaf people?**

The thesis explored the complexity of the definition of deafness, which includes aspects such as deaf identities, sign language (including multilingualism) and the current state of research in Deaf Studies.

In addition, various technologies for the deaf (TFD) were examined and the underlying issues were highlighted. On a meta level, issues of TFD at the research and development level were examined, where medical ideologies about deaf people prevail and the deaf community is not truly involved in the research process.

The findings of this research addressed the gaps in the existing literature, particularly concerning the central role of deaf people in conceptualization, designing and development.

Furthermore, it emphasized the need to address technoaudism (a specific constellation of deaf signers), explore understandings of Deaf Tech, and move towards a deaf-centered design approach in future discourses that ensures technology is aligned with the needs and desires of deaf people, centering their experiences.

**R<sub>2</sub>: Which alternative socio-technical narratives do deaf people envision by using Participatory Speculative design methods to create technologies tailored to their curiosities and desires?**

By employing Speculative Participatory methods, this thesis presented alternative socio-technical narratives through the lens of Eyeth, a mythical, visually-centered planet inhabited by deaf signers. Rather than focusing exclusively on Deaf Tech, the work collected narratives in a broader social context. These narratives addressed issues such as humanity on Eyeth, the importance of sign language and deaf rights, and visual communication via different media. The environment is designed with glasses, mirrors and visual alarm systems enhancing the visual experience. Further personal devices are designed for sign language allowing, for example, hands-free experiences. Through analysis and discussion, this thesis identified components for Deaf Tech that have been envisioned from deaf participants and highlighted the importance of technological experiences of the deaf people.

### **R<sub>3</sub>: How does collaboration with deaf communities affect the research process and technology design to ensure its relevance and impact?**

By analyzing the interviews, the work discussed and reflected with the participants on the process of the workshop, what Eyeth means to them and what they learned from it. The discussions went beyond their experiences of different research settings and expressed wishes for future collaboration in research, including providing pipelines.

This work took a deaf-led and deaf-centered design approach that allows the experiences of deaf people to be placed at the center of technological conceptualization. By contributing to ongoing discussions, it furthers the exploration of what a deaf-centered design approach entails.

In summary, this work not only addresses pressing issues around Deaf Tech, but also argues for a paradigm shift towards deaf-centered design approaches. By bringing the voices of deaf people to the foreground and incorporating them and their experiences into technology development, we can provide the basis for technological innovations that center on the needs, desires, and experiences of deaf people.

### **7.1 Limitations**

The thesis aims to foster an open dialogue rather than strictly adhering to a rigid framework. Through this approach, it seeks to facilitate discourse on various aspects such as technoaudism, TFD, Deaf Tech, and the deaf-centered approach, which will be further explored in the Future Work section.

The collected socio-technical narratives serve to understand the visions and desires and provide a foundation for exploring their technical feasibility. However, it is important to note that these narratives are not meant to be generalized, but rather to initiate stories from within the deaf community.

As the section on methodology has outlined, it is important to note that the sample size does not adequately represent the diversity of deaf communities. The participants

primarily comprise European, white, sighted individuals, with some of them identifying as queer and neurodivergent. This highlights the need for more inclusive research into the marginalized groups within deaf communities, including BIPOC, DeafBlind and DeafDisabled communities.

## 7.2 Future Work

The work aims to initiate dialogue to deepen and discuss the following aspects:

- I. **Technoaudism:** Discussing the constellation between deaf signers and the related discriminations (audism and linguism), especially in relation to technologies (emphasis on hearing and neglect of sign language due to low resources), exploring the meaning and related implications.
- II. **Conceptualization of technologies for the deaf and Deaf Tech:** Investigation and differentiation that allow to address specific target groups within the DHH communities and contribute mutual understanding to improve the quality of technology and the autonomy of deaf people.
- III. **Exploring deaf-led participatory research in HCI with deaf participants:** This includes the promotion and application of deaf-led research involving deaf groups, while also creating pipelines for different stakeholders. For example, summer schools can be offered as a starting point for longer-term framework initiatives.
- IV. **Deaf-Centered Design:** Ultimately, the investigation and development of a deaf-centered framework embodies fundamental aspects and provides a vision of what it could look like to put deaf communities at the forefront of research and technology design.

## 7.3 Contribution to HCI

There is a need for critical awareness of the impact that the development of (new) technologies has on marginalized groups, in this case for deaf people.

This includes a reflective exploration of engagement with deaf participants, recognizing the diverse spectrum within the deaf communities. Understanding the complexity of deafness encompasses acknowledging individual needs and desires, highlighting the need for tailored technologies and deaf-centered solutions.

Human-computer interaction (HCI) is inherently an interdisciplinary field, therefore it needs more involvement from Deaf Studies research. This intersection emphasizes the importance of considering the perspectives and needs of the deaf communities in the development and implementation of technology as well as understanding the background and potential implications of technologies. For this reason, building bridges is not only

## 7. CONCLUSION AND FUTURE WORK

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relevant for HCI, but also for the research field of Deaf Studies. Through the mutual exchange of both fields, an even deeper understanding of both complex interactions and constellations can be established, which ultimately means an improvement in quality for TFD and Deaf Tech, but also an understanding of the influences of technologies on deaf communities.

By bringing a deaf-centered approach to the forefront, doors may be opened to new opportunities and possibilities for deaf people, while also addressing the existing gap in the literature. It is important to recognize that while deaf people *do* have innovative ideas, they often lack the necessary resources and infrastructure to make them a reality. Furthermore, fostering an enabling environment for deaf researchers to lead initiatives is paramount to advancing inclusive and equitable research agendas.

At the heart of the contribution to HCI is the fundamental question: What does it really mean to employ a deaf-centered design approach? It is a journey to understand the participation of deaf people from diverse deaf communities and expertise is needed to create the space and pipeline for shaping the landscape of technology and research, and bringing novel perspectives into HCI research that will, ultimately, offer Deaf Tech Worth Wanting.



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# Glossary

- AI** Artificial Intelligence
- DGS** Deutsche Gebärdensprache [German Sign Language]
- DHH** Deaf or Hard-of-Hearing
- DIY** Do-It-Yourself
- GT** Grounded Theory
- HCI** Human-Computer Interaction
- IS** International Sign
- LED** Light-Emitting Diode
- LSE** Lengua De Signos Española [Spanish Sign Language]
- NLP** Natural language processing
- POV** Point of View
- SLMT** Sign Language Machine Translation
- SMS** Short Message Service
- SPW** Participatory Speculative workshop
- TFD** Technology/ies for the deaf
- TTY** Teletypewriter
- UCD** User-centered design
- ÖGS** Österreichische Gebärdensprache [Austrian Sign Language]



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