Vrije Universiteit Amsterdam

Universiteit van Amsterdam

Master Thesis

Identifying Inclusivity Issues and Potential Biases against LGBT+ in Software Design

Author: Marcel Stelte (2735128)

1st supervisor: Dr. Anna Bon
2nd reader: Prof. Dr. Hans Akkermans

A thesis submitted in fulfillment of the requirements for the joint UvA-VU Master of Science degree in Computer Science

August 28, 2024

Abstract

Context. Bias exists everywhere. As everyone has their own background and experiences, it is impossible to not be biased. This is especially detrimental for marginalized groups like the LGBT+ community, as they are underrepresented in many aspects of society.

Goal. To prevent bias from causing harm, it is necessary to identify it. In Software Engineering (SE), bias is manifested in the software design process. It is therefore necessary to understand what issues the LGBT+ community faces in software, how those issues can be solved, and why those solutions are not implemented in practice.

Method. To evaluate the current state of LGBT+ inclusivity in scientific research and professional software development, a literature study and interviews with software developers in the LGBT+ community have been conducted.

Results. The results show that many LGBT+ individuals are not able to correctly represent and control their gender information and personal data in many existing software applications. They also face issues caused by heteronormativity in domain logic. Theoretical solutions for the digital representation of identity are proposed. Potential external causes and biases that prevent inclusivity from being considered and implemented in software design are investigated.

Conclusions. The study shows that (i) non-heteronormative requirements are rarely considered and insufficiently defined in both, scientific research and professional SE. Based on those requirements, (ii) a design for an inclusive implementation of gender in software is proposed. The study also shows that (iii) tools and measures to increase inclusivity exist, but are yet to be generally applied and scientifically evaluated in terms of effectiveness and practicality. The findings of this study could be extended to other marginalized communities.

Acknowledgements

Working on this thesis has been an incredible learning opportunity, and finishing it is an achievement that would not have been possible without the support of many different people, which I would like to thank here.

I would like to thank my supervisor Dr. Anna Bon for supporting me for all the time it took me to work on this project. Without her giving me the opportunity to do it, and without her continuous support, I wouldn't have been able to finish this thesis. Likewise, I would also like to thank Prof. Dr. Hans Akkermans for taking the time to learn about this project and to read this thesis.

I would also like to thank the various people that cooperated with me as part of this research and that allowed me to interview them about matters that are equally personal and important. Without them, this thesis would not have been possible.

Lastly, I would also like to thank my mother and my friends who endured and supported me while I was working on this thesis instead of spending time with them. I will forever be grateful for your support!

Contents

Acronyms

ADD Architectural Design Decision

ADHD Attention Deficit Hyperactivity Disorder

AI Artificial Intelligence

AR Augmented Reality

CS Computer Science

EU European Union

GenderMag Gender Inclusiveness Magnifier

GQM Goal-Question-Metric

HCI Human-Computer Interaction

ICT Information and Communication Technology

ICT4D Information and Communication Technologies for Development

ID Identity Document

IEC International Electrotechnical Commission

IS Information System

ISO International Organization for Standardization

IT Information Technology

LGBT Lesbian, Gay, Bisexual, and Transgender

LGBT+ Lesbian, Gay, Bisexual, Transgender, and any other identities

LGBTQ Lesbian, Gay, Bisexual, Transgender, and Queer

LGBTQ+ Lesbian, Gay, Bisexual, Transgender, Queer, and any other identities

LGBTQI+ Lesbian, Gay, Bisexual, Transgender, Queer, Intersex, and any other identities

LGBTQIA Lesbian, Gay, Bisexual, Transgender, Queer, Intersex, and Asexual

LGBTQAI+ Lesbian, Gay, Bisexual, Transgender, Queer, Asexual, Intersex, and any other identities

ML Machine Learning

NBGQ Non-Binary and Genderqueer

OODA Observe, Orient, Decide, Act

RQ Research Question

SA Software Architecture

SDG Sustainable Development Goal

SE Software Engineering

SQ Search Query

SRS Software Requirements Specification

STEM Science, Technology, Engineering, and Mathematics

UI User Interface

UK United Kingdom

USA United States of America

UX User Experience

UN United Nations

VR Virtual Reality

WTA Willingness to Accept

WTP Willingness to Pay

WHO World Health Organization

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Introduction

Bias exists everywhere, and is especially detrimental for already marginalized groups. The Cambridge Dictionary defines bias as *"the action of supporting or opposing a particular person or thing in an unfair way, because of allowing personal opinions to influence your judgment"* (4). This does not mean that bias is a malevolent action, but rather a lack of awareness about how harmful certain actions and decisions actually are.

Bias can be combated by debiasing techniques, which systematically try to broaden the awareness of the participants in many ways. This is especially effective if the participating individuals are from a different background, as bias in a person is usually to the detriment of people from different ethnicities, genders, cultures, religions, and so on. However, to determine which debiasing technique is suitable, the precise bias needs to be identified first. Bias is especially prevalent in the Science, Technology, Engineering, and Mathematics (STEM) field, as around two thirds of the STEM workforce are white, and only one third are not men (5) (6). Such environments can create a social dynamic in which biases and stereotypes against marginalized groups are actually reinforced through collaboration and exchange

One of those marginalized groups is the LGBT+ community. Research has shown that LGBT+ individuals in STEM face more negative experiences than cis-heterosexual people. This is also true for specializations of STEM, like Computer Science (CS) and SE. In an increasingly digitized world, biased software poses an equally increasing issue for the LGBT+ community.

As gender equality is a proclaimed Sustainable Development Goal (SDG) of the United Nations (UN) (7), it is of high interest to ensure the equality of all genders. The goal of this thesis is to identify the issues the LGBT+ community is facing, which biases are causing them, and what can be done to solve these issues. This will be done through the

results of a previously conducted literature study, as well as through an interview study with LGBT+ software developers.

The identified issues are then mapped onto biases that are researched in SE as well as social biases that are currently underrepresented in SE. Solutions for problematic design decisions in existing software are proposed based on the requirements identified, and recommendations about how inclusivity in software can be increased in general are made. Lastly, as this thesis is qualitative in nature, proposals for future inclusivity research are contrived, to eventually quantify the results and conclusions of this thesis.

Positioning of the Author

In a study about bias it is important for the context of the reader to understand the personal position of the author, to control potential biases within the study. The author of this study identifies as a queer cis-hetero man and as an ally of the LGBT+ community.

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Background

For the understanding of the issues and solutions discussed in this thesis, this background chapter will discuss the relevant literature for biases in SE, as well as for requirements engineering.

2.1 Software & Requirements Engineering

To change the way how software is designed and implemented, it needs to be understood how that process looks like right now. A typical SE process is depicted in Figure 2.1.

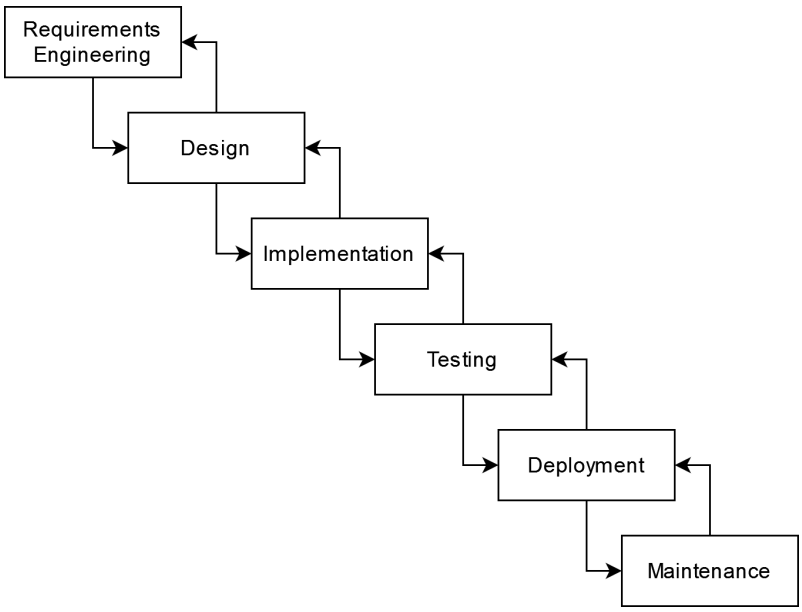

Figure 2.1: The SE process.

The depicted phases are rudimentary in nature, and can be implemented through various

ways of traditional and agile project management.

Technical implementation and all phases beyond are highly context dependent and therefore hard to generalize. On the other hand, requirement engineering is the important initial step that all software projects have to complete. It is especially relevant when discussing marginalized groups, as their requirements are often times not considered, e.g. as will be discussed in section 3.3 for the LGBT+ community.

The exact steps of the requirements engineering process are defined inconsistently in literature (8). Generally, based on a problem, requirements are elicited and analysed (9) (10) (11). They are then documented and reviewed to ultimately create the Software Requirements Specification (SRS). The SRS is then used as a basis for further planning, e.g. to create user stories (12).

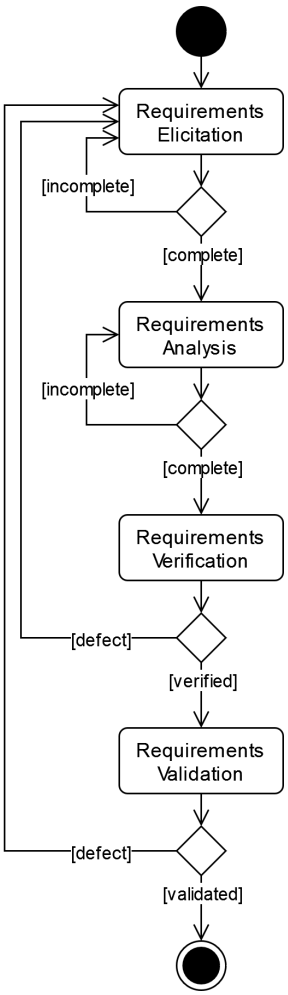

Figure 2.2: The requirements construction process.

The quality-related activities within requirements engineering process are sometimes referred to as *requirements construction* (10). The steps of finalizing requirements during requirements construction are depicted in Figure 2.2 according to Kotonya et al. (9).

During *requirements elicitation*, information about the domain of the problem is gathered and compiled to identify sources of requirements. Those sources are then interrogated about their requirements using various elicitation techniques. Once identified, the requirements are refined and documented (8) (13).

A subset of the completely refined requirements are then analyzed in the *requirements analysis* subprocess (13). A deeper understanding of them is gained by the project team, and potential conflicts are detected and resolved with the sources (10) (12).

Afterwards, it has to be ensured that the requirements are not defect, but designed correctly (*requirements verification*), and that the correct requirements are designed altogether (*requirements validation*) (10) (13).

This process is not linear but iterative, and may be repeated any number of times until the project team and the sources agree upon the defined requirements.

2.2 Bias

To research biases, it is important to understand what bias is, and how it manifests. This background will be introduced in this section.

A cognitive bias refers to a rational deviation from a logical thinking pattern (14, p. 129) that leads to a suboptimal design or course of action due to an undetected lack of internal validity (15) (16). Biases are native to every human being based on their own experiences and feelings about certain artifacts and events. They are usually categorized based on the cognitive pattern that causes them (17), though different biases are applicable in different fields, and might warrant a different classification in some circumstances (16). As the following subsection demonstrates, there is no unified nomenclature and classification for many biases.

2.2.1 Bias Manifestation

Biases can be expressed *implicitly* and *explicitly*. Implicit biases refer to subconscious reactions of people to certain stimuli. They include stereotypes that the biased person is not consciously aware of, which manifest in different behaviour towards people from a different ethnicity or gender, or in the form of negative feelings about different racial or ethnic groups. Implicit biases are less common within the person's own culture.(18).

Explicit biases on the other hand are something that a person is aware of. They manifest as preferences and beliefs and can be something people identify with (19). However, being aware of certain beliefs does not mean that people are able to identify those beliefs as biases. That means that they still influence their decision-making (18).

People who discriminate based on implicit biases do usually feel less accountable for their actions than people with corresponding explicit biases. Studies show, that people committing crimes based on implicit biases are also less likely to be punished (18).

2.2.2 Bias Categorization

As the list of existing biases is quite large, in this section, biases that are specific to SE and were identified as such by Mohanani et al. (15) are described and differentiated, based on a categorization from a different study by Fleischmann et al. (20). In addition to that, some biases that are not part of the SE discourse yet, but are relevant to this thesis, are explained as well.

2.2.2.1 Decision Biases

Decision biases occur during the decision-making process. They cause suboptimal decisions and reduce the outcome of the current process as well as future ones (20).

B-D1: *Hyperbolic discounting*

Hyperbolic discounting is a form of *present bias*, which means that the present is valued higher than the future. It describes the favoritism of immediate payoffs over long-term payoffs, even if the latter ones would be more significant (15) (21).

B-D2: *Infrastructure bias*

Bias towards reusing existing infrastructure over objectively reevaluating whether it is the optimal solution or not is called infrastructure bias (15). While this can be a valid reason due to e.g. financial or organisational factors, opposing factors are sometimes not properly evaluated.

B-D3: *Probability neglect bias*

This bias describes a behavior pattern in which the relevancy of a negative event is calculated solely based on its impact, but not in its likeliness (15). Commonly, very unlikely events with a huge impact are accounted for over-proportionally, while likely events with small impact are ignored (22) (23) (24).

B-D4: ***Sunk cost bias***

Using a past investment as a justification for a current investment, or as a factor for any current decision in general, even though they do objectively not correlate, is called sunk cost bias (15) (25). It is likely to be rooted in personality traits of decision makers (15). Some also categorize this bias as a stability bias, which is a subset of decision biases (20), as described in subsubsection 2.2.2.3.

In general, decision biases are favoured by environments where the fear of failure or the punishment of such is big, as they create behavior patterns that re-use already existing solutions and courses of actions. One reason for this can be that those solutions have been proving to be working in the past, even though the projects do not correlate. Another potential reason is that moving away from a previously or currently used course of action would already imply a failure, which is especially apparent in the case of the sunk cost bias (**B-D4**) (25).

2.2.2.2 Action-oriented Biases

Action-orientated biases are a subgroup of decision biases. They causes premature actions for which not all possible alternatives are considered. Instead, an arbitrary solution that was discovered the fastest is used (20).

B-A1: ***(Over-)confidence bias***

Judgements are made due to overestimations without sufficient statistical evidence (25) (26). The exact reasons for this behavior are unknown, but potential sources include what can be described as wishful thinking (**B-I5**), putting too much focus on positive (reinforcing) arguments compared to negative (disconfirming) ones, and human nature (26). Other theories claim that overconfidence is built by working on simple tasks and then trying to apply the successes from those onto more complex tasks without further reflection (15). This bias is more common in less experienced people (26).

B-A2: ***Impact bias***

The emotional impact a future event will have is overestimated in terms of its reaction, magnitude, and/or length (15) (27). The name of this bias succeeds the *durability bias*, which generally describes people's overestimation of the length of their emotional reaction to an event. Compared to that, impact bias also includes the potentially wrong prediction of one's initial emotional reaction to an event (27).

B-A3: ***Invincibility bias***

Similar to the (over-)confidence bias (**B-A1**) but specifically towards oneself, this bias occurs when one is overconfident in their own abilities (15).

B-A4: ***Miserly information processing***

The unawareness of the fact that not all information are processed will lead to less than optimal outcomes and even failures (15). This usually happens if a person feels like the chosen course of action is sufficiently good, and does not bother to find an alternative (28, p. 124).

B-A5: ***Normalcy effect***

The underestimation of the likelihood and impact of potential interruptions is called normalcy effect (15). It can also be described as unreasonable optimism (29).

B-A6: ***(Over-)optimism bias***

While similar to the normalcy effect (**B-A5**) on the first glance, this bias describes the overestimation of the likelihood and magnitude of specifically positive events and outcomes (15). It is therefore also a potential source of the (over-)confidence bias (**B-A1**) (26). It is different from the probability neglect bias (**B-D3**) because the focus lies on events with positive outcomes instead of ones with negative outcomes. Optimism bias is found more often in technical roles like software developers, than non-technical roles (15).

In IT, many of these biases lead to bad requirement analysis' and bad resource plannings, especially overconfidence and optimism bias. This in turn can be described as *illusion of control* (15) (25).

2.2.2.3 Stability Biases

Stability biases are another subgroup of decision biases.They also focus on behaviour patterns that make people persevere in using already existing solutions and courses of action, even though objectively better solutions exist (15) (20).

B-St1: ***Anchoring and adjustment bias***

If individuals make a judgement and create a solution based on incomplete information, and are then unwilling to adapt and adjust based on further information, it is called anchoring to the initial solution. Improper or lacking adjustment and the reuse of unnecessary artifacts contribute towards errors and reduced productivity, as well as

inflexible planning. It is more present in inexperienced, uncertain, and inflexible people (15).

B-St2: ***Belief perseverance***

Belief perseverance describes the behaviour pattern of sticking to a certain belief or assumption, despite already being proven wrong (15). It is similar to the anchoring and adjustment bias (**B-St1**), but focuses explicitly on situations in which the original anchor is not just unfitting but inaccurate.

B-St3: ***Default bias***

Also known as *status quo bias*. People are proven to not change an already existing default decision without validating it or its alternatives (15) (30) (31). It is suggested as a potential explanation for the endowment effect (**B-St4**) (30).

B-St4: ***Endowment effect***

Putting disproportionally high value on something a person owns compared to something comparable that they don't own is called the endowment effect (15). This can occur due to various reasons (30) (32) (33).

2.2.2.4 Interest Biases

Interest biases cause illogical reasoning due to a personal preference or sympathy for certain things, ideas, or people (15). They can appear at a broad number of points during a decision-making process, and are usually to the detriment of parties that are not favoured by the decision-maker (20).

B-I1: ***Confirmation bias***

Confirmation bias describes the behaviour of favouring or putting more attention towards sources that agree with a person's personal belief, while disregarding sources that disagree (15). This impacts many stages of a project. Especially in IT, design, construction, testing, and maintenance are affected, as a person usually assumes that their artifacts are correct (15). Different sources also classify this bias as a pattern recognition bias, which are described in subsubsection 2.2.2.5 (20).

B-I2: ***Disconfirmation bias***

The disconfirmation bias complements the confirmation bias (**B-I1**), as people not only try to prove their own opinion, but also try to focus on finding sources that disprove opposing opinions (34).

B-I3: *IKEA effect*

Also know as *I-designed-it-myself effect*, it describes the behaviour pattern that makes people put greater value into artifacts created by themselves compared to equivalent artifacts created by others (15) (35).

B-I4: *Valence effect*

When people tend to give events with a positive outcome a higher likelihood of occurring than events with a negative outcome, solely or at least partially because they have a positive outcome, despite the fact that the outcome is not linked to the probability, it is called valence effect (15).

B-I5: *Validity effect*

The validity effect describes the phenomenon that statements that are encountered more frequently are subconsciously perceived as more likely to be true (15).

B-I6: *Wishful thinking*

Wishful thinking describes the behaviour pattern of underestimating the likelihood of an event with negative outcome, and/or overestimating the likelihood of an event with a positive outcome (15). As mentioned before, it factors into the (over-)confidence bias (**B-A1**). It differentiates from the probability neglect bias (**B-D3**) and (over-)optimism bias (**B-A6**) because the impact of the outcome is irrelevant.

2.2.2.5 Pattern Recognition Biases

Pattern recognition biases describe a series of biases that favour pieces of information and courses of action that are similar to information and plans already present in a person's mind over alternatives that require a more different thinking pattern (20). This means that a person will prefer more familiar ideas and solutions over ones that are perceived to be more outlandish (15).

B-PR1: *Availability bias*

Availability bias describes the phenomenon of favouring information that is more widespread and available over harder to obtain information (15) (25). This can not only cause an incomplete requirement analysis in IT projects, but also issues in project management if the project team does not have all relevant information at hand at any time (25).

B-PR2: ***Mere exposure effect***

The mere exposure effect describes the observation that the attitude towards a stimulus can increase over time solely due to repeated exposure without any reinforcement (15) (36). One reason for this is the increase in familiarity with that stimulus (37, p. 241).

B-PR3: ***Fixation***

A fixation describes the behaviour pattern of disproportionally focusing on only a subset of aspects of an event, artifact, or idea (15). A fixation can be influenced by framing (**B-Pe3**) (15).

B-PR4: ***Semmelweis reflex***

The Semmelweis reflex describes the initial opposition towards any idea that challenges established scientific laws within the domain of scientific research (38). It is named after Hungarian-Austrian physician Ignaz Philipp Semmelweis (39).

2.2.2.6 Perception Biases

Perception biases affect how new information is processed. Decisions can be influenced not only by biased data, but also by data that is processed with a bias (15) (20). Perception biases are among the most researched biases especially when it comes to Information System (IS) usage (20).

B-Pe1: ***Attentional bias***

Attentional bias describes an imbalance in how much attention is given to certain cues when processing new information compared to others (15). People with attentional bias will process certain cues with a higher priority, based on how they are related to a certain goal they are committed to (40).

B-Pe2: ***Contrast effect***

The contrast effect describes a behaviour pattern in which people tend to evaluate certain artifacts, events, or other people, based on comparable artifacts, events, or people, instead of objective predetermined criteria (41). This can incorrectly improve or reduce the perception of the newly evaluated thing (15).

B-Pe3: ***Framing effect***

If two artifacts or events are evaluated differently because they appear to be different on the surface level, despite being formally identical, that happens due to the framing

effect (15). Studies show that framing effects are highly replicable, making framing an effective tool (42).

B-Pe4: ***Halo effect***

The halo effect describes unwarranted attempts of using general global information to solve a specific local problem, despite the fact that the used information is not necessarily applicable to the problem (15). The likeliness and magnitude of the halo effect during an evaluation increases with each individual measurements (43). It can be caused by confirmation bias (**B-I1**).

B-Pe5: ***Representativeness bias***

Representativeness describes a form of bias in which issues are incorrectly generalized and simplified. Due to that, specific aspects are overlooked (44). This bias is not always classified as a perception bias (15).

B-Pe6: ***Primacy and recency effects***

The primacy and recency effects describe that people are more likely to remember the first and last elements of a list or series, respectively (15). These effects have been observed in multiple studies about e.g. the placement of hyperlinks in User Interface (UI) design (45). Both these effects can cause a disproportional focus on the respective subset of the total amount of evaluated elements (25).

B-Pe7: ***Selective perception***

Selective perception describes the behaviour pattern of being less likely to notice stimuli that would contradict a belief, or would cause a negative emotional reaction. It causes people to perceive the same stimulus differently (15) (25) (46).

2.2.2.7 Social Biases

Social biases are usually inferred from a person's relationship to other people. They affect both perception and decision-making and cause prejudices and unwarranted favoritism (15) (20) (47). They are also especially relevant to this thesis, as marginalized groups like the LGBT+ community are often excluded from popular opinions and mainstream decisions. Just like them, social biases are rarely investigated in SE (15).

B-So1: ***Bandwagon effect***

The bandwagon effect, also sometimes referred to as *herding*, *herd mentality*, or *contagion effect* (20) (48), describes the phenomenon of adopting a certain opinion because

it aligns with the popular consensus (15). Instead of coming up with their own decision, people prefer to join an already existing group (48).

B-So2: *Stereotyping*

Stereotyping describes a generalization of a person based on a group of people they share characteristics with. It is cited as a major cause of social injustices, especially in racial and gender contexts (49).

B-So3: *Cultural bias*

Cultural bias describes a set of prejudices that a person can have against people of another culture. The prejudices are embedded in the person's own culture (50). As culture is a complex topic with many facets, cultural bias can be dissected into many more specific biases, like *language bias*, *racial bias*, *religious bias*, or *regional bias* (51). As gender and sexuality are viewed very differently in different cultures, cultural bias can be a big influence on how they are viewed and implemented in SE.

B-So4: *Gender bias*

Gender bias describes prejudices and disadvantages about people based on their gender. SE specifically is a field dominated by men, which disadvantages other genders who are underrepresented based on stereotypical gender roles. Heteronormativity specifically also disadvantages non-binary poeple. Gender bias causes discrimination and reduces productivity (52). In recent years, studies have shown that gender bias in SE is becoming more implicit, but is still strongly present (53).

B-So5: *Algorithmic bias*

Algorithmic bias is not a specific bias, but a phenomenon that exists at the intersubsection of social biases and CS. It occurs when social biases influence the implementation or outcome of an algorithm, e.g. by using a biased dataset, or by implementing social biases into domain logic. They are especially dangerous in Artificial Intelligence (AI) and Machine Learning (ML), because they can reinforce certain biases that stem from biases input data, or are undetected by performance measures (47).

2.2.2.8 Selection Biases

Selection biases, also known as *selection effects*, describe a group of biases that cause improper randomization in the selection of to be evaluated data, artifacts, or individuals.

They can falsify study results by over- or underrepresenting certain data points (54). Examples are *detection bias*, *exclusion bias*, and *popularity bias*. Those biases in turn are also part of other bias categories, like *information bias* (16).

For SE, they are mostly relevant in identifying stakeholders for requirement analysis, and when trying to find software testers, but less so for defining and implementing requirements. Therefore, they are not further investigated in this study.

2.2.2.9 Memory Biases

Memory biases refer to the diminishing quality of memorized information over time (15) (20). This category of biases is largely ignored in SE literature (15), due to which only few biases are categorized as memory biases. A prominent example is the *hindsight bias* which describes the usage of hindsight knowledge to claim that the outcome was predictable from the start already (15), and which is similar to the contrast effect (**B-Pe2**). Another example is the *time-based bias*, which is a version of hyperbolic discounting (**B-D1**) that exists due to the memory of a short-term payoff.

These specific biases are largely either irrelevant for the design of new IT artifacts, or are in some capacity already accounted for in biases of other categories, and are thus not further investigated in this thesis.

2.2.3 Biases in SE

Based on the mapping study by Mohanani et al. (15), the effects of biases can be mapped to specific stages of the SE process described in section 2.1, which can be seen in Figure 2.3.

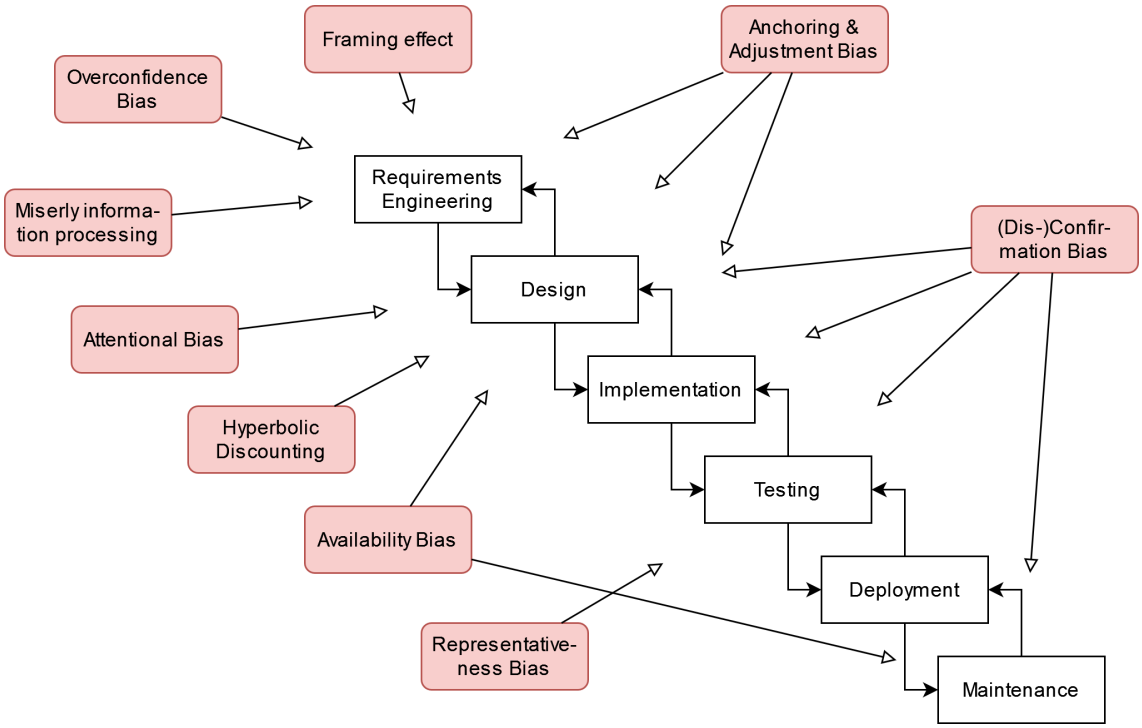

Figure 2.3: Effects of biases on the SE process.

3

Gender, Sex, and Sexuality in SE

To understand the inclusivity issues faced by the LGBT+ community, the meaning and state of gender inclusivity in software design needs to be discussed first. This includes a definition of sex, sexuality and gender, and how digitisation impacts them in terms of limitations and opportunities. Part of this discussion is a literature study about how gender is implemented in software, and what issues that causes for members of the LGBT+ community. Lastly, a summary of the current state of academic research in this field will be provided.

3.1 Literature Study

The information in this section is partially based on a literature study that was conducted prior to this thesis. The design and key findings about the state of the evaluated literature are described in this subsection, while findings about gender, sex, and sexuality are discussed in the rest of this section.

3.1.1 Study Design

The goal of the literature study was to understand how members of the LGBT+ community are currently disadvantaged by existing software, and how this issue is researched. Using the Goal-Question-Metric (GQM) approach (55, pp. 39 - 42), that goal can be described as follows:

To achieve that goal, three Research Questions (RQs) were formulated:

RQ1: Is the definition and implementation of gender in a digital context biased, considering people who identify themselves as non-binary exist?

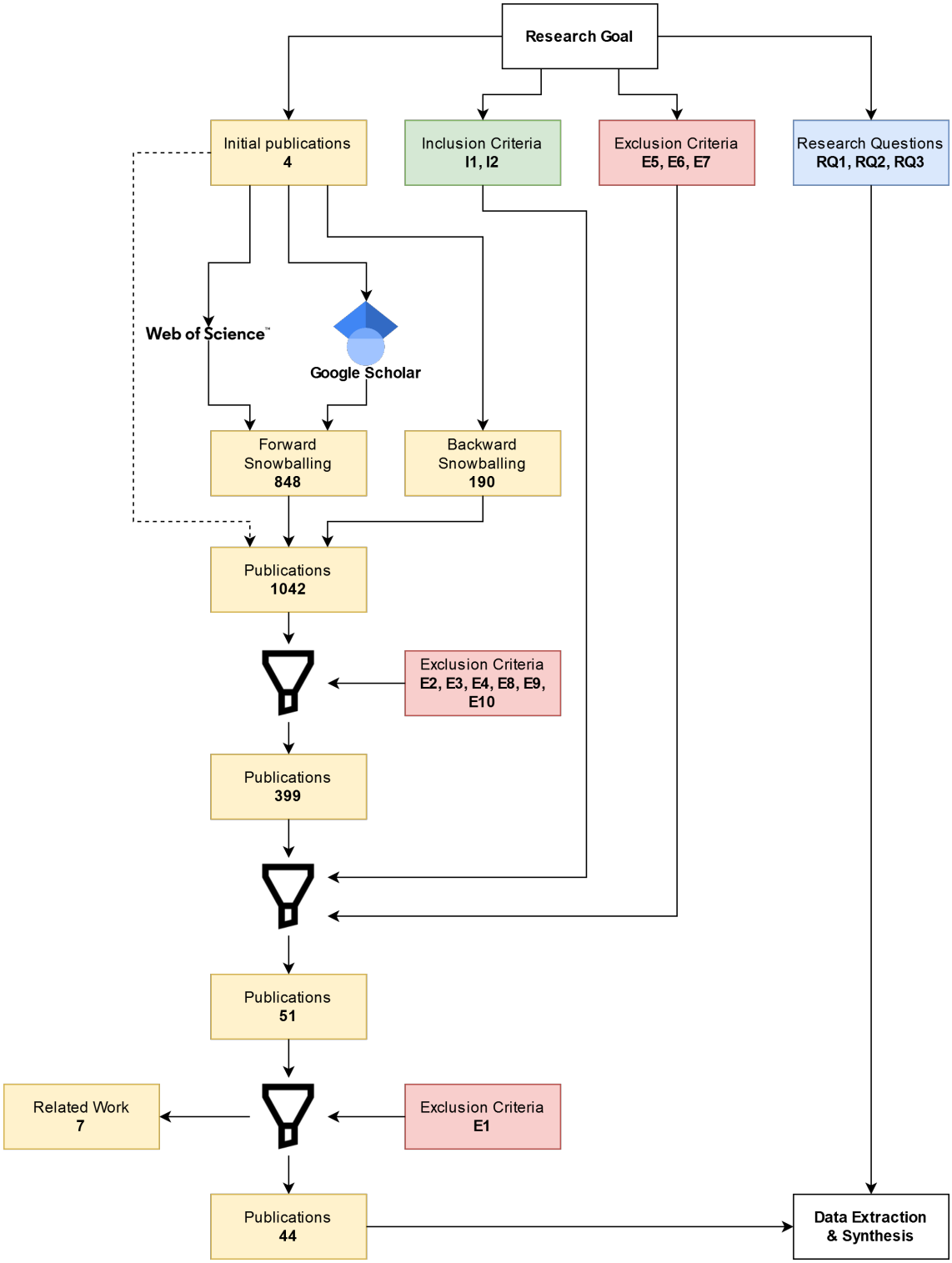

Figure 3.1: Process of the literature study including amount of publications at each step.

Purpose	Identify
Issue	impact of, and countermeasures against bias against LGBT+
Object	in Software Design
Viewpoint	from the viewpoint of software developers and LGBT+ individuals.

RQ2: How does bias against members of the LGBT+ community manifest in software, and what are the effects of it for members of the community?

RQ3: What are ways to counteract these biases against the LGBT+ community in software design?

The exact steps of the literature study are depicted in Figure 3.1. An initial set of four studies was snowballed once in each direction, using the *Citations* view on *Web of Science* (56) and the *Retrieve citing works* feature in *Publish or Perish* (57) for *Google Scholar* (58) for studies that are referencing any of the initial studies. Exclusion criteria **E2**, **E3**, **E4**, **E8**, **E9**, and **E10** were applied first, as they focus on properties in the snowballed studies' metadata, and thus allowed the exclusion of certain studies without having to read them. Afterwards, the inclusion criteria and exclusion criteria **E5**, **E6**, and **E7** were applied to find studies that match the RQs. Finally, exclusion criteria **E1** was applied on the remaining studies to filter studies who are literature studies themselves. The remaining studies were used for data extraction and synthesis, and conclusions were drawn that inform both the RQs and the background of this thesis.

The following inclusion criteria were used:

I1 Publications that research LGBT+ issues, bias, and/or other impacts directly, or can be used to draw comparisons to them from other research about identity, gender, race, or marginalized groups and/or specific demographics.

I2 Publications that focus on a technical aspect of the software development process or CS in general. This can range from software architecture and design to the technical implementations.

The exclusion criteria used are the following:

E1 Secondary or tertiary studies, like other systematic literature reviews, research proposals, or similar publications. They do not provide any additional information over the publications they reference. Relevant referenced literature should be identified by the search query independently.

E2 Publications that are not available, as they cannot be evaluated.

E3 Publications that are not available in English, as only those can realistically be verified by the audience of this literature study.

E4 Duplicate publications, as they are redundant.

E5 Publications that focus only on laws or legal frameworks, as those are only defined for already identified problems.

E6 Publications focusing only on education or careers, as the gender gap in STEM is a too different topic compared to bias against LGBT+ in the CS field specifically.

E7 Publications that focus primarily on bias in AI or ML, as bias in those is a research field on its own.

E8 Non-academic publications, such as guidebooks or tool specifications, as well as position and proposal papers.

E9 Papers that have not been peer-reviewed, as it cannot be ensured that they are of high enough quality.

E10 Publications that have been published as dissertations or a thesis.

The four initially used seed publications were the following:

P1: ***The gender binary will not be deprogrammed: Ten years of coding gender on Facebook*** **(59)**
This article describes an investigation into Facebook's history of implementing gender options, and how the system at the time of publication was highly deceptive due to translating the over 50 available genders in the UI into only three genders in the backend. This serves as an example of the systematic issues this literature study tries to uncover.

P2: ***Baking Gender Into Social Media Design: How Platforms Shape Categories for Users and Advertisers*** **(60)**

This paper investigates how gender is implemented on different social media platforms, both from the lens of a user and an advertiser. Thus, it is a good starting point for investigating different software implementations and the rationale used to design them.

P3: ***Software Designers, Are You Biased?*** **(61)**

This paper investigates how bias impacts the software design process for any software developer. It raises questions about how biased software can be problematic, and investigates what methodologies could be deployed to tackle these inherent biases.

P4: ***From Gender Biases to Gender-Inclusive Design: An Empirical Investigation*** **(62)**

This publication explains and investigates the usefulness of GenderMag, a tool created to detect and reduce gender biases in software designs. The authors also make suggestions on how to improve the tool. This paper serves as a base for the GenderMag tool, and gives insight into how a potential tool to reduce bias against LGBT+ individuals could look like.

3.1.2 State of Research

Through the conducted literature study it became apparent that many studies that focus on gender and sexuality in SE are not well connected. As Figure 3.2 shows, the publications that were deemed relevant for its RQs were almost always exclusive to one of the four initial publications used for the snowballing process, with the only exception being seeds 1 and 2 due to sharing some of the authors.

At the same time, it is also evident that research about gender and sexuality in SE only started in recent years. Figure 3.3 depicts that the number of studies about this topic before 2018 was almost non-existent.

3.2 Definitions

In this subsection, definitions for gender, sex, and sexuality will be provided, as being able to understand and differentiate them is relevant to understand the problem that is investigated by this thesis.

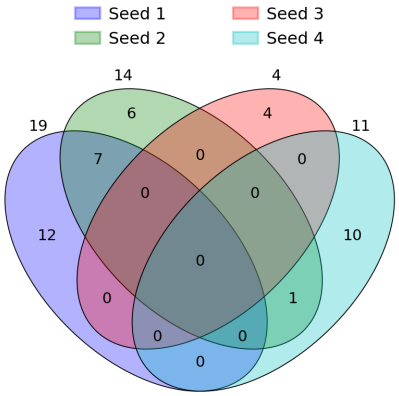

Figure 3.2: Number of relevant publications found per seed.

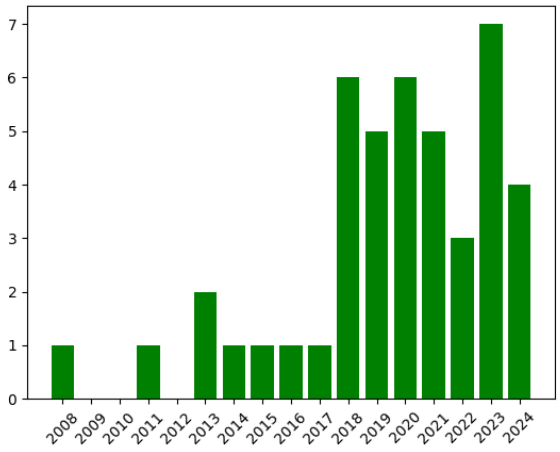

Figure 3.3: Number of relevant publications found per year.

3.2.1 Sex

Sex refers to the biological characteristics of the human body assigned at birth (63) (64) (65) (66) (67) (68) (69) (70) (71) (72) (73) (74) (75) (2). According to the World Health Organization (WHO), it describes "physical and physiological features including chromosomes, gene expression, hormone level and function, and reproductive and sexual anatomy" (76). Since individuals have these features assigned at birth and do not get to choose them, no relation between these features and the individuals' identity can be made. The two binary sexes are referred to as *female* and *male* (77) (78).

According to the 2022 version of the standard 5218 of the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC), sex should be implemented in softwre with the following four options:

- Not known (0)
- Male (1)
- Female (2)
- Not applicable (9)

They note that the order is irrelevant and should not imply any form of discrimination. This definition primarily describes technical implementations, but is in turn based on how gender is implemented legislatively in many countries (79).

Not directly represented in the above definition is the fact that sex is not binary, as neither *Not known* nor *Not applicable* actually imply the existence of a third sex option.

Individuals can be born with physiological features of both genders, which is defined as *intersex* (76). However, as seen in Figure 3.4 this sex is legally recognized only by few countries in the world as of yet (80), e.g. Germany (81) and the United States of America (USA) (82). The legal frameworks used by those countries do not clearly distinguish between sex and gender.

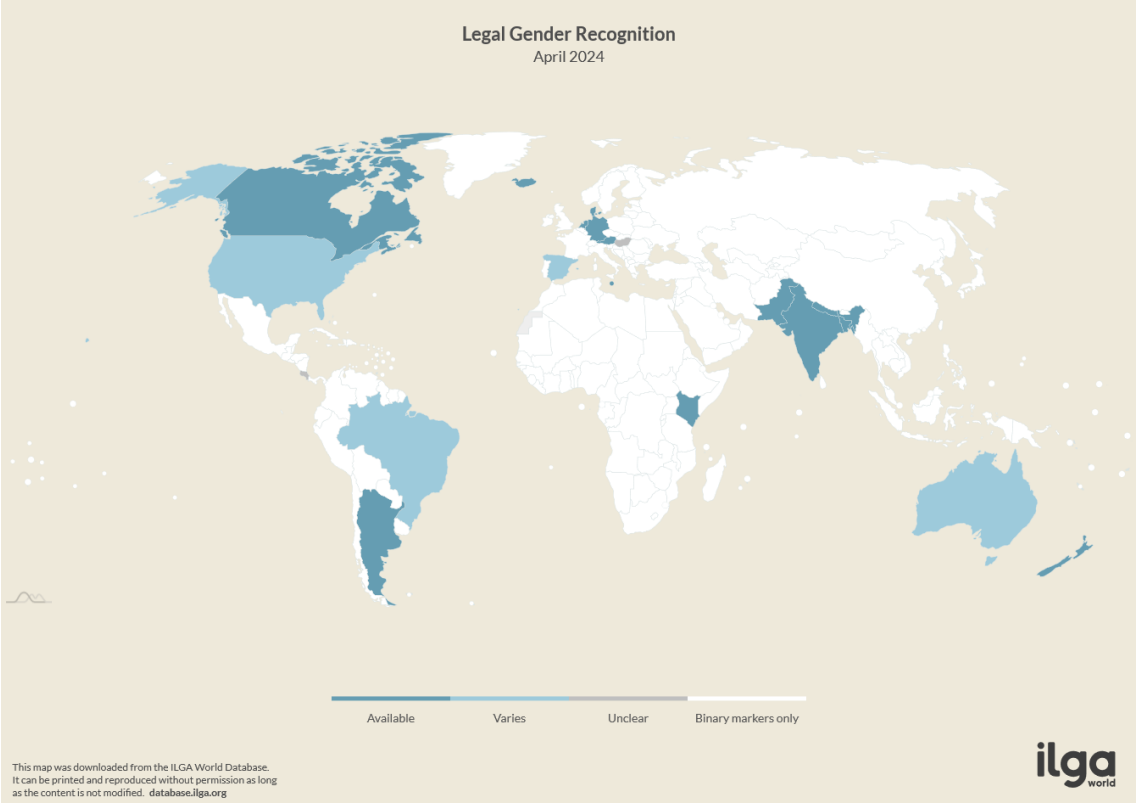

Figure 3.4: Map of countries that allow non-binary gender markers (1).

Some scholars claim that a bigger focus on gender over sex marginalizes intersex people specifically (83).

Intersexuality must not be confused with *transsexuality*, which refers to the sex and gender of an individual not aligning. Transsexual individuals may choose to undergo medical treatment to change their sex, however, this is not a necessity for transsexuality (64) (71). Figure 3.5 shows which countries in the world allow a legal change of a person's gender.

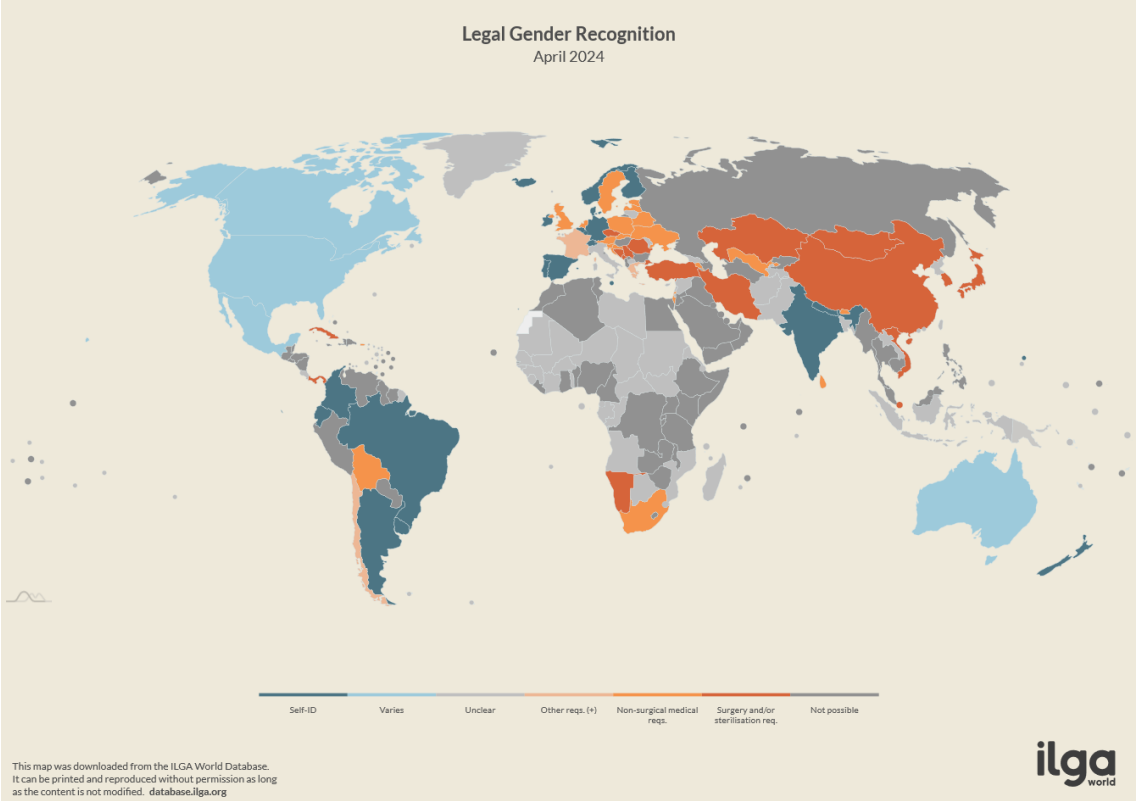

Figure 3.5: Map of countries that allow legal change of gender (1).

3.2.2 Gender

Gender is also often referred to as *gender identity* and describes how an individual identifies itself. Every person has a *gender presentation* that describes the gender which they choose to present themselves having. It is usually aligned with the person's gender identity, but doesn't have to be, which usually happens in cases where there are (dis-)advantages to being identified as a certain gender. Each gender comes with a certain stigma, meaning that society usually has an expectation about how individuals of that gender should behave. This is called *gender role*. As mentioned before, none of this is linked to a person's *gender assignment* or sex (2). Instead, as any attributes linked to gender are either individual or societal, it can be concluded that gender is a social construct (84).

In the following subsection, three major views and definitions of gender will be explained more in-depth. Besides the obvious binary and non-binary gender definitions, ternary is included as an intermediate that acknowledges the existence of non-binary genders, but does not interact with them any further.

3.2.2.1 Binary gender

Because non-binary gender definitions only started being discussed in the 1980s (85), viewing gender as binary was the norm throughout most of humanities history. Even today, many people believe that gender is binary, mostly for religious reasons (86) (87) (88).

A majority of of studies that focus on gender equality, treat gender implicitly as binary (62) (89) (90) (91) (92) (93) (94) (95) (96). To this day, binary gender implementations are the standard for most SE solutions (97).

The two binary genders are referred to as *feminine* and *masculine* (77) (78).

3.2.2.2 Ternary gender

The ternary gender definition exists in-between the binary and the non-binary one. It expands on the binary definition through the explicit addition of *other* genders, but does not further specify them on the same level as *female* and *male*. In SE, there is a noticable trend away from binary gender implementations towards ternary ones (98).

The ternary gender definition is controversial. On the one hand, it includes any non-binary gender identity by definition, even though none of them is included explicitly. This gives people with a non-binary gender identity already a greater sense of inclusion.

On the other hand, there is criticism that non-binary gender identities still are put into boxes that do not allow them to express themselves the same way binary gender can. Whether they are marginalized as female, male, or other makes little difference (99). Furthermore, the ternary gender definition implements a clear hierarchy between the binary genders, which are fully established, and any other gender identity, which is valued less (72) (59) (60) (97). Some scholars even compare this hierarchy to the arbitrary racial hierarchy that was implemented by white Europeans to justify slavery (60).

In IT specifically, ternary gender options are often used because they are rather simple implementations that extend binary gender implementations by including non-binary identities, while keeping the set of possible values a limited codomain. As described in subsection 3.2.1, laws that recognize non-binary sexes and genders also use the ternary model.

3.2.2.3 Non-binary gender

The non-binary gender definition describes gender as a spectrum. In the same way that sex and gender are not related, having a non-binary gender does not relate to being intersex. People may have either no, one, or many genders (100) (68) (71) (63). Being genderless

is called *agender*, while having multiple genders may be called *multigender* / *polygender* or *omnigender* / *pangender*, if the person identifies with any number of, or all genders respectively. There are also more specific denominations like *bigender* and *trigender* for people who identify with two or three genders respectively. Gender may also not be fixed but *fluid*, meaning it can change at any time (78).

While only making up a low percentage of it, non-binary people are still a significant amount of the world's population (78). Due to the separation of gender and sex, and because the lines of the historically binary gender are getting blurred, a bigger societal shift has to happen in terms how feminism and gender equality are defined (101, pp. 7-8).

Non-binary gender identities are part of the umbrella term *genderqueer*, although the terms are often used synonymously. Genderqueerness also includes individuals which identify with a binary gender, but who question certain aspects of their gender role (78). Common abbreviations for communities of genderqueer people are LGBT, LGBT+, LGBTQ, LGBTQ+, LGBTQI+, LGBTQIA, LGBTQAI+, and NBGQ.

At this point, it is also important to understand the meaning and history of the term *queer*, as it is both stigmatized and reclaimed (102). The Cambridge Dictionary lists various definitions for the word queer as noun, verb, and adjective, that either describe a non-traditional understanding of societal gender, or just a general strangeness (103). Especially as a noun, queer was historically used as a slur, and is thus considered stigmatized (104). As an adjective, the term has since mostly been reclaimed by the LGBT+ community and can be used as a positive and reinforcing label. However, some people still use especially the noun as a slur towards LGBT+ people (102). Therefore, the term queer needs to be used carefully (105).

Throughout this thesis, LGBT+ will be used, as it is a simple term that encompasses any identity and does not use any ambiguous abbreviations. For the reasons just described, the term queer will not be included to prevent any negative stigmatization. People qho identify themselves as queer are explicitly included nonetheless, and anyone is free to feel included by the content of this thesis, even if they do not feel represented by a specific label.

Non-binary people are often times facing repercussions for outing themselves (106) (107), as can be seen in Figure 3.6. Due to this and their low percentage of the global population, they are considered a marginalized group and are also rarely considered in SE design decisions.

Historically, gender and sex have not been differentiated, and have mostly been viewed as binary. Publications started questioning the binary nature of gender since the 1980s

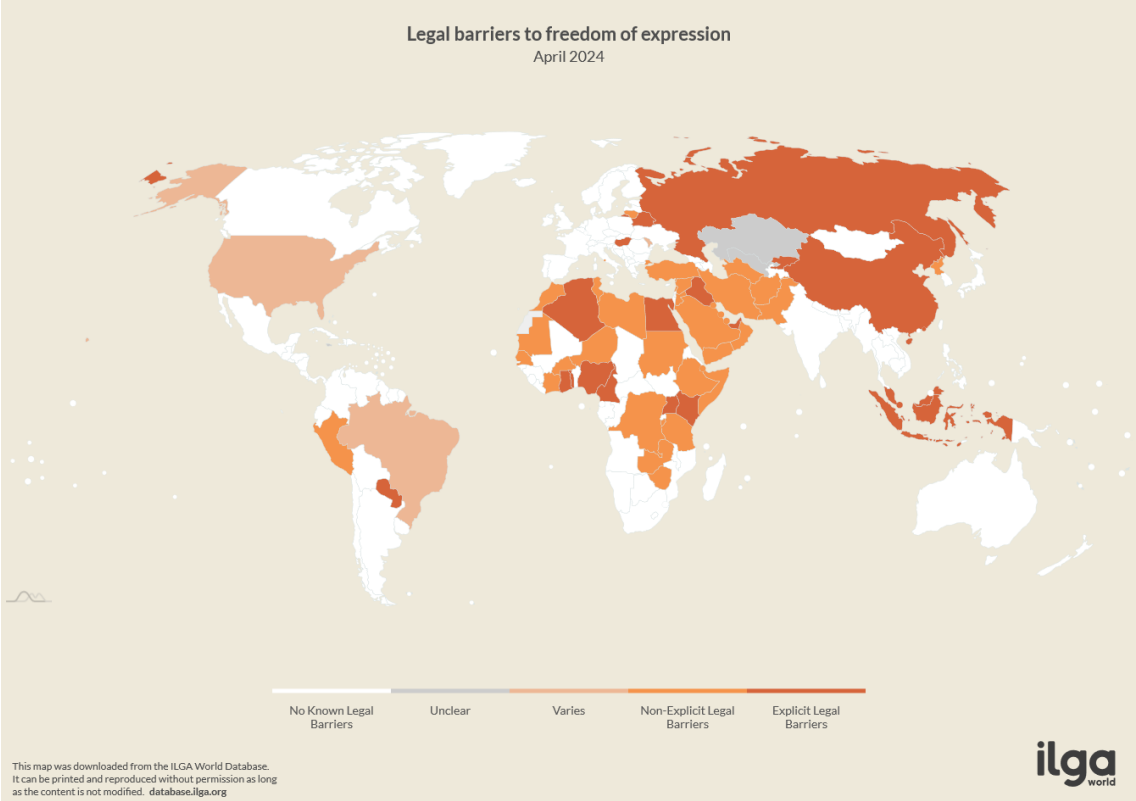

Figure 3.6: Map of countries that outlaw varying forms of non-heteronormative self-expression (1).

(85). Since then, the existence of non-binary genders has been discussed with increasing prominence in science and culture (78). However, it should be noted that genderqueerness already existed throughout many eras in human history (108) (109) (110) (111).

Even though many studies don't explicitly state so, they treat gender as a non-binary spectrum (59) (63) (64) (65) (66) (67) (68) (69) (70) (71) (72) (73) (74) (75) (89) (97) (112) (113) (114).

3.2.3 Pronouns

People are often referred to by their pronouns. Some languages have gender distinctions in the first and second person, but virtually every language uses gendered third person pronouns. Some languages also have gendered plural pronouns, but always use gendered singular pronouns (115). Due to this, third person singular pronouns depend on the referred to person's gender in almost every language.

In English, the *they/them* pronoun can be used both in plural and in singular. The latter case is used to refer to non-binary people who prefer to use neither *she/her* nor *he/him*

(116) (117). However, not every language has proper pronouns for every gender. For example, German and French are grammatically gendered, which means not everything can be expressed in a gender neutral way, including the *they/them* pronoun (117), which makes translating the concerns of non-binary people difficult (59) (72).

Beyond the already established pronouns discussed so far, there is also a rising popularity in *neopronouns*. Neopronouns are neologistig pronouns like *xe*, *fae*, *ey*, and *ze*, that allow non-binary individuals to express themselves beyond the gender-neutral *they* (118).

Adjacent do pronouns are the names of individuals. In some places, people are legally allowed to change their name if they are a trans person. Calling people by their old name is called *deadnaming*.

3.2.4 Sexuality

As discussed in subsection 3.2.1, gender and sex have to be differentiated from sexuality, which defines to whom people are attracted to (119) (69) (71). This attraction is mostly related to gender. There are many different sexualities, resulting from a variety of gender combinations in all participating partners. Some individual might also be sexually attracted to multiple genders or individuals who possess certain traits, or might not be sexually interested at all (120).

Because a majority of the people throughout history identified with a binary gender and as heterosexual, either voluntarily or because they feared social pressure and repercussion, *heteronormativity* has become a default in society (119). This is considered to be stereotyping, as it implicitly defines everything that is different as not normal (63) (121). However, even within spaces dedicated for non-heteronormative individuals, something called *homonormativity* can be observed. In certain dating apps for example, people who are looking for a singular long-term partner are more catered towards than individuals who seek multiple changing short term partners for sexual intercourse (119).

3.3 Pitfalls and Opportunities of Digitization

A large discrepancy exists between gender in the physical world and in digital spaces. While in the phyiscal world gender has historically often times been linked to or at least inferred from sex, this basis does not exist in the digital world. Yet, the way digital spaces are designed is currently heavily influenced by the physical world.

In this subsection, the specifics of how gender has been historically defined and implemented in SE will be analyzed together with the resulting issues members of the LGBT+

community are experiencing. Afterwards, existing countermeasures and ideas will be discussed, as well as the opportunities a world without any link to a person's physical attributes and especially sex provides for gender inclusivity.

3.3.1 Gender Exclusivity in Existing Software Implementations

As discussed in subsection 3.2.2, gender has been historically treated as binary, and thus software design was influenced by that. Figure 3.7 shows that users are not only interacting with the UI of an application when using it, but transitively also with its backend and database(s). Each of those parts of any application has different pitfalls in terms of LGBT+ inclusivity. What they are, and how they make many existing software implementations gender exclusive, will be discussed in this subsection.

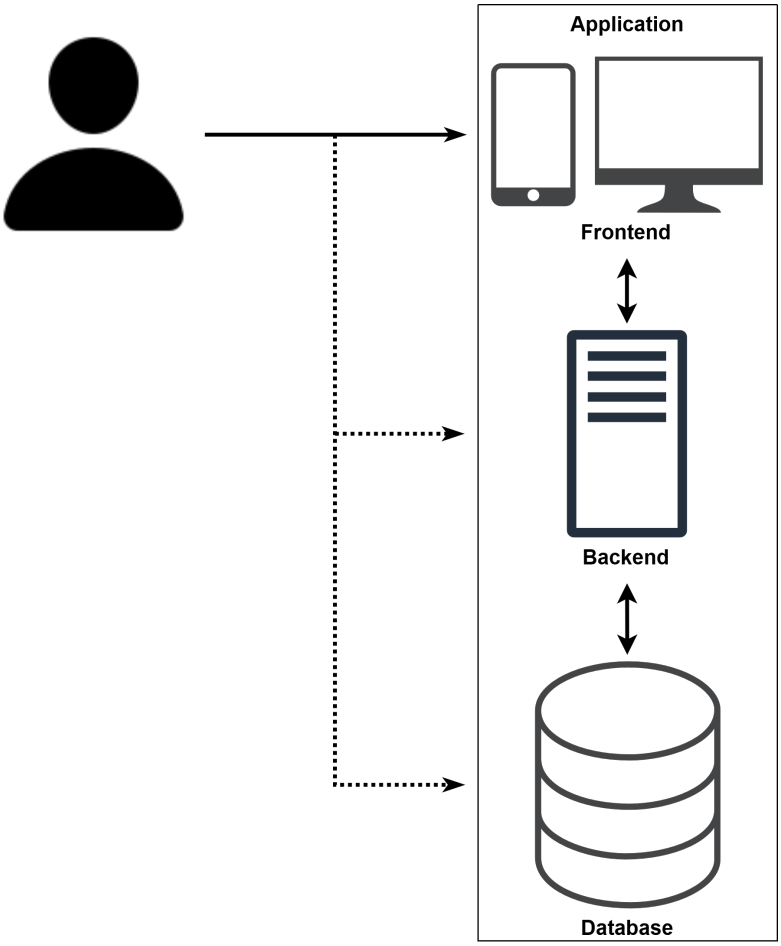

Figure 3.7: Schematic diagram of how a user interacts with a generic application.

3.3.1.1 Heteronormativity in Software UI

The UI of an application is the part that a user directly interacts with, and is therefore oftentimes referred to as the *frontend*.

A majority of applications and platforms that require a user account have a mandatory field in which the user has to state their gender. The selection is binary or ternary in most cases (60) (67) (69) (70) (71) (72) (74), with the latter becoming increasingly popular in recent years (60). Some platforms with a ternary gender input also allow further specification in case *other* or an equivalent to that is selected, either in the form of an additional list, or through a text field. This is an example of the hierarchy between binary and non-binary genders described in subsubsection 3.2.2.2. Additionally, such implementations can lead to an arbitrary exclusion of certain genders if they are not present in the secondary list, or to hypercategorization if any gender can be entered (65).

Some applications also allow the setting of pronouns instead of gender. The issues that arise from such implementations are similar to the ones from forms that request gender information (59).

Examples for binary and ternary gender inputs can be seen in Figure 3.8[1]. An example of a gender input that asks for binary gendered pronouns, but acknowledges the existence of non-binary genders, can be seen in Figure 3.9. The fields can be identified as mandatory by the asterisk (*).

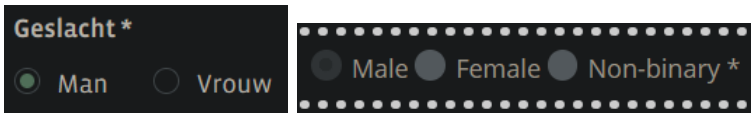

Figure 3.8: Forms with mandatory binary (left) and ternary (right) gender inputs.

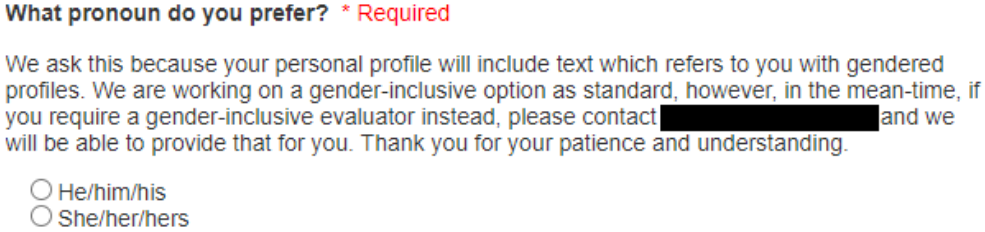

Figure 3.9: Form with mandatory binary pronoun input that acknowledges non-binary genders.

[1] From Dutch to English: *Geslacht* = *Gender*, *Man* = *Man*, *Vrouw* = *Woman*.

The above described implementations can have multiple negative consequences on non-binary people, especially in terms of mental health. In different studies, users reported e.g. that they felt pressured, stressed, or upset (2) (63) (71) (72) (74) (122). If people are not forced to use an application, they might also feel discouraged from using it if they don't feel properly represented and respected by it (75).

There are also legal implications. Users who have to misgender themselves due to limited gender options are technically violating the terms of use of many software platforms by misrepresenting their identity (59) (60) (101, p. 36).

Examples like Figure 3.9 show that some platforms acknowledge the existence of non-binary genders and aim to support them in the future. Such interim solutions can however still cause harm to non-binary people, as they have to do additional work compared to binary people, and have to share highly personal information with people they don't know in the hopes of getting access to an application that they might have to use (63). In some cases this endeavour is even unsuccessful, which causes even further stress (59) (67).

The above described solutions do also ignore individuals who identify with zero or many genders (71) (100).

3.3.1.2 Assumptive Domain Logic

The *domain logic* or *business logic* is implemented in an application's backend and describes how the application behaves based on different inputs and conditions. Often times, assumptions are made during this process. However, while such assumptions can benefit and optimize large parts of an application's use case, they can also exclude marginalized groups, because they are based on stereotypes.

One example for this is a case study from Ireland, in which a transgender woman with children wanted to apply for housing but was then required to fill in information about her husband (63). The business logic of the application made the heteronormative assumption that children have a married woman and man as parents (63) (121). Another example of gender stereotyping are default profile icons on various websites, which in the past used to be gendered silhouettes, as depicted in Figure 3.10. They have been mostly replaced by a singular gender neutral silhouette in recent years.

As discussed in subsection 3.2.2, gender is neither discrete nor fixed, meaning people can have any number of changing genders. In software, that would require not only the ability to enter multiple genders, but also to change and remove them at any point in time. However, such functionality is seldom implemented (63) (74) (121). This can have a discouraging effect on users who think it is pointless to enter any personal data that will

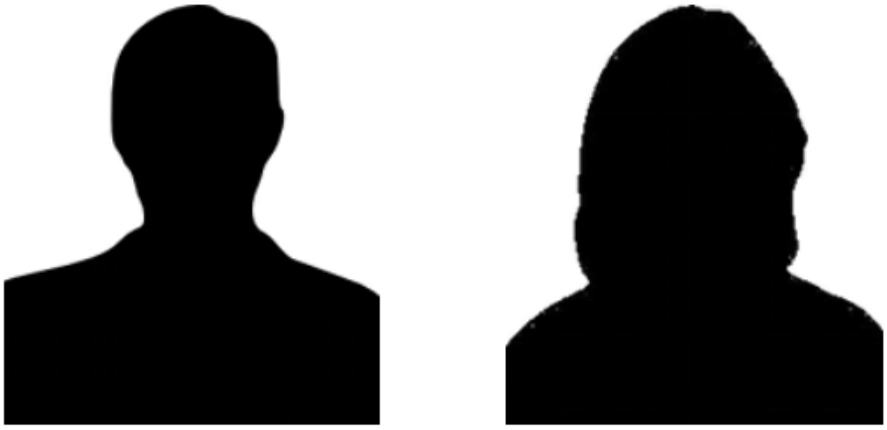

Figure 3.10: Default silhouettes for profile pictures as they used to be implemented on various platforms (2).

eventually be immutably incorrect. They might find it stressful and time-consuming to keep it up to date, or see no incentive to correctly present their gender to begin with (63).

Gender information in software is also a privacy concern. Besides the already mentioned issue of not having full control about it in many cases, many applications also won't allow users to hide personal data from other users (72). The assumption is that it is generally safe to share anyone's gender information with everyone (71) (72) (121). However, this is not even true for women in many places, and especially detrimental for non-binary people, as they might face social issues that range from being prematurely outed to being persecuted (72) (121), like in the countries marked in Figure 3.6.

Especially in domain logic, assumptions about sexuality can also be problematic. For example, until recently, the dating app *Bumble* enforced a feature due to which women had to text first in case of a match (70) (123). However, this feature implied that a match is between a woman and a man, at least in *normal* cases. There are also other cases of heteronormativity and even homonormativity in dating apps, as described in subsection 3.2.4.

Beyond intentionally implemented software designs, there are also issues in applications that make use of AI and ML, as their data is usually heteronormative and thus marginalizes already underrepresented groups even further (60) (63) (69) (71) (74) (98) (119).

3.3.1.3 Persisting Gender Information

Databases are another source for gender-based discrimination. Historically, it is taught in IT and SE classes that an example for a database table would be a person, that that table has a field for gender, and that that field can have two values: One for if the person is a

woman, and one for if they are a man (67). This basic design is excluding any non-binary and non-singular gendered people, but is rarely challenged.

It also limits the functionality that can be provided by any application using a database with such a design, because any non-binary representation in the front- or backend gets removed once the data is persisted (59) (63) (67) (74). Facebook for example decided in 2014 to allows users to choose from one of 58 genders in their account. However, the underlying database was using the ISO/IEC 5218 standard for sex described in subsection 3.2.1. The value stored in that field was actually based on the users chosen pronouns. Due to that, the UI would misgender any user who chose female or male pronouns in combination with a non-binary gender, because the wording of the texts in the frontend were based on the gender field of the database, but would also apply to terms like *child*, which would become *daughter* or *son* (59).

As previously discussed, being able to change and delete gender information is a critical functional requirement for gender inclusive applications. However, even applications that allow users to remove their gender from their profile will in reality only hide it in the UI, but still keep it in the database (60) e.g. to sell that data to third parties (59).

3.3.2 Existing Countermeasures

This subsection will discuss possible countermeasures to the issues that have been discussed in the previous subsection that have been proposed in research.

3.3.2.1 Eliminating the Constraints of the Binary Gender

The implementation of gender as a binary value causes, as previously discussed, issues for anyone whose gender is non-binary, non-discrete, or non-singular. Thus, the obvious solution is to make implementations more inclusive in that regard.

Ternary solutions already exist, but are also inherently flawed, as discussed in subsubsection 3.2.2.2. Nonetheless, they would already be an improvement for applications that are only binary so far (100). Expanding on the idea of a free-form text field for non-binary genders in ternary solutions, some studies suggested to make the gender field a free-form text field altogether (2) (63) (72) (124). Such implementations have been perceived as the most inclusive compared to any other solution (75).

Beyond the concerns of non-binary genders, there is also a requirement for gender implementations to include fluid and multiple genders. People should be able to edit and delete

gender information in their personal data easily at any time (68) (125), and should also be able to enter any number of genders at once (72).

As many of the discussed issues stem from inadequate support for the non-binary gender spectrum, it has been questioned why applications even need gender information to begin with, with the conclusion that it is in fact not required for most applications' functionality (2) (63) (67) (71) (72) (75) (114). Platforms like YouTube and X[1] do not have any gender options in their user profiles, and are still able to provide similar functionality (60).

To address a person adequately, knowing there gender is often times not sufficient. It has therefore been proposed to let users state their pronouns instead of their gender (75) (114), either through an extensive list (72) or a free-form text field. This could also prevent users from being misgendered unintentionally (68).

3.3.2.2 Control over Data, Access, and Functionality

As mentioned in the previous subsection, it is important that users have full control over their data, e.g. by being able to change and delete their gender information at any time. In addition to that, it is also necessary to be able to restrict access to personal data in public applications. That way, users don't have to face potential issues due to their gender, or because they only want to out themselves to certain people, but not everyone yet.

Applications should adopt a private-by-default policy that would hide gender information from everyone, except by users who are manually put on a whitelist (67) (68) (71) (121) (122). Users should also be able to completely block other users (68).

Users should not be required to manually locate their information all the time. Instead, personal information should by default contain an expiration date after which it automatically is deleted, unless the user specifically extends the retention period (68).

It is also important that users can choose what features of an application they interact with, especially on larger platforms that offer many different functionalities. For example, social media platforms often times use a memory feature that shows users pictures from an arbitrary amount of years in the past. This can remind certain user's of traumatic experiences they had in the past, e.g. by showing a transgender person a picture from before they transitioned (125). Features should therefore have at least an opt-out functionality (75), or should even be based on a manual opt-in by the user (125).

[1] Formerly known as Twitter.

3.3.2.3 Systematic Techniques

Many of the discussed issues exist not due to the developers malevolence, but because they don't know any better. To combat these biases, there are many debiasing techniques discussed in literature that should be considered in SE when any form of values are incorporated into software design (126). Studies already demonstrated that the usage of some debiasing techniques can be successful (127). Often times however, they remain theoretical and untested in practice (15).

Generic debiasing techniques include the creation of feedback loops. Instead of just implementing a solution, developers should instead step back and exchange ideas with peers. In the best case those peers stem from different teams and can offer more diverse perspectives (61) (128) (129). To combat specifically overconfidence bias, those feedback loops should implement the *double-loop learning* technique, in which not only implementation techniques but also initial assumptions are challenged (15). In general, it is important to exchange information also within a team to prevent illogical assumptions from being tacitly implemented (61).

Software developers should also adopt systematic over naturalistic approaches, because they favor rational decision-making. Such approaches can be any kind of framework, model, or iterative approach (61) (128) (129). Examples for this are the Observe, Orient, Decide, Act (OODA) loop (129), *GenderMag* to increase awareness for binary gender inclusivity (62) (89) (90) (92) (93) (94) (95) (130), iterative reviews of existing solutions (61), and *planning poker* to combat optimism bias (15).

3.3.3 Opportunities

So far, issues and pitfalls for gender inclusivity have been discussed. However, fully digital implementations also offer unique opportunities, as biological sex in the physical world cannot be linked to a person's digital gender.

When creating a digital user profile, that profile can take on the attributes of the user's true personality, unrestricted by their physical attributes (101, p. 36) (131, pp. 7 - 8). This is especially relevant for trans people who can model their profile fully based on their gender and regardless of their sex. Transitioning people can also use digital avatars, Augmented Reality (AR), or Virtual Reality (VR), to experiment with how they want to present themselves during and after their transition, which is not possible in the physical world (66) (101, p. 80) (112).

One avenue that allows increased representation and identification are video games, if the game designers design their characters accordingly, e.g. by making them androgynous to allow any gender to identify with them (126) (132).

During a workshop, non-binary individuals were asked to design a voice-training app that they would like to see and use. One of the imagined features was the option to receive voice training based on individual aspects of the voice, such as its pitch, tone, and character, and to be able to select how female or male each of those aspects should be individually. This would allow the users to essentially build their own voice regardless of stereotypes of how a female or male voice should sound like (64).

4

Study Design

In this chapter, the design of the conducted study and the extraction and synthesis of the data is described and explained.

4.1 Research Goal

A goal of the study is to identify issues members of the LGBT+ community face. Another goal is to identify potential improvements for those issues. This research goal can be formalized using the GQM approach (55, pp. 39 - 42), as depicted below:

Purpose	Identify
Issue	impact of, and countermeasures against bias against LGBT+
Object	in Software Design
Viewpoint	from the viewpoint of LGBT+ software developers.

This goal is similar to the one used for the literature study as described in section 3.1. However, the viewpoint is moved specifically to the intersection of IT and the LGBT+ community, to gain firsthand insights from people with experience in that intersection.

4.2 Research Questions

Based on the above research goal, multiple research questions can be formulated:

RQ1: What inclusivity issues are encountered by members of the LGBT+ community in software?

RQ2: What (preventive) measures are taken by members of the LGBT+ community to reduce the amount or magnitude of inclusivity issues they would encounter?

RQ3: What improvements can be made that lead to more inclusivity for LGBT+ individuals in software?

RQ3-1: What technical implementations in IT systems can increase LGBT+ inclusivity?

RQ3-2: What external factors prevent inclusivity from being implemented in software?

RQ1 aims to identify the issues that LGBT+ people are currently facing in software based on their identity. The goal of **RQ2** is to see how those issues impact their life. **RQ3** tries to identify potential improvements to the found issues, especially on a technical level (**RQ3-1**), as well as external factors that hinder inclusivity in software desing (**RQ3-2**).

4.3 Interview Design

Based on the research goal and questions, a qualitative interview study was chosen as the optimal way to gather data. Interviews are fitting because it is important to gather first-hand experience about the actual issues the LGBT+ community faces. Because the community is highly varied, it is important to try to include as many different perspectives as possible. The study is qualitative because it is exploratory in nature.

To allow the participants to adequately express their experiences and ideas, and to enable the interviewer to properly react to the flow of the conversation, the interviews are designed to be semi-structured (133). This is generally viewed as a suitable approach for qualitative and exploratory studies. However, there are still general topics that should be touched upon. For that reason, the following list of questions can be referred to by the interviewer during the interviews. They serve merely as a guideline and not as a script. A brief explanation about the purpose of each question is added respectively:

Q1: ***What is your IT background, and how do you identify yourself?***

This question aims to introduce the interviewee, and to gain context about their identity especially within the LGBT+ community, and their experiences of studying and working in IT.

Q2: ***Do you yourself or people you know encounter issues when using software because of your identity? If so, what are they?***

The goal of this question is to get to know the issues the interviewee faces because of their identity, as well as other issues non-heteronormative people they know of encounter. The discussed issues can stem from anywhere, like their daily life, at work, when interacting with authorities, etc..

Q3: ***If alternatives are present, does your identity change the way what software you use, and how you use it?***

Some platforms can be used to different extends or with different goals in mind. Other software might even be optional and can be circumvented entirely. The goal of this question is to understand if and how LGBT+ people have to work around existing solutions, and what factors play a role in determining what their course of action is.

Q4: ***How do you think the software you use or work with can be improved to be more inclusive?***

Previously, the issues the LGBT+ community is facing in software have been discussed. Besides that, there might be other potential changes they would like to see that do not necessarily resolve any issues, but improve their experience in other ways.

Q5: ***Based on your technical experience, do you have ideas or suggestions on how the previously discussed changes could be actually implemented?***

This question intends to tap into the technical knowledge of the interviewee. The idea is to get a different perspective on a technical design and/or solution, which is essential to create less biased software designs. The ideas and suggestions can be on a technical level, on a conceptual level, or anywhere in-between.

Q6: ***What do you think are the reasons these issues have not been interacted with?***

This question aims to see if there are any external factors that hinder inclusivity from being implemented into software and its design.

Q7: ***Do you feel safe comfortable enough at your work to suggest changes that increase inclusivity, like the ones previously discussed?***

As biased design decisions are often made because marginalized groups are not considered, it is important to understand if those marginalized groups even feel welcome to contribute or not. The goal of this question is to understand what issues people

of the LGBT+ community have to deal with before software design even plays a role, especially in the latter case.

Q8: ***Do you have positive examples of how software supports you and/or your identity?***
If designs that are particularly inclusive already exist, they can be discussed as part of this question as a positive example for the further parts of this thesis.

How each interview question relates to the research questions for this interview study can be seen in Table 4.1.

	Q1	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**
RQ1		x						
RQ2			x					
RQ3-1				x	x	x		x
RQ3-2						x	x	

Table 4.1: Mapping between the interview questions and the research questions of the interview study.

4.4 Conducting the Interviews

To gather information about the interviewees' identities, sensitive personal data might be mentioned during the interviews. It is important to treat this data safely and only evaluate it anonymously. Especially gender data can cause harm, depending on the background and culture of the interviewee. Due to that, it should also be expected that not everyone is generally open to be questioned about personal data by someone who is nor part of the LGBT+ community.

Besides that, there are other precautions that have to be met to make the interview an inclusive and open experience for all participants, regardless of their gender, sexuality, culture, or identity. When stating their identity, the interviewees should be able to answer however they want, without any predefined options. As mentioned, asking the participants for information about their identity should be optional. This holds true for other questions in the interview, too. Lastly, while it should be obvious based on the background described in subsection 3.2.2, the sex of the participants is irrelevant, and only their gender and sexuality matter (134) (135).

4.5 Data Storage

Only in cases where the interviewees explicitly agreed to it, the interviews were recorded. The recordings are stored encrypted on an offline storage unit that is not connected to any other computer system. They are meant to be confidential and can not be shared without further agreement by the interviewees.

4.6 Data Extraction

As the interviews are conducted semi-structured, there is no guarantee that every question is asked, and that only those questions are asked. Therefore, data extraction for each question separately is not feasible. Instead, data extraction will be done by research question, based on Table 4.1.

Each individual interview will be recorded if possible and with consent of the interviewee. The answers given by the participants will also be summarized. There will be no fixation on specific metrics or topics within the answers to prevent fixation bias.

The following metadata about the interviews will be collected anonymously if provided by the participant:

- Interview
  - Date
  - Form
  - Location
- Interviewee
  - IT background
  - Identity

4.7 Data Synthesis

The interview summaries from the data extraction step will be combined for each research question. Through this, patterns, similarities, and different perspectives on different topics can be directly compared. The results will also be compared with existing literature.

Based on these summaries, and the background from section 2.2, a mapping is created that tries to link existing issues to specific biases.

5

Results

This chapter will describe the results of the interviews, which can be found summarized in appendix 1.

5.1 Interviews

The interviews (n=7) were conducted verbally and on location if possible (n=2). However, some interviewees were located in a different country (n=4), or preferred to not have a verbal conversation for personal reasons (n=1).

The interviews ranged in length from around ten to almost 30 minutes, depending on how willing the interviewees were to share their personal experiences, and how many specific topics they wanted to talk about.

The interviewees displayed a variety of backgrounds and identities. Among them are people from the European Union (EU) (n=6) and the USA (n=1). The distribution of genders and IT backgrounds can be seen in Table 5.1 and Table 5.2 respectively. None of the interviewees explicitly identified as heterosexual.

	Women	**Men**	**Non-Binary**
Cis		3	
Trans	3		
Unknown			1[1]
Total	3	3	1

Table 5.1: Genders of the interviewees.

[1]While non-binary identities are typically identified as transgender because the gender does not match the sex assigned at birth, not every non-binary person necessarily identifies as transgender.

	Software Developer[1]	CS Student	Software Architect	Data Engineer	Unknown
Total[2]	4	2	1	1	1

Table 5.2: Current IT Backgrounds of the interviewees.

5.2 Research Questions

This section will summarize the statements made for each research question defined in section 4.2 made by the interviews logged in appendix 1.

5.2.1 RQ1

What inclusivity issues are encountered by members of the LGBT+ community in software?

Interviewees reported that they are unable to state their identity correctly in some applications. Not all software supports non-binary gender, so people are forced to misgender themselves if they want to use the application, especially because the gender field is usually mandatory. Similar issues arise because selection fields for pronouns and titles for forms of address have only a limited amount of preselected values that are not applicable to everyone. The main cause overall was a binary gender implementation.

Other interviewees also reported that they are not able to change their gender information once it is stored in a software system. This is especially detrimental for users who are not able to enter their personal data correctly initially, or whose identity changed or changes due to being transgender or genderfluid. A reason for this in larger software systems is apparently that data is shared between applications. In such cases it is unclear which application holds the data, and where and how to change it.

As an example for this, university applications in the Netherlands were named. Student information is initially processed through the centralized national software Studielink. The UI of that application is depicted in Figure 5.1. It enforces a ternary gender, and only allows the third gender under specific conditions, as the notification on the screen demonstrates. Students reported that that information was used in applications specific to their university, like the website and Canvas. Most personal data can not be changed in those specific applications, but it is also not mentioned where the data is coming from. This means that students have no control over their data.

[1] Different developer positions, like web, software, and full-stack, are grouped up here.

[2] Some interviewees are currently active in more than one role, and are therefore counted more than once.

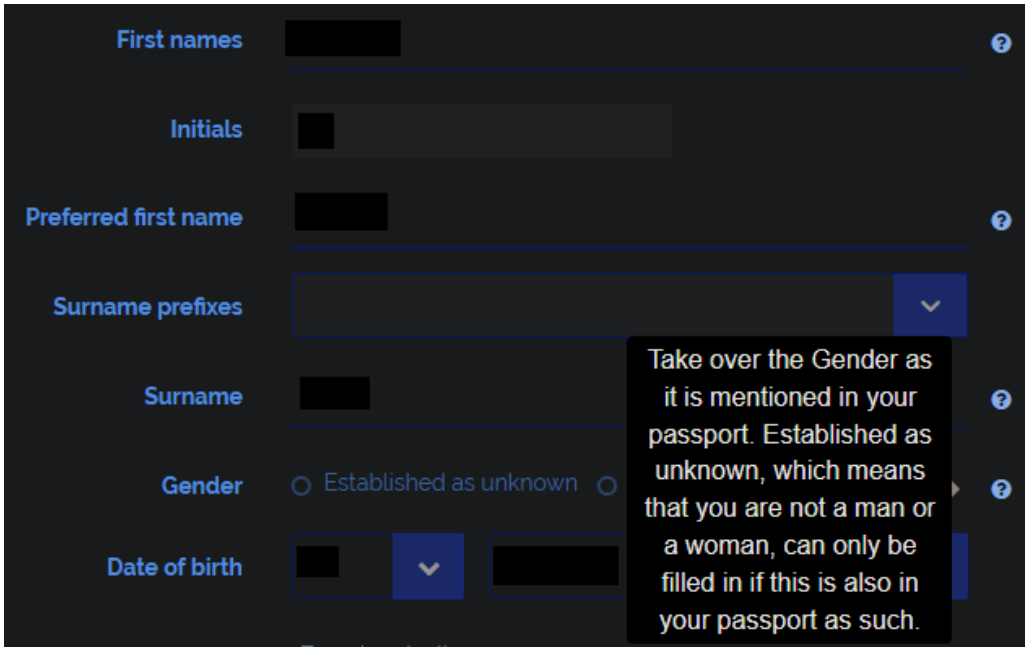

Figure 5.1: Screenshot of the personal details form in a Studielink profile (3).

Another issue in regards to legal names was reported by transgender people specifically. When ordering a package online, people have to identify themselves when receiving it, or when they pick it up. In cases where they are able to enter their preferred name rather than their legal name, the name in the system of the delivery company does not match the name on the Identity Document (ID) of the person, so they are not able to receive the package. This means that people are forced to deadname and misgender themselves even in systems that them to enter their preferred personal data, because they have to match their ID. Other systems even require that the entered information has to match the information on legal documents.

This ignorance towards non-binary or fluid genders and identities causes them to feel stress, because they feel reminded of the fact that they are not valued by society overall. It was also described as intrusive to be asked about personal legal information. Some interviewees also stated that gender information is often times requested and processed for no apparent reason. They questioned why applications would do this in the face of EU laws that should protect personal data.

There are also issues reported in the USA, where users can use any form of ID, e.g. a drivers license or a passport, to identify themselves in many application. One interviewee reported that they were unable to make use of various car sharing applications because

their drivers license got rejected due to having a non-binary gender marker. They were ultimately unable to use car sharing at all.

Another issue that non-binary people frequently encounter especially on social media platforms is hate speech. It was reported that platforms don't do enough to prevent and punish hate speech, especially on X[1]. This causes environments to be unusable and uninhabitable by LGBT+ people. Some platforms even shadow ban LGBT+ content. That means that content gets marked as political and therefore unattractive for certain advertisers, and is therefore no longer recommended to other platform users. The content creator is not notified of this. This can cause them to feel stress because their content significantly loses impressions without any official reason.

Lastly, interviewees reported heteronormativity in domain logic as an issue. Most people simply stated that they use alternatives to heteronormative applications. However, one interviewee described the onboarding process as a new employee of a university. The new employee was required to not only disclose detailed personal data of himself, but also their partner. They felt that this was unnecessary and intrusive, and were worried about what the data was used for.

5.2.2 RQ2

What (preventive) measures are taken by members of the LGBT+ community to reduce the amount or magnitude of inclusivity issues they would encounter?

As described in subsection 5.2.1, members of the LGBT+ community feel generally unsafe on certain platforms and applications due to unregulated and unmoderated hate speech. Therefore, they only use platforms and applications that do not have such issues.

In general, people prefer to stay within their social bubbles in order to not have to deal with random people that might cause them stress or harm. Platforms like Discord offer advantage for such behaviour and are therefore preferred by the LGBT+ community. On Discord, people can organize groups and communities in so-called servers, which can be restricted in their access and function as safe spaces for text, voice, and video interactions. Overall, the internet is perceived as a place that can offer safe spaces, especially because not everyone feels safe in their offline environment.

Some platforms offer no option to enter any gender information. While this is often perceived as positive because it doesn't force people to misgender themselves, some people want to state their gender, as it is an important part of their identity. A workaround that

[1]Formerly known as Twitter.

has become common on X[1]specifically is to put pronouns into the field that is meant to hold the user's location, but can be used as a free-form text field. This allows users to signal how they would like to be addressed in discourses and conversations on the platform.

When using dating apps, LGBT+ people don't use certain applications that enforce heteronormativity. As an example for an app that does not enforce that, OkCupid was mentioned, as it allows a variety of identities and creates the user's profile through asking many mostly optional questions that can be answered broadly.

5.2.3 RQ3

What improvements can be made that lead to more inclusivity for LGBT+ individuals in software?

In this section, potential improvements to existing applications are discussed. Specific technical solutions are elaborated in subsubsection 5.2.3.1.

Outside of making it technically possible, one request was that personal data and especially gender information should be editable everywhere it appears. Alternatively, it should at least be clarified where the data is stored and where it can be edited.

Especially on social apps, several interviewees expressed that it is important for them present their gender. On apps that focus more on functionality, e.g. banking apps, the interviewees care less about correct gendering. Other interviewees stated that in cases where gender information and personal data is requested for no apparent reason, it should either be removed or made optional, or a reason should be given as to why the data is required.

A feature that was described as missing was moderation, especially on social media platforms like X[1]. Certain platforms already implement such features globally or within specific communities. For example, Discord administrators can moderate user messages and posts of their own servers, and can also give those privileges to other server members.

To overcome cultural differences, like the ones that will be discussed more in-depth in subsection 6.2.1, public institutions like universities were called out to act as progressive role models. Not only should they move away from problematic implementations as shown in Figure 5.1, but should instead lead by example when it comes to inclusivity. Mixed classrooms are a positive example for this, as they allow students to participate, even if they do not feel comfortable with themselves in the real world. This is a realistic concern

[1]Formerly known as Twitter.

for transgender people during their transition that can cause them immense stress and mental problems.

5.2.3.1 RQ3-1

What technical implementations in IT systems can increase LGBT+ inclusivity?

Similar to what is described in literature, almost all the interviewees stated that they would prefer gender input fields to be at least ternary, non-binary with a list of options, or free-form text fields, with the latter being the most inclusive implementation. Similar statements were made about fields to enter pronouns, and to enter forms of address. Some suggested that those fields should be removed entirely, but for others it is important to identify themselves with a specific gender. The optimal solution is therefore to make those fields optional. From a frontend developer perspective, removing such fields, or making them optional, would be doable within a single day. However, it was also pointed out that such changes need to be reflected in the backend and databases of applications. The effort of those changes could not be estimated by the interviewees.

Besides that, one interviewee suggested that users should be able to enter a preferred name in any case, even if a platform requires a legal name. As an example, the interviewee described a the onboarding procedure with a company, during which they were asked for both a legal and a preferred name. The legal name was used only for the contract, in any other communication the preferred name was used. Social apps, like social media and dating apps, already don't have any verification for names, and are therefore inherently more inclusive. However, many less social apps, like banking apps and internal applications of companies, are less inclusive in this regard. In any case in which a legal name is required, the application should also explicitly explain for what reason. A positive example for the implementation of names and other identity aspects is Discord. On Discord, users can be a member of any number of servers, which resemble social groups or communities. On each server, a user can choose a different name and different pronouns.

As explained in subsection 5.2.2, members of the LGBT+ community prefer applications that do not enforce heteronormativity. Therefore, to make software more inclusive, heteronormativity should be removed as much as possible from frontend, backend, and databases. Interviewees especially mentioned preferred dating applications like OkCupid, that aids them in finding partners based not only on gender and sexuality, but also on a large set of other characteristics and personality traits. Also, none of the questions have to be answered in a way that excludes certain identities, and there are no inherent restrictions in regards to who can be matched with whom.

More controversially discussed were AI algorithms to prevent and combat hate speech. There were uncertainties about if they can even function in languages other than English, how they would be regulated, and especially how it would be ensured that they wouldn't be harmful towards marginalized minorities like the LGBT+ community due to algorithmic bias. Most interviewees were therefore critical about the usage of AI.

5.2.3.2 RQ3-2

What external factors prevent inclusivity from being implemented in software?

When asked why the previously discussed ideas were note yet implemented in existing software, despite being described as easy changes in many cases, the interviewees described several external factors that either are prohibiting software teams from implementing them, or are creating incentives for not changing the current solutions.

Financial motivations were described as a big factor. As making profit often times serves as the primary motivator for organisations, they see no reason to implement changes that would increase inclusivity, as most marginalized groups have to use many platforms anyway, or are so small that they are not worth the effort from their point of view.

Interviewees reported that financial motivations also impact the moderation of hate speech. One interviewee noted that e.g. on X[1], even before Elon Musk took over, hate speech only got banned from big accounts that were noticed by advertisers because they didn't want to sponsor a platform on which hate speech was allowed. On the other hand, hate speech by users with very few interactions would not get banned, because it went unnoticed or wasn't worth the effort. Nowadays, especially on X[1], certain non-heteronormative beliefs are even banned proactively.

In terms of inclusivity, LGBT+ topics being considered to be political is a negative development in general, as many advertisers don't want to be included in political discussion to be able to appease all the sides in an argument. Therefore, it is in the interest of platforms to minimize exposure of LGBT+ content. This reportedly happened on TikTok, where LGBT+ content got shadow banned. A shadow ban refers to a platform removing certain content or topics from recommendation algorithms without notifying the content creators, who will only become aware of this due to drastically reduced impressions on their content. The platforms have no interest in telling the content creators, as that would cause them to lose users.

[1]Formerly known as Twitter.

One reason for LGBT+ rights being a political topic is the discrepancy in legal situations between countries that are connected on the same platforms. The clashing of different cultures with different believes was described as an issue that slows inclusivity efforts. That in turn can have negative effects on software developers who, despite being part of the LGBT+ community themselves, feel not always comfortable enough to speak out on the behalf of inclusivity. This dynamic can also be observed within countries. For example, people living within cities are generally more progressive and inclusive than people living on the countryside.

Another issue that was reported by some interviewees is the indirect effect of existing laws on software. In many places, laws rarely changed throughout the years. Even software that is not directly regulated needs to comply to those laws in their domain logic, and is therefore regulated indirectly. An example was given by a software developer working at a company that creates an application that helps users with doing their taxes in Germany, where it is a rather complicated process. Despite the interviewees effort, it was decided that such changes were not possible due to legal constraints.

However, the same interviewee also reported that they were suspicious about their management not being entirely faithful about the situation, because the given reasoning was rather vague. The same company also asked the interviewee to conduct an interview about their experiences in the company as an advert for new potential employees. While the interviewee paid a lot of attention to using gender-neutral language in their answers, when the written interview was published, specifically the gendering was changed. Therefore, the interviewee concluded that there are resentments against non-heteronormativity, independent of the legal situation.

Issues due to being connected to other external software or systems that enforce heteronormativity were also reported by interviewees. As described in subsection 5.2.1 in the example of interconnected university software, if an application is connected to external software that enforces heteronormativity, that limits the domain logic of the other application as well.

It was also mentioned that educational institutions can and have to perform the role of a positive example in many societal regards. However, in terms of data privacy, inclusivity, and also media literacy, this is not the case in many instances. For example, some interviewees reported that certain universities will inquire potential employees about a large amount of personal data, not only of themselves, but also their relationships. Especially in Germany, where the internet is not yet as widespread as in other countries, it was also reported that digital media literacy is not taught in a sufficient manner. The acquisition of

X[1]by Elon Mask has shown that social media platforms can be easily manipulated, which can then shape the opinion of many of their users, e.g. about LGBT+ rights and issues. This is especially dangerous without adequate media literacy.

In regards to the suggested AI algorithms that could be used to detect and ban hate speech, it is unclear how effective they actually are, and how well they can even detect hate speech against marginalized groups. Many consider the usage of AI as unethical due to potential selection bias in data, as well as other algorithmic biases. Those biases can make the situation for already marginalized groups even worse. It is also unsure if they would work in languages other than English. There are also no legal regulations yet. While this is also the case for many LGBT+ issues, biased AI might even be more harmful than helpful, especially if it is lacking proper regulations.

In general, it became also clear that software developer do not think of all possible cases when developing software. For example, people in the USA can identify and authenticate themselves via credit data in credit card systems. This however is problematic for people who are too poor to be eligible for a credit card, and are thus unable to authenticate themselves at all. Analogously, it has to be expected that software developers who are not part of the LGBT+ community are not aware of all the existing issues, and even if they are, they usually are mostly aware of issues regarding their own gender, identity, or sexuality, but not all of them at once.

[1]Formerly known as Twitter.

6

Evaluation

In this chapter, the results of the study are discussed and contextualized within the backgrounds discussed in section 2.2 and the results of the literature study discussed in chapter 3. In addition to that, solutions for specific issues are proposed on a theoretical level based on the problems and ideas stated by the interviewees. Potential biases that cause heteronormative software design are also discussed.

6.1 Technical Solutions

Some of the discussed issues were of technical nature, and can therefore be solved through SE solutions. More than anything else, the interviewees talked about how gender cannot be represented properly, though the exact issues differed. In addition to that, a lack of control about both personal data and the User Experience (UX) in applications were criticised. In this section, a proposal for an inclusive representation of gender and identity is made based on the feedback received from the interviewees. Issues found in regards of control of data and content exposure are discussed, too.

6.1.1 Representation of Gender and Identity

One of the most criticized issues in current software was how gender and identity representation in general are implemented. This was the case regardless of whether the described implementation was binary, ternary, or even non-binary with multiple options. The general consensus was that a free-form text field would be the only solution for both gender and pronouns to be fully inclusive.

Some interviewees suggested that gender should not be requested at all, because it adds nothing to the functionality of many applications, and is considered intrusive and the cause

of mental stress. Others however described the importance of being able to identify with a specific gender. The implementation of gender as an optional fields at least for applications that are used socially seems therefore the logical conclusion to conform to both ends of this discussion, under the condition that no gender and identity is excluded.

There are also two often overlooked aspects. One is that gender can be fluid. To support that, software needs to make it possible for it's users to change gender information at any given time. The same goes for pronouns and names. Another aspect is that gender is not singular. People can have zero or multiple gender, which also needs to be supported by software. It is important to note that not stating a gender and stating to be agender are two different things, and have to be differentiated in the implementation, too.

Based on how it is described in literature and by the interviewees, Figure 6.1 shows two class diagrams of how identity is presumably currently implemented in existing software. The left class simply uses a string name and gender each, which in reality is usually restricted to very few values for binary or ternary genders. The right example uses an enumeration for the gender, in this case also only including ternary values, as it is common in many applications. Such implementations are in theory easily expendable to include non-binary genders. However, to represent non-singular genders, a different approach needs to be considered.

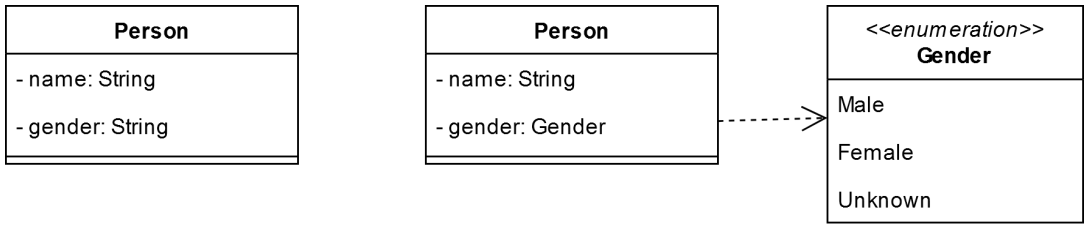

Figure 6.1: Current implementations of gender using a simple string (left) or a ternary enumeration (right).

Figure 6.2 depicts a class diagram for a potential inclusive implementation. Under the assumption that the name of the user is required to begin with, this model includes various options that allow the representation of all previously discussed identities and genders. All inputs should be able to be made through free-form text fields to allow for maximal flexibility, and as many as possible should be optional. Get and set operations and all other operations that are not explicitly described in this section are omitted from the diagram.

For the name, the user should be able to enter a preferred name if a legal name is required for any reason. That name should be used throughout the entire application. Users should also be able to chose a title as form of address.

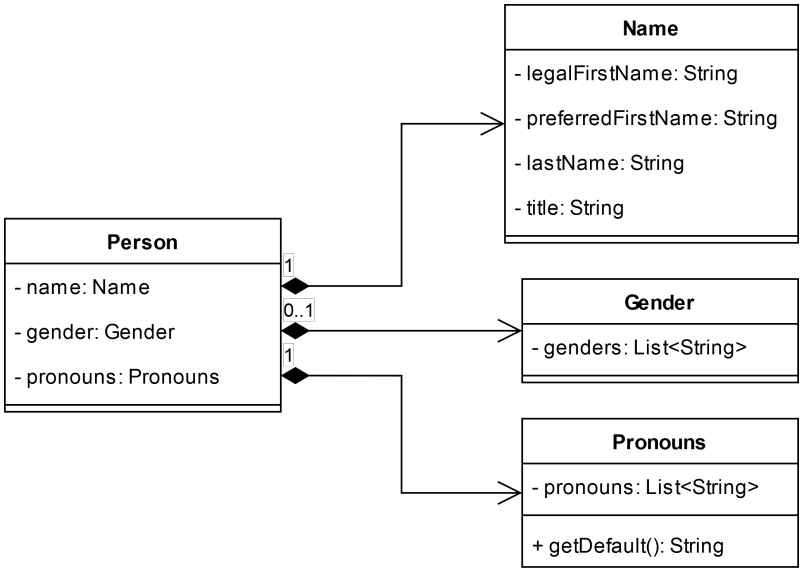

Figure 6.2: Proposal for an inclusive implementation of gender and identity.

For gender, users should be able to fill a list of genders they identify with. Monogendered people can jsut fill their singular gender, while polygendered people can fill any number of genders they identify with. Agender people can leave the list empty. The composition in the class diagram denotes that the Gender object is optional. This is due to the functional difference mentioned earlier. If the object does not exist, the user does not want to disclose their gender, which is different from being agender. While being agender could also be implemented by writing *agender* into the gender field, agender is technically not a gender but the absence of such. Therefore, the approach depicted in Figure 6.2 is more accurate.

In regards to pronouns, depending on their genders and their preference, users might feel comfortable with multiple sets of pronouns, and should be able to state all of them if they wish so. In such cases, the application needs to be able to determine a default value that is used consistently. The user should be able to choose which of their pronouns is the default. This can be represented through a specific position in the list of pronouns. In cases where no pronouns are disclosed, the software should use a gender neutral default. In English, this would be *they/them*, but as discussed in subsection 3.2.3, this might be more difficult in other languages, and thus warrants further research.

User should also be able to have multiple such profiles within the same application. For example, if a platform contains several distinct communities or spaces, it should be possible for the user to represent themselves differently, e.g. because they don't feel as comfortable to out themselves in certain environments. This allows users to control who can see which

personal data.

Ultimately, the class diagram in Figure 6.2 should be treated as an untested proposal that needs to be adapted to specific cases, or might even need to be expanded to include other identities that were not discovered through the literature study and interviews. Nonetheless, it demonstrates how gender identities can be considered in software design with a focus on inclusivity.

6.1.2 Content on Platforms

Another topic that got mentioned multiple times is how LGBT+ content is treated on different platforms. The biggest concern that was voiced was regarding content moderation. The cultural intricacies of this issue will be discussed in subsection 6.2.1, but in general it became clear that any platform hosting user-created content needs some form of moderation. At the same time, moderation should not be abuseable to erase certain views and opinions.

Beyond that however, no clear conclusion can be drawn about how to implement such a solution. The interviewees only specified solutions for small communities, where the role of the moderator can be fulfilled by few people with little effort. On the other hand, existing social media platforms require thousands of employees for such tasks, and those jobs evidently cause psychological issues for the people conducting them (136). If users themselves can remove the content of other users, almost every content is guaranteed to be deleted eventually due do conflicting opinions and personal dislikes, so that is also not a feasible solution.

Another approach that was mentioned by interviewees, and is already used by some platforms to different extents, are automated systems. For example, YouTube uses a system called *Content ID* in which copyright owners can upload any audio, image, or video data they own into a provided database. Any content that gets uploaded on YouTube is then automatically compared to the content in that database, and if it matches either redirects the revenue of that video to the copyright owner or blocks it (137).

A suggestion made by the interviewees was to make use of AI and ML algorithms. However, there are currently no working solutions available, and while research has shown that AI algorithms are getting better at marking only inappropriate content as such without making too many false positives (138), the absolute amount of misses is still way too high to be reliable. For marginalized groups especially, algorithmic bias is also a major concern.

Besides all the mentioned uncertainties, several features that should be available to platform users can still be defined. If a user feels uncomfortable due to certain content,

they should at least be able to hide that content on their own account, and potentially even ban any content from certain users from appearing on their account. That way, users can create their own safe spaces.

On the other hand, content creators whose platform gets removed or restricted due to moderation should be notified about that appropriately, instead of hiding the content without telling the creator. That way, clear communication about the terms of use of the platform is ensured, and content does not get removed for personal, political, or cultural reasons that are not specified anywhere. How this interacts with different cultures and their perception of certain ideologies will be discussed in subsection 6.2.1.

6.1.3 Heteronormative Assumptions

One issue that was primarily discussed in literature, but less so in the interviews, was the implementation of heteronormative domain logic. Many cases were reported in which non-binary and non-heterosexual individuals were not considered in software design beyond how gender and identities themselves are implemented in applications. Examples were instances in which a woman with a child needed to give information about their husband as part of a housing application form, despite being in a homosexual relationship. One example from the interviews was that non-binary gender markers on IDs can not be computed by some applications, which means that those applications can only be used by people with a legally binary gender.

Cases of heteronormative domain logic are highly dependant on their context, which means that no general recommendations can be made at this point, especially due to this issue barely being discussed in the interviews. However, a logical assumption would be to include more individuals from marginalized groups into the requirement analysis and the software testing process, to ensure that non-heteronormative needs and concerns are considered and implemented more sufficiently.

6.2 Categorization of External Threats

In the previous section, potential technical solutions for existing issues were discussed. In this section, the external factors that influence the implementation of such solutions are discussed and contextualized.

6.2.1 Factors outside of Software Engineering

There are several factors outside of the control of software developers that have an influence on their product. In the interviews, the issues that were reported were financial, cultural, political, or legal in nature. They will be discussed in this subsection.

Financially speaking, it was reported that there was no incentive for platform providers and other stakeholder to make changes that make their product more inclusive. Due to that, software developers do not receive any requirements to improve inclusivity. Implementing such changes proactively is possible. However, multiple interviewees reported that the companies they work at either do not care, or are even making excuses as to why such changes can not be implemented. Both these circumstances are rooted in biases that will be discussed in subsection 6.2.2.

Another external factor described by the interviewees are legal constraints. In countries in which LGBT+ issues are ignored or even enforced, software that communicates with federal software has to adapt to local laws, and is therefore likely to conform to heteronormative values. In theory, the EU is providing a legal framework that needs to be implemented each member state's national law, which includes laws focusing on the protection of personal data (139). In practice however, the definition of what is considered personal data and what not is vague (140), which means that software developers have no clear legal guidance in that matter.

Dependencies on external platforms and applications can transitively limit the design space of the internal domain logic of software. For the LGBT+ community this becomes problematic when this causes heteronormativity to be implemented in software for no functional reason. Examples for this are applications that access databases that enforce binary gender and software that assumes heterosexual relationships.

The issues described in this subsection are mostly out of the sphere of influence of software developers. Therefore, as part of this thesis, no recommendations can be made in regards to solving them.

6.2.2 Biases within Software Engineering

Biases are non-technical problems for inclusivity that can be mitigated by software developers themselves. As discussed in section 2.2, many biases are already researched in the context of SE. However, the information provided by the interviewees suggest that especially social biases strongly influence the requirements engineering process in SE, which

are rarely researched. Any implementation based on biased requirements will per transitive property also become biased, and thus cannot be considered inclusive. It is therefore important to identify the biases in requirements engineering correctly, to eventually design proper debiasing techniques.

Interviewees described that software developers currently see no value in making applications more inclusive, especially in less progressive countries. There are many potential reasons for this, including present biases like hyperbolic discounting (**B-D1**). Dependencies on already existing external systems and infrastructure that enforces heteronormativity were also mentioned multiple times. It is unclear whether this is due to actual requirement, financial incentives, or due to infrastructure bias (**B-D2**).

Interviewees reported that, especially when they were working in more remote and rural regions, there was generally a low presence of the LGBT+ community. Therefore, many people do not fully understand issues of members of the LGBT+ community, and the magnitude of the impact they have on them. This was potentially also reflected in SE, as multiple interviewees reported that their coworkers did not care too much about inclusivity issues. A reason for this can be miserly information processing (**B-A4**), which is an action-oriented bias. People don't necessarily discard concerns because they don't take them seriously, but because they don't understand them. Similarly, incomplete information can also lead to anchoring or adjustment bias (**B-St1**), as older solutions are still deemed to be functional by some people, even though they exclude marginalized minorities. In some cases this might even be due to belief perseverance (**B-St2**). In other cases, default bias (**B-St3**) might also be an explanation.

In cases where software developer oppose the idea of non-binary genders, homosexuality, or other LGBT+ identities, they might be influenced by confirmation bias (**B-I1**) and disconfirmation bias (**B-I2**). They will then try to find arguments as to why there is no need for inclusivity, or why inclusivity should not be implemented.

Outside of LGBT+ concerns being more prominent and considered in certain environments and cultures than in others, there is also the general problem of information about LGBT+ concerns not being as readily available as of other, less marginalized groups. Software developers can be influenced by availability bias (**B-PR1**), and will not spend much effort in finding information about marginalized and rarely represented minorities and identities.

Many of the above described behavioural patterns can also be attributed to perception biases. Most perception biases, like attentional bias (**B-Pe1**) or contrast bias (**B-Pe2**), exist independently of certain topics. However, especially due to inclusivity being a political

topic, framing (**B-Pe3**) is a relevant concern. At the same time, because the LGBT+ community is often times seen as one singular group, despite representing a potentially infinite variety of identities, generalization can be a serious issue when considering non-heteronormative concerns. This can happen due to representativeness bias (**B-Pe5**).

Another potential reason as to why software designs might be not inclusive is the bandwagon effect (**B-So1**). Templating and standardizing patterns is an integral part of SE, and developers tend to reproduce certain commonly accepted patterns without critically evaluating them sufficiently.

Other social biases that get in the way of inclusivity include stereotyping (**B-So2**), due to which assumptions are made based on gender roles, rather than the actual concerns of gender identities. Cultural biases (**B-So3**) also play a major part, as culture has a huge influence on people's beliefs and perceptions, and thus shapes their idea of what is important and real. Lastly, as STEM and SE are fields dominated by men, it is clear that gender bias (**B-So4**) is a huge concern, too. Feminine interviewees reported that their concerns were sometimes not taken seriously, potentially due to not being a man.

In addition to these biases present in software developers, there are other places where bias can manifest. AI and ML were discussed as potential solutions to certain problems, but are also very prone to algorithmic bias (**B-So5**). Outside of software development itself, selection biases can also cause problems during the selection of data, requirements, or even stakeholders, software developers, and software testers. However, as this subsection has shown, including marginalized groups into the software development process does not lead to inclusivity.

Table 6.1 contains an overview of the above described biases and their category, as well as whether they are researched specifically in the context of requirements engineering, compared to Figure 2.3. It can be seen that the categories from which these bias stems vary greatly. This means that there are many external factors that need to be considered to correctly identify and mitigate biases. As already mentioned in section 2.2, the exact categorization for different biases is often times itself uncertain.

Figure 6.3 depicts a summary of the findings of this evaluation. It adds the newly discovered biases in green to the previously in Figure 2.3 discussed ones and links them to the requirements engineering step of SE. It also depicts the identified external factors.

It has to be noted that this mapping is based solely on second hand reports. Therefore, before preventive measurements can be evaluated, research needs to be conducted in the field to validate these assumptions.

Category	Name	Researched?
Decision	**B-D1**: Hyperbolic discounting	No
Decision	**B-D2**: Infrastructure bias	No
Action-oriented	**B-A4**: Miserly information processing	Yes
Stability	**B-St1**: Anchoring/Adjustment bias	Yes
Stability	**B-St2**: Belief perseverance	No
Stability	**B-St3**: Default bias	No
Interest	**B-I1**: Confirmation bias	No
Interest	**B-I2**: Disconfirmation bias	No
Pattern recognition	**B-PR1**: Availability bias	No
Perception	**B-Pe3**: Framing effect	Yes
Perception	**B-Pe5**: Representativeness bias	No
Social	**B-So1**: Bandwagon effect	No
Social	**B-So2**: Stereotyping	No
Social	**B-So3**: Cultural bias	No
Social	**B-So4**: Gender bias	No
Social	**B-So5**: Algorithmic bias	No

Table 6.1: List of potential biases against LGBT+ inclusivity in requirements engineering.

The behavioural patterns reported in the interviews matched mostly with decision biases, interest biases, and social biases. Especially the latter ones are rarely considered in SE research and especially requirements engineering (15). Additionally, selection biases might also play a part in identifying stakeholder and software testers, as well as in collecting data for potential AI implementations. However, based on the interviews, no specific indication for this was given. Therefore, no further conclusions can be drawn as a result of this study.

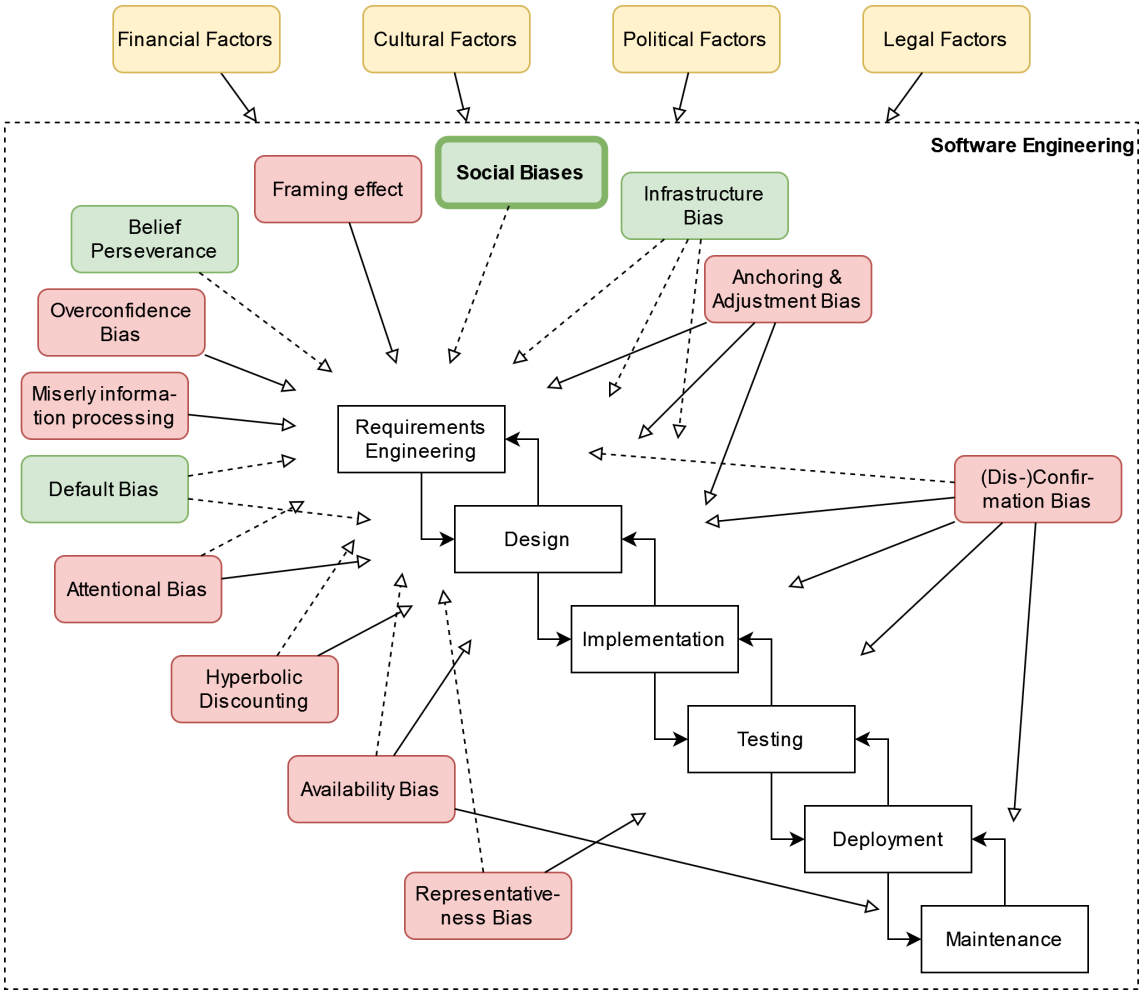

Figure 6.3: Discovered biases and other external factors that effect the SE process.

7

Discussion

In chapter 6, the conducted interviews were evaluated and contextualized. In this chapter, the evaluation if the research questions will be discussed. Additionally, the study itself will be critically analyzed, and avenues for further research will be discussed based on this study as well as the state of the scientific literature.

7.1 Research Questions

This section will discuss how each of the research questions of this study were answered, and how they ultimately ended up contributing to the conclusions of this thesis.

7.1.1 RQ1

What inclusivity issues are encountered by members of the LGBT+ community in software?

The first research question aimed to investigate the issues members of the LGBT+ community are currently facing in existing software. It is the closest to what is already researched in scientific literature, and the results of this study did not contradict the results of the literature study.

However, the interviewees put more emphasis on specifically how gender information and personal data has to be entered into a system, and less on heteronormative domain logic and assumptions. Many interviewees were concerned about people being misgendered, or being forced to misgender themselves.

A potential conflict became apparent between people who prefer to share as little information as possible to protect themselves against biases, and people who prefer to state as much information as possible to embrace their LGBT+ identity. How privacy can be

guaranteed while gender and identity expression is supported needs to be researched further. While a proposal was made that includes both ends of this spectrum in Figure 6.2, it is not yet clear if this model is sufficient in terms of both, the safety it provides, and the possibilites of expression it enables.

7.1.2 RQ2

What (preventive) measures are taken by members of the LGBT+ community to reduce the amount or magnitude of inclusivity issues they would encounter?

This research question aimed to identify the workarounds members of the LGBT+ community use to circumvent the issues discussed in the previous research question. Based on those workarounds, further adjustments to existing software design could potentially identified to make software more inclusive.

Few interviewees stated that they prefer to state more gender information than platforms currently allow them. This is a technical issue that can be solved in SE. However, a majority of the described workarounds focused mostly on the communities on specific platforms. While some interviewees stated that they prefer platforms that give them more options to make themselves comfortable, many interviewees also said that they prefer to use applications that have an inclusive community. Whether those communities are more likely to exist on platforms that have more inclusivity options, solely because of those inclusivity options, is unclear. Nonetheless, there seems to be a relationship between how inclusive a platform was designed, and how likely it was to be used by members of the LGBT+ community, which needs to be researched further.

7.1.3 RQ3

What improvements can be made that lead to more inclusivity for LGBT+ individuals in software?

This research question tried to identify concrete changes the interviewees would like to see in existing software design. The answers to this question were often times directly linked to the answers for **RQ1** and **RQ2**. In addition to that, control over personal data was mentioned as currently insufficient. The same is true for control over what content is recommended to users of certain applications.

The general consensus was that the user should have more control over how they interact with software platforms.

7.1.3.1 RQ3-1

What technical implementations in IT systems can increase LGBT+ inclusivity?

This subquestion tried to identify how the proposed changes could be implemented from a technical point of view. As discussed in subsection 7.1.1, most interviewees focused on issues with entering personal data and gender information. Most proposed solutions were therefore meant to solve aspects of that issue. Based on these proposals and requirements, the model in Figure 6.2 was designed as a potential solution.

While the interviewees also stated that they would like to see less heteronormativity in software, no concrete solutions were presented. In addition to that, the technical feasibility of automated and AI solutions to prevent hate speech was questioned, too.

7.1.3.2 RQ3-2

What external factors prevent inclusivity from being implemented in software?

This subquestion tried to identify potential external factors that influence SE to the detriment of inclusivity. Various factors like biases and financial incentives were mentioned.

Interviewees claimed that there were no financial benefits for increasing inclusivity, and that potential advertisers could see the engagement with a political topic like LGBT+ rights as something negative even. Besides that, cultural and societal differences were brought up as factors that prevent inclusivity, as LGBT+ issues are not taken seriously equally everywhere. Integrating external systems that enforce heteronormativity is also limiting domain logic design space, though it is not clear whether those dependencies are actual legal requirements, or only stated due to laziness or bias. Generally, while not explicitly mentioned, multiple biases were able to be identified. They require further research and confirmation.

7.2 Other Limitations & Learnings

The initial design of the study was based on the results of the literature study. Several specific use cases where investigated by various researchers and studies, but no general conclusions were drawn, as the existing literature is poorly interconnected. Most existing literature focused on very specific cases, or tried to focus on many issues at once. However, there were rarely any solutions proposed outside of the mentioned very specific cases.

Not all existing biases are equally investigated in the context of SE, the most frequently discussed ones are anchoring bias (**B-St1**), confirmation bias (**B-I1**), and overconfidence

bias (**B-A1**). Other biases, like culture bias or gender bias, or more social biases in general, are barely present in SE research (15). Literature that focuses on LGBT+ inclusivity on the other hand rarely discusses specific biases. This makes it hard to design specific solutions for inclusivity issues that are introduced during software design. The conclusion was, that specific biases in SE that prevent LGBT+ inclusivity need to be investigated. Therefore, it was concluded that an LGBT+ perspective on software design is required, due to which the viewpoint of the research goal as defined in section 4.1 was selected. As discussed in subsubsection 7.1.3.1 and subsubsection 7.1.3.2, this was a valid approach that lead to useful results.

In practice, the interviews that were conducted based on the research goal gave indeed further insight into potential issues that prevent LGBT+ inclusivity in software design. At the same time, due to the low sample size and the nature of second hand information, the drawn conclusions have to be treated as hypothetical to a certain degree. This also means that there is still not enough clarity about which biases are actually present to evaluate specific debiasing techniques.

Besides that, functional requirements were also gathered as part of the interviews. As discussed in subsection 7.1.1, the found inclusivity issues were similar to those found in literature. This also includes potential conflicts in software design that need to be considered. For example, multiple studies and interviewees stated that gender data should not be collected, as it has no relevancy in modern society and contributes nothing to the functionality of an application. On the other hand, many studies and interviewees also expressed their wish to identify themselves with specific genders. Software design needs to find solutions that allow both positions of this discussion to be represented adequately, e.g. by making relevant fields optional.

The SE perspective of the interviewees offered some information about the feasibility of certain proposed changes. However, that benefit was limited. Due to the very specific requirements that potential interviewees had to fulfill, the number of interviews that were ultimately conducted was low (n=7). Future research of requirements of the LGBT+ community should therefore not be limited to people with a background in CS. This would also increase the variety of identities that can be interviewed. It was noticeable that every interview contributed something unique, which implies that more varied perspectives will lead to more concrete requirements.

Something that became apparent through evaluating the interviews was that many concerns, especially in terms of identifying bias, can be researched in similar fashion for other

marginalized groups. Research conducted for LGBT+ inclusivity should therefore aim for an exchange and discussion of the results with other inclusivity research.

7.3 Proposals & Future Research

In conclusion, a two-pronged approach for future research should be considered. On the on hand, specific requirements of the LGBT+ community need to be research. This includes requirement analysis with any member of the LGBT+ community. Based on those requirements, potential solutions like the ones proposed in section 6.1 should be implemented prototypical and refined iteratively. They should then be evaluated and tested in terms of applicability and inclusivity by members of the LGBT+ community.

As a part of that, it is important to research the conflict between correct gender representation and privacy that exists between members of the LGBT+ community. As safety concerns are more important in some cultures and environments than in others, it is important to consider the context of any software as part of the inclusivity requirements. Therefore, rather than trying to design a singular model for gender implementation, it might be more important to integrate the consideration of inclusivity requirements into the SE process. This would ensure that software can be inclusive regarding of its context. Those requirements don't have to be exclusive for the LGBT+ community.

On the other hand, bias in software design needs to be researched further. Based on the potential biases identified in subsection 6.2.2, field studies should be conducted in which SE teams are observed over a certain time period, to confirm which biases are actually present. This should be done with teams that include members of marginalized groups, and with teams that do not. Based on the results, debiasing techniques need to be evaluated, tested in practice, and compared based on their performance in a meta-analysis. Based on that, conclusions about which debiasing techniques increase inclusivity in software and SE can be drawn. At the same time, the external factors described in subsection 6.2.1 also need to be verified.

As already mentioned, this research about inclusivity for marginalized groups does not have to be exclusive for the LGBT+ community. The above described approaches can also be expanded for other social issues, and an exchange with other research fields can be highly beneficial to gain a better understanding about how such investigations can be conducted on a large scale. At the same time, it is important to remember that every marginalized group has unique issues and concerns, so approaches and solutions cannot be simply copied from other fields, but need to be investigated in each context again.

8

Threats To Validity

In this chapter, threats to the validity of this research are discussed based on the classification framework by Wohlin et al. (141).

8.1 Internal Validity

As discussed in section 7.2, the study design limited the amount of people that could have been interviewed to gather information about existing issues and functional requirements for inclusive software. For some of the research questions defined in section 4.2, better results could have been achieved by including people without a background in CS into the study. However, this would have essentially resulted in a second study in addition to the study that focused on LGBT+ people in SE.

Besides that, as this thesis has only one author, a certain bias must be expected. Through an intensive research of bias that is also described in section 2.2, the author compared his approach and rationale at each step of the research with those biases to increase their awareness and minimize them. In addition to that, the results of this thesis were discussed with external supervisors to gather alternative perspectives. This overall ensures that the influence of bias in this study is minimal.

8.2 External Validity

One factor that limited the amount of information that could be gather through this study was the low amount of interviews that were conducted (n=7). Originally, several large communities for members of the LGBT+ community in STEM and specific subfields like tech or SE were contacted with an overview of the research project and an inquiry for

intervieweing community members. Most of those communities either did not respond or refused the inquiry. Only one community gave access to their Slack channel. In that channel, to inquiry was shared with the members, but only one member volunteered for an interview.

It is unclear what the exact reasons for this hesitation are. As mentioned in section 4.4, due to being faced with barriers implemented by more privileged individuals outside of marginalized groups, people might be unwilling to discuss sensitive topics with an outsider. They also might be willing to share their concerns, but are feeling uncomfortable for other reasons. It is reasonable to assume that more interviewers with varied identities could be more successful. At the same time, better connections to existing networks and communities might also result in more interviews.

Another issue that was partially introduced by the low number of interview was the lack of variety in identities. Table 5.1 shows their distribution among the interviewees. No individuals that were agender or polygender were interviewed, which could have resulted in more unique perspectives.

8.3 Construct Validity

Because this thesis had an exploratory and qualitative approach and goal, the results could be sufficiently measured through recordings of the interviews and a comparison with the results of the literature study. There were no consistency issues, which implies that the results of the research questions defined in section 4.2 are valid.

8.4 Conclusion Validity

In regards to the conclusion of this thesis, the only concerns are the vagueness of the results achieved through the literature study and the interviews. However, they are already accounted for, as the conclusion includes detailed recommendations about what further research is necessary to obtain and validate more concrete results. At the same time, those recommendations are based on the conclusion of this thesis, which makes it an important contribution to the LGBT+ inclusivity research.

9

Related Work

Different types of cognitive biases in SE literature are discussed by Mohanani et al. (15). By evaluating 65 studies they created a mapping of what effects each reported bias has, and what debiasing techniques are applied to it. They conclude that SE research in this area should shift more towards qualitative and multi-methodological research to better understand where bias manifests. They also discover that only a few categories of biases are frequently researched in SE literature, while e.g. social and memory biases are mostly ignored, and many biases were only researched by a singular study within the study of Mohanani et al. However, they also note that biases are defined incoherently in between studies, and that there is no connection between most studies, which causes what they call a widespread confusion. They lastly conclude that tasks are usually easier to debias than humans, but that there are no universal debiasing techniques that are effective and have no unintentional side effects.

The work of Mohanani et al. is in turn based on a study by Fleischmann et al. (20), in which they investigate the frequency of publications about bias in twelve prominent IS outlets. They find that the amount of publications increased exponentially. However, there are still many research gaps, as specific biases are only researched in certain contexts. They conclude with several recommendations and avenues for future research. Both of the above studies are used as a reference for the categorization and evaluation of biases in section 2.2.

Matthiesen et al. (142) investigate how national differences contribute to the failure of international IT projects. Through two ethnographic studies they find that implicit bias causes racist rhetoric in global software development. They propose three areas for software companies to investigate, so that biases can be identified and addressed. Those

areas are the structures of organizations, work practices, and collaborative tools together with system structures.

Rodríguez-Pérez et al. (143) investigate how different innate diversity factors are researched in SE, and what mitigating tools and methodologies exist to increase diversity. They report that gender makes up the largest part of innate diversity factors that is researched, but that most studies focus on showing that gender bias and differences exist instead of trying to research ways to mitigate that. They also note that other innate diversity factors, such as age, gender, race, or disability require further investigation.

Wang et al. (53) investigate through an empirical study whether software engineers hold not only explicit gender bias, but also implicit gender bias. By analyzing the data from 142 professional in SE, they conclude that regardless of the gender of the interviewee, they associate software development roles with men. Women on the other hand are often seen as housewives and caretaker for the family. The study also finds that, while most participants were able to resist their explicit gender bias, they were not able to do so for their implicit gender bias.

Similarly, Szlavi et al. (144) investigate the theory and implementation of design that is inclusive towards minorities . They argue that the acknowledgement of gender as non-binary is crucial for more inclusive designs. They also warn that different diversity aspects should not be viewed isolated, but that solutions should take a more intersectional point of view. Szlavi et al. also highlight the importance of inclusive imagery, which is the inclusion of underrepresented individuals into the design phase.

Cech et al. (145) investigate the systemic inequalities of Lesbian, Gay, Bisexual, Transgender, and Queer (LGBTQ) individuals within STEM. They discover that LGBTQ individuals are generally disadvantaged within STEM, regardless of their education, job, or perceived effort. Generally, they have to deal with more harassment, more health issues, less career opportunities and job resources, and are more likely to leave STEM, compared to non-LGBTQ individuals.

Bon (146) investigates the mismatch in Information and Communication Technologies for Development (ICT4D) projects between externally formulated requirements and actual internal needs of the users. She highlights the difficulties that arise from external factors, like culture and politics, and emphasizes the importance of integrating stakeholders into the entire SE process. She also proposes an ethics assessment to be carried out as part of the SE process, not too different from the consideration of inclusivity requirements proposed by this thesis.

Lago et al. (147) discusses the four dimensions of sustainability: Economic, social, environmental, and technical. They argue that in practice, mostly economic and technical sustainability are considered, and propose a framework for environmental ans social sustainability. Social sustainability in particular focuses on preserving and expanding the social resources available to every human being by pursuing generational equity. Part of that is the support of, and creation of benefits for social communities. This can potentially be linked to and focused on marginalized communities, such as the LGBT+ community.

10

Conclusion

Based on a review of existing literature about LGBT+ inclusivity in software design, this thesis conducted interviews with LGBT+ software developers to identify non-heteronormative concerns that are not addressed in current applications, as well as potential solutions to those concerns, how they could be technically implemented, and what external and internal factors are preventing inclusivity from being implemented in software.

The results show that the representation of gender in current software is often too limiting to express non-heteronormative identities adequately. At the same time, because the LGBT+ community faces persecution and adversity in many parts of the world, its members also require a higher control of their personal data to ensure their physical safety and mental well-being. These requirements can contradict each other. Some would prefer a more accurate and detailed representation of their identity, while others would like to remove gender information from software to prevent discrimination or worse. It is therefore important that inclusivity requirements are evaluated individually for each application based on its context. Integrating the consideration of inclusivity requirements into the SE process is therefore of high importance.

Some of the external factors that prevent inclusive solutions from being implemented are of political, cultural, or financial nature, and are therefore hard to solve from within the SE space. As discussed above, protecting marginalized identities through privacy is one approach. On the other hand, several biases were identified as potential barriers. Future research needs to investigate those specific biases in existing software development teams, as correct identification is necessary to evaluate and test potential debiasing techniques.

Finally, it is worth investigating how inclusivity issues of the LGBT+ community relate to the inclusivity issues of other marginalized groups, as some of the described issues are not exclusive to gender-related problems, especially when it comes to the identified biases.

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Appendix

Interviews

This section contains summaries of each interview conducted for this thesis.

Interview 1

Note: A few of the statements in this interview were extended upon after the recording.

Date	27/11/2022
Form	Verbal
Location	Online
Language	German
IT Background	Full-stack software developer
Identity	Bisexual trans woman

In her private life, the interviewee uses apps mostly on mobile devices, and mostly streaming services and social media applications. She doesn't experience discrimination or other issues herself, but knows of other people who face issues, especially on X[1].

She herself already filtered her social bubble in a way that prevents most interactions with individuals and content who she would perceive as negative. Ways to make a platform more inclusive are in her opinion:

- Moderation to be able to create a safe space for the LGBT+ community. She names Discord as a positive example.
- No mandatory binary forms of address.
- Being able to search for more than men as a woman on a dating app, although the apps that enforce that are not populated by LGBT+ anyway.
- Content should not be hidden by algorithms because it is categorized as political, which is something that happens for LGBT+ content on YouTube and TikTok.

[1] Formerly known as Twitter.

She claims that the primary motivation behind many big companies is financial, e.g. X[1], where in the past hate speech only got banned because it made the platform less attractive for advertisers. This in turn caused many smaller accounts that spread hate speech to not get banned, as they were irrelevant in acquiring advertisers.

She personally doesn't feel excluded by applications that use mandatory forms of address. She says that the problem for many applications that do not support non-binary forms of address is that if they have to communicate with federal software, that software does not support non-binary forms of address either. As a trans woman, she has more problems with stating her name in forms, as changing here name legally has been too difficult so far. She knows of people who could not collect a parcel because the name on the parcel did not match the name on their ID card, but she also understands why they would state their chosen name instead of deadnaming themselves. This issue does usually not exist on social media.

She explains that users sometimes have to find creative workarounds to make existing platforms more inclusive, e.g. by using the location field on X[1] to state their pronouns. She names OkCupid as a positive example, because it natively provides a large variety of pronouns and generally an inclusive profile creation process that does not require workarounds to be used by members of the LGBT+ community.

She also states that LGBT+ communities and especially trans people feel safer when meeting online, thus many communities seem to form online on platforms like Discord, or in online video games.

In previous jobs she felt not safe to out herself as a trans woman due to working in a sexist environment. When looking for a new job once she was outed, she did not have any issues however. She also states that at here current job the are prohibited from using gender-neutral language. As an example, she states that she gave an interview for her company in which she used gender-neutral language, but when it was published, that language was changed.

She further describes issues with software for the German tax system, which she works on. According to such software, the first person in every household has to be the husband, followed by his wife, which is inherently sexist. This was an issue when same-sex marriage got introduced, in which case a complicated domain logic had to be implemented to determine who the first person is. Such software also includes a mandatory binary form of address title field. According to her management, support for non-binary people needs to be supported by the German tax office first, and can therefore not be implemented

[1]Formerly known as Twitter.

by their company yet. However, she thinks that that is not entirely true, as at least a notification that non-binary people can currently not be supported could be implemented easily. According to her management, this has not been worked on because it is too much effort for too little benefit at this point.

She thinks overall it is bad that the support for the LGBT+ community is bad for business. She personally does not feel excluded by binary gender requirements, but knows that non-binary people do so by getting reminded that they are not valued by society as equals. She reiterates that she thinks that it is part of the problem that LGBT+ rights are a political topic, that potentially could deter advertisers, and thus causes companies to not support them as much as they could.

Interview 2

Note: This interview was not recorded.

Date	10/01/2023
Form	Verbal
Location	Online
Language	German
IT Background	-
Identity	Queer Man

The interviewee works for multiple institutions as fellow and representative, and thinks that institutions themselves should be usable as a tool for emancipation in any form. While mostly working on analogue solutions, he acknowledges the existence of problems in digital spaces, too. Recent projects include changes in databases that allow queer people to label themselves properly, as well as making use of ternary gender markers on websites and in software applications, like *(m/w/d/x)*[1].

He says that during his international work, he noticed that cultural differences are a major hindrance for equality. However, he also noted that after a introduction phase, many boundaries can be eventually removed, as long as people are not talked down to. He also noted that culture can be defined in many different ways, and says that there are also large differences within Germany, e.g. between cities and countryside.

He says that the internet can be a safe space against hate speech, potentially supported by algorithms. However, most algorithms only work with the English language so far, and there are no defined methods about how such algorithms are to be regulated yet. There are also ethical concerns about algorithms, especially when it comes to how they treat marginalized groups. In Germany particularly, the internet also does not have a high acceptance yet. He also highlights the issues in the German education system in that regard, because it fails to adept to digitization.

Ne notes that there are positive examples for increasing inclusivity, like mixed classrooms at universities, that allow people to participate who prefer to not be present physically. On the other hand, there are also negative examples, like Pride events being prohibited in recent years. He also claims that media culture, in which many social developments

[1] From German to English: m(ännlich) = male/masculine, w(eiblich) = female/feminine, d(ivers) = diverse, x = irrelevant/undefined. Note: While German has different words for it, the used terms here are common language and can be used to refer to both, sex or gender. The used abbreviations are commonly used in job applications.

happen, is easily manipulable, which can be currently seen on X[1], where certain opinions get muted and deleted due to the owner's ideologies. That manipulation will eventually manifest in society.

[1]Formerly known as Twitter.

Interview 3

Date	09/07/2024
Form	Written
Location	Online
Language	English
IT Background	Software Developer & Architect
Identity	Non-binary

The interviewee describes a situation they encountered, in which they could not make use of various shared mobility apps (they mentioned Bird and Lime as examples) in the USA. Various ID cards in the USA use a barcode that can be scanned to provide identification in applications. However, since non-binary gender markers have been introduced, many applications fail the identification process if the user has a non-binary gender marker on their ID card. They were therefore unable to use any such service at all.

They also reported an issue in the USA, where credit information is used to verify identity, but because the underlying systems only have credit information of people who had a credit before, they are implicitly excluded.

They also mention that there are several issues with identification of trans people in regards of name changes.

Interview 4

Date	25/07/2024
Form	Verbal
Location	Amsterdam
Language	English
IT Background	Web Developer
Identity	Gay Man

The interviewee notes that for many years, in Lithuania, non-binary gender identities haven't been taken into account until respective EU laws for data protection were introduced. Even with them in place, most applications and companies still collected gender information illegally, and because non-binary gender identities have been mostly ignored, the information was wrong in many cases, because non-binary people were forced to misgender themselves. However, the alternative of going into an office to talk to a person is perceived as even worse and more inconvenient.

The interviewee says that websites and application owners should invest the time to comply with the already existing EU laws by removing the unnecessary fields from the forms instead of just keeping them for no apparent reason. He also states that gender information is outdated nowadays, and that it should not be collected at all. He thinks it is trivial to remove such fields from the frontend or making it optional. He says that it might be difficult to deal with the already existing data though. He also thinks that changing gender fields in a way that everyone is included and no one gets hurt would be rather difficult, because there would be too many options.

As to why this issue has not been resolved yet, the interviewee states that financially there is no benefit for any company in doing so. In his current job he feels safe to bring up such issues, however, he has not always felt that safety. He said, in Lithuania this was not even a topic that as discussed.

He also states that he would prefer being gendered correctly in applications that he uses socially, like social media. He wouldn't mind so much for e.g. banking apps though.

Interview 5

Date	25/07/2024
Form	Verbal
Location	Amsterdam
Language	English
IT Background	CS Student
Identity	Queer Man

The interviewee states that at his university, many students complain about being unable to state their correct pronouns, which causes the university itself to use the wrong pronouns in official documents. It is also not possible to change existing gender data or names, and only hardly possible to change pronouns. Other university applications access the data of the student, but don't allow the users to change them, which causes students to be misgenered and deadnamed. Complaints about this have been mostly ignored.

According to the interviewee, students should have access to their data and be able to change it. He also says that universities claim to need the gender data of their students for statistics and research. He disagrees with that claim. He says that gender should not be a mandatory field, but understands that it can be relevant for research and statistical analysis, but should not be used beyond that. He thinks that accessibility would increase if gender was an optional field.

He says that he isn't sure how the Dutch legislation factors into why this issue remains, because he is not certain about how the university system is interlinked e.g. with national and municipality data, but says it could be a reason next to the costs of changing it. If the reason for this implementation is outside of the university's domain, he isn't sure if the university itself can actually change it.

He wouldn't feel pressured against speaking up for more inclusivity in software design if such an issue would come up during a project as a student, but if he were to work at the university as an employee, he would probably not feel comfortable to go against existing procedures.

He notes that many applications, like social media platforms and dating apps, recently started to have more options to express gender and sexuality, which is a positive. Especially for dating apps, he imagines that this is due to their need to match people more optimally.

Interview 6

Date	26/07/2024
Form	Verbal
Location	Online
Language	German
IT Background	Software Developer & CS Student
Identity	Trans woman

The interviewee states that she is aware of the fact that many people have issues with finding correct forms of address due to the limited options that are usually provided. At her previous job, she was asked by her management what titles for the form of address should be provided and used for the job application process to be more inclusive. Her suggestion is to include more common non-binary options in the selection. In addition to that, a free text field should be provided so that users can chose their own form of address if the provided list is insufficient. In German, the standard form of address titles that should be provided in her opinion are *Herr*[1], *Frau*[2], and *Divers*[3]. An alternative would be to not use a title in the form of address at all, but just the person's last name.

For her personally it is important to state her gender.

According to her, changes to the UI to include more options would be rather simple. She states that at her job, this came up during developing the companies website. She did feel comfortable to be open about the topic at her workplace.

As a positive example she named Discord. In the app people can join different servers, and are able to chose their name and pronouns for each server individually.

[1] Mister.

[2] Miss or Mrs., which are not differentiated in common German.

[3] Diverse, not an actual title but sometimes used as such.

Interview 7

Date	10/08/2024
Form	Verbal
Location	Online
Language	English
IT Background	Data Engineer
Identity	Trans woman

The interviewee stated that she faced issues during her transition. She found it stressful to only be able to state binary gender information in software, and would have liked to have additional options for name and pronouns especially. She would have also preferred it in many cases if those fields would have been optional.

She also described it as intrusive to have to state her legal gender and name that could be verified with her passport, because it took time for her IDs to be updated. She would have preferred it if the systems would have allowed to state a preferred name and gender, if not exclusively then at least in addition to the legal one. She would also like for an explanation every time mandatory legal gender information and names are requested. She would also like to be able to chose her pronouns in applications, which is not always possible.

As to why those issues are not fixed already, she speculated that many developers don't see the need to change a system that is already working, at least from their perspective. The interviewee states that developers have this perspective due to not being aware of the needs of the LGBT+ community. They might also be restricted by external systems that impose heteronormativity, shared databases that were implemented with binary gender definitions and are now not be able to changed easily, or legal regulations that e.g. require that the input data must match the legal IDs of the user.

The interviewee herself reports no issues at her current work regarding her identity as a trans woman, and would feel comfortable to speak up for inclusivity if necessary. She also gave a positive example from a previous employee, where during the on-boarding process she was able to state a preferred name and gender, that were then used consistently in any communication. Her legal data was only required for her contract itself.