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"Oh yes! over-preparing for meetings is my jam :)": The Gendered Experiences of System Administrators

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In the system and network administration domain, gender diversity remains a distant target. The experiences and perspectives of sysadmins who belong to marginalized genders (non cis-men) are not well understood beyond the fact that sysadmin work environments are generally not equitable. We address this knowledge gap in our study by focusing on the ways in which sysadmins from marginalized genders manage their work in men-dominated sysadmin work spaces and by understanding what an inclusive workplace would look like. Using a feminist research approach, we engaged with a group of 16 sysadmins who are not cis-men via six online focus groups. We found that managing the impact of gender identity in the sysadmin workplace means demonstrating excellence and going above and beyond in system administration tasks, and also requires performing additional care work not expected from cis men. Furthermore, our participants handle additional layers of work due to gender considerations and to actively find community in the workplace. To mitigate this additional workload, we recommend more care for care work. For future research, we recommend the use of feminist lenses when studying sysadmin work in order to provide more equitable solutions that ultimately contribute to improving system security by fostering a just workplace.

CCS Concepts: • **Social and professional topics → Gender**.

Additional Key Words and Phrases: sysadmin, system administration, feminism, feminist approach, gender, care work, human factors

1 INTRODUCTION

STEM fields continue to be dominated by men, and people of other genders commonly face barriers to entering and remaining in the field. In the STEM industry and academia alike, cis men are the majority (in terms of the workforce [13, 51, 53], who is being studied [69], and who is *attributed* to producing the knowledge [65, 69]). In men-dominated workplaces, people of other genders face several challenges, such as structural and cultural barriers to entry and higher stress and anxiety, microaggressions, sexual harassment, etc., [8, 32, 42, 70]. Despite all of this, many people persevere

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and continue to work in STEM fields. In the field of system and network administration, gender diversity remains a goal with a long way to go, and most existing scientific literature does not take gender into account. Understanding the role of gender is, however, important. Not only because gender is socially constructed through interaction, but also because perspectives connected to one's gender shape *how* we build, design, and integrate technology [6, 80]. Hence, by taking a stance on system administration through the lens of gender allows us to better understand the underlying social structures and dynamics at play in creating the infrastructures our world depends upon.

In our study, we address this knowledge gap by engaging with 16 system administrators (sysadmins) from marginalized genders (non cis-men) via focus groups. We take a constructive approach (inspired by safety science) that focuses on 'what works well' [21, 40] regarding what sysadmins find easy to do in their work, what are the difficulties that they face, and how they overcome these difficulties. Our constructive approach complements existing research that discusses challenges [7] and focuses less on the day-to-day successes [45]. Subsequently, we analyze the data using a thematic analysis (TA) approach. Our findings highlight diverse perspectives in the sysadmin community, such as doing extra gender identity and practitioner identity work and provide a perspective on the embeddedness of care work in sysadmin work. Understanding and accounting for these are essential for moving towards a more gender-inclusive and just work environment within the field, which in turn is instrumental for building infrastructure that is equitable and non-discriminatory. Since we take a feminist approach, our objective is not to correct the bad politics/practices of institutions or corporations in a top-down way but to find new solutions from the bottom up. To do this, we invited system administrators to share their experiences and better understand what an inclusive workplace—supporting the creation of equitable infrastructures—looks like for them.

Contributions

Our study makes the following contributions:

(1) Using a feminist lens, we highlight the invisibilized and undervalued aspects of sysadmin work, how participants' gender compounds these effects even further and how they persist. Furthermore, we identify and highlight the so-far understudied care work and emotional labour aspects, which are an instrumental part of sysadmins' work and propose more care for these care aspects by recognizing and appreciating them.
(2) We explore and describe the negative interactions within non-inclusive environments and how these aspects permeate into the processes, infrastructures and systems created by teams.
(3) We identify the role of non-management facilitated communities and bottom-up self organization to create inclusive environments and highlight that management should not strive to hinder such developments.
(4) We emphasize the use of feminist research approaches in investigating sysadmin work to enable this work with more equitable sociotechnical solutions. We ultimately conjecture that the matter of an equitable workplace, which allows people to feel safe to be themselves and fosters a just and blame-free culture, is a prerequisite for secure system operations.

Structure

First, we present the theoretical background of our work in Section 2 which includes a history of system administration, care work as part of system administration work, feminist research, as well as the corresponding related work. Second, we present our research methodology in Section 3, including our feminist approach to research. Here we also discuss our method of conducting the focus groups, considering ethics, recruiting and analyzing data. This is followed by detailed findings in Section 4. Finally, we reflect on our findings in Section 5 and present the takeaways in Section 6.

2 BACKGROUND

In this section, we first introduce system administration and how its gender coding has historically changed. We then present the role of care in system administration and related work. Lastly, we describe feminist research in the context of our study and how we used the feminist lens to center the experiences of marginalized genders in the sysadmin domain and related work.

2.1 Gender Roles in the Origins of System Administration

The U.S. National Institute of Standards and Technology (NIST) defines sysadmins as *"individuals responsible for the installation and maintenance of an information system, providing effective information system utilization, adequate security parameters, and sound implementation of established Information Assurance policy and procedures"* [66]. The technology workspace has been men-dominated for the past several decades [79] and remains so [3] despite proposals for making technology-related professions more equitably accessible [71].

However, *traditionally*, the field of computing was very much *not* dominated by a purely WEIRD (Western, Educated, Industrialized, Rich, and Democratic) [38] straight male perspective. The idolized example for this is, most likely, Ada Lovelace, one of the first to work on algorithmic thinking. While the field of computer science was more of a niche of mathematics back then, work by Lovelace was fundamental and influenced computing up until today [2]. The first explosion of *digital* computing and algorithmics-related research occurred during the second world war, specifically around the necessity of breaking German cryptographic implementations. Efforts were centralized in Bletchley Park, where the British Government brought together a diverse set of bright minds to work on computing and breaking German codes [75]. Besides researchers, the (first) computers they built had to be *operated*. This task fell to the Wrens, the women in the "Women's Royal Navy Service" [76]. Overall, Bletchley Park was famed *"as a 'unique' institution, a conclusion derived from the eccentricities of its most celebrated staff members, its perceived egalitarian and collegiate working environment"* [75].

Yet, after the war, the U.K. saw women return to patriarchal gender roles, while others fell to persecution because of their 'divergence' from the 'accepted' standard. The 'Wolfenden Report' serves as a landmark for this shift, codifying such overcome perspectives with heavy support from the church of England [34]. Similarly, Alan Turing was ultimately pushed to suicide by the government due to being queer—for which the British Government only pardoned him in 2017 [24]—and the number of Wrens was reduced to 3,000 [92] from over 75,000 at the end of the war [88].

At the same time, on the other side of the Atlantic, it was also the Navy having a leading role in the development of computing. The most well-known is Rear Admiral Grace Hopper, who started working on the 'Harvard Mark I' and later developed 'FLOW-MATIC', the direct ancestor of 'COBOL' [72]. Similarly, Hedy Lamarr developed a technique for 'Frequency-hopping spread spectrum' [41, 46] communication to evade frequency jamming, which became an integral part of modern wireless protocols like Bluetooth and WiFi [82]. With the space race receiving increasing importance, National Aeronautics and Space Administration (NASA) was founded. Of course—even though still a *manual* effort—computations were a vital part of this, which saw women being employed en mass for this task [58]. This part of history is also deeply connected with the history of racism and segregation concerning women of color working as computers at NASA [25].

What both sides of the Atlantic had in common is that the general theme of *operating* computers was that of a clerk position: Not a prestigious position, but instead one akin to a secretary or assistant. With the rising importance of computing and hence system administration, significant funding, e.g., from DARPA, went into computing research. Along this development, more men

moved into the profession of building and operating systems, ultimately leading to a change in the perception of the job as well as a change in the perceived gender coding of these roles [67]. This is a well documented impact of a patriarchal system, studied in the literature [67], and also known to occur in the opposite direction, i.e., professions being remunerated less and losing social status despite the *work itself not changing* when more women join the profession [48].

Hence, in summary, system administration, or IT work in general, is not a traditionally cis-men-dominated field. Instead, this area of work was taken over when opportunities arose, while pioneers were forgotten or pushed out.

2.2 Care in System Administration Work

Care work is often understood in the context of healthcare and other similar fields of work. While care can be given to people, it can also be given to things in the form of maintenance (and sometimes to change things for the better) [47]. Care work *"is always ongoing, it never finds closure and hence demands affective commitment and dedication"* [47]. It is often *"hands-on, piecemeal, badly accounted for, and feminized"* [47]. Care work relies on improvisation and adaptation. The care aspect of work is usually invisibilized and is not considered to be a task in and of itself. It cannot easily be formalized, so it is not accounted for at an organizational level [47]. Previous work [44] has highlighted care aspects in sysadmin work. For example, quoting a (sysadmin) participant from the study of Kaur et al. [44]: *"if you are not very careful with your time, you can go a whole week without having anything to account for because you are spending your time trying to help other team members."*

Sysadmin work includes maintenance tasks, supporting others when needed and a commitment to ensuring continuous system operations. On the one hand, supporting systems' users is often a central part of sysadmin work. On the other hand, users are often seen as lacking in IT literacy and hence, a burden to sysadmin work. The series 'The Bastard Operator from Hell (BOfH)' by Simon Travaglia [83] is about a rogue system administrator who takes out his anger and frustrations on the system end-users (lusers, a merger of loser and user) who constantly pester him for help. This series is popular in the sysadmin community, and the rogue 'BOfH' (Bastard Operator from Hell [83]) is often seen as a hero [17, 52]. While this series can be seen as a way to vent out the frustrations of a demanding profession, there can be negative consequences for the organization and for those who are embedded within this culture when similar attitudes are emulated in the real world [17, 52].

In summary, sysadmin work includes care work by its very nature in terms of both caring for things and people. Care of things might not traditionally be seen as care work and hence rarely accounted for formally. Care of people is often seen as a burden, making it harder to do the "actual work". In our study, we want to understand the care aspects of sysadmin work better and also shed light on the care aspects that might fall outside of the aforementioned two perspectives. In their study, 'Caring for IT security', Kocksch et al. [47] put forth a set of questions about the role of care which help to guide our analysis. These are, verbatim but itemized:

> *"To work with the notion of care in male-dominated, masculine [1] fields has the potential to question cherished matters of course, raising challenging questions:*
> - *What role does care play in these fields? Where and when does the ethnographer observe care?*
> - *How do careful practices take shape in these fields?*

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[1]We use "men-dominated" throughout this work; "masculine" or "male-dominated" may occur in direct quotes. We do not assign a gender to work environments, and are only retaining the wording in direct quotes from participants and/or previous research.

• *How is care brought up by the field itself—as presence or absence, in the complacent self-presentation of those who care or as allegation of carelessness?"*

A section of IT security research has looked at computer security issues through a feminist lens of care. For instance, in the studies on marginalized populations like survivors of Intimate partner violence [84], refugees [73], sex workers [55] etc. All this research calls for a more *care*-ful consideration of socio-technical systems to better protect people at the margins. Care in IT entails protecting people and striving for fairer and just socio-technical systems.

2.3 Feminist Research

Since care work tends to be feminized and invisibilized (discussed above in Section 2.2), this has consequences for gender equity in the workplace, and hence we believe this is a feminist issue. In their work, Kocksch et al. [47] reflect on their participant's suggestion about having more women on the board because *"they are good with the caring aspects of work"*. The authors critically discuss this statement:

> *"With this suggestion, the sales representative embraces calls to increase the number of women in business leadership positions across the IT sector. He endorses a feminist cause but, at the same time, invokes an utterly sexist archetype—the "caring" woman who works to redeem male carelessness. While we reject such sexism, we do believe that his suggestion conveys important points: **IT security demands care, and it demands a feminist perspective.**" [47].*

Like IT security, system administration is currently a men-dominated field and—following this reasoning—could benefit from a deeper understanding of care work and a feminist perspective. Feminist research is motivated by social justice and looks beyond privileged viewpoints. It encourages us to challenge the positivist notion of objective knowledge and understands that all knowledge is contextual [37]. Furthermore, it roots itself in the observation that *participants* have expert knowledge about *their own* experiences. Feminist research is also about self-reflection of our role as researchers and identifying and understanding the biases we bring to our research. In addition, we must acknowledge the power we hold as researchers and strive to remove this power imbalance. Finally, feminist research advocates for intersectionality [15] (how gender intersects with all other forms of oppression such as race, ethnicity, sexual orientation, ability, class or age), slow scholarship [63], open access [57], and feminist citation [1]. We discuss this further in Section 3.1.

Previous work has taken different approaches to conducting research through a gendered lens. Tanczer [81] interviewed a gender-equal sample of self-defined hacktivists regarding issues of gender, outlined the various mechanisms that create and sustain male-only stereotype within the hacktivist community including the ways in which women hacktivists counteract these. Slupska et al. [74] engaged with users (65.6% women and 9.8% non-binary people [74]) to better understand how they define cybersecurity threats, how they defend themselves from these threats, and the role of cybersecurity in their lives. These studies take gender into account by engaging with a gender-equal sample (of men and women) or with a user group that is largely (but not exclusively) composed of women and also accounts for non-binary people. We also took a gendered approach in our work where we centered the standpoints of sysadmins who are marginalized in this particular professional domain by excluding cis men. Additionally, there have been numerous studies highlighting the experiences of people with queer identities and other marginalized genders in STEM workplaces. LGBTQ+ professionals in STEM are more likely to experience systemic inequities like harassment, marginalization, career limitations, and devaluation of professional caliber [14, 93]. In a study with students of minoritized genders and/or sexualities, participants explained that STEM fields

have lower retention of non cis-men due to a ubiquitous *dude/bro culture* of hyper-masculinity where assuming heterosexuality, treating marginalized students as less intelligent and not smart, anti-LGBTQ+ discourses are pertinent [60]. Mattheis et al. explain that such heteronormative and hyper-masculine cultures make it harder for people of marginalized genders and sexualities in the work place, by silencing them and thereby resulting in major challenges in creating an inclusive environment for them to thrive in [54].

Throughout this paper, we refer to the two-part work of Faulkner [27, 28] titled "Doing gender in engineering workplace cultures". In Part I, the author observed that doing the job often involved 'doing gender', i.e., performing socially guided activities that allude to the expression of masculinities and femininities [90]. Their fieldwork revealed both inclusive practices and dynamics (such as respectful styles of interaction, wide-ranging topics of conversation and humour, care taken to avoid, or challenge, potentially offensive jokes and talk and lastly, mixed-sex social networks) and gender-exclusive dynamics and practices (such as the fraternal markers of familiarity and bonding, the generic 'he', conversation dominated by mens' interests, offensive humour and sanctions against challenging this, heteronormative and sexualised culture, pressures to conform to particular masculinities and organisationally powerful networks of men) [27]. In Part II, Faulkner presents "gender in/authenticity" to describe how engineering and similar technical pursuits are perceived as gender inauthentic choices for women and the "in/visibility paradox" which explains that women engineers are simultaneously highly visible as women yet invisible as engineers in engineering workplaces [28]. Faulkner's conclusions are directly visible in our study and their discussions in Part II [28] have helped shape our analysis and discussion (Section 5) as well.

2.3.1 Gender. Only an individual can state their own gender. *"Gender is not a set of traits, nor a variable, nor a role, but the product of social doings of some sort"* [90]. It is *"constituted through interaction"* [90].

System administration is a men-dominated profession, and social interaction is an integral part of sysadmin work [44, 87]. Since gender is socially constructed through interaction, it is essential to understand the gendered experiences of sysadmins who belong to marginalized genders (people who are not cis-men in this context). This is because *"an understanding of how gender is produced in situations will afford clarification of the interactional scaffolding social structure and the social control processes that sustain it"* [90]. This way, we can better comprehend the social processes underlying sysadmin work and how they are sustained. Because gender is embedded in technological infrastructures [78], it impacts how infrastructures are built and how accessible they are [30], recognizing the role of gender is vital in building gender-inclusive technology and equitable workplaces.

2.3.2 Parallels to Safety Science Research. Feminist research is motivated by social justice and hence tries to center the voices/perspectives of those that have been historically marginalized. Safety science (the Safety-II perspective [40]) teaches us to better account for the real work-in-practice (what is already working well) to support operational safety and resilience. Both approaches are "bottom-up" - they look at what the situation actually is (from the POV of those living it) as opposed to what it is imagined/supposed to be (perhaps based on policies, rules, etc., or from the perspective of the management). Both approaches realize that participants have expert knowledge and center the experiences of those people who are commonly overlooked in scientific research.

In our work we uniquely combine these two approaches. Feminist ideals drive us to imagine and build something new instead of trying to fix existing systems that are fundamentally broken and unjust. Safety-II teaches us to develop our understanding in a "bottom-up" way, and to support the work as it is done in practice. Such a people-centered approach to understanding what works and what is needed is essential to building something new that is more just.

3 METHOD

In this section, we describe the methods used for our qualitative study. We first discuss how our feminist research approach influenced our research methods. Next, we present how we conducted our focus groups, including how we constructed our question and prompt scripts under our research objective. We then describe how we handled research ethics, including ethics council review, and follow this by a description of our recruitment methods and data analysis process.

3.1 Feminist Approach

We centered our research from the standpoints of sysadmins who are not cis-men, hence centering experiences of those who are marginalized in this profession. Investigating the men-dominated field of system administration through a feminist lens will shed light on previously overlooked personal experiences and social processes, as also stated by Kocksch et al. [47] who in the context of IT security expressed that:

> "When we use the feminist concept for studying a male-dominated field not previously analyzed in its terms, we draw attention to the invisibilized, undervalued, and also unruly aspects of doing IT security. In so doing, we hope to expand and deepen the debate about what it means to secure computer systems." [47].

Feminist research ethics teach us to make our work accessible and accountable [5], making the issue of open access a feminist one [57]. Hence, we only submit our work to venues that allow us to publish it in an open access way to invite and enable public engagement with our research.

Feminist Citation. We followed a feminist citation policy by being intentional with our citation choices in terms of ideas that we are building. This does not mean that we cited only a specific group of authors (such as only women). Instead, we reflected on the inter-subjectivity and specific relationality of citation [50] in terms of who we invite to be part of the discourse regarding our field of study. By doing so, we ensure that the discourse we create is not biased by what is acknowledged as established by social convention and construction in a patriarchal society that leads to the present. Instead, we take a reflected position in an attempt to provide a more objective perspective on the subject matter of our research, trying to acknowledge and reflect on historical bias in the literature and focusing on making all relevant voices and perspectives heard.

Reflexivity and Positionality. In line with both thematic analysis (TA) and a feminist research approach, we reflected on our role as researchers while collecting data, analyzing data and presenting the findings. Our research team consisted of four researchers: two engineers who are women of colour (also facilitators of the focus groups), one mathematician/computer scientist woman who is racialized in some Western countries, and one engineer who has experience working as a system administrator and is a cis white man. Everyone in our team has experience working in men-dominated workspaces and in researching expert user populations. The two authors who conducted the focus groups and interacted with the participants were able to deeply understand and connect with the participants' experiences, facilitated by their own professional backgrounds. In our work, we consider this participant-researcher inter-subjectivity as a resource [33]. Although these two authors did not have applied sysadmin experience themselves, they utilized a sysadmin's presence in the research team as a valuable sounding board to validate the directions they decided to take in the study and to request further contextualization of the results.

3.2 Online focus groups

We conducted our qualitative research in the form of focus groups [64]. Focus groups, given a sufficiently safe environment, enable participants to share experiences and—in a colloquial

atmosphere—enrich and encourage each other's participation [77, 91]. To ensure that our focus groups would provide a safe space, we established a code of conduct participants had to agree to before participating, see Figure 1 in Appendix C. During the focus groups, no violations of the code of conduct occurred.

We decided to conduct text-based focus groups. Firstly, text-based participation and interview methods are a useful feature to enable wider participation by system administrators [23]. Secondly, it is long known since the extended work-from-home periods during COVID-19 [68], that remote participation options—especially those that de-identify the participants by removing aspects (like visual appearance or voice)—increase the accessibility of spaces to marginalized groups and participants' tendency to be more open [77]. This method is, therefore, well suited for our feminist research approach. Finally, written communication allows the use of emoji, which not only explicates tone and context [36], something usually lost in transcription, but also facilitates engagement without words. We did not evaluate emoji usage as part of the analysis.

In total, we conducted six online focus groups with 16 participants, which took place between 29 November 2021 and 8 March 2022. We set up a self-hosted chat service using the open source software Mattermost[2] for these focus groups. Each focus group meeting lasted around 90 minutes with 2-4 participants (except one session where only 1 participant joined). In total, we conducted six online focus groups with 16 participants who hailed from seven countries (see Table 1 for details). Two researchers moderated the focus groups. We used open questions to give the participants sufficient room to share what they felt was important in the context of our research questions. Prior to the focus groups, we solicited participants' consent through informed consent forms (see Appendix A) and other background information such as job title, job sector, job experience, job country and gender. We supplemented the informed consent with a 'code of conduct' (see Figure 1 in Appendix C) during the focus groups to maintain a respectful and safe space for the participants.

We started each group by (re-)sharing the code of conduct in the chat. This was followed by welcoming everyone and introducing the two moderators. We then asked for participants' introduction by soliciting (a) a brief description of their day-to-day work, (b) their work experience in years and (c) gender distribution of the team within which they work. This served to start the conversation and to introduce the participants to each other, creating a friendly and safe online space while maintaining anonymity towards other participants, where participants felt welcomed and free to share their experiences and engage with other sysadmins.

Inspired by human factors research in safety science, we take a constructive approach to our question design. We focused more on processes that are working well and less on the problems. Our overall research question is: In what ways do (not cis-men) sysadmins manage to work in the cis-men-dominated field of system administration? We devised three questions to try and answer our overarching RQ and used several prompts to solicit further information; see our detailed questions protocol in Appendix D.

(1) What do you find easy to do in your work? And why?
(2) What do you find difficult to do in your work? And why?
(3) How do you overcome the difficulties you face at work?

We planned to spend about 30 minutes exploring one question before moving on to the next, however, we did not enforce this strictly. Instead, we followed the natural flow of the discussion, deep-diving where necessary while providing space for the participants to engage with each other.

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[2]https://mattermost.com/

Table 1. Focus groups and participants' details. All are self-reported, which leads to use of both "woman" and "female" as gender markers.

Date/Group	Participant	Job Sector	Country	Experience (Years)	Team Distribution	Gender
29th Nov 2021 Group 1	P1	IT	Germany	6	One CIS colleague, one non-binary colleague who is not yet out.	Non-Binary
	P2	IT	India	23	Only woman on the team.	Woman
	P3	Education	Germany	1.5	Five men, two women. Notes that this 'many' women in a team is rare.	Woman
9th Dec 2021 Group 2	P4	Software Dev.	Germany	1-4	Currently working alone, had a male and a female colleague earlier.	Genderfluid
	P5	Education	Germany	14	Three women team of sysadmins.	Woman
	P6	Technology	U.S.	15	Only non-male person in that role. Before in a team of 20 with two women.	Non-Binary
16th Dec 2021 Group 3	P7	IT Security	Germany	17+	Only women in a technical position with two male colleagues.	Female
24th Jan 2022 Group 4	P8	IT Consulting	Germany	20-25	So far mostly worked with teams with less women than men.	Female
	P9	Education	Austria	10+	Until three years ago only women in a team of four.	Female
23rd Feb 2022 Group 5	P10	'La Zone'	France	30+	Works alone.	Both and neither
	P11	Technology	U.S./France	5	One woman colleague in a team of ca. 35 colleagues.	Non-Binary
	P12	Law	U.S.	1	Roughly 70% male colleagues.	Male
8th March 2022 Group 6	P13	IT University	Austria	10	Two men and one woman in a team of three.	Female
	P14	Bio-Tech	Germany	6	Only woman in a team of 30+.	Female
	P15	Non-Profit	Belgium	5	Has one male colleague; All prior colleagues were also male.	Female
	P16	Technology	Canada	25	Five male colleagues.	Female

3.3 Ethics

Our institution's review board approved this project under report number 1826. In this process, the review board audited our data management plan, including data processing and data storage procedures, data privacy impact assessment and compliance with applicable privacy legislation. We did not collect participants' names during the focus groups; hence, our data (extracts of the group chats) does not contain this information. While we did collect participants' job titles during the focus groups as it helped inter-participant interactions, we do not share this information in this paper as it could potentially allow the identification of specific participants or workplaces due to unique job titles used in organizations. Furthermore, given that our participants belong to marginalized genders and the sensitive nature of our data, we deleted all personally identifying participant data after the completion of our study. Additionally, we also completely de-identified our dataset at the end of the research project and save only the aggregated metadata. Our ethical practices align with those proposed for security research with at-risk populations [9]. Finally, the review board also audited the informed consent form that we used for our study with which we collected participants' consent for participation in the online focus groups, see Appendix A. Via this form, we inform the participants what their participation entails, how we will collect, process, and store their data. We also informed them their rights about data deletion and withdrawal from the study.

3.4 Participants and Recruitment

We recruited via our personal and professional networks by directly reaching out to potential participants and to those who might know potential participants. Furthermore, we reached out directly to people who described themselves as 'system administrator', 'sysadmin', 'sysops', 'ITops',

'Ops' in their Twitter profiles. We also invited participants via a public Twitter post. Considering the scope of our study and our feminist research approach, we wanted to engage with people from marginalized genders (in this case, not cis-men). Hence, for all recruitment efforts, we shared our project description (see Appendix B) and asked them to get back to us if they were interested. We did not offer compensation to our participants as sysadmins are generally well paid but very busy in their profession and hence are more concerned about time commitments, as also explained by Dietrich et al. [23].

We were able to engage with 16 participants via six online focus groups; see Table 1. Work experience of our participants ranges from one year to 30+ years. The majority of our participants are located in Europe (11/16), while three work in North America, and one in India. Additionally, one participant works in North America and Europe. Participants work in various sectors, including IT, education, law, biotechnology and non-profit organizations. Please note that this clustering towards European participants stems from our community driven recruitment approach and the comparatively strong community of system operators in Europe, see also Dietrich et al. [23], who observed a similar effect. We are not listing our participants' job titles as sysadmins' job titles can be unique and might make the specific participant or their employer identifiable.

3.5 Data Analysis

We used the reflexive thematic analysis (TA) [11, 12] method to interpret the data. We approached coding and theme development in an inductive and data-driven way. This was done by the two researchers from the team who conducted all the focus groups and also analysed the transcripts. For Phase 1 - *data familiarisation* - two researchers facilitated the online focus groups and later read through the chat transcripts, asking follow-up questions to the participants as needed. For Phase 2 - *coding* - one of the researchers, being the primary coder inductively built the codebook by coding all the transcripts. The second researcher began by coding the first transcript separately and compared their interpretations with the first coder. This process revealed only slight differences in the codes; the researchers combined their codebooks. Moreover, in our approach, we did not strive for code agreement between the coders but instead used two subjective interpretations to obtain a richer understanding of the data. Therefore, we did not focus on inter-rater reliability (IRR), due to the complexity and nuances in our data [56]. The next five transcripts were first coded by the primary coder and then by the second coder, who a) reviewed for any missed codes and b) checked the primary codes for consistency with the data. The two coders regularly (virtually) met to discuss questions and disagreements and refined the codebook to end up with 56 codes (see final codebook in Appendix F). For Phase 3 - *generating initial themes* - the researchers then regularly met to look for themes in the coded data and created visual code clustering and initial themes. They then discussed these themes and clusters with all the four authors. For Phase 4 - *developing and reviewing themes* - through team discussion, we finalized three main themes, namely: nature of sysadmin work from the perspective of marginalized genders, care work in sysadmin work as experienced by marginalized genders and role of gender in sysadmin work. For Phase 5 - *refining, defining and naming themes* - we identified connections between themes and began the process of reporting our findings. We were able to refine the themes further as we reported them and also name them accurately. For the final Phase 6 - *writing the report* - we reported the research process that led us to the findings, including situating our work within the societal and scientific contexts and reflecting on our roles as researchers.

Marginalized genders (not cis-men). Throughout this work, we use "marginalized genders" except in cases where participants specifically mention "women" or a specific marginalized gender. Because we centered the perspectives of all sysadmins who are not cis-men, our data does not clearly

distinguish between the experiences of people from different marginalized genders. Our focus groups were not grouped by gender and therefore this is reflected in the data analysis. We further discuss this along our other limitations in Section 5.3. We refer to marginalized genders by saying "non cis-men" and hence, bring attention to "cis-men". We do this to call out the privilege that comes with being cis in a heteronormative patriarchal workplace and hence, the responsibility to deal with the problem of gender inequity in the workplace.

Emoji Use. In our group chats in Mattermost, we encouraged the participants to interact with each other as it helpful in building the discussion. One way this was done was by using emojis to react to participants' messages which enables participation without words. Emojis helped to bridge the gap between the unsaid aspects of communication and the spoken (written) text, and aided in setting/understanding the tone of the messages and the overall conversation. Emojis were also used by the researchers who facilitated the focus groups so as to fully (emotionally) engage with the participants and create a safe and inclusive space where everyone felt that they are on an equal footing [62].

4 FINDINGS

First, we present sysadmin work as described by the participants, including aspects of care, visibility and gender. Next, we dive deeper into the aspects of care work as a part of sysadmin work and the effect of gender, which are the two main themes we identified. Lastly, we present the different suggestions from our participants towards making sysadmin work more inclusive, drawing from those aspects of our participants' work that already help them.

4.1 Nature of Sysadmin Work from the Perspective of Marginalized Genders

Sysadmin work is complex and includes both technical and social aspects. Sysadmins strive to ensure continuous system operations by maintaining the technical infrastructure they manage. This usually includes providing support to the end users of these systems as and when required. In addition to user support, sysadmins coordinate work with their team and interact with several stakeholders. The participants report coordination with their teams and colleagues (P5, P6, P7) as part of their work and also that *"anything that doesn't depend on others is usually easy"* (P16). Working with colleagues can entail mentoring and sharing experience with less experienced team members. The following exchange between participants P1 and P3 underlines the social aspects of sysadmin work and how the social aspects might be trickier than the technical aspects of this work.

Participant P3 said in the excerpt below that they found it easy to help their less experienced colleague in supporting the end users and also noted that the technical aspects were easier by implying that help was not needed regarding those aspects.

R1: What do you find easy to do in your work? And why?
P3: helping to teach the new guy (student) how to reply to confused or upset users.
P1: hehe, so more technical or more social helping? 😉
P3: social helping
P1: sigh... classic
P3: the technical aspect such as "why can I not use the webApp when I'm offline" is easy 🙂
P1: hehe, true. You have to directly talk to customers? While doing software dev? customers/users
P3: Some of them.
P1: that looks like a bunch of context switches. and I presume the "social helping" of men is not valued or acknowledged by the team, just taken for granted? 😉

Furthermore, a majority of our participants (10/16) reported the technical aspects of their job being easy. Participant P5, for example, said that the *"easiest things to do is the linux stuff: updates, configuration, new servers, because I've been a user and admin for 20 years now, so I know the system's pretty well."* (P5). Other participants noted that routine tasks are easy to do (P7, P8, P9), for example, Participant P7 shared that there are *"many routine tasks I do almost every day, these are very easy because I know them and my systems so well. For example, hunting for lost/stuck mail, adding and removing users on systems, the bread and butter work"* (P7). Participant P1 said that *"finding something to do"* (P1) was an easy part of their job. Several other participants reported fulfilling several roles in their job, sometimes being overwhelmed (P15) and overworked (P5). Participant P3, for example, continued (from the previous excerpt) to share the following:

P3: I was the first student hired, I still fill more roles than I like.
➥ **R1:** @P3 can you elaborate a bit more this? What kind of roles?
➥ **P3:** I peside [sic] over meetings which is kind of odd, since two team members are professors who just do not have the time to take care of another project such as a webapp in production.
I also initially talked many stakeholders to find out requirements for the webapp.
Me taking care of Servers was more or less an exidental [sic], since I'm the "linux resident nerd" regardless of being female.
➥ **R1:** @P3 so these are all the tasks that you do that aren't "supposed" to be your tasks?
➥ **P3:** yes since people who would usually do them have more official papers and a higher pay grade.

R1: 🤔

Regarding social aspects, Participant P9 shared an image with us, see Figure 2 in the Appendix E, to illustrate the experience of interacting with several stakeholders and *"to get them all to the same picture"* (P9). Past work has referred to sysadmins as 'broker technicians', highlighting their role as technical brokers who create a bridge between end users and the technical community [87]. A significant part of sysadmins' work is about supporting people and their work, as was noted by several participants. For example, providing *"live remote support via screen share"* (P6) and *"2nd-level support (to the teaching staff) and 1st-level to colleagues"* (P5). Previous work [44] has also highlighted helping and supporting others as a fundamental part of sysadmin work, ranging from simple to complex tasks. As Participant P1 described it: *"My day work is user support for the internal IT, which involves everything from printer reset to Kubernetes deployments"* (P1). Going back to the first excerpt, when asked why they found the "social helping" part of their work easy, Participant P3 responded:

P3: I think I have better soft skills than the average 19 year old boy.   **P2:** 🤣
➥ **P1:** because of age, gender, or both? 🙂
                                                                                                             R1,R2: 👍
➥ **P3:** I'm not sure. I suspect both.

The above interaction points towards a relation between gender and social/communication skills. Two other participants (P13, P16) shared that they found it easy to communicate with users. Seven participants (P2, P8, P10, P11, P12, P13, P14) expressed difficulties in communicating/socializing with (cis) men. For example, *"men's social activities are not gender neutral"* (P2) and that *"they still feel put out when they need to be inclusive"* (P2), or the men in the team can sometimes be *"demeaning"* (P12), *"condescending or even belittling"* (P14). These difficulties can have widespread and lasting effects as system administration is a men-dominated field (also see 'team distribution' in Table 1). Four participants, in addition to sharing their teams' distribution (Table 1), remarked on the gross gender imbalance in the sysadmin work domain. They noted that *"women are often in*

software engineering jobs and not so much in network or server groups" (P13), that they are *"yet to work with another woman in IT!"* (P14), that they saw increasingly *"more women in webdesign jobs or UX/UI but the sysadmin field is still seemingly running behind"* (P15) and that in their career they *"have only ever met one other woman that did the same thing as me. 🙂"* (P16).

Our participants similarly shared their experiences of working in tech (and within a tech culture) where they saw other women leave the tech field (P2) and they struggled within the *"tech/startup culture, where the norm was that everyone was motivated all the time because our mission was so important. That made it really hard to admit that you had a sh*t job, also to yourself"* (P4). Previous work [89] has discussed this connection between technology culture and the culture of masculinity. Furthermore, three participants said that the hierarchical aspects of their job make it hard for them to say "no" to those who are higher up in the hierarchy (P2, P3), and this can also prevent them *"from doing the essential work necessary to keep things running"* (P5). Past work [61] has elaborated on this relation between organizational hierarchy and patriarchy. Belonging to a marginalized gender in the sysadmin work domain, which is by nature often considered to be invisible work, can compound feelings of being unseen, unwelcome and isolated. We further discuss these aspects in the following two subsections.

4.2 Care Work in Sysadmin Work as Experienced by Marginalized Genders

We have discussed the care aspects of sysadmin work in the background, Section 2.2, in terms of caring for things (maintenance related) and caring for people (helping users and colleagues). Here we dive deeper into these care aspects to better understand the role they play in sysadmin work from the perspective of marginalized genders, what (gendered) care practices look like and how care work was brought up in our conversations.

R1: What do you find easy in your work considering that you work in a cis-men dominated field?
➤ **P15:** Empathy and relating to your non-IT colleagues. Oftentime people will say they feel stupid for asking questions or not getting it and I feel like I'm really good at putting them at ease (maybe because I'm a woman and perceived more as caring).

P14, P16, R2: ❤️

➤ **P14:** @P15 good answer!! I also feel this. I think empathy comes so naturally and easy to me I didn't even consider it here!
P13: yes empathy is an important thing in user support I think

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User communication and support are key to sysadmin work, and previous work has noted the same [44]. The aforementioned excerpt highlights the importance of empathy in user support related tasks. Participant P15 notes how their gender might be playing a role in how caring they are perceived to be and, consequently, how this aids in performing care work in the form of support tasks. In addition to being important, Participant P14 alludes to how easy it is to overlook empathy as a professional quality. When asked if being empathetic affects sysadmin work, Participant P14 said, *"I have heard for years I have great communication skills and I don't think that'd be the case without good empathy skills"* (P14). These attitudes are in stark contrast to 'BOfH' (Bastard Operator from Hell [83]) attitudes discussed earlier in Section 2.2 where user requests for support are seen as a nuisance and burden to sysadmin work. The following excerpt describes in further detail how being empathetic, being understanding of users' issues and taking the time to explain things to them in a way that would make sense to them fits into sysadmin work.

> **P16:** - Talking to people at their level when explaining something to them. This is a super useful skill! Not sure what I can attribute this to, but I like to attribute it to my "soft skill" of being empathetic with people when they're frustrated with their tech
> ➥ **R2:** @P16 Why do you think Empathy is useful, how did you pick it up & do you see others working with you being empathetic as well?
> ➥ **P14:** i also like explaining at the level of others. its one of my favorite things. Because I like learning and sharing knowledge. But its not always easy to me. Sometimes things just click for me and I end up twisting my brain trying to find ways it might click for someone else 😄
> > **P15, P16, R2:** 👍
> ➥ **P15:** Oh I feel this 🙂 Trying to explain it at a low level makes me understand it way better too. In IT sometimes you take things for granted and "this just works this way" but when you need to explain it to a non IT person, they need to know why it works that way. Or they will sometimes ask question you didn't even think off and it makes you learn something new too
> > **P14, P15:** 👍
> ➥ **P16:** I've had a lot of people say they didn't like working with "the other IT" person because they were treated badly, or like they were stupid for not understanding something. I don't think it's something I picked up but it's definitely something I've honed as an important skill. It sets me apart as a consultant... and especially with women operators (like office controllers, managers, those that pick the consultants 😉) I do see it in others I work with, but it's not as prevalent. I can think of 2 people on my team other than myself that I would consider good at talking to people at their level.
> > **P15:** 👍, **P14, R2:** ❤️
> ➥ **P14:** @P16 yes!! i see that commonly in IT (especially as female), people treating others stupid or badly for not understanding or knowing something. I despise this.

Not only does being empathetic help with support and communication to resolve users' issues, but *"people appreciate if they have one who stays calm and do not [sic] loose [sic] patience at their desk"* (P13). This naturally leads to the question of how one's ability to empathize relates to one's identity and how—in turn—this means that some sysadmins are more empathetic than others. In our sample, we find participants to indeed attribute this to traditional gender constructs, e.g., see the third excerpt, where Participant P3 attributed their soft skills of "social helping" to both their gender and experience. Another example, continuing from the excerpt above:

> **P14:** @P16 yes!! i see that commonly in IT (especially as female), people treating others stupid or badly for not understanding or knowing something. I despise this.
> ➥ **R1:** @P14 do you think that being a female in IT helps you notice such things?
> ➥ **P14:** @R1 yes and no. I notice things like that regardless. But in many cases in work I have been on the receiving end of that - the one who is made to feel stupid for asking a question. So I notice it much more when it is done to others as well. I've stepped in many times also.
> > **R1, R2:** ❤️, **P15, P16, R2:** 👏

Here Participant P14 attributed their qualities of being understanding and standing up for others to their own experience of being treated less-than. In another interaction about social skills, participants shared how they felt their gender played a role:

> **R1:** @all Since everyone mentioned that the social aspects of work are relatively easy to do... do you think your gender has something to do with this?
> ➥ **P2:** I'm not a very... sociable woman in general. Being a woman in tech forced me to become more social or risk getting overlooked.
> > **P3, R2:** 🙂
> ➥ **P1:** I think I got most of my social skills by interacting and learning from non-cis non-male people. My own gender came after that and probably is based on much of that, so idk what relates to what in that regard 🙂
> > **P3, R2:** 💕

In the previous excerpt, Participant P2 shared how learning social skills was a way of coping while working in a men-dominated field as otherwise they risked being overlooked. We further elaborate on gender-related aspects in the following Section 4.3.

> **P5:** I [sic] general, I experience this workplace as much more emotion-oriented than previous ones (which were all male-dominated). So, for example, often "i feel bad I didn't do a task" is enough to "resolve" the issue, without the task actually being done by anyone afterwards.
> The problem of feeling personally attacked when asked to do something work-related differently is a huge obstacle to establishing a functional working relationship with some coworkers.
> And I think some of us are so used to having to defend ourselves against men in previous working environments, we take this defensive attitude into our new jobs. I see this with new colleagues, and it usually gets better within a year or two, though
>
> <div align="center">

P6, R2: ❤️
> </div>
> ➥ **R1:** @P5 do you think that having to defend yourself (and the defensive attitude) has an impact on your work?
> ➥ **P5:** I think, I personally don't feel this way. It's more that I'm sometimes afraid to really stand my ground because I don't know if people know I'm trans*, and if they will attribute it to "male socialization." But others behaving like this towards me makes it hard for me to bring up problems and ask for solutions. Especially if that would involve changes on the coworker's part.
>
> <div align="center">

P6, R2: 😣
> </div>

When Participant P5 was asked in a follow-up email, if they thought there were any system security implications of an emotion-oriented workplace such as theirs, they mentioned:

> **P5:** It may have, but both ways, for the better and the worse. The positive effect is that I believe (I hope) that my co-workers are more likely to trust us in the system's administration department than if we were men, and so they're more likely to admit to errors that may have an impact on our systems' security. The negative effect is that some co-workers will find it legitimate to not follow protocols that are security-related (e.g. installing the latest updates on their mobile computers, even when informed it is critical to do so) because of personal, non-work-related reasons.

In the above two excerpts, there are several different aspects of an 'emotion-oriented workplace' mentioned. Firstly, the culture of open communication and speaking up has positive effects in terms of asking for help and admitting when mistakes happen. This helps to create a culture of learning from mistakes instead of blaming for mistakes [19]. On the flip side, Participant P5 shared that coworkers might find it okay to not follow protocols in such a workplace. However, we know that people do that anyway (by mistake or deliberately [20, 26]), so it is better if people are open about it. Secondly, even in an emotion-oriented workplace, it can sometimes be difficult to stand your ground (to do the right thing operations-wise) because a) gender considerations come into play and b) it can become difficult for the other person to speak up as it can lead to one feeling attacked/blamed and in turn, a dysfunctional work relationship. Gender considerations, in this case, include having to consider if one's behaviour will be interpreted through a gendered lens which makes one afraid of being stereotyped, misunderstood and in turn, underappreciated in work one does.

Community in the Workplace. Another way care was brought up was in the form of community support in the workplace. This was in the form of workplaces that have a *"higher-than-usual level of understanding for personal "problems" and health-related issues"* (P5), where *"personal comes first always"* (P4) and *"conflict resolution always gets the space it needs"* (P4). Participant P4 said that such workplace dynamics were enabled by *"company culture"* (P4) and further explaining *"that most of us are anarchists, including our "boss"* 😀 *he's just doing most of the administrative stuff, but also social coordination, and some hierarchy comes from that of course, also formal/legal hierarchy.*

But yeah, it's a special ~~place~~network 😃 *"* (P4). When talking about a good workplace atmosphere, Participant P5 stated that *"Working atmosphere is super essential! On several levels: being able to trust my co-workers (also in terms of identity. Like, my team knows I'm trans*, they're all queer, that helps a lot) [...]"* (P5). When asked about the organizational factors that enable work, Participant P7 emphasised the importance of trust and elaborated that *"we are a small group in a small company, so we know each other rather well and have mutual trust. I think that's a key factor, that I'm trusted to do my work well. And because we are so small there is just no place for hierarchies. We have only one layer below the CEO and owner, and even that is more or less on paper, coordinating rather than disciplining."* (P7). In another focus group, Participant P8 shared a similar experience regarding the (limited) role of hierarchies in the workplace (see excerpt below). Workplace dynamics may also be influenced by the kind of work the organization is doing, as in the case of Participant P15, who shared that *"I currently work at an organisation with more women than men so I do think that helps me. My job works with a lot of minorities and progressive humanitarian projects so they're definitely more openminded than a lot of other organisations. This does have an impact I believe"* (P15).

P8: I have an environment where there are hierarchies, but it doesn't feel very hierarchical.
R2: why doesn't it feel hierarchical?
P8: because the tone of the superiors is right, it is not commanding, communication is mostly appreciative

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In another example, we see how the workplace community can persevere in the face of harmful and regressive messaging from management. It shows how organizational culture can be influenced in a bottom-up way. However, we also find that these dynamics and workplace communities are far from the norm.

P1: The CEO lately wanted to "keep politics out of work-communication" with regard to our social channel, which is also work to discuss against, when the "politics" is your existence (gender sensitive language discussions are the context)

R2: 🙁
➥ **R1:** @P1 you mentioned that the CEO wanted to keep politics out of work. I'm wondering what aspects of your company make it better than others (as u said)?
➥ **P1:** its >60% admins and they value ethics, open source, freedom of speech (not the right-wing kind) and such. therefore, it's clear that just because he wants to, that doesn't mean we do it.

P2: 👆, **R1, R2:** ✋
➥ **P1:** Most people are there because we do Things better that elsewhere and because the people are cool. Knowing this, and knowing we are here for ourselves, salaries are way better elsewhere, gives us all (perceived) power
➥ **P1:** Most people are experts and cannot be easily replaced.
➥ **P1:** leads to community

R2: 💯
➥ **P2:** Now I really want to know where you work. Don't say it. Just - wow
➥ **P1:** my pitch is not that inspiring in reality. Or I might have not seen the darkness of other companies..

There were also mentions of a lack of understanding in the workplace which caused difficulties in establishing processes (P5), expectations (P7) and boundaries (P15). For example, Participant P5 first shared with us that their work environment was a supportive one and that they often missed this in their *" "larger team" outside sysad"* (P5), and they *"would have quit several times"* if it wasn't for their supportive sysadmin team. In the following excerpt, they elaborate what they were missing and how it was affected their sysadmin work.

P5: Working atmosphere is super essential! On several levels: being able to trust my co-workers (also in terms of identity. Like, my team knows I'm trans*, they're all queer, that helps a lot), being supportive with each others tasks and challenges without being derisive, trying to find solutions for schedule-related issues (we all work part-time) and holiday-planning that work as good as possible for everyone. Being mindful of what the others are doing and their workload.
I miss a lot of that often in my "larger team" outside sysad, and I would have quit several times, if it wasn't for my team.

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P6, R2: ❤️
</div>

➥ **R2:** I am really glad that your team is supportive!! Can you tell me a little bit more about what you miss with the larger team and how it affects your work?

➥ **P5:** Thank you. One thing that's super annoying is that we try to establish processes (like, having a shared mail-address for support, so we can react quickly at all times, independent of who works on that day, or requesting certain information in writing, because of the GDPR[a] documentation), and they keep forgetting to use the channels, writing to us individually, requesting new permissions for users verbally in the hallway, they forget that we need to know things beforehand so we can prepare (e.g. a new class with participant accounts to set up cannot be requested on the day the class starts). A lot of it is not intentional but due to everyone's being overworked, but it makes work a lot less easy, and there is a certain level of disregard involved, too.
Also, our boss piling up extra tasks that "can just quickly be done" without realising how much work it is, which keeps us from doing the essential work necessary to keep things running.

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P4, P6, R2: 🙁
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[a]General Data Protection Regulation (GDPR) is a privacy regulation in the European Union (EU) law

The explanation of Participant P5 also alludes to the general unawareness of what their sysadmin work entails and how it remains invisible, only remembered when something isn't working or is needed. Participant P7 further elaborated on a similar experience.

R1: In this "invisibility" an hinderance for you? Work or otherwise?

P7: Sometimes, yes. Others sometimes expect to get difficult problems fixed in a short time because they can't estimate the amount of work involved with them.

P7: They call and ask why xyz *still* isn't working and that brings me out of my concentration and I have to refocus after that, pick up where I was. That's a nuisance.

R1: So, with the invisibility comes this aspect of underestimation of your work? Is that correct?

P7: Yes, I guess you could say that.

The invisibility and unawareness can further lead to underestimation and underappreciation of the work sysadmins do. When sysadmins belong to marginalized genders, the invisibility and underappreciation aspects are often compounded. Participant P15, for instance, shared one way this might be happening.

R1: The next part of the focus group is about the difficulties you face at work. You have already mentioned some such as the negative effects of standing out at work.
Are there any other obstacles that your face that you haven't already mentioned?

➥ **P15:** Project management. I have sooo many things to work at simultaneously and it sometimes gets a bit overwhelming. Also boundaries. I really try to set the boundary that my IT support colleague is the one that will be helping with computer issues (everything 1st line) but some people don't get it or don't want to get it. It's mostly the older women at my job who want me to fix stuff

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P16: ❤️
</div>

➥ **R1:** @P15 why do you think people don't respect these boundaries?

➥ **P15:** They probably don't think it's a big deal and don't understand why this order of 1st line - 2nd line exists. Also maybe they feel more comfortable with a woman because we're "softer"? I'm not sure

➥ **P14:** @P15 Agreed, this is also not a strong suit of mine.

➥ **P13:** That's right. They are feeling comfortable with women.

The previous three chat excerpts show different ways in which sysadmins' work has been affected due to the lack of a supportive and understanding workplace. If not in their own workplace or team, sysadmins find community in other places such as Reddit and StackOverflow (P14, P16), culture (P16), a women-in-tech Slack group (P16), *a "group" with my female colleague to exchange experience"* (P13) and *"an all-women's side-channel chat that we run independently from the main work channels"* (P6).

4.3 Gendered Experiences in Sysadmin Work

Challenges due to gender at workplace. System administrators often face challenges due to their gender in men-dominated spaces, as briefly introduced in Section 4.1. Participants mentioned some challenges directly related to gender at their workplace, like having to do extra work to prove themselves (6/16). For instance, in the excerpt below, P14 mentioned that they have to go above and beyond to get accepted by the team; otherwise, they mentioned *male* colleagues explaining topics they are an expert at. Participant P12 said that they felt a sense *"being demeaning [sic] by the male especially when dealing with deep aspects of their line of duty (law)"* (P12), Participant P14 mentioned being *mansplained* to by some colleagues who *"do not talk to our other male colleagues like that"* (P14) and Participant P13 said they were often ignored and condescended by their male colleagues.

> **P14:** i think my biggest difficulties at work are the fact that I feel like I need to go above and beyond what my male colleagues do just to get a spot on the team.
> People just assume you don't know stuff. I get explained simple stuff all the time where I want to say: how do you think I got this job without knowing that?? most recently I got explained what the /24 means at the end of a IP. This colleague even knows I worked in networking department in the past. How do you get so far and not know that, where you think you need to explain that to someone. I don't feel that need to explain that to any one I work with.
>
> **P15, P16, R2:** 😡
> ➥ **R1:** This is infuriating! Do you think this extra effort/ annoyance has an impact on your sysadmin work?
> ➥ **P13:** I think the same, as a woman you have to give more than 100 percent where men's work is just fine with 70 percent or 80 percent.
>
> **R1, R2:** 🙁

Furthermore, our participants mentioned having to perform higher than men to succeed. *"I think the ratio of high performing women in IT is likely a LOT higher than men, so I agree. In general women do have to perform better to succeed"* (P16). Participants P13, P14, P15 and P16 also mentioned that when dealing with external parties and clients, they need to be more prepared for these meetings because they not only have to talk about the topic at hand but also have the onus of proving their expertise in the subject matter. This is a challenge that women in IT need to tackle on top of their daily activities. As a participant explains, *"I think my biggest difficulties at work are the fact that I feel like I need to go above and beyond what my male colleagues do just to get a spot on the team"* (P14). Participants mentioned that their male counterparts, on the other hand, seem to do well even if they are underprepared in these situations. For example, Participant P14 noticed that their *"male colleagues come to meetings with externals completely unprepared and all is good"* (P14) whereas *"... as a woman you have to give more than 100% where men's work is just fine with 70% or 80%"* (P13). Earlier work [28] has reported similar findings where women in engineering have to do extra practitioner identity work as their professional (engineer) identity is seen as 'gender inauthentic'. Participant P14 summarized this:

> *"Nothing is really easy. I feel like I have to give 110% to even compete or something. even on the parts that I personally find easy"* (P14)

Generally, since subject matter expertise seems to be under scrutiny, our participants reported allocating a large amount of time to prepare for meetings. As Participant P15 mentioned, *"I never ever want to not have an answer because I'm afraid it will reinforce any underestimation"* (P15). This is not referred to as *'preparing'* for the meeting but rather *'over-preparing'*. Participants reported a significant pressure to be at the top of their game so as not to lose credibility as this is seen as *"fuel to those who aren't very nice to us females in IT"* (P15). These pressures relate to the visibility issue of marginalized genders in IT; see also Section 4.3. One may often be alone (and sometimes the first!) to exist in certain work spaces. This, in turn, can induce a feeling/burden of representing the community one belongs to, tied with a fear that every minor imperfection will be picked up and framed as re-enforcing harmful stereotypes by the environment [28]. Moreover, the higher performance requirement is not only related to performance at a job level, women also need to show *"more "experience" than men"* (P13) while applying for the same job. In an example shared by Participant P10, we can see how gender-stereotypes and prejudice played a role in hiring:

> **P10:** As independent, I just moved the hardships to getting paid work. An example: I was approached with a problem. Asked two rounds of questions while working on an approach. Took me two weeks to make a very decent approach. Communication died. Sent three emails. No reply. Spoke with the manager a year later at an [X conference] (which I organized as part of my marketing strategy). He said, the plan was perfect, and they hired a "Kostwinner" to implement it.
>
> **R1:** 😳
>
> ➥ **P10:** "Kostwinner" = "Head of household who needs to make money"
>
> ➥ **R1:** @P10 did you find out why they blatantly ignored your emails and went with a "kostwinner"?
>
> ➥ **P10:** Yes, at [X conference], he said, "That man needed the money". I replied, "so do I, shall I send you a bill for those two weeks?". He got red faced and buggered off from the event.
>
> **P11, P12, R1, R2:** 😡

The above excerpt is a striking example of sexist hiring practice. Not only are engineers from marginalized genders seen as gender inauthentic in their profession, but they are not perceived as breadwinners and hence, not perceived as suitable as men to be salaried employees. In addition, their labour is considered open for the taking. Other ways in which we identified participants having to establish their professional expertise in our study were being *"left alone to move a 300lbs server"* (P2), being *"straightforward and technical in my first communication whenever possible just so they know I "play ball" and know what I'm talking about"* (P15), using *"full official title/signature in email"* (P16), and trying *"hard to prove those people who have bias' towards women in IT wrong"* (P14). Participant P5 elaborated on having to do extra work;

> *"...always having to prove that I know what I'm talking about, that they can 'talk tech' to me, and that I really literally mean what I'm saying when using tech terms (and not just having picked them up from my boyfriend, or whatever they seem to think), that's super exhausting. I double- and triple-check most of my mails before sending them, which I wouldn't do otherwise, I think."* (P5)

Previous work [28] has noted that this extra layer of work done to establish one's professional expertise doesn't really end as it has to be performed "every time they encounter a new colleague, associate or client for the first time" [28].

Coping strategies. The study participants reported coping with working in such men-dominated professions by accepting *"that not everyone will want to work with me"* (P2), by *"picking my battles"* (P2), ignoring prevalent structural issues that have *"always been that way. Like the only woman in the meeting has to bring the coffee because she has to be the secretary"* (P9) and *"gritting my teeth and plowing on, venting with colleagues - especially with the one female colleague I have now <3"* (P9),

by supporting other women (P9), by **not** asking for accommodations (P14) so as not to *"reinforce any cultural biases against women "soft/weak/unable to handle stress" "* (P16), by letting *"roll off the comments from my back"* (P13) and not taking them personally even though *"you are the only gal in the room and the only one being treated like that"* (P14), and by anticipating *"being underestimated"* in meetings (P15).

In addition to accepting reality as it is, coping strategies are also about actively disrupting the status quo, such as by questioning everything (P8), by behaving *"properly towards people and make sexism look like silly foolishness"* (P8), by amplifying *"my opinions and thoughts during meetings"* (P12) and speaking up *"when I see gender bias and I always never hesitate to praise my work infront of my colleagues"* (P12), and by enforcing boundaries (P15, P16). Coping can also look like removing oneself from an unwelcoming environment by abandoning *"a project that I like if there's a man on it that's is insecure about women"* (P2) and limiting after-work socializing because *"men's wives have been known to get jealous or men's social activities are not gender neutral"* (P2), changing departments (P8) and changing jobs (P11). Participant P2 expressed that such avoidance strategies have *"cost me promotions"* (P2). Another participant noted that sysadmins change jobs *"more often than in other fields"* (P1) for several reasons such as better salary or for *"fresh wind"* and *"sadly, this leads to few people "doing the work" and actually improving social conditions, when there are many companies to choose"* (P1). Many of the aforementioned ways of coping with discrimination and unfairness constitute emotional labour [39].

Some of the coping strategies mentioned above constitute gender identity work which stems from being highly visible as a marginalized gender who might stand out in men-dominated workplaces [28]. For example, not asking for accommodations (P14) to not reinforce any unfavourable gender stereotypes. Participant P2 shared the ways in which they do gender identity work:

> *"ways I overcome my gender at work: 1) I dress differently. I stay away from over femininity at work. 2) I am more conciliatory than in my personal life. 3) I change my voice (lower the register) on purpose as I have found it's easier to get my point across. 4) Avoid any natural tendencies that might be overtly feminine."* (P2)

Participant P2 added that, in remote work, there was less socializing, and hence, fewer gender considerations came into play. This was perceived as better in terms of doing gender at work but also called for added efforts around *"relationship building"* (P2). Visibility as women takes shape in the form of stereotypically feminine identities - most commonly as (hetero)sexually available or as mother [28]. As Participant P13 shared, *"if you mention you have kids (I have 3) they are amazed, "uuu - can you do your work without the kids are interrupting you? 😢"* (P13).

Coping strategies affect sysadmin work. Doing this extra work in terms of practitioner identity and coping strategies leads to other effects. For example, sysadmin tasks can take longer to complete because participants reported being slowed down (P2, P14) by the extra tasks being performed and also due to nitpicking where other *"people get their stuff passed in a day with typos and errors that I would get blocked for"* (P11). Therefore, these additional chores performed in the form of coping can ultimately affect participants' sysadmin work. Participant P3 said that in order to cope with all the extra tasks, *"I need to be very organized and have clear priorities. I do try to limit working overtime. Avoiding it is not easy though. I try to delegate whenever possible, though of cause [sic] that causes other issues too"* (P3). Other adverse effects of these coping methods that we observed were missing out *"on a fun learning experience"* (P2), decreased motivation (P1, P14), *"super"* exhaustion (P5) and appearing unprepared when fully prepared (P11). As Participant P11 explained:

> *"especially in engineering where it seems like men will go into maintenance with little preparation thinking it's fine and everything will go well, and when you do prepare more you seem unsure of your ability."* (P11)

Finally, the participants also reported harmful health effects stemming from gender-related workplace issues. In addition to demotivation and feelings of burnout (P16, P14), Participant P9 reported that it had an *"effect on my self-esteem and on how outgoing I am"* (P9). Participant P4 shared their experience of working in a men-dominated tech/startup workplace:

P4: yes, at my previous job it was a lot harder. I got a lot of harsh feedback which I thought I had just to accept, even though I couldn't process it emotionally. One time when I got feedback I was drunk for two days.
I'm not sure whether it was because the company was male-dominated or had this tech/startup-culture, which has of course many patriarchal implications.

<div align="center">

P6, R2: 🙁, **P5, P6, R1, R2:** ☹️
</div>

➤ **R2:** @P4 could you share how this affected/impacted your work?

➤ **P4:** I had a hard time to focus, tried to look busy anyway, couldn't open up... back then I was focussed on writing technical/promotional blogposts instead of sysadmin tasks, so it was creative work, which suffered a lot from this.

<div align="center">

P5, R1, R2: ☹️
</div>

➤ **P4:** It was especially bad because of the tech/startup culture, where the norm was that everyone was motivated all the time because our mission was so important. That made it really hard to admit that you had a shit job, also to yourself.

<div align="center">

P5, P6: 😡
</div>

Gendered In/Visibility. In engineering spaces, "women engineers are simultaneously highly visible as women yet invisible as engineers" [28]. Faulkner explains,

> *"Although the inauthenticity and invisibility of women engineers as engineers means they have to do extra layers of practitioner identity work, their visibility as women often means – paradoxically – that they also have to do an extra layer of gender identity work."* [28].

As we learn from our participants, this effect carries over to people not fitting with the gender binary system. Similar to women, they might not be seen as "real engineers" [27, 28] because such spaces tend to be cis-men-dominated and anyone that does not belong to that identity will be seen as an outsider. And just like women have to do extra gender identity work in the form of being feminine "enough", trans, non binary, genderfluid and agender people might feel pressured to conform to heteronormative expectations. They might also struggle with feelings of belonging and/or might be made to feel like they don't belong in certain work spaces [10].

Sysadmin work is invisible and is usually brought to light when someone needs something or something stops working [44]. As Participant P7 shared with us:

> *"Sometimes I think my work is not really seen by others outside of my field. If I do my work as a systems administrator really good it is more or less invisible, because everything "just works" and if not others just see me typing at my computer, and then it works again."* (P7)

Sysadmin work is invisible and underestimated, as mentioned previously by Participant P7, but also described in earlier studies [44], and traditional textbooks [49]. Due to the invisibility of women engineers and engineers who do not fit in the gender binary, and the invisibility of sysadmin work in their organizations, our participants can experience double invisibility. As a result, these people end up doing extra work both in terms of professional and personal identity. In the following excerpt, Participant P11 shared their experience of being left out of work communication (invisibility) and having to redo their work (extra practitioner identity work). We also see how these dynamics have not only an effect on the participants' sysadmin work but also on their mental health in terms of losing motivation and interest, as exemplified in the following chat excerpt:

> **P11:** so, we have a pretty big timezone difference with most of my colleagues, which used to work fine and not be a big deal
>   ➡ **P11:** but over the past year and a half, I found myself left out of projects, and finding out about them through company emails announcing the project, for instance
>   ➡ **P11:** or, as I said, getting all my work nitpicked for days, or re-done again after I'd done it
>   ➡ **R2:** @P11 So sorry that this is happening.
>   However, just to confirm for the purpose of interpretation, Can you confirm if the nitpicking happens due to gender / working remote?
>   ➡ **P11:** well, as always, it's hard to say definitely if it's for a specific reason, but I know it didn't happen as of a year ago when I was clearly read as male, and I know it doesn't happen for other coworkers, even ones that are remote with a similar time difference
>   ➡ **P11:** so, I would say it's probably related
>   **R2:** 👍
> **P10:** Losing way too much time on the power play communication reduces my effectiveness at getting things started/done.
>   ➡ **P11:** yeah, it makes me feel demotivated, disinterested, and it materially stops me from working on projects with colleagues, etc

4.4 Inclusive System Administration Work-Environment

In this section, we present the different recommendations and ideas offered by our participants for an inclusive workplace in terms of formal and informal processes. In addition, we also report on the current practices at workplaces of certain participants that work well for them. We finish by reporting our participants' reasons for staying in this men-dominated field of work. These thoughts and suggestions shared by our participants provide a practical starting point toward positive change.

Supportive Workplace. In all the focus groups, we asked the participants about the organizational, social and environmental factors that help them overcome challenges they face at their respective workplaces. Almost all our participants mentioned that an inclusive workplace is a requirement for a good working atmosphere. Of multiple aspects that were mentioned, some of the most common asks were mutual understanding, trust, and respect from their team members and co-workers. For instance, one of the participants stated the following when asked about important aspects for them to thrive in the workplace:

> **R1:** [...] I was wondering, what aspects of the workplace would be most important for you to thrive well in it?
> **P7:** As I said, freedom to work as I want to (within sensible bounds, of course). Not having to discuss every step I'm going to do with someone higher up. Mutual understanding, respect and trust with my coworkers. I wouldn't want to work somewhere I know I'm not respected as I am, or are not trusted to do my work.
>   **R2:** 👍

Participant P7 shared that *"..of course in the beginning the old name and pronoun sometimes slipped out by accident when coworkers were talking with or of me, but that got fewer and fewer over time"* (P7). Another common aspect that the participants mentioned was diversity within teams. Promoting diversity by hiring people from diverse backgrounds, gender, race, sexuality and people with disabilities. Participant P3 suggests, *"Hire and promote more diversity, such as immigrants, people with disability and females. Respect those who are different, instead of underestimating their skills"* (P3). In addition to diversity in hiring, timely promotions to qualified people and supportive management were also highlighted, as Participant P7 stated: *"When I read 'Good working atmosphere', I think about team-focused behaviour, cooperation, responsive communication, timely promotions to those who are qualified, supportive management, and sensitivity especially when it comes to race/gender/sexuality/disability, and I find that incredibly important"* .

Participant P1 stated that they expected Human Resource (HR) departments to practice what they profess as a part of the company culture: *"Make HR actually do the workshops for a company to BE the things they write on their homepages. Same for C-Level. Just don't think you're better than other companies, try to get the data on that - and than work with it."* In addition, Participants P2 and P7 mentioned that every HR department and DEI (Diversity, Equity and Inclusion) initiative needs to be supported by the upper management to champion better policies and practices at every workplace. As Participant P2 stated about their workplace: *"The HR needs the backing from management, without it, it tends to go now where. HR needs to be very progressive and walk the talk. I knew we had the right person to sponsor change when she was overheard saying: I dress how I like and I don't have to meet anyone else's idea of gender norms"* (P2). Participant P7, regarding company culture and DEI practices, also stated that, *"The upper level(s) of a company have to support it, but I think it also needs support from the bottom"* (P7). Having a supportive and unbiased team manager *"..that takes notice of communication problems and works on solving them would also be appreciable"* (P11) and *"encouraging openness and transparency in managements treatment to the general workforce regardless of gender"* (P12). When asked about whether any organizational factors help participants overcome gender related obstacles they face at work, Participant P2 mentioned, *"DEI, Resource groups like GayStraightAlliance. Good clear policies. A strong HR department"*. We discuss below in detail the formal processes for gender equity that we encountered.

Process for gender equity. Organizations that some of our participants worked at had some DEI practices in place. Participants P2, P12 and P7 mentioned that their workplaces have HR policies, information and education in place to support gender equity. Participant P12 even stated that policies around biases are followed strictly and in some circumstances *"have previously caused termination of some employees"* (P12). Even when these practices are in place, they still have a long way to go in terms of adoption. While some organizations have these practices in place, Participants P8 and P11 reported that their organizations did not have any such measures in place. In some organizations, DEI resources were not equitably distributed; while some employees had access to them, system administrators were among the few who did not. Participant P9, who works at a university, mentioned that education and coaching are not available for all employees:

> **R1:** @P9 @P8 Are there any measures in place to address your needs at work considering you work in a cis-men-dominated field?
> **P8:** no not with my workplace
> **P9:** I think my boss would get a red head when I tell him with a dead pan face there should be bins on the women's toilets … 🤔
> <div align="center">
>
> **R1:** 😶
> </div>
> **P9:** well, there are supposed to be measures in place
> **P9:** in theory, in practice, I would not go there because I would be afraid everyone would know about it soon after
> <div align="center">
>
> **P8, R1, R2:** 😔
> </div>
> **P9:** It would be nice if there would be some coaching in place, it does exist but 'only' for scientists.
> **P9:** Like doing research in a male dominated scientific field. but there is nothing for administrative personnel

It can be helpful and vital to have a tangible picture of what a just and inclusive workplace looks like. Participant P1 mentioned using data driven analytics, Objectives and Key Results (OKR), and project management tools to support and keep track of inclusion initiatives. Such initiatives should not just be written in words but rigorously followed upon. Regularly surveying employees about *"how accessible and inclusive the workplace is"* (P1) would help to better understand how employees perceive the workplace. Participant P1 suggested that open/vague survey questions such as *"How is the work life balance?"* (P1) could be reformulated to solicit more detailed information from employees such as by asking *"what changed for you, if anything, since the last time. What would help*

you"? (P1). Furthermore, certain *"traditions need to be broken and not carried along"* e.g., only hiring female secretaries (P9). Such metrics can help to avoid the trap of performativity where companies have a DEI program in place while simultaneously the employees feel that they *"shouldn't have to thank someone for not taking the department to a strip club"* (P2).

Why stay in a men-dominated field? As highlighted in the previous sections, system administration remains a very cis-men-dominated field. And participants highlighted a multitude of challenges they face were related to their gender. Most participants indicated that technical aspects of their job were easy for them to do, as mentioned in Section 4.1, while the environment is sometimes hostile and impedes their actual job. Passion and liking for their job was one of the common drivers that came up as a common response by 6/16 participants, for instance, *"It's IT. That's my life, there is nothing else 😀"* (P1) and further elaborated by Participant P7:

> *"I love the work I do. I feel I'm enabling others to do their work and to communicate, and that is something I really like, enabling communication. I also love hunting bugs, figuring out tricky situations. It is very rewarding for me to get to the point where I understand why something isn't working the way it is expected to. It's often a kind of detective work, discovering clues and following them."* (P7)

System administration is a field that is ubiquitous, there is a need for system administrators in almost every organization. For instance, a quote by Participant P1 emphasizes this, *"I am right now looking for more people for my team. The recruiter told me 'There are NO unemployed sysadmins in Germany. Good luck', that's what I mean"* (P1). Availability of jobs was one of the reasons participants mentioned as to why they wanted to stay. Participants P1 and P9 also mentioned that switching companies for a higher salary is easy without having the need to acquire new skills. Job security (P9) was another reason in response to this, *"..also a reason to stay for me is that it is a very secure job and a lot of leeway in other things like free time planing, vacation time"* (P9). Money was yet another reason that came up, one of the participants mentioned that they left the field but came back to the field to an organization that did feminist and anti-racist work, as indicated the excerpt below:

> **P5:** Tbh, I quit after 7 years, studied something entirely different at uni, and never wanted to go back into the field. But money was an issue, and my organisation does really important feminist (and some anti-racist) work, supporting women entering the job market and stuff. So working for this particular org. was the initial motivation to get back into systems administration. Now it's partly working for the organisation, partly the lack of alternatives (I'm over 40, trans*, and have (mental) health issues, after all), partly that I actually do like to do Linux and networking stuff.

Workplace better than others. Some participants mentioned that they stay in their current position because they feel that their workplace is better than their previous ones. Participant P1 expressed that their *"company is better than others, so it's at least kinda rewarding, because there are many political and queer people and we just support each other in our Agenda to queer the place up 😀"* (P1). Supportive bosses and flat hierarchies were other factors that was mentioned by Participant P4, as reported in Section 4.2. Participants P4 and P7 stated that lack of hierarchies is important for them to stay at their current workplace, due to the ease of communication, task distribution, and trust among team-members, *"..we have very flat hierarchies, so it has rarely been a problem. If something (amount of tasks) is too much for us we either do it later or not at all"* (P4). While some participants mentioned positive aspects of their workplace being better than others (P6 and P5) they have worked at or are familiar with, we found a troubling aspect to this because there were some who *felt stuck* at such places. This is reflected in the exchange between P6 and P5 below:

> **P5:** Ah, okay!
> One thing is that the prospect of leaving my job and returning into an "all-gender" (aka: male-dominated, or all-cis-male) team is so horrible, it sometimes feels like I'm "stuck" at my current workplace.
> (Right now, I'm quite content with the job, but it used to be different, and my [sic] very well change over time.)
> Dealing with other people outside the institution (support staff from companies we buy services from, etc.) is often challenging, because they treat us as Lusers. Which sometimes means bug reports are simply dismissed, mails not read properly, stuff like that.
>
> **P4, P6, R2:** 🙁
>
> ➥ **P6:** @P5 Feeling stuck because I've finally found an inclusive job is a huge feeling! I want to leave because I want to expand my horizons, but I remember how awful my past workplaces were and I don't want to give up what I have here with coworkers who gender me correctly and include me in decisions/announcements and respect me personally as well as my contributions. I ended up asking my manager to find me dev work to do instead of applying for a dev job elsewhere because of this even though I do want to move on from doing support so bad it hurts.
>
> **R2:** 🤗, **P5:** ❤️

And while some of our participants mentioned the importance of being able to choose/leave their workplace (P4, P6, P10), (seen also in previous work [4]), others acknowledged how difficult it is to find a workplace where you feel like you belong.

5 DISCUSSION

Here we discuss our overall findings, recommendations for enabling sysadmin work and the limitations of our work.

5.1 Ways of Managing Sysadmin Work as per the Experiences of Marginalized Genders

First, we discuss the findings in the context of our main research question which is: In what ways do (non cis-men) sysadmins manage to work in the cis-men-dominated field of system administration?

5.1.1 Being excellent. Being *good* at their profession was not sufficient for our participants. Instead, the environment created a constant expectation of completely error-free excellence. At the same time, our participants felt that their men-counterparts were not subject to the same pressure to *constantly* excel. The participants excelled at their technical tasks and know-how and by honing their social and communication skills. Similar to earlier findings [4, 28], our participants tried to establish their professional mastery with the expectation of being recognized and respected by their colleagues. Having to deal with other peoples' gender prejudice and discrimination, they spend extra time and effort in the communications aspects, to do their tasks and in the form of emotional labour [39]. This impacts the sysadmin work in several ways such as extra (and sometimes repetitive) tasks which reduces work effectiveness and produces negative effects on mental health.

5.1.2 Doing gender. Doing gender entails the performance of various masculinities and femininities within existing social constructs and dynamics [27, 90]. Among our participants, dealing with gender inauthenticity and gender in/visibility in their role (see [28]) were two prevalent aspects. They coped with this by going above and beyond in the work that they do in both technical and social aspects (as discussed above) but also by constantly taking gender considerations into account. We elaborate below:

Gender inauthenticity: Are you really the sysadmin? Gender inauthenticity is about the perception of someone as not fitting the norm (in their professional role) due to their gender [28]. Despite being an expert user, one participant experienced being treated as a 'luser' by external support staff, based on our participant's gender identity. Traditionally, 'luser' refers to users who may not

be computer-literate and is also used in the context of BOfH (Bastard Operator from Hell [83]) work culture where such users are seen as a nuisance. And while this term is problematic to be used for any group of people, it is worth reflecting on why sysadmins (expert users) are facing this treatment as it ultimately is about gender. Faulkner talks about gender in/authenticity in the context of women in engineering spaces [28] where a woman who is an engineering profession is seen 'gender inauthentic'. They highlight how consequential it is to, both, be an exception and to conform to the norm (the norm in this case is to be an engineer who is a man). People who may not conform to this norm, such as the participants in our study, may then be seen an 'gender inauthentic'. And once someone does not see you as a 'real engineer', they begin to question your professional ability and even gender identity [28]. In response to this dynamic, many people do extra practitioner identity work by being extremely well-prepared, being excellent at what they do and repeatedly establishing technical prowess in social settings, and gender identity work which is discussed below.

Doubly invisible: Too good to be visible. Our data allows us to identify a phenomenon of double invisibility, not previously described in the literature. This relates to gender-related in/visbility issues, i.e., women in engineering spaces tending to be invisible as engineers but be highly visible as women at the same time as described by Faulkner [28] being combined with the 'System Administration Visibility Paradox' described by Limoncelli et al. [49]. What they describe is that due to their job, system administrators are invisible as long as the infrastructure functions, and are *"noticed only if something breaks"* [49]. This means that they remain especially *invisible* as long as they do an *excellent* job. Hence, people of marginalized genders working in system administration are affected by both of these effects, *especially* as they feel additional pressure to excel, which in turn makes them *more* invisible professionally, while the visibility they do receive tends to revolve around their gender *and* things not working well/breaking. Participants overcome this invisibility by doing both practitioner identity work (as discussed above) and gender identity work. Gender identity work takes several forms such as adjusting their femininity (dressing style, voice register, being agreeable) so as to be "better able to strengthen or protect their fragile membership" [28] within a men-dominated profession and steering clear of enforcing any negative gender-stereotypes (like not asking for accommodations so as not to seem weak).

5.1.3 Finding community. Standing up for others and advocating for betterment is of course not part of sysadmin work but 4/16 of our participants spoke about it. Participants recounted incidents of empathetic bravery where they stepped in when someone was being treated badly. This signifies caring at the level of the community by fostering an inclusive workplace. As reported in Section 4.4, we found that a strong HR department, DEI resource groups, good and clear policies (such as clear processes to address discrimination and tangible objectives for inclusivity) were thought to be necessary in overcoming gender-related obstacles at work. However, previous work has shown that HR departments (since 1980s) are seen as the "compliance cop" or the "double agent" or "smiling assassin" [16] due to their core function being that of protecting the company and being answerable to top-management. This is also demonstrated in a recent example from Uber [31, 43].

Community care can be in the form of an understanding ("emotion-oriented") workplace and solidarity with coworkers. Participants found and sustained supportive and inclusive environ-ments in their workplaces in a bottom-up way and formed a community that persisted through microaggressions, unfairness and harmful messaging from top-management. Sharing experiences and finding a support system through other people of marginalized genders often can lead to a feeling of community and being supported at the workplace, for instance the excitement of having another *"female colleague"* for *"venting"* as shared by a participant. Such a work environment, while highly treasured, is an exception to the norm. In fact when they do find a caring workplace, some

participants reported experiencing a feeling of being stuck. This is because being able to change workplaces is an important aspect in one's career development, i.e., to gain a salary increase or promotion [86], and for participants who finally found a caring and inclusive work place, this creates a difficult situation described by participants as 'feeling stuck'. Due to the dire state of the industry in terms of *good* working environments, they saw themselves in a dilemma between advancing their career to new challenges, and risking to give up the caring environment they found themselves in. Here, we want to make explicit that this is *not* an issue of caring work places, but instead highlights the transitive impact of the hostile environments in *other* companies on career prospects for people of marginalized genders.

5.2 Recommendations for Enabling Sysadmin Work

Here we discuss recommendations for enabling sysadmin work as a) found in related work in the field, b) based on participants' input (presented in Section 4.4) and c) according to authors' insights.

5.2.1 Suggestions based on Related Work (Mainstream vs Feminist).

Mainstream. Prior mainstream qualitative research focused on sysadmin work [7, 23, 87] and similar research provides various recommendations to enable sysadmin work, for example, by designing better sysadmin tools, technical support systems [7, 35] and automation [23] to support the complex and coordinative work of sysadmins. In addition to technical solutions, organizational changes such as blameless postmortems and clarifying responsibilities have been recommended in order to mitigate security misconfigurations made by sysadmins [23]. The book "The practice of system and network administration" by Limoncelli et al. [49] ends with a extensive list of suggestions for "what to do when" (including "fixing the perception of being unprofessional") followed by the "many roles of sysadmins" (including "positive roles" such as "the hero" and "the disaster worrier" and "negative roles" such as "the SA[3] who cried wolf" and "the martyr"). It appears that traditional system administration literature mainly puts the onus on the sysadmins to better their work and/or largely relies on technical support to do so. These suggestions miss the feminist perspective and do not account for the gendered reality of system administration work. Hence they do not address the socio-cultural processes underlying sysadmin work and do little to comment on the issues that need addressing in order to enable this work.

Feminist. Related feminist research (introduced in Section 2.3), provided care-related suggestions for gender-equity in the workplace. For example, Tanczer [81] expressed the critical need for change in the quantitative gender imbalance in the workplace as well as the way in which society talks about gender [81] and Faulkner [28] asserted the desperate need for changing the engineering workplace culture and the understating of gender within it:

> "there is a crying need for sustained, organisation-wide equality and diversity promoting efforts to affect profound 'culture change' in/of engineering workplaces. [...] any such efforts need to challenge stereotyped dualisms – to create space for more plural versions of masculinities and femininities, and more heterogeneous understandings of engineering" [28].

Yoder and Mattheis highlight the value of social/institutional policies in promoting supportive and inclusive work environments but also remind us to acknowledge and allow for different individual expressions in workplaces [93]. Mattheis et al. advocate for increasing awareness regarding diversity of gender and sexuality and specifically, trans-inclusive policies and practices, reasoning that trans individuals are made particularly vulnerable by mainstream practices and expectations [54]. Cech and Waidzunas emphasize the need for STEM domains to address anti-LGBTQ attitudes by including

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[3]System Administrator

LGBTQ status in diversity efforts, providing networking and support opportunities for LGBTQ employees, and ensuring equal access to (in)formal benefits [14].

Research that employed a lens of care (Section 2.2), for example the work of Kocksch et al. [47], argues for the need of care in IT security. They noted that while secure technology may tolerate carelessness, keeping technology secure requires a lot of carefulness [47]. The work of Tseng et al. examined digital security-as-care in the context on Intimate Partner Violence (IPV) by using a model for providing security advice that "incorporates the feminist notions of care into an overall sociotechnical infrastructure for caring" [84]. They advocated for care infrastructures for IT security, specially in the context of high-risk survivors.

5.2.2 Suggestions based on Participant Inputs. Our participants shared their suggestions regarding different ways in which their workplace could be better and more inclusive (reported in Section 4.4). These included care-ful practices like a supportive and empathetic workplace environment, and formal processes that protect against discrimination.

Fostering a supportive workplace. A supportive workplace, according to the participants, is one that is inclusive. It is a workplace where teams are comprised of people from diverse backgrounds and where the working atmosphere is based on mutual understanding, trust, respect, openness and transparency. To create and foster such a work environment, participants suggest hiring from a more diverse pool of people (inclusive of immigrants, disabled persons, marginalized genders etc.) and enabling a working culture that puts people-first (such as via timely promotions, sensitivity towards topics of race/gender/sexuality/disability, being vigilant of one's own implicit bias and prejudice regarding others). Workplaces with relatively flat hierarchies and supportive management that reject outdated traditions (such as solely hiring women secretaries) help in facilitating an inclusive working atmosphere. Additionally, an HR department that truly implements their progressive policies and is supported by the management is seen as important. We elaborate the suggestions regarding processes and policies below.

Having formal processes defined <u>and</u> followed. Having DEI practices and HR policies that uphold equity and protect from discrimination is vital. Often these policies exist on paper but are not well-implemented and followed, if at all. Participants suggest that having tangible goals and metrics to measure progress are necessary to ensure that these policies are rightly followed. Suggestions by Participant P1, for example, are to *"have a clear picture and write it down, what the just and inclusive workplace looks like"* and *"get the data of where you are right now and plan/interact with the employees how you can get to your ideal"*, and use *"data driven analytics with regard to inclusion and social skills"*. To collect this data, Participant P1 suggested to move away from questionnaires/surveys with a 5-point rating/Likert-like scale and a generic comments box at the end. Instead, the suggestion is to move towards soliciting open text inputs for improvement suggestions in specific areas and asking *"detailed questions like "how accessible do you think our workplace is", "what changed for you, if anything, since last time" and "what would help you""* instead of the usual *"how is the work life balance"*.

5.2.3 Suggestions based on Authors' Insights. Finally, based on our observations of the role of care in system administration across genders, we recommend more care for care work and underscore the importance of a feminist perspective as it relates to computer security.

Caring for care work. The invisibility and unawareness of sysadmin work can bring with it an underestimation and underappreciation of this work. This, we find based on participant reports, creates a situation where those performing care work are uncared for. Sysadmins are mostly contacted when someone needs something [44, 49]. This can cause work interruptions, high workload and unrealistic expectations for sysadmin work. We find that if such conditions persist, sysadmins might

experience stress, frustrations, demotivation and other negative effects. Toxic workplaces have been said to enable the BOfH (Bastard Operator from Hell [83]) working culture [17] which is the antithesis of a care culture, specially when it comes to interacting with people. A self-reinforcing circle emerges where the undervaluation of care work on an institutional level increases the frustration of performing invisible care work and leads to BOfH (Bastard Operator from Hell [83]) inspired coping mechanisms, which in turn affect the organizations' interaction with and treatment of sysadmins. However, we hypothesize that a workplace culture of community and care has the potential to disrupt this cycle and maybe even reverse it.

Based on our results and prior literature, we claim that to care for sysadmin work is to recognize the vital contribution of sysadmins in forming the bedrock of modern society, and therefore to visibilize[4] and value this work. In addition, care work tends to be badly accounted for *and* operations-critical, so it becomes that much more important to better understand and appreciate it. However, it is also important to not put the responsibility of this on the sysadmins themselves. Instead, we have to (re)build organizations around a just culture, a culture of care, that enables operators to realize good outcomes, that is, building reliable and equitable infrastructure that supports the needs of people and society.

From Feminism to Computer Security. Our feminist research approach is driven by social justice and it guides us towards creating more just and equitable work environments for sysadmins. In our study we centered the experiences of those who have been marginalized in this domain so as understand from them what an inclusive workplace is/could be like for them. An inclusive work environment for sysadmins, we find, is about recognizing the many invisibilized gendered aspects and care aspects of sysadmin work, to *care* for them by understanding and valuing them and to support sysadmin work as it is done in practice. The matter of an equitable workplace is not only a question of gender. Instead, it is a pre-condition to fulfill the basic requirements for an environment to let just culture take effect (for e.g. in the form of blameless postmortems [23]) and make lasting social changes. Ultimately we believe this is essential to perform secure and reliable systems operations, meaning that a safe and equitable workplace in which people can be themselves contributes to computer security and safety in organizations.

5.3 Limitations

Experiences of people from marginalized genders are not all the same. We engaged with sysadmins who are not cis-men to highlight marginalized perspectives but we did not focus on the differences and nuances between the experiences of people from marginalized genders. The effects described in our findings therefore will vary for individuals. Moreover, much of the related work we present focuses on women only (and not much on marginalized genders), which affects the framing of our work and comparability to earlier work.

Our study also has limitations that are common for qualitative empirical work. Our participant population hails mainly from the Global West. Findings from our sample cannot directly be transferred to a broader population of sysadmins outside of the Global West since the dynamics of men-dominated workplaces may be different. However, men-dominated engineering workplaces are the norm worldwide and hence, our findings can be interpreted contextually.

We remained open to intersectional aspects (intersection of gender with other forms of oppression such as race, ethnicity, sexual orientation, ability, class or age) in our work but did not solicit this information from the participants and neither were we able to identify them during the analysis. This could also be because our participant pool of 16 sysadmins was not large enough to capture the diverse perspectives.

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[4]to make visible something that was previously intangible or invisible to the naked eye [22]

6 CONCLUSIONS

We engaged with 16 sysadmins who are not cis-men via six online focus groups and solicited their sysadmin work experiences particularly through the lens of gender. Using a feminist research approach, we were able to identify and describe the hidden/less understood parts of sysadmin work such as the care aspects and the gendered social processes. From the perspective of marginalized genders (sysadmins who are not cis-men), we reported on how they managed their work in a men-dominated profession (see Section 5.1). They do so by a) being excellent in the sysadmin work that they do, b) *doing gender* in the form of performing extra work to establish their professional identity and constantly taking gender considerations into account, and c) finding and creating community in their workplace.

In addition to the care work that we discussed in Section 2, we found that care aspects are present in other ways, such as empathy for people (both users and/or coworkers) and communication skills or 'soft skills' in the form of care practice, looking out for each other in the form of community care and the lack of care for care workers. We identified community care and support as an important way of managing work in a men-dominated work environment. As for the role of gender, we found that gender is deeply intertwined in sysadmin work and observable in the form of doing gender identity work and practitioner identity work.

We know that "there are no technical solutions for social and societal problems" [29] and we cannot hope to enable sysadmin work only through technical means, especially when a major part of this work is social. Traditional research that qualitatively examined sysadmin work generally proposed technical solutions and sometimes social changes. However, in order to truly capture the social dimension and do so equitably, we must employ a feminist lens. We highlighted this by comparing suggestions for enabling sysadmin work by mainstream sources to feminist sources (see Section 5.2.1). Overall we find that sysadmin work, especially the care aspects should be more cared for by being better recognized, understood and rightly appreciated. Finally, yet importantly, we discover that the feminist lens of care can ultimately contribute to increased computer security and safety in organizations by shedding light on the invisibilized care work and emotional labour, which are a significant part of the participants' sysadmin work, and hence fostering a just culture in the workplace.

Future Work. Future work should investigate the similarities, differences and nuances between the experiences of people from marginalized genders not to enforce 'one size fits all' solutions. Similarly, it should also delve into the intersectional aspects by understanding how other factors of identity, such as race, class, or ability play a role. Finally, in line with employing feminist approaches, future work should investigate sysadmin work through a technofeminist lens [18] by further exploring intersections between gender, capitalism, and technology and technological infrastructures.

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A INFORMED CONSENT FORM

We supplemented the informed consent form with the code of conduct (see Figure 1 in Appendix C) for the study and a brief project description (see Appendix B). We also solicited participants' information in this form: job title, job sector, job country, years of experience and gender. We shared the consent form with the participants when they expressed interest in participating and asked for further information about the study. The participants had to choose a yes or no box for each of the items listed below and sign the consent form.

Taking part in the study

(1) I have read and understood the study information (in this form) dated DD/MM/YYYY, or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.

(2) I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.

(3) I have read the 'code of conduct for the focus group' (next page) dated DD/MM/YYYY or it has been read to me. I have been able to ask questions and my questions have been answered to my satisfaction.

(4) I understand that taking part in the study involves participating in three focus groups via texts which will be recorded.

Use of the information in the study

(1) I understand that information I provide will be used for scientific reports and publications.

(2) I understand that personal information collected about me that can identify me, such as my name, email or gender, will not be shared beyond the study team.

(3) I understand that I can request access to and rectification or erasure of my personal data.

(4) I agree that my information (such as the text messages) will be anonymously stored for analysis and can be anonymously quoted in research outputs.

Future use and reuse of the information by others: I understand that once the research project is over (estimated end date DD/MM/YYYY), all my information (personal and anonymized) will be deleted within 1 month after the project and only aggregated metadata will be archived.

B PROJECT DESCRIPTION IN THE CONSENT FORM

The issue: STEM fields continue to be dominated by cis men (and a masculine culture) and people of other genders commonly face barriers to enter and remain in the field. Similarly in the field of system and network administration, gender diversity remains a goal with a long way to go and most existing scientific literature does not take gender into account.

Our study: We aim to address this knowledge gap by engaging with a group of sysadmins who are not cis-men. Through an online focus group we will gather your experiences and views in regards to your system administration work. Our findings will highlight the diverse perspectives in the sysadmin community. These are important for moving towards a more gender-inclusive and just work environment within the field.

Your participation: You will participate in one online focus group meeting which will take place on a self-hosted web-based IRC service and will last about 90 minutes. These meetings will be scheduled in consultation with you and the other participants. Each meeting will contain 3-4 participants. We will do our best to ensure that your anonymity is maintained when participating in these meetings, throughout and after the research process.

Researchers: The focus groups will be facilitated by one PhD researcher (myself). I am interested in feminist research approaches and am investigating the human aspects of system operations. A second PhD researcher will assist.[5]

C CODE OF CONDUCT

Code of conduct

1. The topic will be revealed during the focus group meeting.

2. One PhD researcher acts as a neutral facilitator and a second PhD researcher assists.

3. You can respond directly to the discussion topic and to other participants' messages. You can also respond in the group chat after the meeting in case you think of something later (in the next 2 weeks).

4. You can ignore a question if you do not feel comfortable in responding.

5. You can leave the group if you feel uncomfortable or do not wish to participate anymore.

6. We reserve the right to remove anyone from the group in case of the following:

    a. Disrespectful communication towards others in the group

    b. Verbal or written abuse towards others in the group

    c. Bullying or intimidation

    d. Harassment or discrimination (gender, racial, sexual etc.)

Fig. 1. Code of conduct for the online focus groups

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[5]We included the names and affiliations of all the authors in the consent forms.

D INTERVIEW PROTOCOL

First, the code of conduct (see Figure 1 in Appendix C above) was shared in the group chat. Next we introduced the facilitators using our names and pronouns and asked the participants to introduce themselves without names by sharing

- brief description of your day-to-day work,
- your work experience in years and
- gender distribution of the team within which you work.

We then encouraged the participants to interact with each other during the focus group (for example, by agreeing or adding to each other's comments) by explaining that it would be helpful for the research if we build on each other's experiences and have discussions. The focus groups lasted 90 minutes and we planned to spend around 30 minutes per each **main question**. The list of sub-questions accompanying each main question helped us navigate the group discussions without straying too far from our research topic.

(1) **What do you find easy to do in your work? And why?**
   - What do you feel enabled to do?
   - What enables you?
   - (if gender not mentioned) What is the easiest part of your work considering you work in a cis-men-dominated field?
   - What social, organizational or environmental factors enable you to do your work?
   - What made work and stay in this field/job? What makes you feel welcome?

(2) **What do you find difficult to do in your work? And why?**
   - Examples of the kind of difficulties?
   - Why do you think these obstacles exist? Your reasoning?
   - (if gender not mentioned) Do you face any obstacles considering you work in a cis-men-dominated field?
   - (if gender not mentioned) Have you had any negative experiences considering you work in a cis-men-dominated field?
   - How do these obstacles affect your work?

(3) **How do you overcome the difficulties you face at work?**
   - What social, organizational or environmental factors help you to overcome obstacles you face in your work?
   - What help (if any) do your get from your workplace?
   - (if gender not mentioned) Are there any measures in place to address your needs at work considering you work in a cis-men-dominated field?
   - What would you do/change to make your work better (for a more just and inclusive workplace)?

In the end, we thanked the participants for sharing their experiences and volunteering their time. We invited them to share any final comments and reminded them that the chat forum was open for the next two weeks in case they thought of adding any more comments.

E IMAGE SHARED BY A PARTICIPANT DURING FOCUS GROUP 4

The following image was shared by Participant P9 to illustrate what it is like to coordinate with several stakeholders and to *"get them all to the same picture"* (P9). Interestingly, variations of this image have been around since 1970s [59] in reference to the project management culture in the IT domain commenting on intra-organizational and inter-departmental communication, and client interactions.
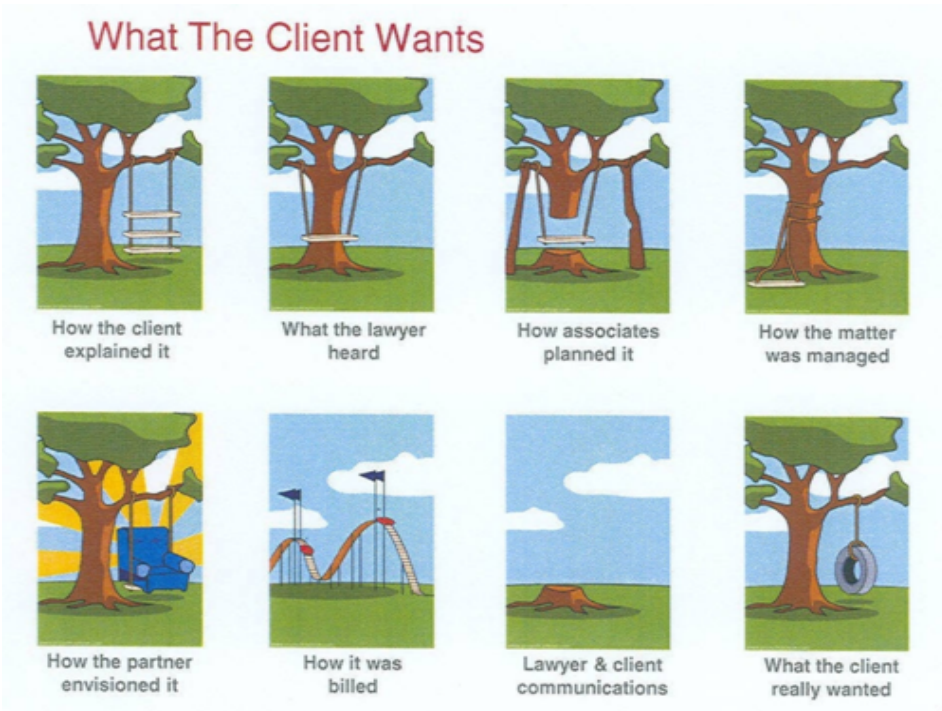

Fig. 2. Image shared to illustrate the experience of working with several stakeholders [85]

F CODEBOOK

Table 2. Overview of our code-book.

Nature of Work

Team gender distribution	16	Fulfill many roles	5	Difficulties of tech/startup culture	2	Engaging with users is key	
Technical work is easy/easier	12	Coordination related tasks in sysadmin work	4	Communication with users is easy	2	Easier to work with younger people	
Socializing with cis men	12	Less women in sysadmining (vs. UX/UI, dev, webdesign)	4	Flat hierachies lead to autonomy in sysadmin work		Experience makes sysadmin work easy	
Gender affects sysadmin work	8	Sysadmin processes ignored by organization	3	Sysadmin work can be lonely		Self-taught sysadmin	
Support tasks in sysadmin work	7	Hierachy in sysadmin work: Hard to say no to seniors	3	Dealing with many stakeholders		Changing jobs may often contribute to unchanging workplace conditions	
Sysadmin work job description	6	Flat hierachies enable sysadmin work	2				

Care Aspects

(Lack of) community support in the workpalce	19	(Lack of) care culture in IT	4	Identity and empathy	3	Empathy and user communication	

Visibility Aspects: *Gender Visibility Impact*

Strategies to cope with sexism	22	Negative effects on health	7	Strategies to overcome gender bias at work	3	Less gender in remote work	
Sexism in the workplace	12	Coping strategies affect sysadmin work	6	Takes longer to do tasks	3	Less socializing in remote work	
Lack of respect due to gender	12	Involuntary trail-blazer	4	Not wanting to ask for accomodations	2	(in) effectiveness of coping	
Having to do extra due to gender	11	(Negative) effects of extra work	4	Gender and social skills	2	Misgendering non-men sysadmins	
Having to prove oneself to others	10	Power of choosing where to work	3	Hard to speak up about needs			

Visibility Aspects: *Invisibility in Sysadmin Work*

Experience provides visibility	2	Sysadmin work s undermined			

Routine Tasks

Workplace better than others	7	Why stay in a men-dominated field	6	Space for low motivation in a fast-paced productivity culture	2	Performative inclusion in the workplace	
Process for gender equity	6	Just culture	2				