Gender Inclusivity in Online Question and Answer Communities: Investigating Community Member Practices and Perceptions to Work towards Equitable Interfaces

by

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Abstract

Online Question and Answer communities (Q&As) are one resource that people use to learn complex, feature-rich software, such as graphic design software. Community members, both learners and experts, collaboratively create a knowledge base by authoring content in the form of questions and answers. Q&As benefit from a variety of users drawing from their experiences to contribute content, and the users themselves can grow professionally and personally by participating. However, Q&As might not be fully inclusive, with certain user groups not participating to their full extent. As a result, Q&As may be missing perspectives, content may become biased, and users may miss out on opportunities.

In this thesis, I investigate how Q&As appeal to people of different genders, and how interface design affects people's perceptions of, and participation in Q&As. I analyze content of two live Q&As for gender differences in who contributes and in what content is preferred. I interview users to understand how they currently perceive Q&As, and to identify how motivations and deterrents to participating differ between genders. Finally, I conduct a task-based field deployment study using prototype Q&A interfaces to see how people of different genders use and perceive additional community presence information.

I find that current graphic design Q&As appeal less to women than they do to men: women participate less frequently than men do; women appear to prefer content which is less valued and often discouraged; and women receive less validation for their contributions than do men. The findings suggest ways to make Q&As more gender-equitable communities. Adding community presence information, as well as social considerations to a Q&A interface design seem to promote a more inclusive and humanized environment, which is more welcoming to women. Despite these positive effects, some participants are

uninterested in community presence information, seeing these design changes as unsuitable for Q&As' purposes and which may implicate privacy concerns. Nevertheless, there is potential in these interface design revisions to promote more gender inclusivity in Q&As.

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Publications

Portions of this thesis have been published in conference proceedings, either previously or forthcoming at the time of publication of this thesis. Permissions for these publications to appear in this thesis have been granted by their publisher. The following is a list of publications that appear in this thesis, organized by chapter.

Chapter 3 and Chapter 4

Patrick Marcel Joseph Dubois, Mahya Maftouni, Parmit K. Chilana, Joanna McGrenere, and Andrea Bunt. 2020. Gender Differences in Graphic Design Q&As: How Community and Site Characteristics Contribute to Gender Gaps in Answering Questions. *Proceedings of the ACM on Human-Computer Interaction* 4, CSCW2, Article 113 (October 2020), 26 pages, https://doi.org/10.1145/3415184

Chapter 5

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Chapter 1

Introduction

Online communities have become popular spaces for learning and troubleshooting complex feature-rich software (e.g., graphic design software, 3D modelling applications, statistical analysis packages) [48]. These communities offer rich learning materials, such as guidance for accomplishing tasks with screenshots and videos, tips on adapting workflows to different software versions, and sometimes even resources tailored for users with unique application needs and skill levels. Importantly, online communities can offer benefits to content authors as well as to content consumers. For authors, in addition to the intrinsic rewards of helping other community members, participation is an opportunity to showcase skills [147,215] and can open informal networking opportunities that can be useful for advancing one's career, as recruiters look at these communities to find experts to hire [52,175,222,223].

Given the benefits of these online feature-rich software communities, it is not surprising that designing and evaluating how well they support users is an active area of research. Many studies explore various knowledge-sharing formats, such as external tutorials [68,147], comments to tutorials [17,43,101], in-software help content [27,121], command recommendations [103,122], and creative livestreams [61]. What is surprising, however, is how little we know about those who are currently contributing their knowledge online and about how Human-Computer Interaction (HCI) as a field can better support diverse users

and content generators. Identifying people who are not contributing and creating more appealing communities might encourage them to contribute, allowing them to benefit from the potential advantages mentioned above. Furthermore, the communities themselves would include a greater variety of content, which might otherwise be at risk of only being of interest to majority groups [36,155] and of containing biased perspectives [205]. The advantages of supporting all content authors illustrates the need for HCI researchers to understand contributors' characteristics explicitly as part of developing inclusive online communities.

One such contributor characteristic is gender. I investigate how software learning resources and their communities appeal to people of different genders, how some genders might be underrepresented, and how can interface design be used to work towards greater gender inclusivity. In light of the above, if people of different genders are not participating equitably in knowledge-sharing for using feature-rich software, the materials produced might be less diverse than they could be, and some will miss out on important networking and career advancement opportunities. Ultimately, studying the experiences of people of different genders and their interactions with technology will produce insights that contribute to more inclusive designs [18,72,204].

Online software learning communities can take many different forms. For this thesis, I study gender as it relates to Question and Answer communities (Q&As). Q&As are online platforms where users can ask and answer questions about a diverse range of topics, including languages, gardening, programming, travelling, and playing games. Users provide feedback on questions and answers in the form of comments, as well as by voting mechanisms that promote useful content. Together, these components shape learning resources. However, I am particularly interested in those Q&A topics where using complex software is a significant component, such as when users ask for help, resources, examples, opinions, etc., to learn software. These Q&As therefore have two notable properties: they are technical resources for improving software learners' skills, and they are environments where users interact with each other to produce and promote useful questions and answers (e.g., [176]).

One topic with significant software usage is graphic design. There are many popular complex graphic design programs, such as Adobe Photoshop, Adobe Illustrator, GIMP, Inkscape and Sketch. These software are very well-known and some are freely available, making them accessible to a wide professional and hobbyist audience. Their ubiquity and popularity mean that many people seek help learning them [59], ensuring that there is a wide range of content and users available for my investigation – questions, answers, askers, and answerers in the case of Q&As. For HCI researchers, graphic design software have also become a canonical example of complex, feature-rich software (e.g., [17,25,46,60,93]).

To summarize, online communities offer rich software learning resources, yet these communities may not appeal to all potential users and contributors. As contributing content brings significant benefits to both contributors and the communities, it is important to ensure that everyone is well-supported. As a step towards building more inclusive communities, the focus of this thesis is on how Q&As for graphic design software appeal to and better support people of different genders.

1.1. Research Questions and Approach

The goal of this thesis is to investigate gender differences in use and perceptions of graphic design Q&As and how Q&A interface design can impact these differences. I approach this goal through three major components. First, I study current behaviours and content preferences in Q&As; then, I investigate how people currently perceive Q&As and motivations and deterrents to contribute content; and finally, I explore how a novel interface design may impact user behaviours and perceptions. Specifically, I answer the following research questions:

1. How are people currently participating on graphic design Q&As? Are there differences between men and women? Are there any differences between graphic design Q&As with different characteristics?
2. How do men and women currently perceive graphic design Q&As? What do they see as motivations and deterrents to participation?

3. How do people of different genders use and perceive a novel graphic design Q&A with additional community presence information? Do users perceive Q&As to be more inclusive environments because of community presence information?

To answer the first research question, I conducted a content analysis of two popular graphic design Q&As. I collected approximately 330 answers submitted by content authors. Using a combination of manual inspection and validated tools to resolve author gender, I then compared content using quantitative and qualitative methods to uncover potential gender differences. To explore if community characteristics, mechanics and social norms could impact any gender differences I observed, I also compared the content from the two Q&As. I describe my method and results in detail in Chapter 3.

The analysis provided information about what people do in Q&As, and differences between people of different genders and between Q&As. To gain insight into why these differences occur and to answer our second research question, I conducted an interview study. I recruited 24 men and women graphic designers for semi-structured interviews. I asked them to share what they see as motivators and deterrents to participating in Q&As. I analyzed the interviews qualitatively to identify any gender differences. Chapter 4 describes the details of the interview study.

I then used the findings from the content analysis and interviews to inform novel interface designs factors to examine if design change can influence participation and perceptions. As I describe in Chapter 5, I created two prototypes with additional community awareness information. I used these prototypes in a ten-day task-based field deployment study with 30 participants to answer my third research question. I collected usage data, post-interface questionnaires and post-study interviews, and analyzed them quantitatively and qualitatively. The findings consider whether community presence information is a promising design factor that can encourage participation and gender equity.

Similar to most prior work in gender HCI, my first two studies only speak to gender differences between men and women. To work towards increased inclusivity, I also sought non-binary participants for the third study.

1.2. Summary of Contributions

This thesis provides empirical contributions in the form of three studies: a content analysis, an interview study, and a task-based field deployment study. I show that there are gender differences on graphic design Q&As, in the form of participation gaps and in types of content submitted and appreciated. I uncover motivators and deterrents perceived by Q&A contributors, and discuss how community presence information may promote more gender-inclusive Q&As.

I also contribute two artifacts in the form of two prototype Q&A interfaces with additional community presence information, which I used to investigate how users perceive and are affected by such information when using Q&As.

1.3. Reflexivity Statement

A significant portion of this thesis uses qualitative and/or subjective research methods, therefore, I would like to briefly acknowledge how my background played an important role in interpreting the findings and conducting the studies [149].

At the time of writing this thesis, I am a 29-year-old man who has studied computer science for almost 12 years. I have witnessed first-hand, throughout my academic and industry experiences, how computer science has a severe gender imbalance with a masculine culture, which, in part, motivates me to study gender HCI.

I am also a Franco-Manitoban Métis active in both Franco-Manitoban and Métis communities, which find themselves in a majority Anglophone, non-Indigenous environment. Until adulthood, I only regularly spoke in French (both at school and at home). When I started my studies at the University of Manitoba, where English is the language of instruction, I had to adapt my language and thinking to be able to succeed. Outside of university, I have been directly discriminated against for my heritage and have heard many similar stories from friends and family. Having these experiences encourages me to use my position to contribute towards building inclusive communities.

In this thesis, I investigate how people use and perceive Q&As. Although I am not an active contributor, I regularly use Stack Exchange, one Q&A we investigate. I use it both to find

specific questions (it is a very popular resource for programmers and was an invaluable resource when I was implementing the prototypes in Chapter 5), and to browse questions of various topics. I try to keep up to date with the culture and development of Stack Exchange. I also occasionally use Quora, the other Q&A I investigate, but am not as familiar with it as I am with Stack Exchange. As I consider both of them to be valuable learning resources, I believe it is important to make them more inclusive.

Other people have also brought their own perspectives to my interpretations of the data. Men and women HCI and sociology researchers with various backgrounds have offered feedback to help ensure the research remained sensitive and appropriate throughout. For example, while analyzing interviews, four women of various ages and cultural backgrounds provided input that led to the themes that I describe in Chapters 4 and 5.

1.4. Thesis Outline

Chapter 2 presents background on the state of gender research in HCI, as well as prior work related to my approach to answer the research questions. Chapter 3 describes my content analysis of two graphic design Q&As; Chapter 4, my interview study with people who participate in one or both graphic design Q&As; and Chapter 5, the task-based field deployment study using my prototype Q&A interfaces with additional community presence information. In Chapter 6, I reflect on my findings and approaches used in my studies, offering considerations for future research based on what I learned. I summarize this thesis in Chapter 7 and discuss potential avenues for future research.

Chapter 2

Background and Related Work

In this chapter, I first offer a brief background of the current state and challenges of gender research in HCI to contextualize this thesis. I then overview prior research on gender in online communities, as well as on the motivations and deterrents to participation in online communities.

2.1. Research in Gender HCI

The field of HCI has long recognized the value of considering gender when investigating technologies, with some work dating from at least the 1980s (e.g., [82]). There are many motivations for considering gender diversity and inclusivity in HCI, including for economic purposes (women represent a significant portion of the market [181]), political causes (such as advancing feminist movements (e.g., [8])) and ethical reasons (it is simply the right thing to do) [187]. Examples of gender-sensitive HCI work include uncovering gender inclusivity issues in interface and interaction design (e.g., [171,204]), identifying gender gaps in executing research (e.g., [141,159]) and investigating how technology can empower people facing gender discrimination (e.g., [131,169,184]). Despite advances and continuous interest in gender HCI, the field continues to face challenges as it matures in a social and cultural environment where systemic discrimination persists.

Developers, designers and HCI researchers often assume the systems they create are gender-neutral [214], but unintentional and implicit biases often lead to designs advantaging men [33]. One example is the fact that HCI and related vocabulary is often perceived to be masculine despite being grammatically gender-neutral [15]. This creates a cycle between excluding people of other genders [9], and strengthening negative perceptions of technology [187]. Tools such as GenderMag [19] exist to help developers be more cognizant of gender in their designs, but the continued biases occurring in interface design and software development highlights the ongoing need for HCI researchers to continue to explicitly study gender in all domains.

A second challenge that HCI faces is how it treats and presents gender. For one, most HCI research treats gender as binary [91], so most prior work I reference speak exclusively about men and/or women, and if not, often *others* people who do not identify as men or women [170]. To be fully inclusive, not only men and women should be considered in gender research, but also individuals who identify as non-binary, as well as those who use multiple terms to describe their gender identity. Furthermore, gender vocabulary is inconsistently used in HCI research [58,92,141] and beyond [66,114], for example, by conflating sex with gender by interchangeably using terms for male/female sexes with masculine/feminine genders.

Cognizant of these challenges and motivated to support better gender-sensitive HCI research, I wrote this thesis and conducted the research with every effort to use inclusive methods and accurate language. Based on recently-published guidelines for conducting and reporting gender HCI research [20,91,165,170], I let participants self-report their gender and actively sought participants who are non-binary. When discussing prior work that is clearly about gender, I use man/woman regardless of the terms the referenced publication uses. In this way, I aim to contribute an example to conducting gender HCI research inclusively and according to maturing and evolving guidelines.

2.2. Gender Differences in Online Communities

Recent work on gendered participation in online communities has produced nuanced findings, which collectively suggest that how men and women contribute differs according

to the nature of the community and domain of knowledge (e.g., [105,129,144,155,200]). Given that Q&As are meant to be knowledge bases and to provide social interaction, I summarize prior work that has studied gender differences in online communities that fill one or both of these roles.

Wikipedia is a well-known open encyclopedia reflecting the perspectives and knowledge of its contributors and has thus received much attention from gender researchers. Research finds that both its contributors and its knowledge content have issues regarding gender balance. Fewer women make edits to articles than men [5,105], but the women who do contribute tend to make longer revisions. Prior work has suggested a number of factors that contribute to differences in participation. Hargittai and Shaw have found that internet skills (which they measure by years of internet usage, autonomy of usage and frequency of usage) is a strong predictor of level of contribution on Wikipedia, where more skilled individuals are likelier to contribute; yet, on average, women have lower such internet skills [75]. Menking and Erickson describe how women Wikipedians have to engage in emotional labour to participate in Wikipedia's environment [126], and Menking, Erickson and Pratt describe how women must develop techniques to navigate and edit Wikipedia safely [127], efforts that might deter some from becoming contributors.

Research has found that what knowledge content is shared also has a gender bias. When comparing Wikipedia and Encyclopaedia Britannica, Reagle and Rhue found that although coverage of articles about men and women on Encyclopaedia Britannica is unbalanced, it is even more so on Wikipedia [155]. In direct contrast to these findings are Wagner et al.'s results, where they found that, on Wikipedia, women are potentially overrepresented compared to men in number of articles [205]. As the latter research is more recent, it could be possible that efforts to address this gender gap have been succeeding and that we should continue working towards building inclusive communities. However, Wagner et al. have also found that articles about women emphasize that they are women and tend to focus on their relationships with men, but not vice-versa [205]. This is not just a problem with Wikipedia: similar results have been found in another open knowledge base, OpenStreetMap. More men contribute to the database [185], and on average, somewhat in contrast to the Wikipedia imbalance, men contribute knowledge about feminized spaces

more frequently than women and vice-versa [36]. Therefore, given the fewer women contributors overall, there is less knowledge shared about masculinized spaces. These two examples illustrate how gender imbalances in the community impacts what knowledge is being shared.

In socially oriented websites, such as blogging and discussion groups, findings are more mixed. Although no gender-specific preferences for methods of online communication and relationship building have been found [193], there are platform- and domain-based differences affecting men and women's objectives and levels of engagement. In blogging, women tend to favour the social aspects and use the activity as a creative outlet; men are more interested in opinions and information, while both see blogging as a leisure activity and find similar levels of satisfaction [144]. When video blogging, women create more blogs about personal matters, whereas men focus more on blogs about entertainment, public issues and technologies [129]. Women interact more with other bloggers, for example by asking for topics that they should cover in their own blogs, than do men [129]. Conversely, in online travel communities, women attach more importance to entertainment and enjoyment [207]. In cancer communities, women post more frequently than men, and in particular, share more messages about emotional support, while men are more likely to answer questions [65].

Q&As, the focus of our work, have both encyclopedic and social elements. Gender differences in Q&As have been studied from a variety of different perspectives, including Q&A usage, content contributed, and received validation. Looking at Q&A mechanics usage, more men than women post content [200], and men post [123,200] and use upvoting and downvoting mechanisms [221] more frequently than women. Analyses of archival data suggest that content-wise, men write longer answers, receiving more feedback than women as a result [162]. Men are also more willing than women to "play the game," authoring content likeliest to increase their reputation scores [200], while based on words used in authored content, women have a more cooperative than competitive attitude, as well as a supportive and collective outlook of the community with the aim of improving everyone's knowledge (using collective language like "we" instead of "I" and positive and encouraging words) [221]. Finally, in terms of validation, men earn more reputation points

than women do [99,123,200]. Men are also likelier to receive upvotes based on the perceived competence of their posts and their popularity, while women tend to receive upvotes only based on their existing popularity [162].

Based on prior work, it appears that women tend to contribute community-oriented content. Men tend to ask more informational questions (those that are factual in nature, e.g., How can I unlock a layer?) while women ask more conversational ones (those that are opinion-oriented, e.g., What are your favourite techniques to retouch a portrait?) [64], and it appears that women are more apt to engage in discussions compared to men [221]. Linguistically, women use positive and encouraging language, while men tend to be neutral [99], women use more inclusive and team-oriented language [221], and women display more emotion through the use of emoticons [53].

In short, it appears that Q&As have stronger appeal among men and men appear to gain more advantages from participating compared to women. This prior work, however, has often focused on gender impacts of technical contributions in fields where men are the majority (e.g., [57,123]) and of non-technical contributions where gender ratios are balanced (e.g., [129,207]). My investigation of graphic design software Q&As is different in two important ways. First, feature-rich software is a cornerstone of graphic design, and knowledge in this field comes in various forms, from technical software tips, to ways to achieve creative outputs, to opinions on different workflows [26,97,102]. Second, the graphic design field has a relatively balanced number of men and women [182], which generates interesting insights about participation rates in comparison to the more common phenomenon of domains with more men, such as programming [200], where men far outnumber women [182] (there is evidence that people in gender minority situations participate differently than when they are in the majority group [31,196,210]). I thus investigate communities where the knowledge sharing has both technical and non-technical components, and where men and women are at least present in the field in similar numbers.

To summarize, prior work has found that men and women exhibit differences in rates and types of participation as well as in content generation, and these participation and contribution differences vary between and within types of communities and over time. This emphasizes the need to study gender differences in more sub-fields, and as they develop. I

extend this work by studying the gender gap in graphic designers using Q&As to share feature-rich software knowledge – a field with similar numbers of men and women using platforms for technical knowledge and opinions. Like all of the work referenced above, I first examine contributions from a binary perspective of men and women.

2.3. Motivations and Deterrents to Participating in Online Communities

General motivations to share information on different platforms (e.g., Q&As, online discussion forums, product/service review sites), or lack thereof, has received much attention in prior work. Research has identified a number of motivation aspects, involving both intrinsic and extrinsic motivation [117,134,151]. Intrinsic motivation leads to altruism, learning opportunities and claiming personal ownership, while extrinsic motivation focuses on raising status, accessing restricted information, and obtaining financial rewards [81,120]. Informed by this previous research, Sun et al.'s model identifies four aspects affecting a person's willingness to contribute online with associated deterrents [188]: community factors [98,138], individual factors [138,160,192], commitment factors [133,153], and site quality factors [42,138].

One social factor I investigate with respect to its role in motivation is social presence and awareness (SPA). SPA is the idea of community members being mutually aware of each other and their activities: it is the "reciprocal awareness of others of an individual, and the individual's awareness of others within an interactive social space" [35]. In HCI, the idea of enhancing SPA has been used in various ways. It includes work such as feeds [51,76], alerts [112] and parallel interfaces [197,220] to keep people aware of community activities and project progress. Enhanced SPA tools encourage user engagement and other positive social behaviours, including motivating active participation. For example, teacher activity dashboards increase social interactions between peers [128], online shoppers' engagement with a task increases when aware of collaborators' activities, [211] and learners' awareness of knowledge sources and communities as well as they engagement are increased when using social network visualizations [168]. In contrast, poorly-used or presented SPA information can reduce work quality [49,172], emphasizing the need to develop and study implementations specific to community characteristics [128]. Although research on

motivating factors for participating in online communities spans many domains, I focus on the work studying online Q&As.

To encourage quality contributions from users, reward and reputation mechanisms exist on many Q&As. These features have been described as crucial for motivating knowledge sharing behaviour [83], but research of Q&As adopting such systems have found that it is not that simple. For Q&A users, reputation is not as important as their rank relative to other users [212] and they will try to earn as much reputation as possible in a day to compete [120]. In addition, receiving thanks from a question asker seems to be more motivating when it affects a leaderboard [94].

Other studies about motivations in Q&As have taken a more nuanced perspective. Motivations can evolve over time, especially as users transition into different roles in the community [63]. Research shows, for example, that gamified elements, such as badges, can stimulate initial participation [23], but that enjoyment of helping others is a strong motivator once a user starts actively participating [50]. Similarly, users with higher levels of expertise [190], and even professionals [218], answer simply to help others, even though they may have less time to answer questions [134], whereas other users have stronger extrinsic motivations, such as improving their reputation and expecting reciprocity [218]. This is supported by work done outside of Q&As, which found active and expert users simply enjoy helping others, and that others had expectations from the community in return when they participate [104,209].

The relationship of extrinsic and intrinsic motivations for participation in Q&As has also been studied. Extrinsic rewards, such as receiving virtual rewards, undermine intrinsic motivations, such as enjoying helping others [219]. For example, adding market exchanges to a Q&A (i.e., the question asker must pay for answers) negatively affects community attachment [81], with similar findings outside of Q&As as well [4]. Even when non-monetary rewards (such as advertising extra reputation points for the best answer) are offered, questions receive fewer answers, although the asker's chosen "best answer" is posted sooner [28].

One social motivator for participating in Q&As, particularly among women, has been described in prior work as peer parity [55], more generally known as homophily: the

phenomenon describing people's preference to interact with other, similar individuals [108]. Homophily has long been known to exist in various environments, including affecting elections [107], farmers [14], students [136], and more recently, MySpace users [194], Wikipedia editors [85], and online forum users [84]. Homophily can have multiple impacts. Wikipedia, Stack Overflow and Epinions users give higher evaluations to users or content authors similar to themselves [3]. In a commercial setting, consumers of online stores have higher levels of trust for product descriptions written by similar users as opposed to other user- or brand-generated content [109]. Specifically with Q&As, women tend to answer questions asked or already answered by other women [55,130], are likelier to view questions or upvote answers to questions asked by other women [53] and generally tend to interact with women more than men [16]. Communication between two people who share characteristics is more effective: with similar experiences and knowledge, less time is spent trying to understand one another [158]. It is no surprise, that community leaders, event organizers, developers and others therefore create opportunities for encouraging homophilic behaviour to take advantage of these effects. For example, icebreakers [41] and robot characteristics [164] have been used to build more productive relationships by highlighting similarities between activity participants, however, explicitly prompting homophilic responses has not been investigated in Q&As.

Prior research has also identified deterrents to participation in Q&As. As one might expect, if a user does not know the answer to a question, they are less likely to participate [37,209]. Active users sometimes choose not to answer questions out of concern of how the question asker will react, how their answer will lose meaning if too many other answers are posted, or because they are not familiar with the question topic [37]. The length of the question also seems to affect how many answers it will get; on an academic Q&A, long questions lead to fewer answers [40], while on a generic Q&A, the opposite was found [115]. Privacy concerns also affect users' behaviours, where increased anonymity might be more appealing and encourage higher-quality contributions and increased user retention [6,89]. I add to this research by looking at the impact of gender on deterrents to contributing to graphic design Q&As.

In summary, community reward mechanisms meant to encourage participation do not have their intended effects in all cases (in particular, among women, as seen in the previous section) and that there are many factors affecting motivations to contribute knowledge to Q&As. I add to this body of research by providing insight into patterns of participation and contribution by both men and women in the domain of graphic-design software and follow up by investigating how interface design, in particular, additional community presence information using SPA and homophily, can be used to foster inclusive community dynamics by motivating participation.

2.4. Summary

Prior work investigating gender and online communities have found significant gender differences in participation and content preferences. Different motivators to encourage participation have been explored, but they do not appear to appeal to people of underrepresented genders. This prior work has mostly focused on technical content with heavy presence from men, or non-technical content with similar numbers of men and women.

I contribute studies with technical Q&As about topics with similar numbers of men and women practitioners and investigate how gender differences may manifest themselves in this different environment. I then use SPA and homophily, which have shown benefits in other areas, instantiated as community presence information in a Q&A, to see if people are affected and if perceptions of Q&As change.

Chapter 3

Investigating Current Practices in Q&As

Q&As are valuable online communities for graphic design professionals and hobbyists to share and learn software knowledge. There is a large body of research studying how interface design can be used to help create and consume software knowledge content (e.g., [17,27,122]), however, little is known about the characteristics of content contributors and how their content is appreciated by Q&A readers. For instance, in the context of gender, do people of different gender identities participate at different levels, does their content receive different levels of validation, and are there any differences in content preferences?

To answer these questions, I conducted a content analysis of two popular Q&As used by graphic designers, Graphic Design Stack Exchange and Quora, to provide ecologically valid insights into gender differences in participation. I analyzed two Q&As with different characteristics to examine if content and community preferences differ between them (in addition to differing by gender). I analyzed the content of answers collected from both Q&As according to a range of metrics, including length, linguistics, and type of content; I measured how the community showed appreciation for answers by assessing scores and their authors' reputations. My investigation of the current state of software knowledge Q&As, finds gender differences in participation, with indications that Q&As seem to have stronger appeal among men.

In this chapter, I describe Stack Exchange and Quora, my methods for sampling and analyzing content from these communities, and the findings of my content analysis. This work, combined with the work in Chapter 4, was presented at the 2020 ACM Conference on Computer-Supported Cooperative Work and Social Computing (CSCW'20) and appears in the Proceedings of the ACM on Human-Computer Interaction, Vol. 4, CSCW2, 2020 [45].

3.1. Characteristics of Stack Exchange and Quora

For comparison purposes, my content analysis involved two communities: Quora (Figure 1) and Graphic Design Stack Exchange (SE) (Figure 2). In this section, I describe some of their key characteristics.

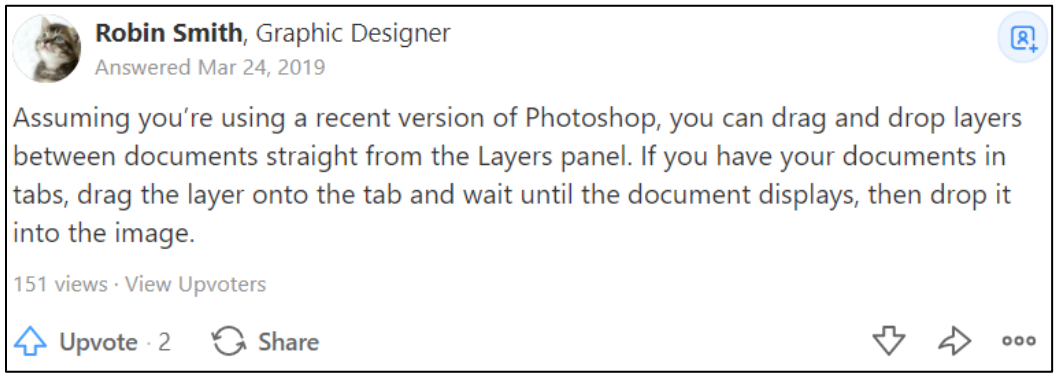

Figure 1: Screenshot of an answer on Quora. The answer author with their qualifications are at the top (pseudonymized for this thesis), followed by the answer content, and then the buttons for voting and sharing. The answer's score is displayed beside the upvote button (2 in this case). The downvote button is on the right side.

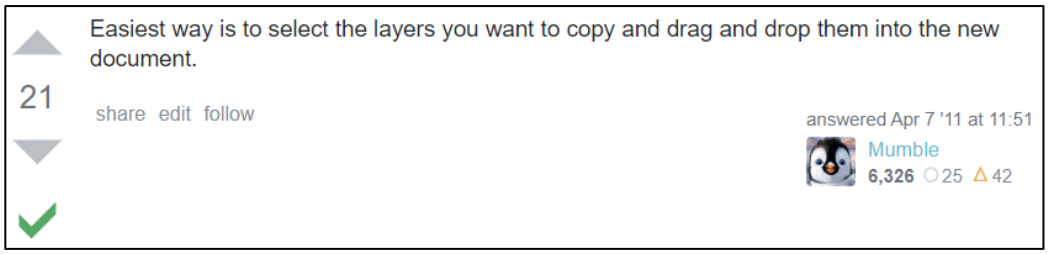

Figure 2: Screenshot of an answer on Stack Exchange. The answer content is in the center, the answer's score (21 in this case), voting buttons, and a green checkmark indicating it is the accepted answer are to the left, and the author is in the bottom right corner (pseudonymized for this thesis). Below the author's name is their reputation score (6,326) and the number of badges earned (25 silver badges, 42 bronze badges).

Quora is a general-purpose Q&A; every subject potentially has a *topic* of questions available. A user will see content from topics to which they subscribe. In 2019, Quora's stated gender distribution was 57% men to 43% women [152], with gender ratios likely varying by topic [150]. For this study, I focus on topics related to graphic design.

On the other hand, Graphic Design Stack Exchange is but one community (called exchanges) under the Stack Exchange umbrella. A user must register to each individual exchange. While no statistics are available for Graphic Design Stack Exchange, the gender ratio on Stack Overflow, the original and most popular exchange, is heavily dominated by posts from men [177]. It is important to keep in mind, however, that Stack Overflow is exclusively for programming questions, a field where the majority are men [182].

As Q&As, both Quora and SE are composed of questions and answers. To show appreciation towards content, users can vote on answers: upvotes increase an answer's score, while downvotes decrease it. SE additionally allows question askers to pick one *accepted answer* (the green check mark on the left-hand side in Figure 2). Answer order on SE is the accepted answer first, then in decreasing order by answer score, which is prominently displayed next to each answer (on the left-hand side of Figure 2, 21 in this example). On Quora, answer score is deemphasized (the bottom left of Figure 1, 2 in this example) and is one of several aspects considered in their "black-box" algorithm for sorting answers. Furthermore, on SE, answer scores affect the answerer's reputation score (along with earned badges and other activities) (shown in the bottom right of Figure 2), which determines privileges (such as posting abilities, access to moderation tools, and access to website analytics). Quora does not have a reputation feature.

One of Quora's rules is that users must use their real name. Although based on the honour system, other users can report those with names they believe to be false. Answers include the author's name, and optionally, a line on their qualifications (top of Figure 1, Robin Smith, Graphic Designer in this example). Conversely, SE users can use any username they want. Some use their complete real names, some a nickname, others maintain a default username of the form *user12345*. SE does not have a line about qualifications like Quora, however, users' reputations are displayed next to their username (bottom right of Figure 2, Mumble with a reputation score of 6,326 in this example). In both communities, users have

the option of adding links on their profiles to their webpages and profiles on other communities.

To summarize the two Q&As I am analyzing, Quora is a general-purpose Q&A with slightly more men than women users, while SE is a topic-specific Q&A, which I estimate has a stronger presence of men than Quora based on demographics of other Q&As in its network. Both allow users to upvote and downvote answers, determining answer score, but SE puts stronger emphasis on this mechanic, using answer scores to influence user reputation and to bestow privileges to certain users. Furthermore, SE allows question askers to select an "accepted answer" as the single best answer to their question. Quora requires users to share their identity publicly, while SE allows users to remain anonymous.

3.2. Method Overview

I collected approximately 200 answers from Quora and SE each. With each answer, I collected its score, content, and post time, with the author's name, location, and profile URL. For SE answers, I also recorded which ones were accepted answers and the authors' reputation scores. The sampling method is described in section 3.3.

Using author names and profile information, I assigned authors as men or women based on their self-presentation, although not every user's gender was identifiable with the available information. The gender resolution approach is described in section 3.4.

I analyzed the answers qualitatively and quantitatively, looking for gender differences. The analysis procedures are described in section **Error! Reference source not found.**.

3.3. Sampling Answers from Quora and Stack Exchange

My goal was to collect a sufficient number of Q&A posts by men and women on Quora and SE. In collecting questions and their answers, I followed these criteria: (1) The questions had to be about using Photoshop. (2) After I observed that many questions with fewer than two answers were difficult or poorly phrased, the questions had to have at least two answers to control for quality. (3) I collected the complete set of answers from each

question. I aimed for approximately 200 answers per platform to enable strong signals to emerge from the data, while still being a feasible sample for collection and manual coding.

I focused the analysis on content related to Adobe Photoshop, a feature-rich application that is frequently used by graphic designers and is regularly used in the literature as a canonical feature-rich application (e.g., [17,25,46,60,93]). Due to Photoshop's complexity, questions can elicit a range of answers, including both technical and opinion-related (e.g., perspectives on different workflows).

To collect answers from SE, I used the Data Explorer tool [173], which takes queries and outputs content from the SE network. As SE's community and interface have evolved over time, I aimed to collect recent posts, so I filtered the output to include posts between June 24th, 2017, and July 6th, 2018. To satisfy the first and second criteria, I filtered for questions that had the *adobe-photoshop* tag and which had more than one answer. The questions were then randomly ordered to remove any sorting bias by the querying tool. The tool then returned 353 questions. I collected all the answers posted to these questions.

Since Quora does not have a similar tool, I collected questions manually. I opened the *Adobe Photoshop* topic and saved all the questions that my web browser would load (532 questions). I randomly ordered the questions, to reduce bias from the default sorting method. I then manually opened the questions' pages, adding those that satisfied my criteria to the dataset.

Although I filtered using the adobe-photoshop tag (SE)/Adobe Photoshop topic (Quora), some questions were either misclassified or were not about learning/using software (e.g., were asking how to obtain Photoshop). To focus on feature-rich software knowledge sharing, I further ensured that the sample of questions related to any of the following: Photoshop commands, the feasibility of an idea, requesting examples of sample output, or how to obtain a particular effect. From the initial set of 885 Quora and SE questions satisfying criteria 1 and 2, I collected answers until I had at least 200 answers per platform. By satisfying criterion 3, with the dataset contained 203 answers from 80 SE questions, and 202 answers from 32 Quora questions.

We then attributed the authors' gender (see 3.4). Following this sampling method, I found that only nine answers (4%) on SE were provided by women, compared to 126 provided by men (63%), whereas Quora had 38 (19%) and 156 (77%) respectively. Although this might be representative of the distribution of men and women, the nine answers authored by women on SE are an extremely small set to analyze and are too sparse for statistical tests. Therefore, for the SE data, I instead use all questions from the original set of 353 questions that had at least one woman answering it, while randomly selecting other questions that fit my criteria to reach at least 200 answers. This means that this sample is no longer representative of the distribution of men and women contributors, however comparisons between answers from men and women are still valid. For the remaining analyses in this chapter, I use this set of answers, which has 27 (13%) posts by women, and 121 (57%) posts by men. The gender distributions are illustrated in Figure 3.

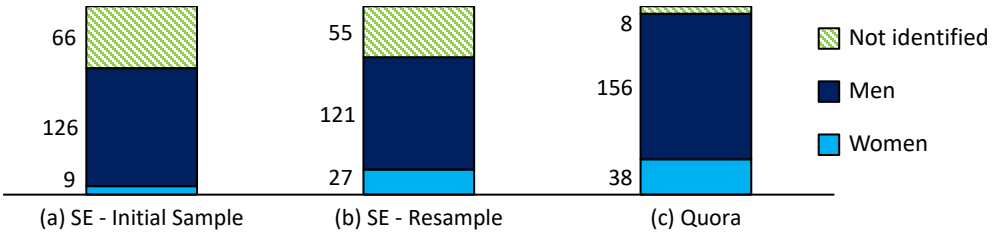

Figure 3: The distribution of sampled answers by gender. The purpose of (b) was to include more posts from women for analysis; (b) and (c) are the main data points used in the analysis.

For brevity in reporting results, I exclude answers that could not be attributed to a man or a woman (so numbers will not sum to 100%). My analysis of posts by authors whose gender we were not able to resolve suggested that this data tended to fall in between the results for men and women, see Appendix A for more detail. The remaining analyses include 148 answers by 71 unique users from SE and 194 answers by 167 unique users from Quora. Most of the contributors in the sample posted only a single answer, with a median number of answers of 1 for both men and women on Quora (IQR = 0) and SE (IQR = 1).

3.4. Resolving Genders of Contributors

In the main data sample (Figure 3 (b) and (c)), we coded gender manually as follows. Two researchers (myself, a Canadian man, and a co-author [45], an Iranian woman) independently coded all the answer authors as presenting themselves as a man or as a

woman, or as not presenting any gender-identifying information (not identified). As far as we could tell, none of the answer authors presented themselves as non-binary. Our coding considered a combination of the following: gender identification in profile (e.g., pronouns, gendered role such as "father"), gender identification in linked accounts, gender identification in posted content, name (if a real name was used) and profile picture. According to Cohen's kappa, there was high agreement between the researchers for SE (κ = 0.823, p < 0.001, 95% CI, 0.727 to 0.919) and Quora (κ = 0.845, p < 0.001, 95% CI, 0.741 to 0.949) users' genders. The researchers then discussed cases where disagreement occurred until they reached consensus on the final code (man, woman, or not identified).

For the initial SE dataset with few women (Figure 3 (a)), and an additional dataset used to generalize one of our findings (response speed), described in 3.6.2, I leveraged a tool used in prior work on gender differences in online communities to minimize our manual work: Vasilescu et al.'s 2012 Gender Computer [200]. The tool uses a name-based approach, similar to other studies using existing posts by online community members [78,100,201], and is generally found to be more accurate than other automated alternatives [200]. The tool compares author names to name lists from 33 international regions (e.g., using censuses) and assigns gender when the name is twice as likely to be one gender than the other. For the names left undefined by Gender Computer, we manually resolved as many as we could using the above-described method.

Vasilescu et al. report an accuracy of 90% in gender recognition [200]. When comparing the tool's results to the entirely manual approach using Cohen's kappa, there is substantial agreement for both SE (κ = 0.687, p < 0.001, 95% CI, 0.55 to 0.824) and Quora (κ = 0.757, p < 0.001, 95% CI, 0.649 to 0.865). Considering resource constraints in identifying genders in such a large dataset, I consider Gender Computer to be a reasonable tool for the additional analyses.

I acknowledge that my data analysis will not speak to the contributions of those whose gender we could not resolve, however, I include a summary of the complete data in Appendix A. I also emphasize our gender resolution method is based on how users present themselves, so those who do not use their name, or use a gender-neutral name (without any additional identifying information) may not be accurately resolved.

		Graphic Design Stack Exchange			Quora		
		Men's Medians (IQR)	Women's Medians (IQR)	*p*-value	Men's Medians (IQR)	Women's Medians (IQR)	*p*-value
Answer Characteristics	Answer Length	83 words (80)	86 words (117.5)	0.907	57.5 words (81.5)	60 words (90.5)	0.646
	Response Speed	2.9 hours (15.2)	3.2 hours (17.5)	0.851	***16.9 hours (114.5)***	***744.6 hours (3763.8)***	***< 0.001***
	Clout	***50 (25.9)***	***61.8 (13.5)***	***0.021***	58.7(28.8)	66.3 (36)	0.296
	Emotional Tone	49.3 (47.1)	62.1 (50.9)	0.365	62.1 (65.7)	74.6 (65.9)	0.272
	Analytical Thinking	89.5 (15.7)	89.7 (20.8)	0.217	76.2 (40.7)	82.3 (42.2)	0.988
Community Appreciation	User Reputation	***13184 (24961)***	***96 (4247)***	***< 0.001***	- N/A -	- N/A -	- N/A -
	Score of Answers	*1 (2)*	*1 (1.5)*	*0.051*	1 (2)	1 (3.75)	0.176
	Accepted Answer	23.1%	11.1%	0.200	- N/A -	- N/A -	- N/A -

Table 1: Summary of the content analysis. Statistically significant results are bolded and italicized. Potential trends are italicized. Answer length is the number of words in an answer. Response speed is the number of hours between asking a question and an answer's post time. Clout is the level of humility (0) or confidence (100) expressed in the text through a language analysis. Emotional tone measure a text's tone from negative (0) to positive (100) using language analysis. Analytical thinking describes writing style, from an informal, narrative style (0), to a formal, logical, hierarchical style (100). User reputation is SE answerers' total reputation scores earned from question and answer scores, as well as earning badges. Score of answers is the sum of upvotes and downvotes on an answer. Accepted answer is the percentage of answers that have been selected by question askers as the best answers to their question.

3.5. Data Analysis

I analyzed answers quantitatively. I used Mann-Whitney tests to compare medians and Pearson's chi-squared tests to compare categorical distributions. I report results as significant if $p < 0.05$ and as potential trends if $p < 0.1$. To determine question types, I used an inductive analysis approach [32]. I used open coding to categorize the questions over many iterations, with an additional researcher (one of the co-authors of this chapter's conference publication [45]) going over the codes and samples of the raw data after every iteration. Two other researchers (also co-authors) provided feedback on the codes to ensure they were understandable. I ensured that the question types were mutually exclusive and

could describe all questions in the sample. I used the Linguistic Inquiry and Word Count 2015 tool [145] for linguistic analyses. The medians and inter-quartile ranges are in Table 1.

3.6. Results

In this section, I examine differences in contributions by men and women both within and across platforms. I begin by comparing the nature of the answers by men and women. I follow this with gender differences in which answers and users receive community appreciation.

3.6.1. Type of Knowledge Contributed

To contextualize my analyses, I start with the type of questions answered in the sample and any gender differences in responses to particular question types.

The open coding identified four question types: looking for a factual answer (e.g., yes/no answer, location of a command, troubleshooting software); asking for opinions (e.g., other users' preferred technique); requesting examples (e.g., of output or of common tasks using a tool); and asking for workflow or technique information (e.g., how to accomplish a task). Examples of each can be found in Table 2.

Question Type	**Type Definition**	**Example Questions from Quora and SE**
Factual	Question has a factual, definitive answer	What blending mode is this?
Opinion	Asks for users' preferred techniques or tools	Which is the best tool for a clipping path in Photoshop?
Example	Requests for example output or example command usages	Can you show me your Photoshop-edited photos?
Technique	Describes how to accomplish a task	How can I bright up a picture through Photoshop?

Table 2: The question types with definitions and examples.

When looking at the distributions of men and women's answers according to question type, the results suggest a potential trend for SE's question types (SE: $\chi^2 = 4.879$, $p = 0.073$, Quora: $\chi^2 = 2.417$, $p = 0.517$). On SE, women appeared to answer more questions asking for opinions than expected, as opposed to factual-type questions, and the opposite held for

men. Further, the distributions of question types across SE and Quora are quite different. On SE, answers center around factual or technique questions. On Quora, the community with higher representation from women, the majority of answers offer opinions, closely followed by techniques. Only Quora included answers providing examples. Figure 4 illustrates these distributions.

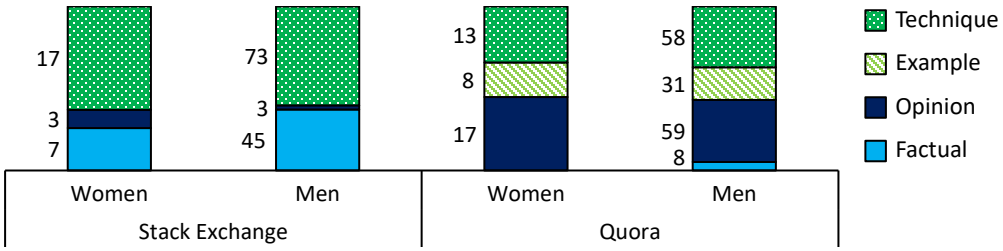

Figure 4: The distributions of sampled answers by which question type they address.

3.6.2. Characteristics of the Answers

I then looked at gender differences in the content of the answers, including answer lengths, the speed at which they were posted (relative to the question), and their linguistic properties.

Answer length: I examined differences in answer length by comparing word counts. On SE, men and women had answers of about the same length (Mdn 83 vs. 86). This difference was not found to be statistically significant ($U = 1609.5$, $z = -0.119$, $p = 0.907$, $r = -0.01$). On Quora, men and women also had answers of similar lengths at 57.5 and 60 words respectively, a difference not found to be statistically significant ($U = 2820.5$, $z = -0.462$, $p = 0.646$, $r = -0.033$).

Response speed: Motivated by prior findings on fast response times on SE [120], I looked for gender differences in response speed. On SE, men and women posted responses at about a similar time lag, with no statistically significant difference ($U = 1595$, $z = -0.191$, $p = 0.851$, $r = -0.016$). On the other hand, women posted far later than men on Quora. This difference was both large, with women's median lag time being 40 times that of men, and statistically significant ($U = 1329$, $z = -4.623$, $p < 0.001$, $r = -0.342$).

Considering the large difference on Quora, I explored the data further. First, I looked at which types of questions tend to elicit later responses. I found that the median response time for opinion-type questions (60 hours) was higher than for the other question types

(technique: 31 hours, factual: 3 hours, example: 36 hours). I also observed that, regardless of question type, all but two questions that received a much later answer (e.g., > 100 hours after being posted), had received at least one reasonable answer within the first day.

Given the large variability in the time lag from women on Quora as well as the difference from the data of SE's women, I resampled Quora answers to see if the result was unique to particular data points in the data. I resampled 106 answers using the previously described method (to check only response speed). After pre-processing, I analyzed 19 answers from women and 81 from men (a similar ratio to the main sample). With this second dataset, men (Mdn 11.18 hours, IQR = 71.22) still posted sooner than women (Mdn 31.90 hours, IQR = 6224.33). While the difference in medians is not nearly as dramatic in this second data set (3x vs. 40x), the difference continued to be statistically significant ($U = 534.0$, $z = -2.069$, $p = 0.038$, $r = -0.207$).

Linguistic analysis: Using the Linguistic Inquiry and Word Count 2015 tool [145], I looked for gender differences in three linguistic summary variables that I hypothesized as relevant: clout, emotional tone, and analytical thinking. This linguistic tool has been developed over decades of research, with each summary variable having undergone peer review [146]. It is a standard tool used by the human-computer interaction community, although its original purpose was for diary and reflexive writing analysis.

Clout refers to the level of confidence exhibited in the text. A high score in clout describes confident, seemingly high-expertise text, while low clout describes a humble style. On SE, women expressed higher clout in their answer text than did the men, a difference that was statistically significant ($U = 1170.5$, $z = -2.299$, $p = 0.021$, $r = -0.189$). On Quora, the difference in clout score for men and women was not statistically significant ($U = 2640$, $z = -1.047$, $p = 0.297$, $r = -0.075$).

The tool characterizes the emotional tone of a text as ranging from negative (at 0), to positive (at 100). On SE, answers from men had a more negative tone than did the women's answers. This difference did not reach significance ($U = 1450.5$, $z = -0.912$, $p = 0.365$, $r = -0.075$). On Quora, men, on average, again had a more negative tone than did the women, but the difference was not significant ($U = 2624$, $z = -1.102$, $p = 0.272$, $r = -0.079$).

A higher analytical thinking score means that the text has formal, logical, or hierarchical properties, while a low score represents informal or narrative styles. Men and women displayed similar levels of analytical thinking on SE, with a difference not found to be statistically significant (U = 1384, z = -1.239, p = 0.217, r = -0.102). The difference was also not statistically significant on Quora (U = 2959, z = -0.016, p = 0.988, r = -0.001).

3.6.3. Which Answers Receive Community Appreciation?

I next turn to gender differences in answers being appreciated by the communities. I looked at three dimensions of appreciation: users' overall reputation scores, the score of answers, and which answers are chosen as accepted answers.

User reputation: On SE, users earn reputation points through their answer scores (see above) and badges earned through community activities such as posting comments, receiving a certain number of upvotes, etc. Here I compare reputation scores for all users who have answers in our dataset. Men's reputations were higher than women's reputations (Mdn 121 vs. 27), a difference found to be statistically significant (U = 698.5, z = -4.652, $p < 0.001$, r = -0.382). Quora does not calculate a summary reputation score for its users.

Score of answers: Users can give upvotes and downvotes to answers, the sum of which are answers' total scores. Men on SE received higher scores than women, a difference that did not reach statistically significance but suggests a trend (U = 1254, z = -1.951, p = 0.051, r = -0.16). Conversely, on Quora, Table 1 shows that both men and women had similar scores (U = 2564, z = -1.357, p = 0.176, r = -0.097). However, with women's scores having a greater spread than men's scores, I do not discount the possibility of a significant difference given more data.

Accepted answers: SE encourages question askers to pick one "best" answer. In the SE sample, 23.1% of men's answers were accepted answers, while only 11.1% of women's answers were selected. This difference, however, is not statistically significant (χ^2 = 1.929, p = 0.2). This form of community appreciation does not exist on Quora.

3.7. Discussion

In studying the gender dynamics on existing collaborative communities such as Q&As, I provide ecologically valid insight into the extent to which these communities' design decisions and cultures are appealing to both women and men. Despite gender balance in the graphic design field and the potential for a range of contribution types (e.g., from technical to opinion-oriented posts), women were underrepresented in the content sample. With participation rates by women at 4% in the SE sample and 19% on Quora, this places the gender balance closer to those found in prior work on programming-centric Q&As (1-8%) [55,57,123,200] and encyclopedic platforms (13-23%) [5,75,105,126,127], than it does to, for example, blogging or online health communities (33-84%) [65,129,144]. This could suggest that feature-rich design software is viewed primarily as technical entities, even though there are a number of non-technical contributions being made, particularly on Quora.

A key takeaway from the findings concerns the importance of considering different communities. The sampling from two different Q&A communities illustrates how, even within the same domain, aspects of community norms and platform design can encourage or discourage gender-diverse contributions. Women participate more on Quora than on SE, and there are fewer differences when comparing contributions from men and women on Quora. On SE, Women expressed more clout and had lower reputation scores, and potentially posted more opinions and had lower answer scores than men did on SE, while there were none of these differences on Quora. On the other hand, women posted answers on older questions more frequently than men did on Quora, but not on SE. Both men and women posted answers to different types of questions on Quora than they did on SE, namely, posted more opinion-based answers than factual ones.

A second key takeaway from the findings is that women contributors to Stack Exchange get fewer benefits than men are from community appreciation and reputation systems. The findings suggest that appreciation of content written by women is lower in SE, with prior work suggesting that this criticism might be serving to drive away women [87,156,157]. My study is not the first to identify gender issues with online community appreciation, particularly with respect to reputation systems [123,200]. The findings, however, provide

new insight into their scope, for example, by showing that they persist outside of programmer-centric communities to fields with greater gender balance. It would be further interesting to examine patterns in who votes on what content. Unfortunately, the gender of a majority of users who upvote and downvote content is not identifiable. The list of people who vote is publicly available in both Stack Exchange and Quora, but only obtainable through hidden interfaces. Therefore, these users tend not to have public or detailed profiles, perhaps believing that voting is completely anonymous due to its aggregated nature.

One approach to improve reputation systems is to adjust the scoring system, with recent work proposing an alternative scoring method that cuts the difference between men and women's reputation scores on Stack Overflow by half [123]. However, when looking at Quora's users' scores, there is little difference between men and women's scores, and that they are in fact, quite low scores overall, suggesting that Quora's scoring mechanism is seen as a less important feature than SE's. In a second study, described in Chapter 4, I use interviews to complement these findings to examine how appealing these reputation systems are to men and women.

The results do not speak to the root causes of the differences in community appreciation. For example, I speculate that men and women appreciate different types of content. Stack Exchange prioritizes short turn-around times for factual answers [120], and actively discourages answering questions soliciting opinions [69], yet women are much more likely to provide answers to opinion-oriented questions, and to continue to respond to older questions (particularly in the case of those soliciting opinions). Policies such as encouraging factual, non-opinion-based answers are carried over from Stack Overflow; these might be suitable for programming-centric Q&As like Stack Overflow but might not be appropriate for domains such as graphic design, where other types of knowledge, such as opinions, are also important. While further study is needed to determine why women are more likely than men to continue to respond to older questions, the data suggests that the emphasis on response speed and "correctness" might not be appealing equally to both genders. I speculate that a combination of factors is at play. For one, Quora regularly prioritizes older questions on users' feeds giving these questions increased community visibility. When older questions continue to receive answers, the discussion is starting to

go beyond the initial factual answers, with newer answers focusing on opinions. From the content analysis, women appear to be more comfortable sharing opinions than men. Platforms that encourage this behaviour, emphasizing and rewarding answers that update old questions and that include opinions might encourage more contributions from women and lead to higher appreciation for those types of answers.

The findings also reveal tonal differences. It could be that the community with higher representation of men is favouring patterns of expression that more closely align with their own (e.g., those with a more neutral tone). Appreciation could also be subject to conscious or unconscious bias. Prior work showing very strong evidence of gender biased assessments of teaching [118] and resumes [132], provide excellent starting points for further investigation.

3.7.1. Limitations and Generalizability

To permit wide-scale analysis of existing contributions, my approach involved manually inferring the gender of contributors through their linked profiles, pronoun usage and names, as well as the use of an automated name-based tool for some secondary analysis (e.g., response speed). While I took steps to increase the reliability of the gender labels (e.g., using multiple coders from two countries), and the findings generally align with prior research where users have disclosed their gender directly (e.g., in surveys [57]), I acknowledge that my gender classification is likely imperfect. The findings also do not consider the contributions of those whose gender we could not resolve, and more work is also needed to capture perspectives of those who do not identify with a binary gender classification.

I focused the content analysis on a single feature-rich application for graphic design (Photoshop). The results are likely to extend to other feature-rich applications (e.g., 3D modelling tools and video-editing suites), where the tools are complex, with numerous ways to approach any given task, and where users often turn to similar online communities for help. A more interesting question is whether different patterns might emerge when it comes to sharing other types of graphic design knowledge, such as strategies for effective visual design, which might be less centred on the use of a technical entity. My interview

study briefly touches upon the idea of supporting different types of knowledge. Future work should also consider other ways people of different genders share feature-rich software knowledge online, such as through tutorials or livestreams [61].

3.8. Summary

The above analysis highlights some key gender differences both within and between two online Q&A platforms for graphic design software. Both Q&As are skewed towards contributions from men, despite gender balance in the graphic design field. The participation of women, however, is over four times higher on Quora than on SE (4% in our original SE sample vs 19% on Quora). Women seem to answer more opinion-oriented questions on SE than men do, and, overall, Quora elicits more opinion-oriented knowledge than SE. Linguistic analysis indicates that on SE women's answers expressed more clout than men's answers. On Quora, women were far more likely to respond to old questions than men, sometimes dramatically so. In terms of community appreciation, men on SE generally have a higher degree of recognition than women.

With this content analysis, I confirm that there is a gender imbalance in at least two online software communities, despite having a relatively balanced number of men and women graphic designers. I identified gender differences in these communities in terms of content characteristics and community validation. In an interview study, described in Chapter 4, I complement these findings to better understand the perceptions of community members, what motivates them and what are some deterrents they see when participating.

Chapter 4

Investigating Perceptions of Contributing to Q&As

From Chapter 3's content analysis, I learned about gender imbalances in content submitted to two online graphic design software knowledge communities. To better understand the differences I observed and to uncover further gender impacts, as a next step, I interviewed community members to see what they perceive to be motivations and deterrents to participate. To this end, I conducted semi-structured interviews with 24 graphic designers who have used SE and/or Quora. In this section, I describe the participants, my interviewing method, and some of the interesting results contextualized with the findings from the content analysis and previous work. See Appendix B and Appendix C.1 for ethics certificates approving this study. This work was presented at the 2020 ACM Conference on Computer-Supported Cooperative Work and Social Computing (CSCW'20) and was published in the Proceedings of the ACM on Human-Computer Interaction, Vol. 4, CSCW2, 2020, alongside the content of Chapter 3 [45].

4.1. Participants

I recruited 24 graphic designers through word-of-mouth, advertising on a university campus, social media websites (e.g., Reddit), and directly on Quora (recruiting on SE is forbidden by their terms of use) (see Appendix C.2 for recruitment material). I only

included participants who used Quora and/or SE to offer or to receive help for graphic design.

Eleven participants self-reported as women, while 13 self-reported as men at the time of the interviews. None of the participants self-reported as non-binary. All participants had professional experience in graphic design or were training to work in the field. Although only 11 participants were active contributors in these communities, everyone reported relying on Quora and/or SE as one of their sources for online graphic design help. Table 3 lists details about participants.

	Gender	**Platform Used**			**Content Submitted**				**Graphic Design Expertise Level**		
	Total	Quora	SE	Both	Question	Answer	Both	Neither	Advanced	Intermediate	Beginner
Women	11	9	7	5	4	3	1	5	5	5	1
Men	13	13	7	7	4	5	4	8	4	7	2
Total	24	22	14	12	8	8	5	13	9	12	4

Table 3: Interview participants' characteristics. The Quora and SE, and Question and Answer columns are not mutually exclusive.

4.2. Method

After signing a consent form (see Appendix C.3), I started the semi-structured interviews by asking participants to self-report their gender and to describe their graphic design and software experience. I then asked about their Quora and/or SE activities. If participants had posted, I asked about their motivations, and if they had not, I asked about deterrents to participating. I asked them to explain what makes Quora and/or SE unique, and if they used both websites, to compare them. I ended with a discussion of how they determine the quality of answers. I was interested in gender differences that would emerge naturally through my discussions with participants, so I did not ask specifically about the differences revealed in the content analysis. See Appendix C.4 for a sample of the interview questions.

The interviews lasted 45-60 minutes. Seven participants recruited locally were interviewed in person, while the 17 others were interviewed over videoconferencing software. One participant (M16) asked to conduct the interview over text chat.

All interviews were fully transcribed, and participants could request to review their transcripts (two participants requested a copy of their transcripts). During analysis, I

removed gender information from participants' quotes to reduce my own bias. I first used open coding to get an initial sense of the data. Then, with another researcher (a co-author of this chapter's publication [45]), we collaboratively and iteratively developed an initial set of themes from the transcripts and codes, grouping quotes about similar topics or feelings [125]. Themes were further discussed, reinterpreted, and revised by four researchers (all co-authors) during multiple joint meetings. I then categorized the themes as containing either quotes from men, women, or both (the gender information now being reintegrated with the quotes), and as either about Quora, SE or both. With themes identified from the data, I then used previous work to guide further interpretation of the data.

I looked for indications of gender differences in the transcripts, however, I was also cognizant of the complexity of issues that might hinder clear patterns from emerging with this type of qualitative data (e.g., [34,208]). For example, gender is but one part of a complex social environment with many factors that may come into play (e.g., socioeconomic status, race, ethnicity, education) and I am careful to not incorrectly strictly attribute gender as the reason behind every finding without further study.

4.3. Key Findings

The interviews revealed various reasons why men and women who are graphic designers might or might not participate on Quora and/or SE. The primary themes I identified involve: the importance for graphic designers to share different perspectives, a stronger sense of community on Quora, and the efforts needed to contribute. I also describe contradictions in answering old questions and thoughts on showing appreciation for content.

Participants who reported themselves as men have labels starting with M, and women, W.

4.3.1. Sharing Perspectives Motivate Graphic Designers

Participants who posted on the websites were largely motivated by reasons that are well-documented in the literature, including receiving recognition [13], feeling good about helping [216], reciprocity [188], and it being a quick way to receive help [120].

> *I answer people's questions. It's a […] marketing tactic for me, to get clients. So, I have a profile on there, and then people can follow. It'll lead to my website. (W9)*

> *Commitment is a two-way street in online communities, that's how it balances, helping each other and receiving help at the same time. I am excited to share what I've learnt and I feel a sense of contentment whenever my help is appreciated. (M16)*

One motivation unique to graphic design software, however, was the desire for designers to share unique perspectives, even if it might not be the "best" solution:

> *Even if [there is already an answer, if] I'm writing a post, I'll still continue with it, just in case [it is] a different idea. Because I mean, if everyone on the internet can read it and answer it, they might find something even better. […] Isn't that the whole point of having the internet? The whole world gets to talk to each other and say, "well you could also do this thing." (W10)*

While this participant advocated for discussions collectively furthering knowledge, not all participants felt that sharing their perspective was worth the effort, a point I revisit later.

Questions with definite answers generally do not leave much room for different perspectives. In the content analysis, I found few answers to these types of questions on Quora, and indeed, participants found it easier to give opinions on that platform:

> *While in Quora, it's more like, there's a lot of room for discussion and less room for practical answers. […] If you're looking for maybe deep answers, and long discussions, then Quora is more suitable for this, but if you are looking for something straight to the point with your answer and move on, then probably Stack Exchange is a better place, it's easier to find answers there. (M2)*

> *[Low-quality answers take] time away from relevant answers […] But then everyone has a right for an opinion so that's the purpose of Quora, so that it's a balance. (W9)*

That participants felt it easier to share opinions on Quora, might partially explain some of the longer lag times that I observed. As the content analysis indicates, opinions appeared to account for more of the later posts, and women posted most of them. Together, this could imply that women feel welcome to share their opinions at any point in time on Quora, even if there are already answers. SE had mostly factual questions or questions about technique – it is possible that once there is a correct answer, there is not enough incentive to post additional answers.

4.3.2. Stronger Sense of Community on Quora

Previous work suggests that women engage more with members of online communities than do men [129,144], and that women tend to acquire knowledge by socializing [24,191].

In my interviews, women pointed out that there are deterrents to doing so, particularly on SE, while no men volunteered this as a deterrent.

The biggest issue that came up was the anonymity of the other users on SE; there is no information about other users, making the community feel impersonal. In contrast, Quora enforces the use of real names.

> *I [can] find out [what] this person [using their name] is doing professionally in Photoshop. Some [of the] ideas important to me, [like what] are [their] origins. […] But the other ones that have anonymous nicknames, no. They're not important to me, you know? (W24)*

> *I'm talking to a person I don't know. […] The Stack Exchange experience is very cut and dry. You know, it's just like, here's my question, here's some answers. People chime in, blah, blah, blah. […] It feels a bit overwhelming to just have people sort of like throwing answers at you. I'd rather deal one on one. […] (W27)*

Although men also mentioned the issue of anonymity, they phrased it as a privacy concern rather than a deterrent to communication:

> *[My] issue is when I make an account, after a while, I tend to forget about them. You know nowadays, they have a database or something, and [my information] gets stolen. (M5)*

Prior research suggests that women are generally more concerned with their own privacy online (e.g., [54,80,217]); however, when it comes to knowledge sharing, men appear to be more concerned [24]. These results seem to lend support for this distinction.

A further issue is the size of the community. Other women described Quora's community as very large. Although this has its benefits, such as being easier to reach many people for help, participants felt like this could be overwhelming, or that their mistakes would be noticed by a large audience.

> *[It's] almost like you can hear a pin drop and you're like, um, in a minute you're gonna understand why no one's commenting on this if you just thought about it for a little bit longer. (W25)*

Participants suggested that a potential solution would be to more clearly define local communities that form around Quora's topics. This follows the idea that women tend to communicate in more private circles and that men have large social networks [10,12].

Overall, it appeared that the women considered Quora to be a more social community than SE:

> *Quora is a little bit more social according to me. And if I'm getting information about graphic design, […] it's like a social site. You can ask about anything. It's really interesting. But Stack Exchange is more professional, that's, my opinion. It seems more professional, it's a little less interesting. (W6)*

Thus, while the size of Quora was daunting to some, social aspects seemed more important to the women in my sample than to the men, with Quora providing the better social balance.

4.3.3. Too Demanding to Post, Probably in Vain

Many participants talked about the challenges of crafting answers, to the point that it was not worth their limited time. Prior research has found that women, on average, tend to have less time than men due to carrying a larger percentage of the domestic work in addition to their professional duties [198]. Some men spoke about the effort it took to be authoritative enough, while women expressed the opinion that posting answers was not worth the effort. Below, I elaborate on some of the time/effort-related deterrents to creating and posting answers.

First, there is the expectation that authors carry authority in their answers. Participants mentioned that they did not feel that they could post if they did not have this authority:

> *An answer should be authoritative. I don't think I have that. […] An authoritative answer, in my opinion, […] is completely factual, is full of facts, is correct. It cannot be disputed; there is no discrepancy or no errors in the answer. (M5)*

This means that a sufficient amount of effort is necessary when posting adequate answers, including the effort of researching the problem and crafting sufficiently elaborate and justified responses:

> *[Sometimes,] when I have written down an answer, or maybe 30% of the answer, I feel that this is going to take too much time, I have to back it up this way, I have to attach the source, or whatever. And I just feel it's not worth the effort, and I close it. (M21)*

Interestingly, men spoke about the importance of authority more frequently than women, with only a couple of women mentioning it in passing.

Even if participants made effort to post questions and answers, most worried about receiving negative feedback in response. While both men and women expressed concerns over negative feedback, at least one woman felt that the criticism was less severe on Quora:

> *If you're going on Quora, you know that you can ask the dumber questions, and you won't really get put down with negative answers, or anything. So, I [feel] it's more comfortable for beginners. (W26)*

The content analysis shows that content in SE is more negative than on Quora, with prior work suggesting that criticism might be internalized more by women than by men [87,156,157]. Concern over negative feedback might also relate to the linguistic differences in clout that we see on SE, where women who do post despite this deterrent, do so with more authoritative language than men.

Overall, a few of the women, and one man, simply did not see enough benefit to answering questions, on either SE or Quora. The following quote indicates that current reward mechanisms were insufficient to justify the effort:

> *It just turns into a competition sometimes. It seems where it's kind of, like, this is internet points. None of this is real at all. (W25)*

This sentiment from women is understandable, given the findings from the content analysis that women's posts were less appreciated than men's posts.

4.3.4. Paradox of Stale Questions

Findings of the content analysis, show that most answers were posted soon after the questions, except in the case of women's answers on Quora. In the interviews, without being prompted, many participants volunteered their thoughts on the age of the content they were reading or contributing to. However, they had contradictory feelings about this issue, and I did not observe any clear gender differences.

Participants agreed that recent answers tended to be more useful; any software features would likely be more up-to-date and more modern techniques would be shared.

> *I kinda go by date, first. So, I see, I try to pick the one that's closest to current times. So, if I see one from 2013 versus one from 2018, I'll click on the one from 2018. (M12)*

Even when they felt they could provide an up-to-date answer in light of new software versions and techniques, they assumed the asker had probably found an answer elsewhere.

> *It never makes sense to me to answer an old question, from like a year ago. I just assume that they've already solved it, or they've already moved on from it. (W26)*

Despite the benefits to updating answers, this also counters internet culture:

> *It's called "necroing" a thread. And basically, it's an online courtesy of when at least, the longest you would comment on something is 6 months. So, if […] everybody solves it in the month of 2013, and then I come in 2016 or 2018 and I'm in the same thread and "hey guys have you solved this," that's considered to be really rude. […] Especially if they solved the problem, […] most of the people tend to look at you as an idiot. (M12)*

Research shows that overall, men use the internet more frequently than women, and in such a pattern that potentially exposes them to this aspect of internet culture more often [143].

4.3.5. Community Appreciation of Content

Given the gender differences in community appreciation that I observed on SE, I asked participants to describe answers they would show appreciation towards. Almost all participants mentioned they would upvote answers that contain explanations, examples, screenshots, and are properly formatted. No participants, however, mentioned the posted guidelines as influencing their upvotes. The participants also generally refused to give downvotes, unless the answer was truly inappropriate (e.g., was offensive). They explained that the author had at least made an effort to share knowledge, so did not want to discourage them:

> *Maybe the answer doesn't have good elaboration or are not enough, but they are not bad, or they are not wrong, you know? So, I think just the wrong answers need a downvote. So, I just put upvotes. Because people need encouragement, not discouragement, actually. (W24)*

Even though all participants had opinions about showing appreciation, no clear picture emerged that might explain the gender differences I observed in SE content appreciation.

4.4. Discussion

Q&As, such as Stack Exchange and Quora, have taken different approaches when it comes to developing their platform features, policies, and cultures. Interpreted in light of other gender research (e.g., [10,24,191]), these findings suggest that the differences across the two platforms are likely caused by a set of complex, interdependent factors. Like with any such complex phenomena, a collection of studies from the HCI research community will be needed to isolate different properties of the community and how they impact men and women differently, with my findings highlighting some particularly salient factors. By overviewing my findings, I point to the need for continued innovation from the HCI community to establish guidelines (for design or otherwise) that will help communities encourage and support more equitable participation.

Interview participants described limited opportunities for diverse perspectives and a lower sense of community on SE, compared to Quora. SE might have inherited some of its reputation, culture and community norms from the programmer-centric Stack Overflow, which has far more men than women [177], however, few interview participants were even aware of Stack Overflow. A similar finding from the content analysis points to the fact that SE had few opinions. This is a fundamental and conscious decision that SE's developers have made when creating the website and when enforcing its guidelines. Although developers might have good rationale to encourage what they see as high-quality content, they may be unknowingly discouraging participation from some of its members, including a disproportionate number of women, and losing out on valuable knowledge.

In the same vein, previous work has found that women acquire knowledge by socializing [24,191] and in the interviews, more women than men expressed missing social elements, things as simple as real names and being able to relate to others, as a key deterrent to contributing. The lack of social elements appears to be affecting women disproportionally; it is possible that women are simply using other help channels that are inherently more social, such as asking experts for help directly. Incorporating more prominent social features could help encourage women's participation online. Examples include more elaborate user profiles, personalized sub-communities, and real-time chat rooms. Both SE and Quora have social areas such as chat rooms, but they are not tightly integrated with the

knowledge-sharing areas. Similarly, it has been found that SE users from collectivist cultures would benefit more from Q&As with additional social considerations than those from individualist cultures [142].

The content analysis in Chapter 3 could not speak to whether men and women appreciate the Q&As' reputation systems. In the interviews, one woman outright volunteered that she was not motivated by a reputation score. A number of others indicated that they did not have the time to interact heavily with the community, meaning they would not be able to earn enough reputation to access all features. Combined with the content analysis, that men and women do not receive the same levels of appreciation, and might appreciate different content, this suggests the need to consider fundamentally different motivation/reward structures that appeal to people of all genders. Alternate mechanisms for highlighting user contributions could be considered by Q&A designers. For example, one could imagine summarizing the range of questions answered, or the degree to which answers have employed a positive or negative tone.

Some interview participants commented on the fact that it takes a lot of effort to author content, with some women saying that it is not worth the time, suggesting that lowering the time it takes to contribute might encourage more participation from women. In the area of feature-rich software, examples could be tools that support lightweight sharing from within an application [111], those that make it easier to share rich application context [121,203], or Q&A systems that are directly integrated within feature-rich software [27,121]. I encourage researchers developing novel tools to consider gender more explicitly, both during development (e.g., using GenderMag [19] to identify potential software design biases) and in subsequent evaluations. Given that online communities are used widely in conjunction with feature-rich software, it is important that the research community deal with their intersection in a more gender-inclusive way.

4.4.1. Limitations and Generalizability

My interviews provide perspectives on two graphic design communities for sharing feature-rich software knowledge and shed initial light on gender differences in deterrents to contribution. Further study is needed to both ascertain the generalizability of the findings

to a broader population and to understand the relative importance of the different deterrents. For example, some of the participants would compare Quora and/or SE to other Q&As that they used for graphic design help. It would be interesting to learn how these Q&As' environments and cultures, in addition to interface design, affect participation (e.g., a few participants mentioned Q&As popular in China). To this end, large-scale detailed surveys (e.g., as conducted by Ford et al. [57]) would be an important complement to qualitative insight that would additionally allow researchers to collect and analyze other characteristics to supplement and/or confirm my findings about gender.

All interview participants self-reported as either men or women. Although for a large-scale automated analysis like the content analysis in Chapter 3, it would be very challenging or time consuming to identify users with other gender identifications using current tools, this does not present an obstacle for interviews when participants can freely select any gender. It would be important to hear the perspectives of people who do not identify as men or women as they may face unique challenges that remain underrecognized by the HCI community. While conducting the task-based field deployment study I describe in Chapter 5, this awareness prompted me to modify my approach to participant recruitment to better involve non-binary participants.

I focused my first two studies on graphic design Q&As with the assumption that a field with a similar number of men and women would lead to closer-to-equal levels of online participation. However, there are other factors affecting gender parity in a field, such as wages and leadership positions held. These could further impact online participation and unfortunately, graphic design could still be considered to be male-dominated along these other measures [2,70,90,181]. It would be interesting to see how demographics of a community's leadership and general audience might influence people's perceptions towards contributing content.

4.5. Summary

From the interview study, I learned about differences between Quora and SE observed by participants: that it is important for graphic designers to be able to share perspectives, that Quora has a stronger sense of community, that there is pressure to contribute high-quality

content to the point that it may not be worth the time to create it, that there are trade-offs to answering old questions, and that our participants preferred to be encouraging than to downvote content.

Combining results from the content analysis in Chapter 3 and the interviews of Chapter 4, I determined interface design as a potential approach to reduce the gender participation divide. Specifically, it appears that women like sharing opinions and tend to appreciate Quora's higher sense of community. These socially-oriented findings suggest that integrating more social information into a Q&A's interface might reduce gender differences. In Chapter 5, I describe how I added community presence information on a Q&A's interface and conducted a task-based field deployment study with these interfaces to better understand users' perspectives and potential uses of such information.

Chapter 5

Investigating Perceptions of Community Presence Information in a Q&A

The results described in Chapters 3 and 4, in combination with prior work, suggest that women are underrepresented in existing Q&As and do not receive as much validation for the content they post compared to men, resulting in women not getting all benefits of participating in Q&As (e.g., showcasing skills [147,215], growing their networks [52,175,222,223]) and Q&A content being of lower quality [22,47,189,202]. I uncovered that insufficient social consideration in the designs of Q&As appear to be one factor deterring women from participating. Working towards improving social considerations in Q&As, I studied how two components of socialization can impact perceptions and use of Q&As. In particular, I introduce what I refer to as *community presence information* as a way to foster 1) homophily, which describes a person's preference to interact with individuals similar to themselves and 2) social presence and awareness (SPA), the reciprocal relationship describing a person and their community's members' awareness of one another's presence.

To investigate how community presence information can impact Q&As, I created two Q&A interfaces, which I named Community Presence interfaces, with additional information showing 1) how community members are similar to a user (homophily) and 2)

which questions community members have viewed (SPA). Representing SPA and homophily as community presence information, I investigated how this information can influence users' perceptions of Q&As. In addition, I further considered how the degree of detail of community presence information might affect responses from users: if the information needs to be detailed to impact one's sense of SPA and homophily or if it suffices to have a high-level summary.

In this chapter, I describe the design process I used to arrive at my interfaces, the Community Presence interfaces I prototyped, and how I used them in a task-based field deployment study to elicit user perceptions. I include qualitative and quantitative findings of the study and show that integrating community presence information in a Q&A is a promising approach for working towards gender-inclusivity, despite mixed participant reception. This work has been accepted for publication in the Proceedings of the ACM on Human-Computer Interaction, Vol. 6, CSCW2, to appear in November 2022, and will be presented at the 2022 ACM Conference on Computer-Supported Cooperative Work and Social Computing (CSCW'22) [44].

5.1. Incorporating Additional Community Presence in a Q&A

To investigate how community presence information can impact perceptions of a Q&A, I created two Community Presence interfaces by adding information about question viewers (a "view" being recorded when clicking on a question) to the question feed of a Q&A, focusing on promoting a sense of SPA and homophily. In this section, I describe the design process and how it led to the current designs, as well as the interfaces I developed as high-fidelity prototypes.

5.1.1. Designing Q&A Interfaces with Additional Social Considerations

The results from Chapters 3 and 4 suggest that Q&A interfaces lack social considerations that appeal to women. I used an iterative process of rapidly sketching different ideas, investigating the literature, and gathering informal feedback from HCI researchers to guide my exploration of Q&A interfaces with additional social considerations. I explored ideas involving real or simulated social interactions or social information. They included adding

automated agents that would encourage participation, creating subgroups among similar users, implementing tools for collaboratively authoring content, and assigning mentors when content authors need assistance (which was an approach investigated by other researchers in parallel to my exploration [56]). Of the ideas explored, I felt that adding community presence information was the most promising: it builds on existing Q&A features, did not require substantial development work (e.g., did not need an artificial intelligence) and added minimal complexity to Q&A interfaces (which is already a deterrent described by women [57]).

The next step was to determine what information would be displayed. I informally mapped out a design space for different types of community presence information, including user representations, visualizations for activities one may do in a Q&A, and different user relationships. For representations, I considered names a person might use: their real name (as in Quora), a real but not their own name, a nickname, a username, or even names for an invented character the user might take the role of. I also looked at a user's visual representation, profile icon, display picture or avatar: an abstract geometric shape (as used by Stack Exchange by default), a selfie, a caricature, a pet, an invented character, or an object or logo meaningful to the user. I repeated this activity for indicators of a user's activity level (e.g., reputation score, online status, badges earned, sharing cursor movements), actions a user might take (e.g., upvote or downvote, share a status, accept answers) and user relationships (e.g., following/follower, friend, groups) and other elements. Analyzing this design space, I determined that most, if not all of these ideas are based in the concepts of SPA and homophily, important factors in socialization [161].

Turning my attention to developing low-fidelity prototypes with a focus on emphasizing SPA and homophily in a Q&A (see Appendix D for examples of these prototypes), I developed the following objectives that guided my designs towards the implemented high-fidelity prototypes:

1) The user should see community presence information at a practical and informative scope. The 1-9-90 principle [137] states that 1% of users of an online community actively generate new content, 9% contribute to existing content, and 90% only consume the content. I believe that showing the entire community of users'

information would be overwhelming, and that only showing question and answer authors' information would leave the interfaces too sparse of information. Therefore, I decided that as a first step in playing the role of showing SPA, the interfaces should show question viewer information, as a mid-point.

2) Some interview participants mentioned that they find it difficult to empathize with unknown or anonymous people. This is also supported by previous work, for example, pointing out that women might engage sooner if a woman has already participated in a discussion [55]. I wanted to use community presence information to help users relate to others, with the aim of prompting homophilic responses.
3) In designing the interfaces, I did not want to create a new knowledge-sharing format or introduce distractions from the main activities of a Q&A. Therefore, the primary way of interacting on the Q&A should remain through asking and answering questions about a particular topic. I aimed to keep user interactions with the interfaces simple by using information already collected by Q&As automatically, or that could be collected through minimal user input.

With the three objectives in mind, I created two high-fidelity prototypes, which are described in the next subsection.

5.1.2. The Aggregated Views and Detailed Individuals Interfaces

My exploration of the design space led to the decision of adding community presence information in the form of interface elements emphasizing SPA and homophily. The interfaces list information about question viewers, indicating their "presence" on a question, and this is designed to increase a sense of SPA. Meanwhile, to promote a sense of homophily, the interfaces display information about viewers' characteristics, prioritizing viewers with similarities to the user. To discern how the level of detail of community presence information can impact reactions, I designed two Community Presence interfaces. I elaborate the Aggregated Views and Detailed Individuals interfaces below.

The Aggregated Views interface (Figure 5) provides a high-level summary of the community presence information. In addition to information commonly found in a Q&A (question's title, question asker's name, date and time the question was asked, number of

answers and views the question has received), the interface lists each of the characteristics for which the user provided information in their profile. For each of the characteristics, the percentage of question viewers sharing that characteristic is shown (in the case of age, it counts the number of viewers who are at most five years younger and five years older than the user). With this interface, the user cannot see any detailed information (including characteristics) about individual viewers, the user can only see the aggregated community percentages for characteristics identical to their own. The intent is for users to see where viewers most like themselves are present on the Q&A.

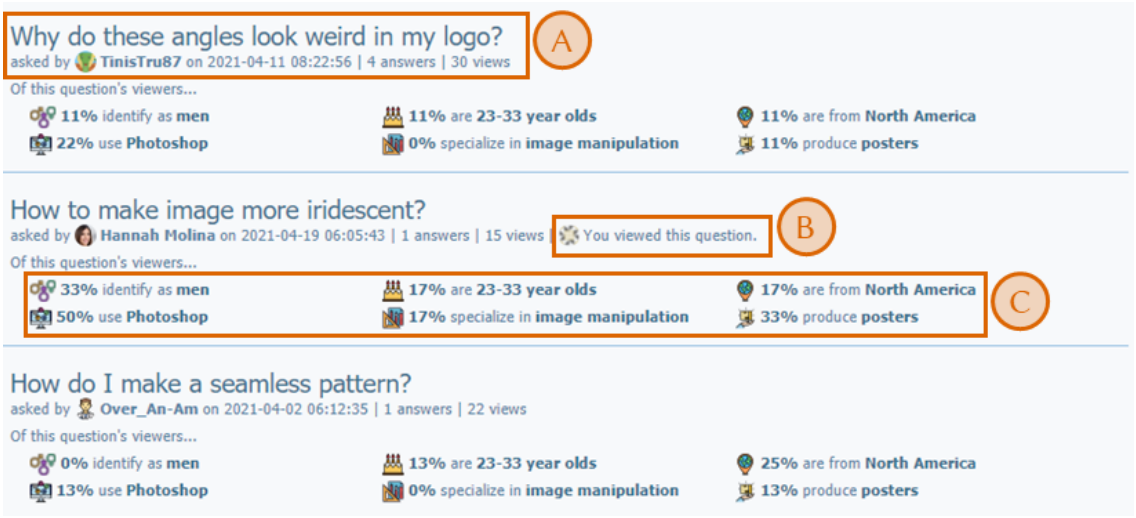

Figure 5: The Aggregated Views interface. A) Standard question information. B) An indicator showing the user has viewed this question. C) For each characteristic, the percentage of question viewers who have the user's characteristic. Here, the user is a 28 year-old North American man, so he can see how many 23-33 year-olds (28 ± 5), how many North Americans and how many men have viewed each question (17%, 17% and 33% respectively in the highlighted example).

In comparison, the Detailed Individuals interface (Figure 6) displays information about individual question viewers. Each question displays two lists of question viewers: viewers that the user has followed and viewers that share some similarity with the user. In my implementation, these "similar viewers" must share at least one characteristic with the user, are sorted from most to least similar, and a maximum of six are displayed (due to space limitations). When the user hovers over a viewer's icon, the viewer's profile is displayed, showing all their characteristics (of those specified in the viewer's profile). Any characteristics that are the same as the viewer's are highlighted (as is the case with the Aggregated Views interface, viewers with the user's age plus-minus five are considered to

have the same age). The user can choose to follow or unfollow users from their profiles. This way, the user can see individual question viewers specifically, with a detailed view of their profile. With this interface, users do not see community-wide statistics.

Both Community Presence interfaces make use of and display user characteristics. People's characteristics can be divided into two groups: external and internal characteristics [62]. External characteristics can generally be obtained without much interaction with a person and often represent a "surface-level" view of one's identity (e.g., name, place of birth, age, gender). On the other hand, deeper interactions with a person are needed to understand their internal characteristics (e.g., values, philosophies, preferences, attitudes). As the type of a characteristic that people share in common can impact the strength of each other's impressions [62], we selected six characteristics as a starting point for our investigation: we treat gender, age and region the user identifies with as external characteristics, and preferred software, specialization and product type produced as internal characteristics.

Figure 6: The Detailed Individuals interface. A) Standard question information. B) Viewers that the user follows. C) Viewers who share characteristics with the user, ordered from most to least similar, fading out as they become less similar. D) The user can hover over profile icons (PosterCreator's in this screenshot), to see a viewer's characteristics. Any characteristics shared by the user are bolded (both the user and PosterCreator produce posters in this example), and the user can choose to follow/unfollow the viewer.

5.2. Investigating the Effects of Additional Community Presence

To see how community presence information can impact a user's perceptions and engagement with a Q&A and to test if there are any gender differences, I conducted a ten-day task-based field deployment study. I used the ten-day interactions with the Community Presence interfaces to ground interviews on how community presence information can be used to promote inclusive environments. See Appendix B and Appendix E.1 for ethics certificates approving this study.

For the purposes of this study, I again chose graphic design as the Q&A topic. For reasons similar to those discussed in previous chapters, graphic design has many different complex software, allowing for a variety of content, including content related to workflows, troubleshooting and opinions. It is also a field that has near-parity in the number of men and women practitioners [182], something important to consider as unbalanced gender composition of a group can impact level of engagement [88].

5.2.1. Participants

I recruited people with graphic design knowledge and aimed to balance the number of men and women participants. I also sought to include the perspective of non-binary participants. I advertised through word-of-mouth and on social media websites like Reddit and Facebook, specifically targeting graphic design, women in graphic design and tech, and GSRM (gender, sexual and romantic minority) groups. I asked potential participants to share what kind of graphic design work they do, and at what frequency to ensure they had knowledge about graphic design software. I offered to conduct the study in English or in French, although all participants chose to participate in English. Participants received $25 CAD after signing the consent form, and $125 CAD upon completion of the study. See Appendix E.2 for sample recruitment material.

I recruited 30 participants: 14 self-reported as men, 14 as women and two as non-binary when starting the study. Participant ages ranged from 20-45, with the median age at 24.5. Participants reported how long they did graphic design work professionally or as a hobby: three indicated less than a year, twelve 1-5 years, nine 6-10 years and six over 10 years. Participants also identified their primary job title and field of work/study: 21 identified as

graphic, UI or web designers, three participants had jobs indirectly related to design (i.e., marketing), six participants did not identify anything related to design as their profession (three in business management positions, two in healthcare, one in hospitality). The call for participation did not require participants to use Q&As as I wanted to include perspectives of those who do not use Q&As. In all, 21 participants visit Q&As, with eight men and seven women having asked or answered questions.

5.2.2. Conditions

As a comparison point to the two Community Presence interfaces, I developed a Baseline interface that only has information that is commonly found in Q&As (see Figure 7). Every participant used the Baseline interface and one of the Community Presence interfaces so that I could see if gender differences in usage patterns or perceptions would emerge. Therefore, the study had a mixed design with one within-subject factor (*Interface Type*: Baseline and Community Presence interface) and two between-subject factors (*Gender*: man, woman and non-binary; *Enhancement Type*: Aggregated Views and Detailed Individuals interfaces). The order of interface and enhancement types was counterbalanced between genders.

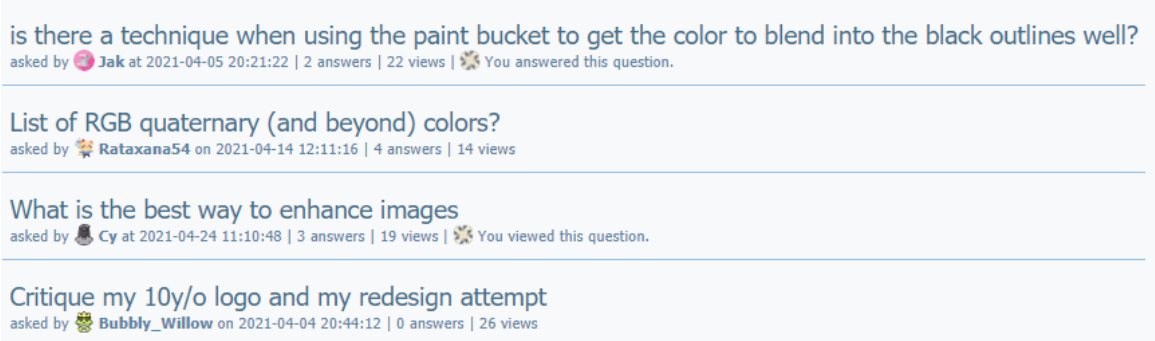

Figure 7: The Baseline interface. Each question only has the information commonly found in Q&As and indicators showing which questions the user has viewed.

5.2.3. Q&A Content

As explained previously, graphic designers use a variety of software with the potential for a variety of questions. To increase ecological validity, I considered many factors when determining the Q&A populating process. For practical purposes, I had to ensure that the Q&A contained questions every participant could answer. Furthermore, as described in

Chapter 3, content type and source may have an impact on a person's willingness to answer, with different question types appealing to men and women differently, so I varied and balanced the sources of content.

In all, I collected two groups of 40 questions about graphic design from Graphic Design Stack Exchange and Quora each by using various graphic design software as filters/tags/search terms. I had ten questions (five from Graphic Design Stack Exchange and five from Quora) from each of the following types of questions: seeking factual/troubleshooting information, workflows, opinions, and examples. Although the original questions usually requested answers for specific software, I made all the questions software agnostic to allow participants to answer any question regardless of known software.

Previous work also suggests that the number of existing answers can affect contributors' willingness to answer questions [37,55]. I randomized the number of answers per question from 0-5, ensuring that each question group described in the previous paragraph had the same total number of answers. The answers were sourced from the original questions' answers.

I created 50 users for the Q&A, 25 per group of questions. Based on suggestions that they may impact participation and engagement [74], I invented usernames and selected profile icons using various styles found online (realistic names, fictional character names, fantasy names, with and without numbers and symbols; photographs, cartoons, images of popular media, people, animals, symbols). As I wanted to see if homophily can play a role in participant behaviour and perspectives when using the Community Presence interfaces, I generated characteristics for each of the users, ensuring a variety of combinations of characteristics. The users' characteristics were randomized with the following constraints: there were 40 men, 40 women, 10 non-binary users for gender; a distribution in age from 18-65 (the curve leaning towards the younger end of the range), with randomized regions, software, product, and specialization (where each one had a minimum of one and a maximum of nine). I randomly assigned each question and answer to a user as its asker/answerer and randomly assigned users as question viewers.

The question groups and their associated answers and viewers were assigned to participants in a round-robin fashion.

5.2.4. Procedure

After confirming the participant's graphic design abilities, I met with the participant for an initial meeting. I explained the study's purpose and the procedure (see Appendix E.3 for this meeting's script). The participant filled in a consent form (see Appendix E.4), a demographics questionnaire (which included identifying the characteristics needed for the Community Presence interfaces) (see Appendix E.5) and received $25 CAD.

Following the initial meeting, the participant used the first assigned interface for a period of five days to ensure that they got familiar with the interface, were able to fully explore it, and had time to do research if needed to answer Q&A questions without researcher pressure. I instructed the participant to try to use the Q&A every day and to answer at least one question per day (but to answer as many as they felt comfortable answering). To reduce participant posting anxiety and workload, and as reassurance that their content would not be judged or be misleading to potential readers, I told the participant that the community was constructed and static, but that the participant should otherwise pretend that it was real and to try to behave as they do with live online communities. After the five days, the participant filled in a post-interface questionnaire (see Appendix E.6). Once the questionnaire was submitted, the participant could access the second interface, where they followed the same procedure as with the first interface.

After filling the second post-interface questionnaire, the participant and I met once more for a semi-structured interview. These interviews ranged from 30-60 minutes, and focused on the participant's thoughts on the Community Presence interfaces and the participant's feelings and perceptions of the community as they were using the Q&A. As part of the interviews, I introduced the interface that the participant did not use to elicit initial comparative reactions. The participant received $125 CAD at the end of this session. See Appendix E.7 for sample interview questions.

5.2.5. Data Collection and Analysis

The primary data-collection method for participant interface preferences and perspectives was the semi-structured interviews. In addition, the Q&A prototype collected which questions the participant viewed/clicked on and answered, and I had the post-interface questionnaire administered twice per participant. The questionnaire had 35 Likert-like questions, taken from questionnaires used to measure SPA [11,73,113], homophily [124], engagement [139] and sense of community [1,43] (see Appendix E.6).

All interviews were fully transcribed, and participants could request to review their transcripts (16 participants requested to review their transcripts). The transcripts were then analyzed thematically: I grouped participant quotes by similar topic and feeling, then assigned thematic labels. A second researcher reviewed the groupings and themes, rearranging the quotes according to her interpretations and modifying the labels. Together, we then went over the quotes and themes again, discussing our interpretations and revising the labels until we were in agreement [125].

Participants rated their agreement to the 35 questions on the post-interface questionnaires using scales of 1 (strongly disagree) to 5 (strongly agree). The answers were then summarized into three summative values: sense of SPA, sense of homophily and sense of engagement (the scales for sense of community having been combined into the others). I compared quantitative means (number of questions answered and clicked on, the three summative values) using a two-way ANOVA and report results as significant if $p < 0.05$.

5.3. Results

The task-based field deployment study revealed mixed participant reception and perceptions of having community presence information available in a Q&A. All participants had a clear preference between the Baseline interface or their assigned Community Presence interface. As Figure 8 shows, overall, participant preferences are generally evenly spread out with no clearly preferred interface across participants. The findings shed light on how and why participant perceptions diverged.

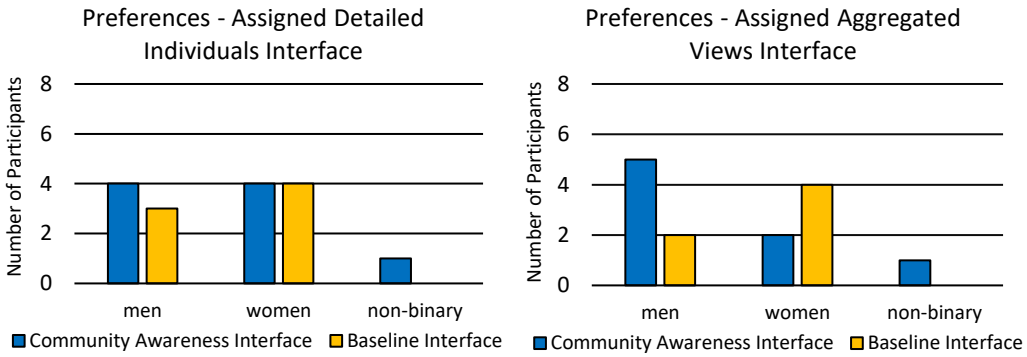

Figure 8: The distribution of participant interface preferences.

5.3.1. Perceptions of Potential Uses and Usefulness of Community Presence Information

Although I saw consistency in participant responses on the potential uses of the community presence information, their opinions differed on their perceived usefulness in a Q&A. The interview themes shed light on what participants saw as important factors when determining their position in terms of humanizing the Q&A, of using homophily and heterophily to promote inclusive environments and of privacy implications. I also found some differences between men and women, particularly about the potential role heterophily can play in inclusivity. When presenting interview quotes, identifiers that start with M are from participants that self-reported as men, W as women, and N as non-binary.

Community Presence Information Humanizes the Q&A: Almost every participant explained how the community presence information shifted how they viewed the Q&A; greater focus was placed on the users as opposed to the content. Participants had mixed feelings towards this change of focus. Some participants suggested that this was a good thing and felt like it was easier to engage and interact with the Q&A.

> *I think because of the percentages below each question, it made me think more about the community [with the Aggregated Views interface]. [With the Baseline interface], I just skimmed through the previous answers. (M01)*

> *The [Baseline interface] was more like a Q&A with people you don't know. The [Detailed Individuals interface] for me looked more like a forum, that you have people that are similar, always there, hanging out, helping each other. The [Baseline interface], I didn't feel like that, even though the [users] were the same. (M08)*

Many of the participants who viewed this shift positively described this effect as humanizing the Q&A. They felt like the displayed characteristics gave life to the other users and made them more "real," to the point that some participants wondered if the other users were in fact, other participants in the study (despite understanding that they did not see content from other participants). In contrast, participants often used the word "bot" to describe the users that appeared on the Baseline interface.

> *It was nice because as I said, it felt like someone real. It felt real. It felt like a real community. […] I could get some information from this person, not just this person has this question, or just someone with another username and nothing attached to it. (W02)*

> *For the [Detailed Individuals interface], [the users] didn't feel like bots. They felt like real people. So, because they had names that I knew they had interests that I could have read. (M13)*

Participants receptive of the humanization of the Q&A saw positive changes to their perception of the Q&A. M08 described that he felt greater empathy for users asking questions. He felt a greater desire to be helpful as opposed to his usual behaviour.

> *[I] started to care about those icons that said [I was] related to a real person. […] I would [do research] for [people]. In the [Baseline interface] maybe I would just put a "Google it" you know? "Google it, man, it's an easy question, it shouldn't be there. It's so easy that it's not good for the community to be that naive." But in the [Detailed Individuals interface], maybe I would be more empathetic about that. I would do the extra mile for them. (M08)*

M04 and W12 additionally described that humanization affected their trust in the content: M04 described the users with community presence information (i.e., characteristics) as more trustworthy and reliable, while W12 described the content on the Baseline interface as being less trustworthy.

> *I think more interest is developed, you have that authenticity, I don't know the exact word. But it feels more reliable, it doesn't feel like a bot is answering or something like that. (M04)*

> *I wouldn't trust the answers [on the Baseline interface] nearly as much […] versus on the [Detailed Individuals interface]. (W12)*

Other participants felt negatively about shifting the focus from the content to the users. A few participants expressed they would feel unwanted pressure to participate or would be

more self-conscious about their participation if their presence were known to other users, especially if they did not answer questions.

> *If I open the question [and] did not answer, I would not like for people to see that it was me. Maybe [they would] feel ignored or something like that. – W06*

> *Then it also kind of makes me feel like [I'm being rude] if I'm on the site and then I view [a question], but then I don't answer it, so there it creates this weird interaction I feel. Where you know it makes me self-conscious when I shouldn't be self-conscious and there's no reason to be. (M02)*

Finally, some participants (men and women) expressed that community presence information simply does not belong in a Q&A despite any advantages it brings and understanding that other people may find it useful. They explained that Q&As are for knowledge-sharing and that socializing is not important for this task.

> *I kinda don't care about people. Ok, I want to help and be helped but when I [am in a] graphic design community […], I'm just in for the content, not [to] make friendships. (M05)*

> *For me I'm just [using this kind of platform] to help teach, whereas others might actually use it for this kind of [community presence] information. (W13)*

Based on the interviews, participants consistently explained that their perception of the Q&A changed because of the community presence information: a greater focus was placed on the users and the community as opposed to the content. Participant reception of such a shift in focus was quite mixed, however, with participants diverging on the value it can provide to a knowledge-sharing platform.

Homophily and Heterophily Can Both Promote Inclusive Environments: In general, participants, regardless of gender, felt like they had an easier time relating to and feeling included in the communities when using the Community Presence interfaces than when using the Baseline interface because they could see active users similar to themselves. For example, W11 explains how knowing that someone is from the same place as her, makes it easier to connect with them, W03 describes how it is easier to fit in with others like her and N01 describes how they chose to see content posted by people similar to themselves:

> *[W]hen someone's from the same place as me for some reason it makes me feel like we connect in some way. (W11)*

> *The thing that caught my eye […] the first time [is the list of similar users]. I will look for the similarities. […] I would look for that because it gives you a sense of fitting in. (W03)*

> *[I was] more interested in seeing what people like me would say. Yes, so if there were two like similar questions [I] picked the one that had more people in my demographic. (N01)*

The above responses assume that there are similar users viewing questions to begin with. One woman mentioned that she might consider viewing questions with no women viewers to ensure that women are represented, suggesting that there needs to be a "starting point" that could welcome future users.

> *[I]f it was like 0% of the people who answered this question or viewed this question are women and I would be like, "hey we need some representation," I might view the question. (W07)*

Although my goal was to use homophily to affect perceptions of the Q&A, some women talked about the effects of heterophily, while men and non-binary participants did not. As opposed to homophily, where people are likely to engage with others with similarities, heterophily is the phenomenon where people are likely to engage with others with differences [158]. With the Detailed Individuals interface, women welcomed seeing users and their characteristics, whether the characteristics were the same as theirs or not. On the other hand, women could only see how many users matched their characteristics with the Aggregated Views interface and wanted these numbers to also include viewers that were unlike them. For example, W07 and W05 appreciated seeing geographically and gender diverse users.

> *If you ask a question, you assume everyone is this white dude from North America. And so it was really nice to see like there is like a diversity of people answering. (W07)*

> *[I]t's important to feel like I'm in a global melting pot. [People] have different qualities of life around the world as well. So, you may be thinking that like everyone is using Photoshop, but for someone in Zambia, where I am, or in South Africa, where I'm from, Photoshop might be expensive. (W05)*

To summarize, most participants saw value in seeing viewers with similarities to themselves. However, women in particular desired to see (more) information about diverse viewers. Homophily and heterophily can potentially both be used to promote inclusive

Q&As, as participants said seeing similar users to themselves helped them feel like they fit in, and women described seeing diverse users as a signal that everyone is welcome regardless of their circumstances.

Integrating Community Presence Information has Privacy Implications: Participants' heightened awareness of other people viewing the Q&A came with some costs, especially as information is needed to populate the user profiles. Some participants using the Detailed Individuals interface had privacy concerns with sharing information about themselves, even if they recognized the information as not being personally identifying; they did not trust how other users would use or interpret such information. No participants using the Aggregated Views interface had such concerns, perhaps because the data was aggregated.

> *[It's] common on social media that [people] send, I don't know, some not good things to your profile when you can chat with them when they know you're a boy or a girl. (M10)*

> *I'd like to see something like that, how others are seeing me right now. Maybe it's difficult because of the data is personalized so they're going to see different from me. I don't know how they're going to see me. I was worried about that. Because if I wanted to make an impression, I didn't know how they're going to see me. (M08)*

There was even one participant concerned that some users might put in false information in their profile for deceptive purposes.

> *Like on [social media] they'll say they're a woman when they're a man. People feel more inclined to like get close to them. There's a lot of deception on the Internet. (W05)*

Some participants phrased their heightened privacy concerns using the Community Presence interfaces as an advantage. Since they could see other viewers' information, they had a clearer idea of how their own information was being shared. With the Baseline interface, they knew information was being collected and shared, but nothing precise.

> *Because of the […] percentages that were shown [on the Aggregated Views interface], I was more conscious about [the characteristics] that [I was publicly sharing]. (M01)*

> *I think with the [Detailed Individuals interface] I just kind of had this sense of like […] I'm in a group, and these are the only other peers. I feel this is what they're sharing, like it was kind of like I had less privacy concerns because it felt like other people were also sharing stuff. (W12)*

In short, although participants did have privacy concerns about having to share more information, there was an upside, that community presence information showed how that information was being used.

5.3.2. Impacts of Community Presence Information on Behaviour and Questionnaire Responses

In the interviews, the majority of participants reported intentionally trying to behave identically using both interfaces (e.g., answer a precise number of questions per day), and tried to give the same answers both times they filled the questionnaires. I believe this happened in part because I did not emphasize interface comparisons as part of the study to participants, but rather as an exploration that could help us better understand using interfaces to work towards gender inclusivity. Some participants explained that they behaved similarly across their assigned interfaces because they believed that otherwise, they would be inconsistent and misrepresent themselves or even their gender. In addition, I am cognizant of anchoring effects when participants fill the same questionnaires multiple times [30]. Therefore, when comparing quantitative means, I only consider data from participants' first-assigned interface and so have *Gender* (man vs. woman) and *Interface Type* (Community Presence interface vs. Baseline interface) as between-subject factors. I did not compare *Enhancement Type* (Aggregated Views interface vs. Detailed Individuals interface) nor include non-binary participants due to data sparsity. In future work, it will be important to include non-binary participants in quantitative analyses to get a complete picture.

I logged the number of answers posted and questions clicked. I also calculated three summative scores from a questionnaire administered after each condition (but as described above, only analyzed data from the first condition). In all, I analyzed the means of seven men and six women using the Baseline interface and seven men and eight women using a Community Presence interface. All quantitative data were analyzed using a two-way ANOVA. In this section, I describe the results in detail, see Table 4 for a summary.

Participant Usage and Contributions: To get a sense if participant usage would change between interfaces, I compared the number of answers they posted and the number of questions they clicked on between interfaces.

I saw a main effect on *Gender* for the number of answers posted ($F_{1,24} = 10.454$, $p = 0.004$), where men (Baseline: 16.143, Community Presence: 17.714) posted more answers than women (Baseline: 10.500, Community Presence: 8.000), replicating previous findings in Chapter 3 and prior work (e.g., [123,201]), but I saw no statistically significant effect on *Interface Type* ($F_{1,24} = 0.038$, $p = 0.847$) and no interaction effect of *Gender* × *Interface Type* ($F_{1,24} = 0.735$, $p = 0.400$).

Variable	Baseline interface		Community Presence interface		Effects		
	Men's Means (*SE*)	Women's Means (*SE*)	Men's Means (*SE*)	Women's Means (*SE*)	*Gender*	*Interface Type*	*Gender* × *Interface Type*
Answers posted	16.143 (3.247)	10.500 (1.875)	17.714 (2.714)	8.000 (1.195)	**$F_{1,24} = 10.454$ $p = 0.004$**	$F_{1,24} = 0.038$ $p = 0.847$	$F_{1,24} = 0.735$ $p = 0.400$
Questions clicked on	22.143 (3.225)	22.333 (2.848)	26.286 (3.006)	13.375 (2.203)	**$F_{1,24} = 5.051$ $p = 0.034$**	$F_{1,24} = 0.724$ $p = 0.403$	**$F_{1,24} = 5.358$ $p = 0.029$**
SPA min: 13, max: 65	43.429 (1.938)	42.500 (3.233)	44.429 (2.644)	41.875 (2.601)	$F_{1,24} = 0.441$ $p = 0.513$	$F_{1,24} = 0.005$ $p = 0.944$	$F_{1,24} = 0.096$ $p = 0.759$
Homophily min: 11, max: 55	35.143 (2.064)	40.833 (3.506)	38.857 (3.188)	31.125 (1.807)	$F_{1,24} = 0.150$ $p = 0.702$	$F_{1,24} = 1.290$ $p = 0.267$	**$F_{1,24} = 6.470$ $p = 0.018$**
Engagement min: 11, max: 55	42.571 (2.359)	44.333 (3.127)	44.571 (2.716)	38.125 (1.726)	$F_{1,24} = 0.909$ $p = 0.350$	$F_{1,24} = 0.733$ $p = 0.400$	$F_{1,24} = 2.791$ $p = 0.108$

Table 4: Results from interface usage and questionnaire data divided by *Interface Type* and *Gender*. Statistically significant main and interaction effects are bolded.

As for question clicks, I also saw a statistically significant main effect of *Gender* ($F_{1,24} = 5.051$, $p = 0.034$) but not of *Interface Type* ($F_{1,24} = 0.724$, $p = 0.403$). I did see a statistically significant interaction effect of *Gender* × *Interface Type* ($F_{1,24} = 5.358$, $p = 0.029$). As illustrated by Figure 9 (left), it appears that men clicked on more questions using the Community Presence interface (26.286) compared to the Baseline interface (22.143), whereas women clicked on almost half the number of questions using the Community Presence interface (13.375) compared to the Baseline interface (22.333). This could mean

that women did not need to click on as many questions to obtain the information they needed to pick which questions to answer, with the information on the question feed (i.e., the community presence information) sufficing. It is also possible that the women did not use the interface as much, but the other findings do not lend much support for this interpretation.

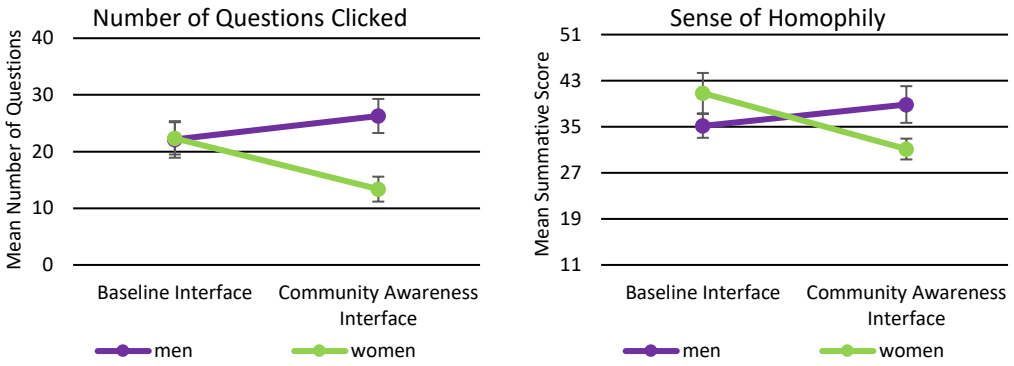

Figure 9: Mean number of questions participants clicked on (left) and participants' sense of homophily (right). Error bars represent *SE*.

In summary, I did not observe many changes in behaviour. However, this also potentially suggests that the community presence information did not prove to be too distracting from the task.

Participant Sense of SPA, Homophily and Engagement: To compare participants' sense of SPA, homophily and engagement, I used three summative scores from the questionnaires. The summative scores could range from 13-65 for the sense of SPA and 11-55 for both sense of homophily and engagement, where a low score demonstrates a low sense of SPA/homophily/engagement. In calculating the summative scores, I inverted the scores for any negative statements (e.g., a 1 for "I felt as if I was alone in the community" was converted to a 5 for the SPA score).

Looking at sense of SPA, men (Baseline: 43.429, Community Presence: 44.429) and women (Baseline: 42.500, Community Presence: 41.875) had similar scores: I did not see a statistically significant main effect of *Gender* ($F_{1,24} = 0.441$, $p = 0.513$) or of *Interface Type* ($F_{1,24} = 0.005$, $p = 0.944$), nor an interaction effect of *Gender* × *Interface Type* ($F_{1,24} = 0.096$, $p = 0.759$).

As for scores for sense of homophily, I did not see statistically significant main effects of *Gender* ($F_{1,24} = 0.150$, $p = 0.702$) or *Interface Type* ($F_{1,24} = 1.290$, $p = 0.267$). However, I did see a statistically significant interaction effect of *Gender* × *Interface Type* ($F_{1,24} = 6.470$, $p = 0.018$). Looking at Figure 9 (right), there is a slight increase for men comparing the Baseline interface (35.143) to the Community Presence interface (38.857) and a decrease for women between the Baseline interface (40.833) and the Community Presence interface (31.125). There is some support for this difference from the interviews: women seemed to be more sensitive to heterophily and diversity, with the Community Presence interfaces making this information more easily available, heterophilic responses could have been stronger than homophilic ones.

Finally, for sense of engagement, men (Baseline: 42.571, Community Presence: 44.571) and women (Baseline: 44.333, Community Presence: 38.125) again had similar scores, with no statistically significant effect of *Gender* ($F_{1,24} = 0.909$, $p = 0.350$), of *Interface Type* ($F_{1,24} = 0.733$, $p = 0.400$), or of *Gender* × *Interface Type* ($F_{1,24} = 2.791$, $p = 0.108$).

5.4. Discussion

This study has shown that community presence information has potential to change user perceptions of a Q&A by humanizing it, by promoting a more inclusive environment and by increasing user privacy awareness. On the other hand, some participants felt that such information does not belong in a Q&A because it detracts from the content, and some were concerned about privacy implications. Below I elaborate on my findings and promising directions for future research. I also discuss limitations of this study.

5.4.1. Community Presence Information: Choosing When and How to Reveal Personal Characteristics

Participants mentioned that community presence information humanized the Q&As. In particular, the focus shifted from the content to the Q&A users, potentially increasing participant trust of content and empathy towards other users. Participants also mentioned feeling a heightened sense of homophily seeing that they share characteristics in common

with viewers. I saw these perceptions expressed with both Community Presence interfaces, despite their differing levels of detail.

The women expressed some feelings of heterophily, which is generally not well supported by the Aggregated Views interface, since it only shows viewers with the user's characteristics. I considered showing summaries of all characteristics on the Aggregated Views interface but was concerned about presenting an overwhelming amount of information that would, as a result, de-emphasize the similar viewers. To address this concern, some participants suggested that the information could potentially be available on demand. However, these same participants then mentioned that this might start transforming the interface from showing community presence to an analytical tool to better understand community composition and interests. In short, it appears that organizing user characteristics into user profiles is a promising compromise for showcasing community diversity.

Some participants expressed privacy concerns with community presence information, including that too much information might be shared, and that the information is shared upon question viewing (as opposed to when answering a question). For the study, I assured participants that any information they provided (including their characteristics) would be anonymized and used for research purposes only. I did ask participants which of the characteristics they would be (un)comfortable sharing given a live deployment. While many participants did not have strong feelings on the matter, some participants were concerned that this information could potentially be used maliciously, for example, to harass women, which is a well-known phenomenon on the internet (e.g., [71,110,154]). Furthermore, some participants explained that showing their activity to others could cause undesirable pressure to participate. Sharing characteristics and activity might make some users feel even more vulnerable than they already do, potentially widening the participation gap I would like to close.

I chose to show viewers as opposed to active contributors on the interfaces to highlight a wider range of community activity. Showing only question askers and/or answerers might help users feel a higher degree of control over their presence: when asking or answering a question, a user has already consciously decided to signal their presence. On the other hand,

showing only active contributors would skew community presence to those comfortable contributing content. One potential compromise would be to allow viewers to opt-in/opt-out of having their presence displayed. This would increase flexibility at the cost of additional interface complexity. It would also impact how the community is represented.

In my implementation, participants were required to provide data for all six of the characteristics used by the interfaces. This decision was primarily for study purposes: I wanted to ensure that the interfaces could compare participants with my fake users with the intent of prompting homophilic responses. However, it is unclear if Q&A users would be willing to create and maintain profiles in the first place. Both participants that did and did not see potential in the approach said they would be willing to provide their characteristics, but they might have said so just to please the researcher [39]. Compounded with the privacy issues mentioned above, it would be reasonable to assume hesitance from Q&As users to provide personal information.

Future versions could give users the option to not provide data for all characteristics or hide their choices from others. While this might alleviate some of the privacy concerns, the benefits of my interfaces in promoting homophilic and heterophilic responses do rely on sufficient community data. Another possible solution would be to reconsider the list of characteristics to ensure that there is enough for users to feel comfortable supplying at least some data. For example, participants offered ideas ranging from graphic design skill level to specifying favourite books, movies, and food. Users could therefore tailor how the interface supports homophilic and heterophilic responses. Another approach would be to collect user characteristics, but not display them to others. However, users may become mistrustful of a system that does not explain how it determines similarity [195]. Future research could also consider different approaches for prompting homophilic responses, for example, by matching content authors using their writing styles.

I populated the interfaces with fake users and ensured all characteristics were represented with no strong imbalances (e.g., 40 men, 40 women, 10 non-binary users). The goals in doing so were twofold: I wanted to ensure that a participant with any characteristic would be able to see users with the same characteristics; and large community imbalances in representation can negatively impact participation [88]. Real Q&As tend not to have such

balanced representation. For example, Quora and Stack Overflow have more men than women users [150,180]. It is possible that explicitly displaying characteristics could increase the risk of creating a vicious cycle: seeing that a community has low representation might in fact discourage someone from participating. These issues are more evident with the Aggregated Views interface than with the Detailed Individuals interface. The Aggregated Views interface provides a global view of community demographics, including any imbalances, whereas the Detailed Individuals interface show only select viewers. The composition of this set of viewers has the potential to deemphasize imbalances (e.g., a woman user could potentially see only other women viewers in this list). In fact, it is possible that "similar, underrepresented viewers" could end up being overrepresented in the Detailed Individuals interface, but I do not consider this to be a problem, as the interfaces are meant to emphasize user similarities. Additionally, prior work about skewed community demographics tend to refer to posted content only; viewer demographics are more challenging to collect but might not be as skewed as active contributors. Further research is needed to understand this impact.

5.4.2. Using Community Presence Information to Improve Women's Participation

My motivations for including community presence information for promoting a sense of SPA and homophily include improving social dynamics in Q&As, and eventually working towards solutions that increase participation from women. This study suggests that this approach is a promising initial step towards these goals, despite some resistance from participants.

Using community presence information, I aimed to prompt a homophilic response from participants. My intent in showing that there are users similar to participants using the Q&A was to create stronger feelings of belongingness, especially since gender homophily is stronger among women than men [7,106]. Although the findings support this assertion, women clarified that seeing a diversity of users has the potential to encourage them to keep using the Q&A. How an interface might simultaneously support both phenomena is an interesting design problem. For example, one might consider showing similar community members to a new user, but gradually increasing the number of diverse members to encourage retention.

The women participants clicked on fewer questions. They did not exhibit this behaviour on the Baseline interface, nor did men on any interface. This suggests that women obtained more information they needed to pick which questions to answer from the question feed, potentially showing stronger interest in the community presence information compared to the men. The other gender-related quantitative results did not show strong effects, apart from the number of questions answered (which is unsurprising given prior work [123,201]). Thus, this study did not demonstrate strong positive gender effects, but also did not show signs of the extra awareness information causing a significant distraction. Given that participants were required to answer at least one question per day, it is also possible that I have not captured participants' natural sense of engagement. As for SPA, most of the questions asked about participants' awareness of user activity, and it might have been difficult for participants to look past the mock, static community we created. A longer-term, more open-ended deployment is needed to better understand the impacts on women's participation and engagement.

In my interviews, one participant clearly expressed that he felt more empathy for people asking questions when there was community presence information and I saw similar inklings from other participants. These sentiments suggest that community presence information could potentially assist in creating a collaborative or collectivist environment. Currently, Q&As are quite individualistic and competitive [120], which is a deterrent to participation, especially among women. The findings suggest that if community presence information can lead to collaborative environments, Q&As might have greater appeal among women, who already display supportive and community-oriented values [221]. In addition, we might see increased participation from others with collectivist outlooks who do not feel included in Q&As [142].

Although community presence information has potential to improve women's participation in Q&As, some men and women participants felt that this information does not belong in Q&As. They felt that the Q&A would shift from a knowledge-sharing community to a social networking one. Many users go to Q&As for knowledge-sharing, and some might think that exclusively social features distract from this objective. It is possible to hide social features from users who do not want them, but social dynamics could still change and

cannot be "toggled off." I argue, however, that this concern is a bit of a contradiction, seeing that Q&As are both social communities where people interact with each other, asking, answering and voting on questions, as well as networking environments, where people can find new connections and professional opportunities, among other potential avenues for advancement [52,175,222,223]. It is not certain if Q&As would "further become" social networks: additional social features enhance this aspect of the interaction, they do not replace the goal of asking and answering questions. These contrasting views could be a signal that there is a mismatch between how different people define Q&As and what they desire Q&As to be. Many participants mentioned that humanizing Q&As is a positive, while it appears that some people want Q&As to focus on the content and be unbiased knowledge sources (which, tends to bias content men prefer [33], and is difficult, if not impossible, to attain in general). This desire to maintain the status quo highlights that Q&As have structural issues that need to be studied and opens interesting questions about what people believe to be ideal Q&As, what kinds of interactions should occur in Q&As and how to balance these different preferences.

5.4.3. Moving Beyond Community Presence Information and Q&As

In this chapter, I investigated how community presence information can be used to work towards improving feelings of socialness in Q&As. Social presence and awareness and homophily are not the only two components of social interaction, nor is community presence information the only way for an interface to take advantage of social phenomena. For example, one can consider allowing users to use alternative feedback mechanisms rewarding good social behaviours [119] or to form sub-communities to support one another in the sometimes overwhelmingly large Q&As [57]. Combining and comparing solutions, so that they interact as a whole will be an interesting challenge, particularly as feature awareness in Q&As is a deterrent reported by more women than men [57]. It is important that any new features integrate well with existing mechanics and are easy to discover, understand and use.

I also uncovered that community presence information has the potential to change users' focus from content to community members. Participants felt like their attention was drawn to users displayed on the interface, raising the perceived relative importance of those users.

Similar designs could be used to direct user attention to one part of a Q&A over another, impacting community norms or values. For example, an interface could highlight users exhibiting good behaviour (however "good behaviour" is defined by the community), or Q&A topics that could use more attention, in addition to showing similar users. More research is needed to understand the possibilities and full implications of these impacts.

Q&As are for asking and answering questions about a particular topic and so I could leverage information gathered through these tasks (e.g., question views). Other platforms may have different uses and/or contexts, which may not provide the same or any information that could be collected implicitly. For example, it may not make sense to use "views" as community presence information for community-contributed software tutorial comments (which are usually all displayed on the same page) or for in-software help (which do not have traditional help browsing interfaces). Q&As are also composed of questions, which are discrete entities that I could use to identify user presence. In general, exploring how to share community presence information on other knowledge-sharing communities present interesting future work.

5.4.4. Limitations

In the ten-day task-based field deployment study, I populated the interfaces with ecologically valid content, however, they were not powered by live communities. Although this was done intentionally, so that participants would not need to be concerned about community criticism, it may have increased their confidence levels beyond what they would exhibit in a live community. Additionally, to guarantee that participants would have sufficient exposure to the interfaces, they were asked to answer at least one question a day. The most significant impact of these two decisions would be on the number of answers that participants posted: it is likely that it is higher than what participants would have posted on a live Q&A. Long-term field studies would allow participants to engage with community presence information in a natural setting, raising ecological validity. Long-term studies are also needed to see permanent effects on user behaviour [140].

Furthermore, my interfaces did not contain some features that are commonly found in Q&As. Popular features include commenting on questions and answers, and reputation

systems. I did not include these features to focus the study on the community presence information. These other features, however, do have a significant impact on gender participation (e.g., [162,200,221]). It is possible that the design of these features excludes certain people, among them women, that inclusive elements, potentially such as community presence information, might not be enough to overcome this exclusion. Future research should examine how integrating community presence information in fully-featured Q&As might help encourage more gender-diverse participation.

Two potential limitations of the study are the self-selection [167] and novelty effects [96]. Respectively, these effects describe biases in the study, such that participants are self-selected and keen to participate in the study; and that new systems are novel, which increases participants' interest in using them. Sometimes, both effects are included as part of the Hawthorne effect, describing that participant behaviour changes simply by being observed in a study, although its definition and existence are controversial [96,116]. Altogether, these effects suggest that participants might have behaved in ways that would lead to more positive findings than had they encountered the interfaces in the wild. Although it is possible that these effects did impact the findings, I argue that the study method limits the extent of their impact. An important data-collection method was the semi-structured interviews, which gave insight in participant behaviours during the study, allowing me to explicitly consider the impacts of these effects [116]. In addition, many participants described the Baseline and Community Presence interfaces as equally novel, which is supported by the mixed preference data. I do acknowledge, however, that participants might still have been biased to provide positive feedback [39].

Finally, the study had a relatively low number of participants considering the between-subjects analysis I used for the quantitative data. A study with a larger number of participants would give a clearer picture of usage differences between genders and interfaces. I also had an insufficient number of non-binary participants to include this group in the quantitative analyses. For studies to be fully inclusive, the number of non-binary participants should ideally be balanced with the number of men and women.

5.5. Summary

I presented an investigation into using community presence information to improve Q&A users' sense of social presence and awareness, and homophily, with the eventual goal of promoting participation by women. Based on interview and questionnaire data of a ten-day task-based field deployment study, I found that community presence information can humanize a Q&A, promote an inclusive environment, and increase privacy awareness. These findings suggest many different potential avenues for further researching how Q&As can use community presence information to foster healthy social dynamics and encourage participation from women.

Chapter 6

Considerations for Researching Gender and Online Communities

In this chapter, I reflect on the findings and methods across all three studies and discuss how they contribute to the goal of building more gender-inclusive online communities. I consider the importance of involving gender diverse population in research, as well as the challenges I faced in doing so. Additionally, I discuss how I used the study methods to investigate online communities, but that they provide only a first step in developing more inclusive online communities and that there are other perspectives that need to be taken into account.

6.1. Involving Gender Diverse Populations in Research and Design

With this thesis, I sought to answer if and how gender differences manifest themselves in Q&As, and to identify how Q&As can potentially be made more gender inclusive. Q&As aim to be welcoming of everyone and do work towards that goal (e.g., Stack Exchange's Code of Conduct offers tips on how to be friendly [174]), and I believe that it is fundamental that underrepresented people feel safe and that they belong. After uncovering gender differences in Q&As, I explored how Q&As could be modified to be more inclusive through prototyping and the task-based field deployment study. In this section, I offer

reflections on the importance of including gender considerations in research and design, and on some of the challenges I faced conducting gender HCI research.

Gender HCI research often treats gender as a binary construct [91]. Not only is this false, as there are more than the masculine and feminine genders, gender is a multi-dimensional spectrum and people do not fall neatly in one category or another. For example, some men have more feminine characteristics than others and some women have masculine characteristics. Not only is it important that research be attentive about not reinforcing gender assumptions [206], but should also consider that these characteristics manifest themselves in how people interact with systems more strongly than their "assigned gender" [9,204]. Furthermore, gender is complex and multifaceted. It can be used to simply describe multiple personal characteristics, in a sense, used as a proxy variable for other characteristics [92]. In other words, researchers sometimes use gender to generalize and combine other user characteristics, such as confidence, communication skills, sociability, problem-solving abilities, and internet usage skills. Throughout this thesis, the primary variable I studied was gender, but it is likely that studying some of these other, specific characteristics can better help understand how to make Q&As more inclusive. This reinforces the point that it is not sufficient to "design for women," but to involve everyone in the design process, including women and people of diverse genders.

Ensuring that all perspectives are taken into account will lead to greater inclusivity, but it will not lead to one ideal, "most inclusive" interface solving all issues regarding exclusion. I developed two interfaces to investigate the potential of using community presence information to work towards gender inclusivity, but I do not believe there will be a one-size-fits-all solution to ensure equitable participation. It is likely that a collection of features and/or interfaces will be needed to make communities fully inclusive. For example, prior work suggests that reputation systems are appealing among men [221], while I found support for social interfaces among women; combining features and possibly allowing feature personalization could allow everyone to have a community design they find appealing. Determining how feature combinations and personalization can be integrated in online communities will be important future work, but it is essential that people of diverse

genders are involved in this research to ensure proper representation in feature development.

A further advantage of involving people of underrepresented genders is the curb-cut phenomenon. The curb-cut phenomenon describes how considering the needs and desires of one audience can unintentionally, but positively impact other user groups. The term originates from regulations requiring adding curb ramps to sidewalks to make them accessible to people using wheelchairs – this requirement also made sidewalks easier to use for people pushing strollers, luggage or carrying heavy loads [148]. In software design, explicitly considering women also offers benefits to men (i.e., by correcting interaction failures among women, we can also correct interaction failures among men that were not initially considered as failures) [204]. In the context of Q&As, designing inclusive communities will likely bring benefits to men as well, possibly those new to graphic design and unconfident about their skills, for example. The aim is to ensure inclusivity (for everyone) by addressing areas that might not be fully inclusive yet.

It is in this spirit of inclusion and creating universal designs that I specifically advertised in GSRM (gender, sexual and romantic minority) groups. Research often excludes non-binary people from studies or surveys by *othering* them, or by simply not allowing someone to self-identify beyond binary genders, effectively erasing them from wider contexts [135]. By excluding non-binary people from research, they are excluded from user populations we are developing and designing for, perpetuating a cycle of exclusion [79] and undermining inclusivity. Unfortunately, the perspectives of non-binary people are largely absent from my findings, except from the qualitative results of the task-based field deployment. Although I suspect that non-binary people would benefit from efforts to improve gender inclusivity, they might also face deterrents that men and women do not.

Motivated to work towards gender diversity in online communities, a primary objective in the second and third studies was to have the same number of men and women participants. According to census data, there are relatively equal numbers of men and women graphic design practitioners [182], but this balance did not manifest itself anywhere in my studies. The content analysis shows that women do not contribute as much content as men and despite advertising extensively in groups specific to women and non-binary people, such

as in GSRM and women in tech communities, I had to turn away men to balance the number of men and women in the interview and task-based field deployment studies. Without specifically advertising for men, approximately twice as many men than I included in our studies contacted me, expressing interest in participating (compared to having included every woman and non-binary person that contacted me). Furthermore, the number of (openly) non-binary people is far lower than either the number of men or women, with about 0.14% of Canadians over 15 years old identifying as non-binary [183] (with similar numbers according to other surveys [67]). Although the number of non-binary participants I had in my studies fits within this range and is therefore representative of the population, it is important to recruit more non-binary participants – like I did for women – to ensure that all perspectives are included. Without an appropriate number of participants [21], it becomes difficult to see trends, such as those I uncovered from statistical or thematic analyses of men and women's data.

A potential reason I struggled to ensure gender diversity in my participant groups, is that women [29] and non-binary people [66] face greater research fatigue than men. There is a lot of research conducted to investigate various issues women and non-binary people face, and especially in combination with the low numbers of non-binary people, it means that they are frequently asked to participate in studies. In addition, they face discrimination in their daily lives, and they often have to relive potentially traumatic experiences as part of studies [38], often with few to no visible benefits following this research [29]. Due to such increased emotional costs, potential participants might prioritize research that appear to be more impactful in their daily lives [77]. Although my research does not directly focus on lived experiences, research fatigue could be a factor that affected recruitment. As a potential solution, advertisements for studies should consider being explicit about what kind of involvement is (not) necessary to participate; my task-based field deployment study for example, did not need participants to share prior experiences with me, but potential participants might have assumed that such sharing was part of the study.

Overall, ensuring equitable gender representation in HCI studies is an ongoing challenge. I adapted my recruitment methods as time went on as I discovered new communities and opportunities. Unfortunately, the circumstances were less than ideal for using the recruiting

strategies I learned, as I ran the task-based field deployment study during the COVID-19 pandemic, limiting access to some local resources (such as clubs and other organizations). I emphasize the need for the HCI community to continually improve recruitment methods to ensure gender inclusivity in studies.

6.2. Investigating Online Communities in the Face of their Complexity

Online communities such as Q&As, are complex ecosystems involving interconnected and continually evolving components and characteristics, such as community members, social norms, technical implementation details and owners. In this thesis, I was able to capture some of these factors, and either analyze them directly (e.g., the posted data I used in the content analysis) or otherwise take them into account in my analyses and methods (e.g., the posted data informed the pre-populated content in the task-based field deployment study). Each of the studies had a particular focus, which, together, contribute towards painting a bigger picture of how Q&As can impact people of different genders' participation and perceptions. In this section, I discuss some of the aspects of Q&As and how they relate to this thesis.

One major component of Q&As that is significant in my work is the content that Q&A users contribute. I expended more effort than I expected to maintain the integrity of the data, to make sure that what I were analyzing was complete and correct; this includes resolving author genders and determining the type and tone of content. The content analysis required multiple techniques, including multiple researchers doing manual passes over the data, as well as using automated approaches. Collecting such data by asking interview participants directly (or otherwise contacting Q&A users directly without necessarily interviewing them) would have simplified this part of data collection. However, only using this method would mean I would only be able to collect a fraction of the content; it is unlikely that I would have obtained a response rate from hundreds of participants to match the content analysis's sample size. Furthermore, one advantage of carefully analyzing the content was that this method allowed me to address the cold start problem [163] when designing the task-based field deployment study. This problem describes the situation when a new community or system does not have enough content or users to showcase its

full potential, and new users do not have examples upon which to base their own participation and content. In preparing the third study, I was concerned that participants would not know how to participate if they did not have any example content to build upon. This is why I made sure that the interfaces were pre-populated with a diverse set of content and users. The content analysis was very useful to this end, it provided me with information about the variety of content found in Q&As.

A further factor of online communities that can be studied is the degree of interaction users have with each other in online communities. On one end of a hypothetical scale measuring "socialness", content is published for consumption but only allows simple user interaction after the fact (e.g., user comments on tutorials and blogs). On the other end, users collaborate to generate content in live environments (e.g., discussion forums and chatrooms). Current Q&As fall somewhere in the middle of these extremes, where people create content by asking and answering questions, but once the question is answered, the content is meant to be a part of long-lasting repositories. Some Q&As allow discussions to happen (including on Stack Exchange and Quora), but these discussions are relegated to de-emphasized comment sections under the primary content (i.e., the questions and answers). Through the combination of the content analysis, interviews, prototyping and reviewing prior work, I saw that the current level of emphasis on commenting capabilities does not seem to be sufficient to be inclusive. I observed how Q&A users naturally interact with Q&As and based on posting patterns, determined that women tend to answer subjective and socially-oriented questions; I heard from Q&A users that current Q&As do not seem to support social interactions very well despite users' desire to do so; and based on my ideation and literature survey, I saw that there is room for different approaches that could support or enhance social interactions in Q&As.

Based on the findings and prior literature, I inferred that adding community presence information to a Q&A could potentially improve interactions. Although this appeared to be a promising starting point for working towards improving Q&As' appeal among people of underrepresented genders, it is still unclear if (the lack of) social considerations of Q&As is a cause or effect of user gender imbalances. For instance, the lack of social considerations in Q&As could be due to there being few users who desire more social consideration, or

these people are absent from Q&As because of these missing considerations. In addition, although I see potential to work towards improving participation of people of underrepresented genders using community presence information, there might be other causes or deterrents from undeveloped or missing Q&A characteristics that are discouraging people's participation that would need to be addressed before significant positive changes occur.

In the end, participants had mixed feelings about adding community presence information to Q&As. Some of the concerns were to be expected but have clear paths to promising solutions, such as selectively sharing information. However, other points of concern might not have obvious solutions and were perhaps not well considered using my study methods. Community norms are one of the important factors that participants mentioned. It appears that community presence information does not fit with current norms well. In retrospect, concerns about community norms are woven throughout the findings of the content analysis and interview study (e.g., implied by which content receives more upvotes) and it is a primary point of concern that frequently comes up in Q&As (e.g., [119,120]). Stack Overflow, one of the communities under the Stack Exchange umbrella, recently tried to add a new "thank you" feature for users to give thanks to content authors [178]. It was soundly rejected by active community members with one important reason being the same one I heard from participants, that it does not belong in a Q&A and that Stack Overflow "should not become a social networking website" [179].

One of the specific criticisms of Stack Overflow's implementation of the "thank you" button was the lack of involvement from active community members in developing the new feature and that the focus was to appeal to the "lowest common denominator," that is, those users who might not become active (whether or not these users do become active is not certain) [179]. On one hand, these active community members' opinions carry influence in defining community norms, as they are part of the reason for the success of Q&As [120]. On the other hand, these users are those who already enjoy the privileges and most advantages of Q&As and might not have as much incentive to improve the community. In the case of this thesis, I feel that the people who participated in the studies were those who see value in graphic design Q&As, and that hope to see Q&As be

continuously improved, and/or those who are aware of gender issues in Q&As. These are people who are probably not as influential (or else they would already be using their influence for positive changes), but who use Q&As enough to want to see improvement. Seeing as active community members feel quite strongly against these social features, it might be appropriate to involve them directly in their creation. A participatory design study, for example, involving both active users that currently guide community norms, and users who feel excluded, could allow people with different experiences to have a voice in shaping approaches for enhancing social interaction while limiting concerns of transforming Q&As away from desired social norms.

Ideally, I would have captured and been more cognizant of community norms and other community factors during the task-based field deployment study, but it is difficult to do so without collaborating with existing Q&As. The content analysis captured a snapshot of two communities and the interview study helped provide context, but I was missing some important factors and information. Unfortunately, testing new ideas with people using live, existing communities would pose significant challenges. This approach would require substantial development work before being able to test if the idea of community presence information is even viable, including integrating the new features with any of the existing functionality. Furthermore, a live deployment would allow little control to the researchers, which could make it difficult to manipulate and analyze variables as needed. All considering, a task-based field deployment study allowed me to bypass these challenges, while investigating the viability of the idea. Now that it is clearer that the idea of adding community presence information can potentially improve inclusivity in a Q&A, doing live deployments could be an appropriate step moving forward.

6.3. Summary

In this chapter, I offered my reflections about the three studies I conducted. I explained how considering gender in research is valuable, despite its complexity. I explained the challenges of recruiting gender diverse participants, as well as some potential methods to use for overcoming these challenges. Then, I described how online communities such as Q&As are complex entities, how my studies complemented each other to investigate some

aspects of Q&As and discussed how social norms will be an important factor to study further when working towards improving gender inclusivity. I ended by suggesting what would be the ideal study method to have used, but why it was not suitable for this stage of investigating designs that could be used to improve gender inclusivity.

Chapter 7

Conclusion

Online software learning Q&As are not gender inclusive. Using a content analysis and an interview study, I demonstrated how current Q&As do not equitably support and appeal to people of all genders. Q&As appear to have more appeal among men compared to women, with women contributing far less content. Using a task-based field deployment study with prototype Q&A interfaces, I showed that additional community presence information is one way to add social elements with potential to be more gender inclusive than the status quo. In this chapter, I summarize the contributions this thesis makes to various areas of HCI and potential avenues for future work.

7.1. Thesis Contributions

This thesis makes empirical and artifact contributions to the areas of gender HCI and software knowledge sharing.

7.1.1. Contributions to Gender HCI

The three studies in this thesis focus on better understanding how Q&As can be more gender inclusive. Through the content analysis in Chapter 3, I show that men and women tend to author different types of content, write with language using different tones, and receive different levels of validation from the community. In Chapter 4, I describe how the

interview study identified differences in perceptions between men and women of Stack Exchange and Quora. Together, the two studies suggest that Q&As do not appeal to women as much as they do to men, potentially due to a lack of social considerations in their design.

This leads to the contributions of Chapter 5, where I conducted a task-based field deployment study of two prototype community presence interfaces. I uncover differences in perception and usage between men and women. Although the findings about preference are mixed and that men still contributed more content overall, I show that adding community presence information is an approach worth investigating further for advancing towards better gender inclusivity.

7.1.2. Contributions to Software Knowledge-Sharing

Through the content analysis and interview study, I show that Q&As as software knowledge-sharing platforms do not appeal to everyone. The mechanisms currently in place, such as reputation systems, are successful at encouraging quality content [120], but mostly among a particular audience – in this case, men.

I contribute two prototype interfaces and a task-based field deployment study which show one approach that could potentially lead to more inclusive communities. By incorporating additional community presence information in software knowledge-sharing community interfaces, information that is already collected, communities can work towards being more inclusive. As more diverse user groups feel comfortable sharing, content being created might become less biased and cover a greater variety of perspectives, increasing overall content quality. Furthermore, I show that community presence information can be used to shift users' perceptions from content to the community, which could be a tool for future community-based interfaces.

7.2. Limitations and Future Work

7.2.1. Generalizing Beyond Q&As and Graphic Design Software

For this thesis, I focused on Q&As about graphic design software. I believe that adding social consideration is quite feasible for Q&As for other types of software, although the details will need to be adapted (for example, the user characteristics about the kind of

graphics a user produces, as used in my prototypes, would make less sense outside of graphic design). Similarly, moving beyond software and into other Q&A topics, such as gardening or cooking, should be relatively straightforward. The required information I used to implement my prototypes are universal to all Q&As: users, views, questions, etc., are well-understood concepts across online communities. Provided that the information (i.e., characteristics) presented is adapted to the community's interests, I see little difficulty adapting my prototypes to other domains. However, the impacts of additional social considerations or users' willingness to adopt such changes might be different. For example, it is possible that communities surrounding more subjective-oriented Q&As (e.g., Workplace Stack Exchange, which is about interacting in the workplace), might have more positive feelings about social considerations of Q&As, as social considerations align more closely to those Q&As' purposes. More research is needed to investigate how community and Q&A characteristics might affect how people view social interface elements and interactions.

I focused my investigations on Q&As about graphic design software and my prototypes involved emphasizing one social aspect in Q&As. As I mentioned in Chapter 6, there are software knowledge-sharing communities with a different level of socializing, such as articles, tutorials, forums, chatrooms, classes, etc. Although it appears that Q&As are lacking social considerations, other types of online communities might have different needs for improving gender inclusivity. For example, if a community already heavily emphasizes social interactivity between users (e.g., chatrooms), it is unlikely that even more social considerations would have a significant impact on gender inclusivity. On the other hand, adding social considerations to a platform with little ability to socialize (e.g., tutorials) might not be appropriate, as the limited levels of social interaction might be what community members find appealing in the first place. Future investigations would have to consider the gender imbalances of these communities, determine what people of underrepresented genders would find appealing, and develop interface solutions suitable to those communities. Although confirming the viability of using social approaches to improve gender inclusivity in software learning communities would be valuable, it is possible that different approaches altogether would have to be considered.

It is also important to not treat improving social considerations or adding community presence information as a solution for all issues related to inclusivity. Emphasizing community presence and promoting participation can risk covering up deeper structural issues of online communities. Community members might be encouraged to participate *despite* existing issues, which could lead to a false sense of inclusivity. We have seen the potential to use community presence information to work towards greater gender inclusivity, and it could potentially be used to create spaces fostering discussion and collaboration, eventually leading to further improvements. However, more investigations are needed to uncover structural issues that exist in Q&As and online communities in general, which deter participation from people of underrepresented genders.

7.2.2. Including Further Gender Considerations

In this thesis, I investigated how people of different genders use and perceive Q&As and found differences between men and women. As I explained in Chapter 6, gender is complex, and only a part of a person's identity. Although I found differences between men and women, it is unlikely that gender exclusively can fully explain those differences. There are other characteristics should be investigated to get a better understanding of what can encourage people to contribute to Q&As. For example, personality traits, culture, upbringing, and confidence could all have impacts as well – and they are all likely to interact with one's gender. The concept of intersectionality describes compounding discriminatory effects when an individual has multiple underrepresented identities [166]. For example, women who write using less-common dialects might contribute less content than women writing with standard North American styles, and strategies to encourage participation should reflect the unique challenges people with intersecting identities face. To my knowledge, very little work about intersectionality and Q&As has been published, if any, while only a few examples considering intersectionality within online knowledge-sharing communities in general exist (e.g., [186,199]). More work is needed to generally understand how people with different identities and their intersections use Q&As, and how Q&As can be made more inclusive for all.

I was generally able to compare data between men and women but had difficulty including non-binary participants due to data collection challenges (content analysis) and data

sparsity (interview and task-based field deployment studies). As gender HCI matures as a field, it is important that all genders be considered in research, not just the binary ends of the spectrum. This could involve developing methods to include gender minorities in a sensitive and appropriate matter. Some strategies have been published for appropriately collecting survey and questionnaire data (e.g., [86,170]), however challenges still exist in doing content analysis and recruiting gender diverse participants.

Furthermore, researcher characteristics and group dynamics should be taken into consideration. It is known, for example, that the genders of interviewers matter when speaking to participants [213]. It would be interesting to have the researcher's gender match the participants': it might be easier for the researcher to establish a rapport with participants, which could mean participants are more comfortable sharing information, providing richer data. Furthermore, involving multiple participants simultaneously in focus groups or workshops could be a means to empower them and bring up interesting discussions.

7.2.3. Investigating Changes in Behaviour

The content analysis and interviews provided a snapshot of current user behaviours and perspectives on Q&As, and the ten-day task-based field deployment study uncovered the potential of using community presence information to work towards inclusive communities. Due to the short length of the task-based field deployment study, I could not see if there were any changes in behaviours among the participants. Seeing an increase in participation among people of underrepresented genders will take time [95], it is unlikely that study participants would suddenly change behaviours in a few days. For example, I do not expect women to contribute at the same rate as men immediately after trying better interfaces, this would be a gradual change over the course of the interface's adoption. Long-term studies will be needed to see if community presence information and/or other social considerations is an effective tool for encouraging participation.

7.2.4. Long-Term Vision

With this thesis, I have shown that women are underrepresented in online graphic design Q&As, and I have shown that interfaces can potentially be developed to bridge gender gaps.

The ultimate goal of this research is to build fully inclusive, equitable and gender diverse Q&As so that people can concentrate on learning, contributing, and advancing themselves and their communities without having to worry about negative interactions with other users. By researching different platforms, communities, features, etc., and considering gender from the beginning of development processes, I hope that HCI research can provide better guidance to interface designers and initiate structural change towards inclusive design.

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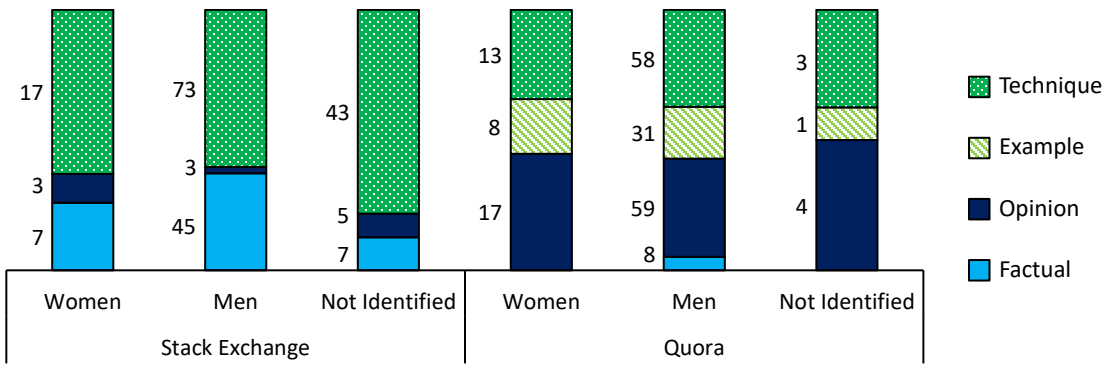
Appendices

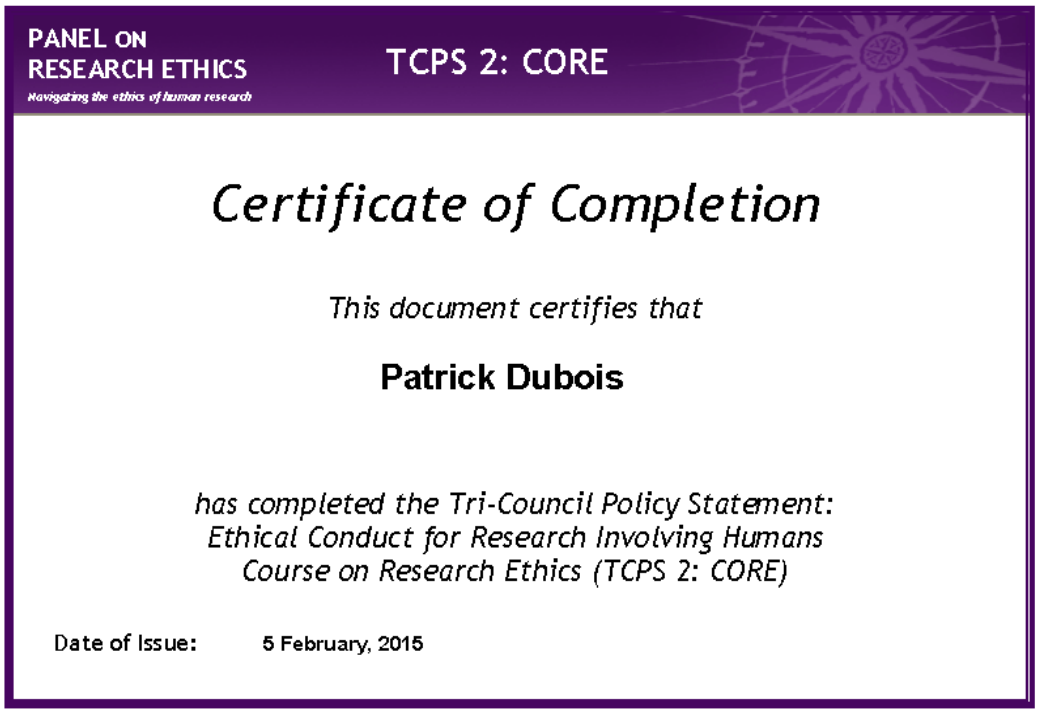
Appendix A – Content Analysis Results Including All Users

		Graphic Design Stack Exchange			Quora		
		Men Medians (IQR)	Women Medians (IQR)	Not Identified Medians (IQR)	Men Medians (IQR)	Women Medians (IQR)	Not Identified Medians (IQR)
Answer Characteristics	Answer Length	83 words (80)	86 words (117.5)	159 words (225.5)	57.5 words (81.5)	60 words (90.5)	16.5 words (19.3)
	Response Speed	2.9 hours (15.2)	3.2 hours (17.5)	3.2 hours (12.5)	16.9 hours (114.5)	744.6 hours (3763.8)	99.5 hours (140.3)
	Clout	50 (25.9)	61.8 (13.5)	44 (22.4)	58.7(28.8)	66.3 (36)	76.1 (41.3)
	Emotional Tone	49.3 (47.1)	62.1 (50.9)	49 (31.4)	62.1 (65.7)	74.6 (65.9)	56.2 (73.2)
	Analytical Thinking	89.5 (15.7)	89.7 (20.8)	87.9 (14.4)	76.2 (40.7)	82.3 (42.2)	39.6 (75)
Community Appreciation	User Reputation	13184 (24961)	96 (4247)	19530 (15966)	- N/A -	- N/A -	- N/A -
	Score of Answers	1 (2)	1 (1.5)	1 (1)	1 (2)	1 (3.75)	0 (0.8)
	Accepted Answer	23.1%	11.1%	14.5%	- N/A -	- N/A -	- N/A -

The distributions of sampled answers by which question type they address



Appendix B – TCPS 2: CORE Certificate



PANEL ON RESEARCH ETHICS
Navigating the ethics of human research

TCPS 2: CORE

Certificate of Completion

This document certifies that

Patrick Dubois

has completed the Tri-Council Policy Statement:
Ethical Conduct for Research Involving Humans
Course on Research Ethics (TCPS 2: CORE)

Date of Issue: 5 February, 2015

Appendix C – Interview Study Documents

C.1. Ethics Certificate

UNIVERSITY OF MANITOBA | Research Ethics and Compliance

Human Ethics
208-194 Dafoe Road
Winnipeg, MB
Canada R3T 2N2
Phone +204-474-7122
Email: humanethics@umanitoba.ca

PROTOCOL APPROVAL

TO: **Andrea Bunt**
Principal Investigator

FROM: **Julia Witt, Chair**
Joint-Faculty Research Ethics Board (JFREB)

[redacted]

Re: **Protocol J2018:080 (HS22286)**
Participating in Online Software Communities: The Role of Gender

---

Effective: November 26, 2018 **Expiry:** November 26, 2019

Joint-Faculty Research Ethics Board (JFREB) has reviewed and approved the above research. JFREB is constituted and operates in accordance with the current *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans*.

This approval is subject to the following conditions:

1. Approval is granted only for the research and purposes described in the application.
2. Any modification to the research must be submitted to JFREB for approval before implementation.
3. Any deviations to the research or adverse events must be submitted to JFREB as soon as possible.
4. This approval is valid for one year only and a Renewal Request must be submitted and approved by the above expiry date.
5. A Study Closure form must be submitted to JFREB when the research is complete or terminated.
6. The University of Manitoba may request to review research documentation from this project to demonstrate compliance with this approved protocol and the University of Manitoba *Ethics of Research Involving Humans*.

Funded Protocols:
- **Please mail/e-mail a copy of this Approval, identifying the related UM Project Number, to the Research Grants Officer in ORS.**

C.2. Sample Recruitment Material

Research Study: Sharing Software Knowledge in the Design Community

We are currently conducting a study to understand how women and men with graphic design experience interact on the Graphic Design Stack Exchange and/or Quora. Whether you are a poster or a reader, we are looking for people to share their experiences. If you have shared some of your knowledge to answer some questions on the Graphic Design Stack Exchange and/or Quora, or have used these platforms to answer your own questions (whether you posted them yourself or not), we thought that you might be interested in hearing about this project.

Participation would consist of a single interview session for 30 to 60 minutes, during which we will discuss your thoughts and experiences on online software communities, such as Stack Exchange and Quora. The interview can occur over teleconferencing software, such as Skype or Hangouts.

Participants will receive $20 CAD in either cash or a gift card at your choosing.

If you are interested or need more information, feel free to contact me. Additionally, if you know someone, or another group that might be interested, feel free to let me know!

This research has been approved by the University of Manitoba Joint Faculty Research Ethics Board.

C.3. Consent Form

UNIVERSITY OF MANITOBA

DEPARTMENT OF COMPUTER SCIENCE

Winnipeg, Manitoba
Canada R3T 2N2
(204) 474-8313
FAX: (204) 474-7609

Research Project Title: Participating in Online Software Communities: The Role of Gender

Researchers:

Dr. Andrea Bunt, Associate Professor, Department of Computer Science, University of Manitoba, [redacted]

Patrick Dubois, PhD Student, Department of Computer Science, University of Manitoba, [redacted]

Please take the time to read this carefully and to ensure you understand all the information.

This consent form, a copy of which will be left with you for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

You are invited to participate in a project on the topic of comparing the differences in how males and females interact within online software communities. The goal of the project is to gather information about how males and females interact within online software communities. If you have any questions or concerns at this time or any time during the project, please feel free to ask the researcher for clarification.

As part of this project, we will ask you to participate in a semi-structured interview about your participation, usage, and opinion on online software communities, taking about 30-60 minutes.

Participation in this project is voluntary. After signing this consent form, you will receive a $30 CAD gift card or $30 CAD in cash for your participation.

Data collected for this project will be retained for a period of maximum three years in a locked cabinet or password-protected computer in a locked office or laboratory in the EITC building, University of Manitoba, to which only researchers associated with this project (Dr. Andrea Bunt and Patrick Dubois) have access. In addition, the University of Manitoba may look at research records to see that the research is being done in a safe and proper way. We intend to present results as part of degree requirements and as academic publications. Again, no personal information about your involvement will be included.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. By doing this you also confirm that you are of the age of majority in Canada (18 years or more). In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the interview at any time, and/or refrain from answering any questions you prefer to omit. Even by withdrawing, you will keep your compensation. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.

This research has been approved by the University of Manitoba Joint Faculty Research Ethics Board. If you have any concerns or complaints about this project, you may contact Dr. Andrea Bunt at [redacted] or the Human Ethics Coordinator (HEC) at [redacted] or at [redacted]. A copy of this consent form has been given to you to keep for your records and reference.

We wish to record our discussions. The audio will serve as a reference point in our data analysis, allowing us to review the discussion in detail. Any information you choose to contribute is completely confidential and will be used for anonymized research analysis. We may use anonymized quotes for purposes of dissemination; your name will not be included or in any other way associated with the data presented in the results. By signing this consent form, you agree that you understand this and that we may use the recorded audio for data analysis purposes only.

☐ I wish to receive a summary of the findings.

☐ I wish to receive a copy of the transcript of the audio recording to confirm its accuracy.

Please write your email address if you checked a box above:

Participant's email address: _____

Participant's signature: _____ Date: _____

Researcher's signature: _____ Date: _____

C.4. Sample Interviews Questions

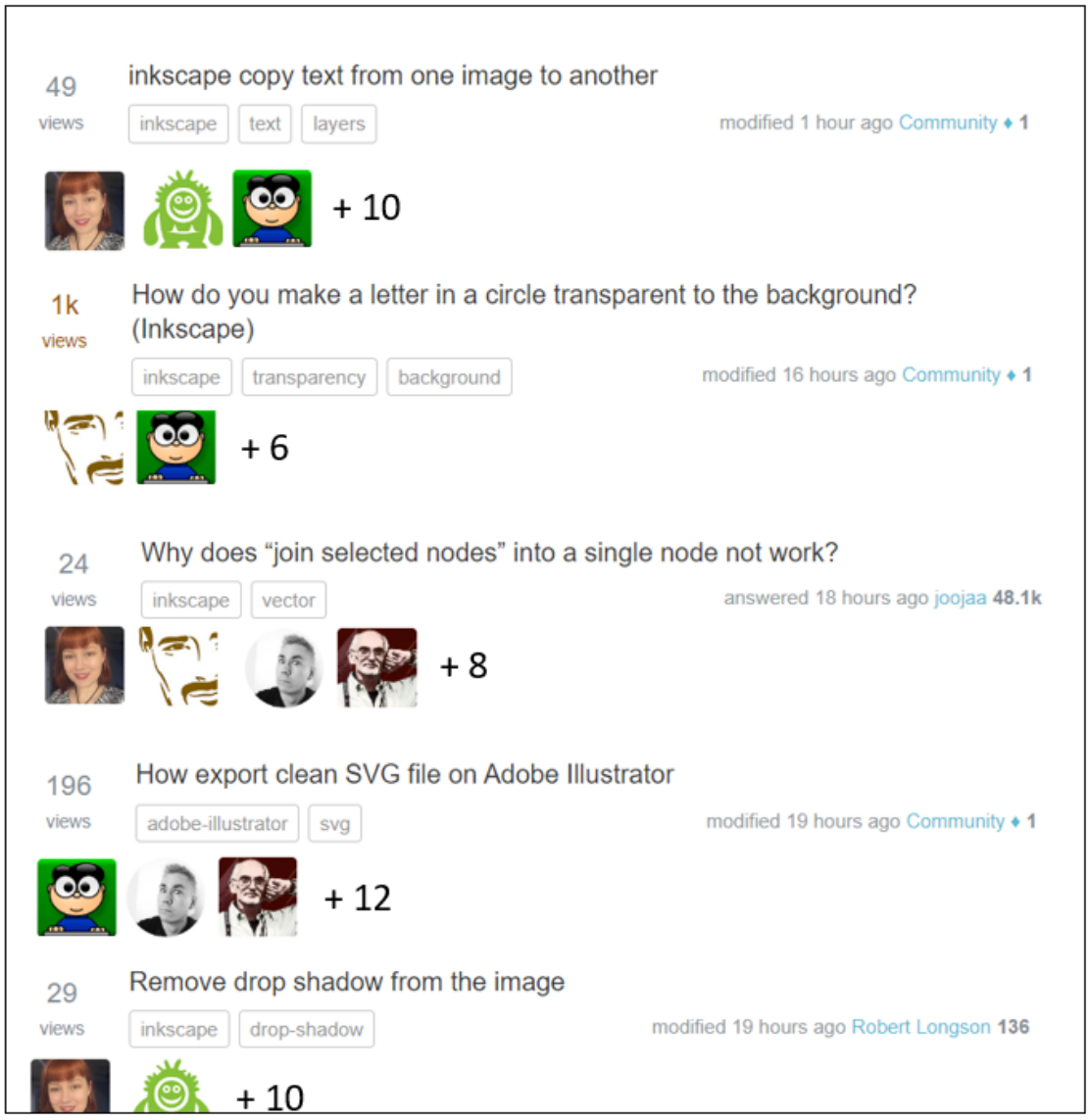
1. What gender do you identify as?
2. What is your first language?
3. What is your current occupation?
4. How would you describe your expertise level at graphic design?
5. What software do you use in your profession?
    a. How would you describe your expertise level with Photoshop?
6. How would you describe your activities on Quora/SE?
    a. Have your experiences mostly been positive or negative? Why?
7. Do you consider yourself an active participant or mostly a reader?
    a. What is preventing you from participating? Why do you doubt your skills?
    b. What pushed you to start participating?
8. Are you aware of posting guidelines? What are some that you remember?
9. What are some things that suggest better post quality?
10. What are your thoughts on the guidelines enforced by the site and its community?
11. Have you ever asked a question on the site?
    a. What kind of questions do you ask?
    b. Can you tell me about the last time you asked a question?
    c. What are your expectations when you post a question?
    d. What has prevented you from asking questions?
12. Have you ever answered a question on the site?
    a. Can you tell me about the last time you answered a question?
    b. What motivates you to post answers?
    c. What kind of answers do you post?
    d. Can you describe an answer you feel proud of? Why are you proud of it?
    e. To you, what makes a good answer?
    f. What kind of effort do you put into crafting an answer?
13. Have you ever started writing a post on the site, then decided against it?
    a. What caused you to reconsider?
14. Have you ever come across unanswered questions, but decided against answering? Why?

15. Have you used mechanisms to promote a post? (e.g., voting)
    a. What prompts you to use these mechanisms?
16. How do you evaluate a answer's quality?
    a. Do you consider a poster's qualifications? Any cues?
17. What would you consider a low-quality answer? Do you think they have a place/role on the site?
18. What is your opinion of the community?
19. How would you improve the site?
20. Are there any personal experiences that stand out? How about experiences as an observer?
    a. Can you describe a positive experience?
    b. Can you describe a negative experience?
21. In your opinion, what are the important differences between Quora and SE?
22. Do you feel the site is dominated by a people with certain characteristics? Gender?
23. Any final thoughts?

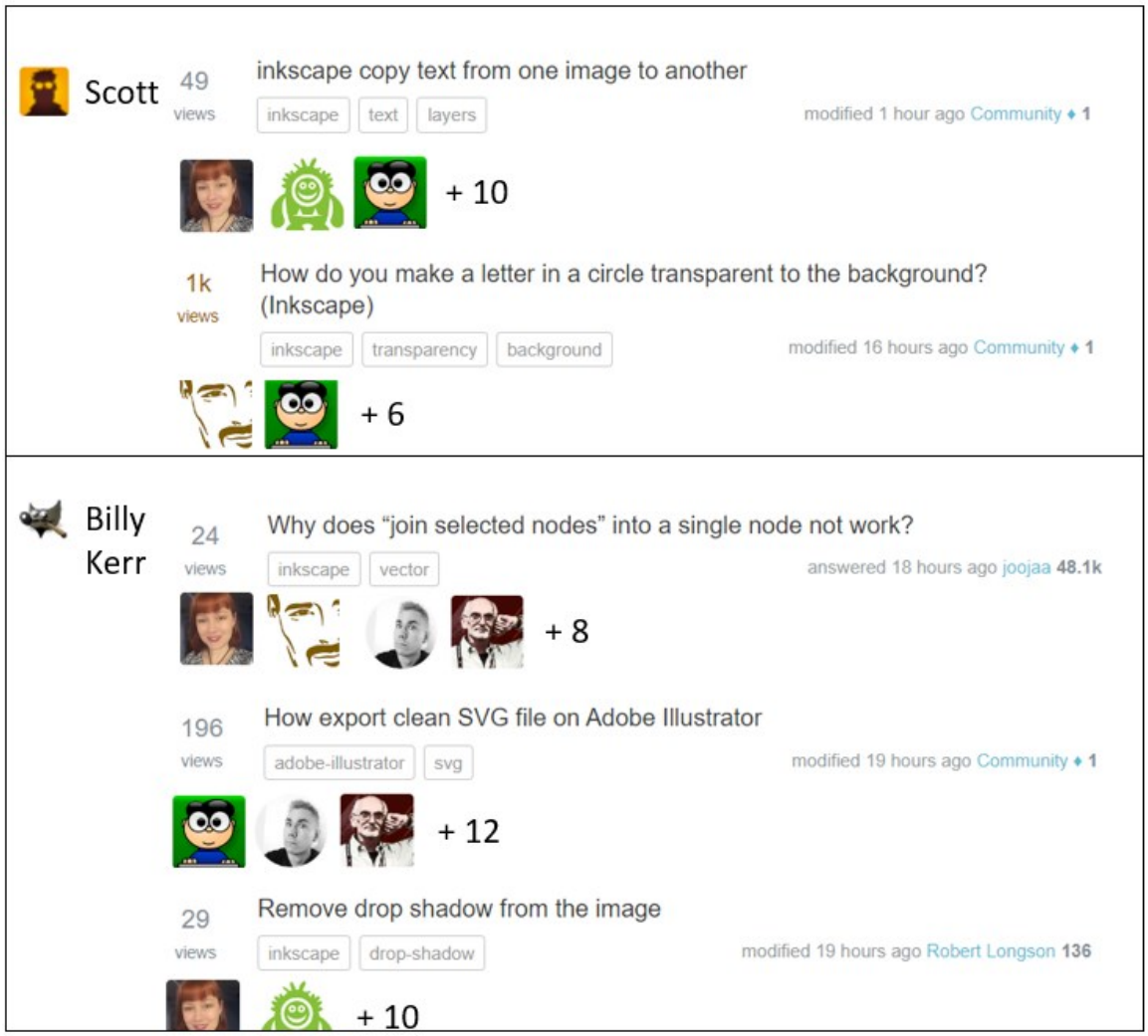
Appendix D – Example Low-Fidelity Prototypes

I generated several low-fidelity prototypes while exploring the design space for Q&A interfaces with additional social considerations. This was part of the process that led to developing the prototypes I used in the task-based field deployment study. Here is a selection of non-interactive sketches that I generated.

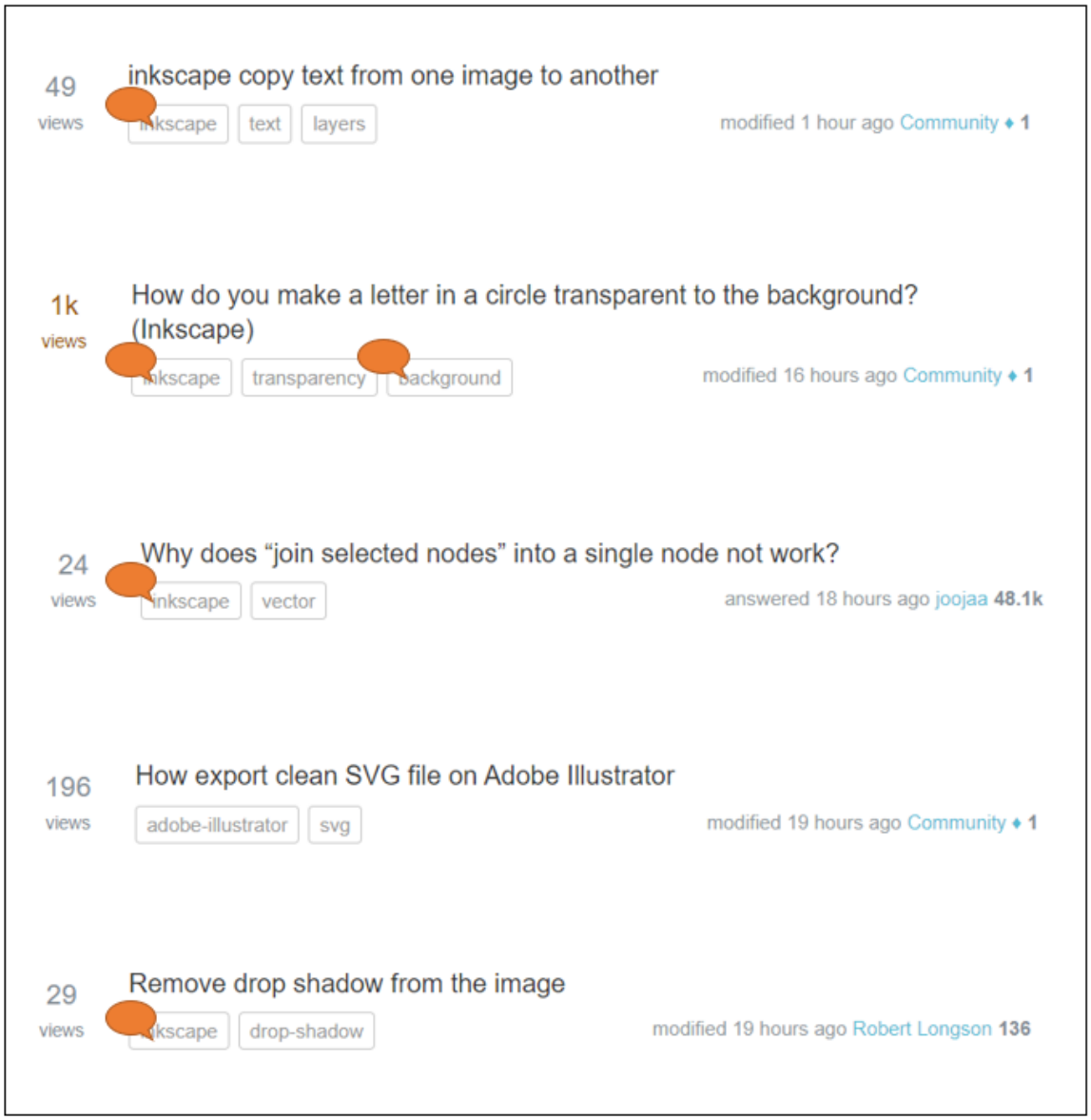
A prototype interface showing question viewers' profile pictures under the respective questions. Particular viewers would be selected (according to some metrics that were not yet determined) to be shown to the user more frequently in order to encourage the user to recognize repeated viewers.



A prototype interface grouping questions by “similar viewer.” Some viewers are identified as being similar to the user (according to some metrics that were not yet determined) and the questions they have viewed are grouped together in the user’s interface. Like the previous prototype, other viewers are also shown under each question.

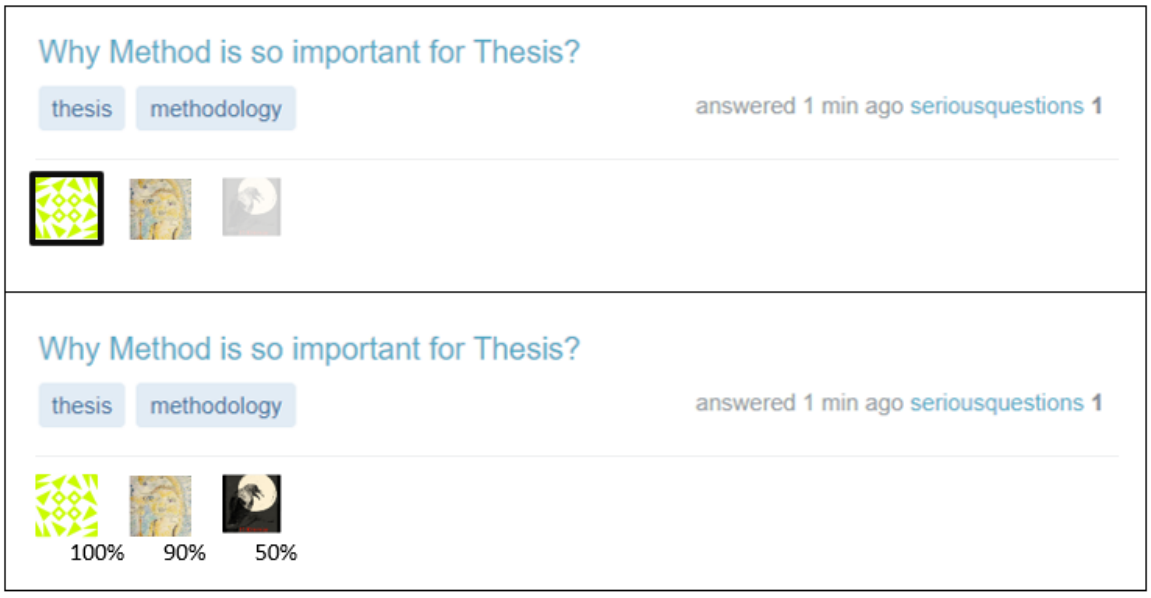


A prototype interface showing “hot topics.” Some Q&As allow question askers to tag their questions with keywords. In this prototype, keywords that have a lot of recent activity would be highlighted to the user, to emphasize where “more people” seem to be “congregating.”



A prototype interface showing a timeline under each question. Different events are shown on the timeline using viewer profile pictures in combination with icons representing some action, e.g., upvoting content, posting a reply, or simply viewing the question with no other action.

Two different prototype interfaces showing similar question viewers under each question. The top prototype highlights very similar users and fades/greys out less similar users. The bottom interface shows a "similarity score" for each viewer. The metrics for determining user similarity had not yet been determined.



Appendix E – Task-Based Field Deployment Study Documents

E.1. Ethics Certificate

University of Manitoba | Research Ethics and Compliance

Human Ethics - Fort Garry
208-194 Dafoe Road
Winnipeg, MB R3T 2N2
T: 204 474 8872
humanethics@umanitoba.ca

PROTOCOL APPROVAL

To: **Andrea Bunt**
Principal Investigator

From: **Andrea Szwajcer, Chair**
Joint-Faculty Research Ethics Board (JFREB)

[redacted]

Re: **Protocol # J2020:063 (HS24280)**
Participating in Online Software Communities: Motivating Participation of Underrepresented Groups

---

Effective: October 13, 2020 **Expiry:** October 13, 2021

Joint-Faculty Research Ethics Board (JFREB) has reviewed and approved the above research. JFREB is constituted and operates in accordance with the current *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans.*

This approval is subject to the following conditions:

i. Approval is granted for the research and purposes described in the application only.

ii. Any modification to the research or research materials must be submitted to JFREB for approval before implementation.

iii. Any deviations to the research or adverse events must be submitted to JFREB as soon as possible.

iv. This approval is valid for one year only and a Renewal Request must be submitted and approved by the above expiry date.

v. A Study Closure form must be submitted to JFREB when the research is complete or terminated.

vi. The University of Manitoba may request to review research documentation from this project to demonstrate compliance with this approved protocol and the University of Manitoba Ethics of Research Involving Humans.

Funded Protocols: Please e-mail a copy of this Approval, identifying the related UM Project Number, to the Research Grants Officer at [redacted]

E.2. Sample Recruitment Material

Looking for graphic design professionals or hobbyists to participate in a user study by answering questions on prototype Q&A sites

I'm a PhD candidate at the University of Manitoba studying how interface design can be used to engage people with an online community and to see how such interventions affect people of different genders. We are looking for people 18 years old or over who identify as graphic designers or who do graphic design work professionally or as a hobby who would be interested in participating in a user study. The study can be conducted in English and/or in French.

Over 10 days, the study participant will be asked to use two different prototypes for a mock question and answer site about graphic design software. We ask the participant to use the prototypes daily, answering at least one question a day. Participants will use each prototype for 5 days, each followed by a questionnaire. Before we start the study, we will schedule a meeting (estimated 60 minutes max) to explain the study in detail, and at the end, there will be another interview (estimated 90 minutes max) where we will discuss the participant's experiences. The participant doesn't have to use a camera during our meetings, but they do have to speak (unfortunately, we can't use a chat system).

The entire study will last about 10 days and participants will have free access to the prototypes during that time. The meetings will occur over teleconferencing software, and participants will use a standard web browser to access the prototypes and other study material (however, the prototypes have only been tested in Chrome on a desktop/laptop computer; JavaScript needs to be enabled).

Participants will receive $25 CAD (converted to requested currency) at the start of the study, and $125 CAD following the second interview. Participants may withdraw from the study at any time during the study and retain any compensation received at the point of withdrawal.

We are trying to get the perspectives from a diverse set of participants. Everyone who fits our above-mentioned criteria can participate, but we enthusiastically encourage women and non-binary people to get in touch. I want to assure potential participants that you do

not have to be an expert graphic designer, but only have knowledge about graphic design software.

If you are interested, have any concerns about eligibility or would like more information, feel free to contact me by direct message. I'm also happy to answer questions and provide more detail in the comments. Feel free to share the study with other people!

This research has been approved by the University of Manitoba Joint Faculty Research Ethics Board.

E.3. Script

Thank you for spending the time in participating in our study! We know that you might be busy, and particularly in these times, things might be hectic. We really appreciate your presence here today. I'll probably reiterate this many times, but if you have any questions, feel free to ask, and interrupt if necessary. Keeping you informed is a priority.

We are studying how people of different genders interact with question and answer platforms and investigating ways we can impact participation on these platforms. In our previous work, for example, we found that women and men tend to contribute different types of knowledge to Q&A sites at different rates. With this study in particular, we are using different prototypes to see how design elements could be used to impact gender participation.

I will go in more detail once we get to it, but to briefly introduce what you will be doing: over the span of 10 days, you'll be using 2 different prototypes of Q&A systems. These systems have fake communities that have been inspired by real ones, so you might see some content that may be familiar if you spend a lot of time on Q&A sites. Either way, don't worry. Your goal will be to try to use the prototypes every day and answer at least one question per day. After each prototype, you'll answer a questionnaire, and at the end, we'll meet again for an interview session where we can discuss your impressions.

Does this sound good? Do you have any questions?

Will you be using Chrome?

To start, here is the website that you'll be accessing: [URL to access prototype]

The login information is as follows, please save it for the duration of the study: [username].

Please log into the website now. The first thing you'll see is a consent form. Please take some time to read and understand it. I'll turn off my video for now to make it less awkward while you read, but I'm still here and listening if you have any questions.

At this point, before moving on to the next screen, I like to discuss about the honorarium…

Next, you'll see a demographics questionnaire. One part will be used to get a better understanding of who you are. Answer to the best of your ability in the text boxes. The other part will be used by one of the prototypes. The options are limited, so we understand they might not contain the most accurate information about yourself. However, pick the options you feel describe you the best.

Now we're at the interesting part. You should now have access to the first prototype. It's more or less a standard Q&A site, with some additional information, especially as you start using it. Hopefully, it's self-explanatory, but feel free to ask me questions. We suggest you take a bit of time to explore and get familiar with it, but do what feels right for you. For the next five days, we ask that you use the prototype every day, and try to answer at least one question per day; although we encourage you to answer as many as you would like. The questions you see on day one are the same you'll see for the 5 days, so to phrase it a little differently, you'll have 5 days to answer as many questions as you want, but to spread it out over the 5 days. Don't worry about getting answers wrong or having to look up for answers yourself. We're not evaluating you or judging your level of knowledge.

The community of users is static, any activity you will see is your own. However, we ask that you put yourself in the mindset that this is a live community with real people as much as possible. I'll point out that the questions intentionally don't specify any software, so feel free to specify any software in your answers if it makes sense, even if the software you pick may be different from any existing answers.

On the fifth day, you will receive a reminder that it is the fifth day with that prototype. After you've done that day's activities, you'll be asked to fill a questionnaire. Instructions to access it will be available in the reminder. Once you fill the questionnaire, you'll be done for the day.

On the next day, when you log in, you'll see the second prototype. Please take some time to get yourself familiar with it, because it will have some differences to the first prototype. You'll follow the same instructions for that one. Keep in mind that that prototype has a different community, so everyone there will be new to you. Again, pretend that this is a real, but different community from the first. After five days, again, you'll fill the questionnaire. Soon after, we will have our second meeting.

Any questions?

A few things I'll note. These are prototypes, and so some of the functionality may be rougher than what you might be used to, and you might encounter some bugs. If you come across something that doesn't seem to be working correctly, make a note of it to share with me. The first things you should try is refresh the page and log in again, that seems to fix most problems. If the problem persists, please let me know.

The entire website is a single web page, so don't use your browser's back and forward navigation buttons, they'll move you away from the site. Every time you open the webpage, you'll have to log in again. And every time you log in, the questions you see might be in a different order than previously.

You'll also notice that to answer questions, you'll only be provided a plain text box, if you would like to share an image of something, you should upload it to an image hosting site and include a link to the image in your answer. Links aren't clickable, and paragraphs might be combined into a single paragraph, but I'm working on trying to solve these two issues.

Let's schedule our second meeting.

If you know anybody who would participate…

E.4. Consent Form

University of Manitoba | Department of Computer Science
Faculty of Science
Discover the unknown + Invent the future

E2-445 EITC
University of Manitoba
Winnipeg, Manitoba, Canada
R3T 2N2
T: 204-474-8313
F: 204-474-7609

Research Project Title: Participating in Online Software Communities: Encouraging Engagement of Underrepresented Groups

Researchers:

Dr. Andrea Bunt, Professor, Department of Computer Science, University of Manitoba, [redacted]

Patrick Dubois, Ph.D. Candidate, Department of Computer Science, University of Manitoba, [redacted]

Mahya Maftouni, M.Sc. Student, Department of Computer Science, University of Manitoba, [redacted]

Funding Agency: Natural Sciences and Engineering Research Council of Canada (NSERC)

Please take the time to read this carefully and to ensure you understand all the information.

This consent form, a copy of which you can download for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

Project Summary

You are invited to participate in a project about the effects of interface design on engagement with online software communities. The goal of the project is to understand how we can use interface design to encourage online participation of underrepresented groups, such as women. If you have any questions or concerns at this time or any time during the project, please feel free to ask the researcher for clarification.

As part of this project, we will ask you to meet with us over teleconferencing software to go over the study details, complete a demographics questionnaire, use two interface prototypes over 10 days, each followed by post-interface questionnaires, ending the study with a semi-structured interview over teleconferencing software about your participation, usage, and opinion of the prototypes. In total, there will be two meetings over the 10 days, the first lasting at most 60 minutes, and the last one at most 90 minutes. We will use teleconferencing software agreed upon by you and the researcher for the interviews.

Compensation

Participation in this project is voluntary. After signing this consent form, you will receive a $25 CAD gift card or $25 CAD in cash for your participation. After the completion of the study, you will receive a $125 CAD gift card or $125 CAD in cash.

Data Management

Data collected for this project will be retained for a period of maximum three years (October 2023) in a locked cabinet or password-protected computer in a locked office or laboratory in the EITC building, University of Manitoba, or at the researchers' homes. Only researchers associated with this project (Dr. Andrea Bunt, Patrick Dubois and Mahya Maftouni) will have access to this data. In addition, the University of Manitoba may look at research records to see that the research is being done in a safe and proper way. We intend to present results as part of Ph.D. degree requirements (thesis and defense) and as academic publications. Again, no personal information about your involvement will be included.

We wish to audio record our interview using a small hand-held digital recording device at the end of the study. The audio will serve as a reference point in our data analysis, allowing us to review the discussion in detail. The audio file will be transferred to a researcher's computer immediately following the second interview and will be deleted from the recording device. The audio file will be deleted by the end of October 2023.

We will also collect any interaction data from your usage of the prototypes. Any information you choose to contribute is completely confidential and will be used for anonymized research analysis. We may use anonymized quotes for purposes of dissemination; your name will not be included or in any other way associated with the data presented in the results. By signing this consent form, you agree that you understand this and that we may use the recorded audio and prototype usage logs for data analysis purposes only.

You may freely withdraw of the study if you do not consent to the collection of any of this data.

Withdrawal

You may withdraw from the study at any point during the study. Withdrawal is possible until your transcript is ready for review, if you request one. If a transcript is requested, you may withdraw within one week of receiving the transcript or the most recent communication from the researcher if changes are requested, by emailing the researcher. Following this period, withdrawal will not be possible. During the study, you will be considered as withdrawn if you do not reply to researcher emails within five days and have not attended a scheduled meeting. Your data will not be saved. You will retain any compensation that you have received prior to your withdrawal (as per the steps of the study in relation to the timing of the withdrawal).

Risks and Benefits

The expected benefits of the research are a greater understanding of how social elements of an interface can help engage participation in an online community. You might also gain a greater understanding on how gender can potentially impact online participation and how interfaces can be used to encourage engagement. The risks are no greater than in everyday life.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. By doing this you also confirm that you are of the age of majority in Canada (18 years or more). In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time, and/or refrain from answering any questions you prefer to omit. You will retain any compensation that you have received prior to your withdrawal (as per the steps of the study in relation to the timing of the withdrawal). Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.

This research has been approved by the University of Manitoba Joint Faculty Research Ethics Board. If you have any concerns or complaints about this project, you may contact Dr. Andrea Bunt at [redacted] or the Human Ethics Coordinator (HEC) at [redacted] or at [redacted]. A copy of this consent form can be downloaded for you to keep for your records and reference.

☐ I wish to receive a summary of the findings. The summary will be sent by the end of December 2021.

☐ I wish to receive a copy of the transcript of the audio recording to confirm its accuracy. Transcripts will be sent within two weeks of the final interview. You may withdraw within one week of receiving the transcript or the most recent communication from the researcher. Following this period, withdrawal will not be possible.

Please write your email address if you checked a box above:

Participant's email address: _____

Participant's signature: _____ Date: _____

Researcher's signature: _____ Date: _____

E.5. Demographics Questionnaire

We would like to know a bit more about you! This questionnaire has two sections. This first set of questions will only be used by the researchers to get a better idea of who the study participants are. Please remember that your answers here will not affect your eligibility to participate.

---

1. What would you consider to be your field of work/study?

_____

2. What is your job title?

_____

3. Approximately how long have you been doing graphic design work (professionally or as a hobby)?

_____

4. Do you use question and answer sites (does not need to be for graphic design)?

Yes ○ No ○

5. [Show if participant answers Yes on question 4] Which question and answer sites do you use (for example, Stack Overflow, Quora, Yahoo Answers!)?

_____

6. [Show if participant answers Yes on question 4] Have you ever posted content on a question and answer site (for example, questions or answers)?

Yes ○ No ○

7. [Show if participant answers Yes on question 4] Do you use question and answer sites about graphic design?

Yes ○ No ○

8. [Show if participant answers Yes on question 7] Which question and answer sites about graphic design do you use?

_____

9. [Show if participant answers Yes on question 7] Have you ever posted content on a question and answer site about graphic design (for example, questions or answers)?
Yes ○ No ○

The following questions will be used to present some information about other "community members." Your answers do not need to be perfectly accurate and may not need be consistent with eachother (for example, you might not be able to produce your favourite end product with your favourite software). Pick what you feel describes you or that you relate to the best. Again, answers here do not affect your eligibility to participate, nor will it change what content you will have access to. Please remember as well that only the researchers will see this information, and that the "community members" don't truly exist (but please pretend that they do).

---

1. Please select the gender that best describes your identity:
man | woman | non-binary

2. Please enter your age (minimum is 18):

_____

3. Please select the region you most closely identify with:
North America | Latin America | Western Europe | Eastern Europe | Africa | Middle East | Central Asia | Southern Asia | Southeastern Asia | Eastern Asia | Oceania

4. Please select the graphic design software that you feel you are most experienced with or that you like using the most:
Photoshop | Illustrator | GIMP | Sketch | Affinity Designer | InDesign | Xara | CorelDRAW | Canva | Inkscape

5. Please select the type of graphic design activity or task that you feel you are best at:
photo touchup | graphic creation | image manipulation | painting | sketching | prototyping

6. Please select what best describes your favourite end product or output that you produce from your graphic design activities:
photos | websites | posters | icons | fonts | art pieces | concept art | memes

E.6. Post-Interface Questionnaire

Please fill out this questionnaire about your experience using **the most recent** prototype, interacting with **the most recent** community. While answering your questions, put yourself in the position of someone within an active community.

Question 1 of 35: I felt like community members would notice and be aware of me.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 2 of 35: I felt as if I was all alone in the community.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 3 of 35: I paid close attention to community members.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 4 of 35: I was often aware of community members.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 5 of 35: I was able to form distinct individual impressions of some community members.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 6 of 35: I could start to recognize some community members.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 7 of 35: I felt informed about community members' actions.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 8 of 35: The information provided about community members helped me know what to do.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 9 of 35: I felt like I knew exactly what kind of information I provided about myself to the community.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 10 of 35: I had privacy concerns when using the question and answer platform.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 11 of 35: Knowing that community members could see information about myself influenced my own actions.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 12 of 35: I felt like I did not help community members very much.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 13 of 35: I felt like I could provide value to the community.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 14 of 35: I felt like community members have a lot in common with me.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 15 of 35: I felt like the expertise of community members to be similar to mine.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 16 of 35: I felt like the background of community members to be similar to mine.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 17 of 35: I felt like community members think like me.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 18 of 35: I felt like community members shared my values.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 19 of 35: I felt like community members have thoughts and ideas similar to mine.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 20 of 35: I felt like community members have similar needs, priorities, and goals.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 21 of 35: Fitting into this community is important to me.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 22 of 35: I can trust people in this community.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 23 of 35: I care about what other users of this website think of me.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 24 of 35: Being a member of the community made me feel good.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 25 of 35: The time I spent answering and browsing questions just slipped away.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 26 of 35: I felt frustrated while using the Q&A platform.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 27 of 35: I found the Q&A platform confusing to use.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 28 of 35: I put in a great deal of effort to learn how to use the Q&A platform.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 29 of 35: I put in a great deal of effort to use the Q&A platform.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 30 of 35: The Q&A platform was attractive.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 31 of 35: Using the Q&A platform was worthwhile.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 32 of 35: I had moments of hesitation when using the Q&A platform.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 33 of 35: I was able to learn something from using the Q&A platform.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 34 of 35: I was stimulated to do additional reading or research on topics asked about in the Q&A platform.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

Question 35 of 35: The diversity of topics prompted me to continue to engage with the Q&A platform.

Completely disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Completely agree
○	○	○	○	○

E.7. Sample Interview Questions

1. What is your reaction to the study? Feel free to talk about anything you want.
2. What did you think of the two different interfaces?
3. Which interface did you prefer? Why?
4. Did you feel like the questions were different between prototypes?
5. How did you pick which questions to answer? Did you simply go top to bottom, browse, etc.?
6. What did you think of the two different communities?
7. Can you tell me about a memorable community member?
8. Which community did you prefer? Why?
9. Which community did you like the least? Why?
10. What did you like/dislike about each community? Why?
11. Does knowing what community members do affect your own participation?
12. What did you like/dislike about each interface? Why?
13. How did you feel about seeing information (demographics, expertise) about the community?
14. How did you feel sharing information about yourself to the community?
15. Did you use this information to guide your usage of the platform?
16. How do you feel sharing this information about your own activities to the community?
17. How would you feel using this other interface (show third interface)? Why?
18. How does it rank relative to the other interfaces?
19. Are there any other comments you would like to make, anything you would like to add?