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Simone Stumpf
City, University of London, UK
Simone.Stumpf.1@city.ac.uk

Daniela Busse
Oracle, USA
danielabusse@fastmail.us

Anicia Peters
Namibia University of
Science and Technology
Namibia
apeters@nust.na

Jessica Cauchard
Ben Gurion University
of the Negev
Israel
jcauchard@acm.org

Shaowen Bardzell
Indiana University, USA
selu@indiana.edu

Elizabeth Churchill
Google, USA
churchill@acm.org

Margaret Burnett
Oregon State University, USA
burnett@eecs.oregonstate.edu

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Contents

Gender-Inclusive HCI Research and Design: A Conceptual Review

Simone Stumpf[1], Anicia Peters[2], Shaowen Bardzell[3], Margaret Burnett[4], Daniela Busse[5], Jessica Cauchard[6] and Elizabeth Churchill[7]

[1] *City, University of London, UK; Simone.Stumpf.1@city.ac.uk*
[2] *Namibia University of Science and Technology, Namibia; apeters@nust.na*
[3] *Indiana University, USA; selu@indiana.edu*
[4] *Oregon State University, USA; burnett@eecs.oregonstate.edu*
[5] *Oracle, USA; danielabusse@fastmail.us*
[6] *Ben Gurion University of the Negev, Israel; jcauchard@acm.org*
[7] *Google, USA; churchill@acm.org*

ABSTRACT

Previous research has investigated gender and its implications for HCI. We consider inclusive design of technology whatever the gender of its users of particular importance. This conceptual review provides an overview of the motivations that have driven research in gender and inclusive HCI design. We review the empirical evidence for the impact of gender in thinking and behavior which underlies HCI research and design. We then present how HCI design might inadvertently embed and perpetuate gender stereotypes. We then present current HCI design approaches to tackle gender stereotypes and to produce gender-inclusive designs. We conclude by discussing possible future directions in this area.

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1

Introduction

Recent years have seen a growing number of calls for considering gender during the design or evaluation of software, websites or other digital technology (e.g., [27, 37, 65, 74, 221]). Calls like these have arisen from an emerging awareness in HCI of findings from the social sciences that are relevant to the way people use and design technology. For example, gender has been investigated in Psychology, Sociology, Education, Marketing and Politics [10, 13, 23, 27, 47, 146, 152, 187, 197]. Such studies have revealed differences[1] in thinking styles, perceptions, behaviors and attitudes with respect to gender. Empirical research has also shown that gender plays out in the *use* of software and other digital technology [19, 22, 34, 84–86, 100, 119, 125, 141, 175, 188, 190, 192].

However, emerging work on bringing together gender research with software design choices is fragmented across multiple disciplines. For example, research gatherings such as panel discussions, special interest groups and workshops [11, 44, 65, 66] have revealed that even the most knowledgeable participants at these events had little commonality among the papers and venues they cited.

[1] These findings are independent of whether such differences are learned or innate, as most are not tied to physiological sex differences.

This review aims to help bring such works together, by synthesizing the current state of affairs and future possibilities on how gender comes together with HCI design. Our conceptual review focuses on motivations for carrying out inclusive HCI design tackling gender, underlying evidence for considering a range of users' cognitive and behavioral styles whatever their gender, issues that can arise if inclusive design approaches are not adopted, and how to combine gender with inclusive HCI design.

1.1 What is Gender?

This review draws upon a social construct perspective of gender. Under this conceptualization, gender identification, gender expression and performance might not necessarily align with biological sex. Although biological sex characteristics can also play a role in the design of user interfaces and software (e.g. smaller average hand sizes of women can impact touchscreen phone usage [132]), these sex differences are generally outside the scope of this review.

The large majority of the work on gender with HCI implications has been from a binary perspective, focusing only on individuals who self-identify as men and those who self-identify as women. As this is a review of existing work, much of the discussion that follows necessarily also focuses on those two genders. Fortunately, the HCI community has seen recent contributions from queer and intersectional perspectives that include, for example, updated notions of gender identity on a spectrum, and non-binary notions of gender. We explicitly consider these perspectives in Section 3 and Section 5.

1.2 Gender and Inclusive HCI Design

Recent HCI design approaches have sought to address the marginalization of user groups in an effort toward 'universal usability'. Newell and Gregor [155] proposed 'User Sensitive Inclusive Design' for the design of technology and this requires an explicit focus on considering who the 'user' is [176], usually adapting typical user-centered design techniques and processes to include people with disabilities. More recently, inclusive HCI design has been conceptualized as the design of technology so that

it can be accessed and used by as many people as possible, regardless of their background, to achieve a more inclusive society [50]. In line with this endeavor, inclusive design strives to avoid 'variant designs' that cater to only one specific user group.

The scope of this review is where gender considerations meet the design of inclusive technology: gender-inclusive HCI design. Because of the review's focus on *technology*, it specifically excludes related topics of gender-inclusive curriculum design, organizational change for greater gender inclusiveness, recruitment and retention of women in the field of computing, or increasing and broadening women's participation in computing. Likewise, inclusiveness issues not specifically about *gender*-inclusiveness, such as age, race, ethnicity and cultural differences, are excluded. Although these topics add additional complexities and have intersectional relationships with gender, they are sufficiently broad and deep in their own right to warrant reviews of their own.

1.3 Why Investigate Gender in Inclusive Design?

The idea of gender being relevant to HCI research and design is not without controversy. Some might believe that gender does not matter at all in HCI. Among those who do accept that gender matters, there is a range of views. This range includes the 'essentialist' perspective, which hold that cognitive and behavioral differences among genders are innate, to a 'social construct' perspective, which sees gender differences and stereotypes as arising through society's attitudes towards gender roles [38, 218]. Our review leans toward the latter (social) perspective, but is also relevant to those who hold the former (essentialist) perspective.

In this subsection, we review three common motivations that underlie much of the work on gender in inclusive design: economic, ethical/inclusivity, and political/feminist motivations.

1.3.1 Economic Motivation: Market and Market Potential Relating to Women

Most economic arguments in the literature focus on the economic advantages of technology products that are as appealing to women as they have traditionally been to men.

Women often tend to use the same kinds of software as everyone else. For example, 58% of women in the US have used online banking applications and 35% mobile banking, compared with 63% and 35% of men, respectively [75]. According to Pew Research [2], as many men as women accessed social networking sites from their cellphones (41% of women and 39% of men). Even games, in the past primarily used by men, have now been used almost as frequently by women, for example, in 2018, 45% of gamers were women [226]. The previous gender gap in social media, skewed towards women, is rapidly closing, to 80% of women vs. 73% of men [2, 67]. LinkedIn's user base turned from being predominantly men to 44% women and 56% men in 2019 [227].

However, there have been gender differences in the software bought and used. Turning again to games, although games are played and enjoyed by everyone to a similar amount [228], many of the games they chose to play are different. For example, RuneScape reported in 2014 that 84% of their game players were men [107].

Another example domain is mobile applications. Women have predominantly used apps for social media, news, productivity, lifestyle and books, whereas men used more apps related to business, games, travel, health and fitness, and navigation apps. Table 1.1 summarizes some of the reported similarities and differences with mobile applications.

Women make up about half the population (e.g., the US Census 2010 reports 50.8%), and their potential in the marketplace is huge. According to a recent estimate in Forbes Magazine, women drive 70%–80% of consumer purchasing [26]. The Harvard Business Review estimated women's 2014 total income worldwide at over $18 trillion—over twice the GDPs (gross domestic product) of two of the top emerging markets (China and India) combined [185]. Women are already an important consumer sector for technology products. For example, 65% of women in the U.S.A. use a desktop computer at home, 58% a home laptop, and 18% own a smartphone (compared with 71%, 57% and 18% of men) [39].

In some areas, women have outnumbered men as consumers. For example, women seem to be the drivers in social media [21]. There are several studies confirming women's early adoption of and dominant usage

Table 1.1: Gender statistics on mobile apps. Shaded rows show similarities, unshaded show differences

	Women	Men
Monthly usage of apps	30 hours 58 minutes	29 hours 32 minutes
Monthly usage of mobile web	3 hours 46 minutes	3 hours 45 minutes
App purchases	+17% more	
App installations	+40% more	
App spending value	+87% more	
Productivity apps	+89% more	
News apps	+90% more	
Social media apps	+611% more	
Health and Fitness		+10% more
Travel apps		+19% more
Navigation apps		+40% more
In-app spending value		+42% more
Games		+61% more
Business apps		+85% more

Sources: [46, 229].

of social media, for example, women use social network applications more than men [109, 206], and women were the earlier adopters of healthy living social technology and interacted more with this technology than men [117].

There have been differences among the different social media used (Table 1.2). Facebook has been more heavily used by women (77%) than men (66%), while Reddit had only 36.3% women users compared to 63.7% men. Pinterest is reported to be heavily skewed toward women [69] and research has shown different behavioral patterns in relation to Pinterest that might explain its popularity [47, 81, 161]. Miller *et al.* [148] suggested some of the reasons for its appeal to women include: (1) perceptions of the site in popular media, (2) design affordances especially for novices, which initially suggest topics, and (3) the initial visual design and content experience reinforces a 'traditionally feminine' image. Their overall finding is that men are less likely to identify with a site that they perceive as being for women.

Table 1.2: Gender breakdown for social networking platforms

Social networking platform	Women (%)	Men (%)
Overall	76%	72%
Facebook	77%	66%
Twitter	21%	24%
	(17% in 2013)	(18% in 2013)
Pinterest	42%	13%
Instagram	29%	22%
Reddit*	4% (2013)	8% (2013)
	36.3% (2014)*	63.7% (2014)*
LinkedIn	27%	28%

Sources: [68, 225].

* It is difficult to obtain a demographic breakdown as Reddit users are mostly anonymous with no profile information. The 2013 results were from a random sample of 2252 Internet users aged 18+. The 2014 results show traffic flow to the Reddit Media Kit Page and not necessarily users.

1.3.2 Ethical Motivation: Inclusive Design and Use for Everyone

From an inclusive design perspective, any gender that is being marginalized by technology is problematic, and this is the ethical argument for considering whether software is gender-inclusive. One possible reason that potential, unintended gender bias could arise could be that about 75%–80% of technology designers and developers are men [5, 221].

If technology marginalizes according to gender, numerous impacts potentially arise. From a fairness perspective, when HCI designers create software that they believe is for everyone, they (and we) would like that technology to be equally usable and useful for all genders, so that everyone has an equitable chance of accomplishing their goals. Hence, HCI designers need to ensure that they explicitly consider how to design inclusively.

Usability by everyone has far-reaching downstream implications. For example, although Wikipedia has attracted an equal amount of interest from everyone as consumers of the information, it has been found that its contributors and editors tend to be men [123]. Forte *et al.* [74] argue that this gender bias influences Wikipedia's inner workings and is

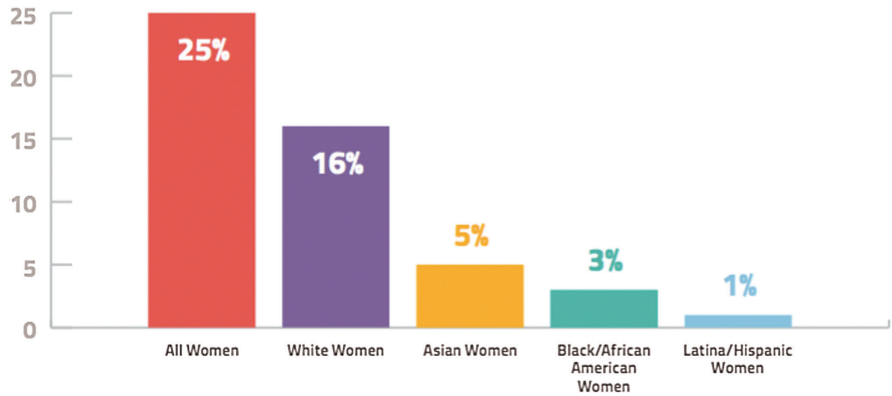

Figure 1.1: Computing occupations held by women.

Source: [5].

damaging as it may reinforce unequal patterns of not only participation but also the knowledge that is produced.

Marginalization and lack of inclusiveness can reinforce attitudes towards technology. For example, attitudes toward technology could impact people's education choices, such as what classes they take and what they major in, potentially contributing, for example, to the current low percentage of women in computing science classes in high-school and college, their career choices, and the low percentage of women in the software industry [5] (Figure 1.1). Potential downstream impacts extend even further, such as by potentially reinforcing the stereotype that women do not like technology in general or are not skilled at it [9, 214]. Finally, given that a diverse workforce produces better products [4, 61, 130, 163], the low gender-diversity in the software industry, potentially due in part to the software itself, is problematic for the industry.

1.3.3 A Political Motivation: Feminism and Feminist HCI

Inclusive design can also be motivated by a political, feminist approach that seeks to expose and/or intervene upon gender inequality and commits to an emancipatory agenda [171]. Feminism views gender injustice as a paradigm example of social injustice, whose struggles, theories, and methods can productively illuminate other emancipatory social

struggles. Thus, feminist theory has sought to delineate the operations of patriarchy throughout different areas of human life, including body practices, sexuality, identity formation, popular culture, and design.

As a movement and an academic discipline, feminism integrates a collection of theories, analytical and interpretative methodologies, ethical values, and political positions, which have evolved over the past two centuries, largely with and through women's struggles during the same period. Feminists engage with a range of concerns, including issues of agency, fulfillment, identity and the self, equity, empowerment, diversity, and social justice [9]. Given this long period of development and the range of areas of engagement it is unsurprising that the idea of what 'feminism' is, what the core issues are, what are or are not legitimate contributions, etc. are all hotly debated. Even when it comes to what are effective, practical and appropriate strategies for understanding and engaging with the world, there is debate.

Thus, it is widely acknowledged that there is no single, canonical feminism, but that feminism includes many form of feminist thinking [203, 209]. These include Liberal Feminism which concerns itself with gender equality in the public sphere, such as equal pay, equal access to education, better work condition for women, etc.; Radical Feminisms which considers the oppression of women as the most fundamental form of oppression and is focused on social change; Cultural Feminism which aims to foster the development and nurturing of a specifically women's culture which is 'inherently kinder and gentler' with gender differences not biologically determined but instead so thoroughly ingrained as to be intractable; Marxist and Socialist Feminisms which see the economic system as the root of oppression of women; Ecofeminism which holds that a patriarchal society will exploit its resources without regard to long term consequences as a direct result of the attitudes fostered in a patriarchal/hierarchical society and that in resisting patriarchal culture, eco-feminists feel that they are also resisting plundering and destroying the Earth; Postcolonial Feminisms seeks to account for the way that racism and the long-lasting political, economic, and cultural effects of colonialism affect non-white, non-Western women in the postcolonial world; and French Feminism which advocates the importance of social and political activism to create equal opportunity and access to justice

for women and is concerned with how women's socio-economic and psychological experiences are intertwined. A unifying aspect of all of these approaches and concerns is that, first, they make a distinction between male and female, masculine and feminine, or men and women; second, they address the existence of a subordinate hierarchy in which women are disadvantaged; and third, these approaches have a macro- and micro-political agenda in opposing women's inequality [90]. This does offer a simpler way of engaging with feminist thinking that sidesteps (without disregarding the importance of) deep debates among and between different feminist approaches.

The study of gender and gender inclusiveness in technology use and design is thus an important focus as part of a feminist approach, because gender is 'embodied in historical and contemporary representations of women as consumers, objects, and designers' [30] and 'ideas about society, including gender, shape the ways we make, do, and design things; these things, in turn, become part of how we identify, structure, represent, and perform gender' [128]. Feminist perspectives consider that technology use and design is not gender-balanced, that relationships of power and agency are central to this, and that the inequities result in unequal power dynamics in the workplace and in the work sphere more broadly [172, 173]. There is research in this area that explicitly calls itself feminist, invoking feminist theories, thinkers, and methods, while pursuing an emancipatory IT agenda for women and marginal population [9]. There is also a common form of feminist research in technology that does not explicitly identify itself as feminist, directly reference neither major ideas or figures of feminism, and stops well short of using terms like 'patriarchy.' At the same time, these works acknowledge and seek to resist the masculinization of technology and to expose gendered assumptions in technologies that might hinder women's access [14, 84, 88].

Adopting a feminist perspective can lead to insights and recommendations to advance and refine theory, methodology, critique and design [8], in part inspired by Bardzell [9] to engage in 'reflective integration of feminist strategies as a resource for interaction design.'

1.4 Review Method

A conceptual review aims to organize ideas of other researchers around an area of study, to synthesize evidence, clarify concepts, and to identify research gaps. Our methodology followed the five-part process we describe next. Although we present them in linear fashion, the steps overlapped and impacted one another as we progressed.

In the first step, we conducted a targeted search through relevant journals and conference proceedings in the ACM Digital Library using the following combination of the keywords: gender, design, software, development, technology, computer use. In the second step, we expanded our search to Google Scholar using the same set of search queries as before. We read through the abstracts of papers and books to determine the relevance of the publication to the subject area. Publications that combined aspects of gender with design considerations for technology were included in our preliminary set. We did not restrict our search to a specific timeframe, topic or specific technology domains, but we excluded articles outside the review's scope and articles in which gender was merely mentioned as a statistical device, blocking or control mechanism in studies. Third, we used the references' sections of the preliminary set of publications to add to our literature survey. Fourth, we performed an informal search on Google using the same keywords as we had used on Google Scholar. This search yielded different information sources such as blogs, online news and magazine sources, which supplemented the previous set of academic publications. Last, when we needed to update statistics, we performed a Google search for the latest statistics in domains and topic areas such as 'e-commerce', 'online social networking', 'mobile apps'.

Our results included articles across computing-relevant fields such as software engineering, human computer interaction, cognitive psychology, consumer behavior and information systems. We then categorized the articles we found by venue, year, topic, theories addressed, design considerations and gender concepts highlighted, and used the categorization to develop thematic groupings of the articles, relating to concepts relevant to cognitive and behavioral styles that impact technology use, and concepts that relate to gender-inclusive HCI design.

1.5 Organization of this Review

The organization of this review is as follows. We begin our review of empirical research on gender differences on cognitive and behavioral styles and how these relate to use of technology. Following this, we survey how non-inclusive design can inadvertently create and reinforce gender stereotypes. We then provide a review of current efforts in how to include gender perspectives in inclusive design. We conclude with a discussion of possible future directions in this research area.

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