Broadening Gender in Computing for Transgender and Nonbinary Learners

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***Abstract*—Gender disparities in computer science education have been a key focus of efforts to Broaden Participation in Computing (BPC). While the importance of outreach to women and girls has become well established, many researchers may not be aware of the needs of students who identify across and outside the gender binary. As more teens and young adults identify as transgender and/or nonbinary, computer science researchers and practitioners will need to understand how the needs of these students align with and diverge from those of their cisgender peers. In this position paper, we discuss how current BPC efforts targeted toward women and girls may unknowingly discourage transgender and especially nonbinary learners and call for the RESPECT community to Broaden Gender in Computing through additional research and discussion.**

***Index Terms*—gender, broadening participation, nonbinary, transgender**

I. Introduction

Many efforts to Broaden Participation in Computing (BPC) have focused on gender, with the specific goal of increasing the number of women and girls in computing [1]. However, many, if not the majority, of these initiatives approach gender from a static and binary perspective, though an increasing number of people identify as transgender or nonbinary [2], [3]. For the purposes of this paper, we consider those who have a gender identity different than the one that they were presumed to have at birth to be transgender [3] and those "whose gender is not male or female" [4] to be nonbinary. It is important to note that these categories are not mutually exclusive [5]. To understand how trans and nonbinary identities have previously been discussed in relation to BPC, we examined the titles, abstracts, and keywords from each prior RESPECT conference for strings and substrings related to gender in general, women or girls specifically, and LGBTQ+ identities, as shown in Table I. Only three of the 202 records seemed relevant to trans and nonbinary learners, with papers focusing on the sense of belonging of LGBT computer science (CS) students [6], homophobic or transphobic wikipedia vandalism [7], and the representation of queer people of color in games [8]. Given the past approaches to diversify participation in CS and the rise in transgender and nonbinary identified young people, it is our position that programs for women and girls could have the unintended consequence of discouraging or excluding transgender and nonbinary participation. This is important not only because demographic trends indicate more people are sharing these identities [2], but because students are in the process of developing and exploring many aspects of their identities (from computing to gender and beyond) that will interact in complex ways. Our goal is not to diminish important work by others to diversify computing, but to advocate for a population that will become increasingly visible in our schools, workplaces, and society. We as a community need to be with the times to improve notions of justice in computer science education (CSED). Therefore, we must commit to Broadening Gender in Computing through expansive understandings of gender that include transgender and nonbinary learners.

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TABLE I
Gender in RESPECT Abstracts, Titles, and Keywords

Year	Total Papers	Gender	Women / Girls	LGBTQ+	Any Term
2015	36	12	15	1	20
2016	28	8	7	1	10
2018	28	10	10	0	14
2019	49	10	16	0	22
2020	61	14	27	1	30
All	202	54	75	3	96

We do not advocate for this change in a vacuum. The first author is someone for whom the boxes don't work well and has sought to represent similarly situated persons in previous work in the sport management research space. The second author identifies as a cisgender woman. The third author is a nonbinary trans genderqueer human, best represented by they/them pronouns. While the first and third authors identify as part of this community, they recognize that they do not speak for all for who do, especially queer and trans people of color (QTPOC). We also acknowledge that our use of categories and labels provide us with communicative convenience but fail to capture the breadth, complexity and nuance of gender. In what follows, we use our scholarly and personal experiences to outline the importance of broadening gender in computing by describing the growth of transgender and nonbinary identities, the current state of gender-focused BPC efforts, and opportunities and challenges presented by transgender and nonbinary identities for computer science education.

II. Transgender and Nonbinary Identities

Sex and gender are related but distinct concepts, both socially constructed. Sex describes physical attributes of human bodies that we have labelled; as noted by activists and scholars advocating for intersex peoples' rights to bodily autonomy, sex itself is constructed, manipulated, and reinforced within the socio-medical complex [9]. Gender describes a more internal process of self-identification which may or may not manifest in a gendered affect or outward presentation [10]. As noted above, transgender people have a gender identity different than the one that they were presumed to have at birth [3]. There are some commonly used acronyms and terminology that members of the CSED community should become familiar with. AFAB and AMAB are used to refer to people who were Assigned Female or Male at Birth (respectively). It's important to recognize the action implied in these acronyms in that the assigning of a gender is something that happens *to* someone by others, which is a process that continues throughout life as people ascribe certain characteristics, behaviors, habits of mind, abilities, and preferences to others based on their own perception of someone else's gender.

While there is much overlap between transgender and nonbinary identities, there are important distinctions as well. Both groups of people do not identify with the gender that they were assigned at birth [3]. However, whereas many transgender individuals conceive of their gender as matching the one "opposite" of what they were assigned at birth, nonbinary people can eschew this binary notion of gender altogether [11]. Some nonbinary people view their gender as part of a continuum that operates between something called a 100% Male and a 100% Female. Other nonbinary people reject the idea of a continuum. As with all contemporary social phenomena, these definitions and understandings of self are being debated and discussed within the transgender and nonbinary communities. Furthermore, as noted above, trans and nonbinary identities are not mutually exclusive and many people identify as both [5].

A. U.S. Transgender and Nonbinary Population

While typically conceptualized as a small population, there are more and more transgender and nonbinary-identified people in the US. According to the Williams Institute [12], [13], about 1.4 million (0.6%) adults and 150,000 (0.73%) 13-17 year olds identify as transgender. Recent estimates suggest that for adults between the ages of 18 and 23, the rate of transgender identification rises to 1.8% [2]. A rough estimate of the number of nonbinary people in the United States can be computed by combining estimates of transgender persons in the US with estimates of the proportion of transgender adults identifying outside the gender binary. Multiplying the above figures by the 35% of United States Transgender Survey (USTS) respondants who identify as nonbinary [3], we can estimate over 500,000 nonbinary adults in the US. Nonbinary identities and expressions in the world are also increasingly recognized by key gatekeepers, such as state motor vehicle commissions [14], [15] and colleges and universities [16]. Looking specifically at higher education, Beemyn [17] found that 0.6% of first year students at a large public university in the Northeast identified as transgender. Of those, 62.5% had a nonbinary identity. With computer science as a highly in demand major [18], [19] and individuals likely to begin gender transitions around college age [3], the likelihood of CS departments encountering transgender and nonbinary students is increasing.

B. On Campus and in the Workplace

According to the USTS, trans and nonbinary people face discrimination in nearly every aspect of being, with nearly 30% of respondents living in poverty, 77% reporting at least one negative educational experience due to being transgender, and nearly one in five respondents having "reported being fired, denied a promotion, or not being hired for a job they applied for because of their gender identity or expression" [3, p. 12] in the year prior to the survey. On campus, Budge, Domínguez, and Goldberg [20] found that a low sense of belongingnesss was associated with higher levels of minority stress experiences among nonbinary students in higher education. Within computing, Stout and Wright [6] noted that individuals with LGBTQ identities were more likely to consider leaving computer science due to a low sense of belonging in CS. A low sense of belonging seemed particularly impactful for undergraduate LGBTQ women and LGBTQ graduate students in general. Beemyn [21, p. 18] conducted interviews with 208 students, 111 of whom had a nonbinary gender identity. Of those 111, all but one "said that their college was not doing enough to support them." Those students reported issues with infrastructure (lack of gender inclusive bathrooms, housing, and health care), forms, documents, and records that do not respect their identities or gender diversity in general, a failure to teach key stakeholders about gender diversity, as well as a "lack of supportive spaces on campus for nonbinary students, especially nonbinary students of color" [21, p. 28].

In the workplace, Rainey and Imse [22] found in a test of anti-transgender hiring bias that notional resumes led to a discrimination rate of 15% for a transgender woman, 12.5% for a gender non-conforming person using gender neutral pronouns, and 0% for a transgender man. In the technology field we find anecdotal evidence for part of this pattern, where a trans woman found that the number of responses she received to her resume after changing her name were drastically lower than those with her pre-transition name; however, a trans man faced less resistance to his IT advice from the same colleagues post-transition [23]. However, this picture is not universal of a transgender experience in the workplace. Reality is more complex. For example, a second notional transgender man in Rainey and Imse's study had the highest discrimination rate (69%), with the major difference being that his cover letter expressed his passion for trans rights. Therefore, we must be mindful that a workforce culture that occasionally produces benefits to individual transgender people can still be shaped by transphobia and needs to be counteracted.

III. Current Gender-Focused BPC Efforts

Participation of trans and nonbinary students in K-12 CS classes is difficult to assess as most data classifies students within the gender binary, though some districts are now allowing students to register with a 'X' gender marker instead of 'F' or 'M' [24]. While we have limited data on the numbers of trans and nonbinary CS students for a variety of institutional and learner-centered reasons, we believe that pre-existing underrepresentation of women and girls are likely to cause inclusion issues for trans and nonbinary students. For example, 80% of nonbinary respondants to the USTS were AFAB [3]. Since only 3% of nonbinary respondants said that they always told others that they were nonbinary, researchers and practitioners who encounter these nonbinary persons in the course of their work will likely not realize they have done so. While the majority of trans men and nonbinary persons indicated that they started their transition before age 24, nearly two-thirds of trans women said they began transitioning at age 25 or older [3], beyond the age at which many gender-focused interventions are employed. In addition, while efforts to include nonbinary persons do not specifically say that AMAB students are excluded, with a lack of a strong signal to the contrary, they may be hesitant to participate. We must also consider that QTPOC will face additional hurdles that their white peers may not [25].

Computer science has significant gender disparities at all levels from K-12, through higher education and into the workforce. Even among STEM fields generally, CS has a particularly pervasive gender gap, the severity of which is even more pronounced for women who are racially and ethnically minortized [1]. In K-12 there is low participation in CS generally including course taking (even when accounting for availability) and interest in pursuing a CS major. In 2019, 56% of all AP exams, typically seen as the apex of an academic pathway, were taken by girls, yet only 29% of AP exams in computer science were taken by girls [26]. Schools with a majority of students from racial and ethnic groups that have been minoritized in the US and/or students eligible for free or reduced lunch are least likely to offer CS, further compounding the access challenge for students of color, particularly girls [27].

In higher education the gender gaps persist. The 2018 Taulbee Study run by the Computing Research Association [28] found that in the last decade the number of women earning bachelor's degrees in computing and information science has gone up, but a significant gap in degree attainment remains with men earning 78.8% of the degrees and women just 21.2%. There has also been an increase in women of color earning a bachelor's degree in CS though at a lower rate than white women. Generally, there is greater diversity among women than men earning bachelor's degrees in computing.

The gap continues to persist through the PhD at nearly the exact ratio which leads to underrepresentation of women in faculty positions. For example, in 2018-2019 the percentage of women hired into tenure-track positions in computing was 22.9% [28]. In computing and mathematical occupations generally, women comprise just 25.8% of the workforce [29], despite the overall professional workforce being 57% women [26]. Once again, women of color are even further underrepresented in computing with only 3% of the computing workforce made up of African-American women, 7% Asian women and 2% Hispanic women [26].

A. Importance of Broadening Gender in Computing

Addressing the gender disparities has been a multi-prong effort focusing on increasing participation in computing through recruitment efforts, curricular modifications and pedagogical practices. According to Zweben and Bizot [28], several national organizations have emerged to build the capacity of schools, universities, and companies to increase the representation of girls and women in computing: the National Center for Women in Information Technology brings together change makers, provides resources and tools to educators (including administrators) and employers, and addresses policy reform efforts; the ACM Council on Women in Computing focuses recruitment, retention, and support of women in computing in higher education; AnitaB.org focuses on workforce related issues for women in computing and technology.

Research on the factors associated with the underrepresentation of women in CS focuses on access girls have to computing, particularly in the early years both at home and in school, a feeling of lack of belonging in computing [30] (which may be exacerbated by stereotyping of teachers and guidance counselors [31], [32]), as well as popular media [33]. Subsequently, the efforts to address the disparities often focus on increasing access for girls in computing through interventions such as girls' coding clubs or the use of tools for teaching coding such as gaming [34]. Focusing on increasing a sense of belonging in computing closely tied to belongingness to a gender may have the unanticipated outcome of further gendering the field of computing at a cost of including people across the gender spectrum.

While not having a sense of belonging is likely to be a factor for trans and nonbinary people in CS, the factors that create a sense of belonging may differ for them. Therefore, it is important that we seriously examine the assumptions and essentializations that underpin our efforts to recruit and retain a more diverse set of people into computing and technology. The impulse to want to change the situation for girls and women in computing is a good one, and the intent here is not to deride the work done over the decades in this area, but to provide additional perspective about how gendered approaches to gender equity might produce unintended consequences. For example, while activities like dance and textiles that have historically been gendered themselves [35]–[37] and an produce positive results in the classroom, uncritical use of these activities risks re-essentializing the category of girl and producing gendered ways of applying computing. Again having these activities to attract interested students is not the issue, but having only having traditionally girl-typed activities available can create an unintended barrier for some students. Pederson, Greaves,

and Poole [38] writing in the health promotion field offer up a framework for gender-transformative change that articulates a step beyond gender-specific interventions that seeks to root out and transform "harmful gender roles, norms, and relations". CSED programs should incorporate this work and build on it, not just for trans and nonbinary learners, but for cisgender community members as well since gender expansive literacy is important for practitioners and researchers. Two recent examples of professionals who would have benefited from more nuanced understandings of gender are the AI researchers who did not consider how generating pictorial representations of people from their voices might adversely impact transgender people [39] and the highly criticized authors of a retracted article on gender and mentorship whose use of an algorithm to "determine" the gender of article authors failed to classify nearly half the names [40].

IV. Future Work to Broaden Gender in Computing

CSED researchers and professionals already have the tools necessary to Broaden Gender in Computing and we hope this paper provides the impetus to apply them to this effort. One concrete piece of future research could build off of the work done by Stout and Wright [6] through qualitative and mixed methods. Building off of literature from the Transgender Studies field, we can begin to see how trans and nonbinary students at all levels of the K-12 and Postsecondary pathways interact with and perceive our work, and - particularly for Postsecondary students - how they understand the culture of Computing and whether or not they feel part of that culture and community. In addition to the serious business of learning computer science, youth are exploring and developing their identity (gender and otherwise) throughout their development. As we design our interventions, we need to be mindful that this development doesn't pause when they interact with our materials and tools. For example, evidence suggests that English language learners respond to the opportunity to customize a digital "learning companion" avatar in an intelligent tutoring system to more resemble themselves [41]. While additional work has yet to be published, we have heard from this research team that they are beginning to see middle school students using a customizable avatar to explore and represent their gender identity. These interactions could provide a safe environment for students to explore their identity (through the use of avatars), or they could unintentionally reinscribe harmful demarcations between genders. Our community needs to situate our interventions, our work, the culture of Computing and Computing Education within a political landscape that targets trans, nonbinary, and gender-nonconforming people – medically, socially, psychically and physically. If we uncritically allow these politics to shape the terms of our work, we will become what we are working against.

V. Conclusion

While we have outlined the broad strokes of the challenges faced by transgender and nonbinary learners in computer science, our paper only scratches the surface of this complex topic. What is clear is that gender-specific solutions to the underrepresentation of women in computing may have unintended consequences for transgender and nonbinary people by essentializing a gender binary that they may identify outside of. Beyond framing this as another issue of lack (ie, that there aren't enough trans or nonbinary people in computing), we can use the opportunity to seriously engage with the expansive (and sometimes explosive) views of gender that trans and nonbinary identities present. This gives us the opportunity to question what expansive understandings of gender can do for computing as well as what computing can do for gender-expansive individuals. As we continue our march toward education justice, it's worth asking the questions, "How are gender justice and education justice linked?"; "In what ways might a reliance on a binary approach to the underrepresentation of women unwittingly feed into and maintain the same systems that produced our current computing workforce landscape?"; and "What is our role as researchers, but also as members of communities, in bringing the fight for gender justice into computing education spaces?" We ask that our fellow researchers join us as we attempt to Broaden Gender in Computing through additional study and intentionality for trans and nonbinary learners.

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