Increasing the Participation of Women and Underrepresented Minorities in Computing:
Missing Perspectives and New Directions

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Background and Historical Context
The past two decades have sparked a wealth of research and educational interventions to promote the participation of women and girls in computing. In light of this research, we have come a long way in understanding many of the key barriers girls face. In general, these barriers include student perceptions of technology and technology careers; hostile or male-dominated classroom or workplace cultures; irrelevant or outdated curricula and pedagogies; popular culture representations of science and technology; peer influences; lack of mentors/role models; and unconscious biases of teachers, counselors, parents, and other adults; to name a few (e.g., Ashcraft et al., 2012; Barker & Aspray, 2006; Margolis et al., 2008). This research also makes recommendations for addressing these barriers, including unconscious biases, creating more inclusive classroom or workplace cultures, and introducing computing in ways that engage girls and engender a feeling of belonging. As a result, a number of educational interventions or programs to increase girls’ interest in technology have emerged over the past decade or so.

While some progress has been made, significant inequities still persist. Girls comprise only 19% of all CS AP test takers and young women earn only 18% of all Computer and Information Science bachelor’s degrees (College Board, 2012; National Center for Education Statistics, 2011) and even fewer in research institutions (13%, 2012, according to the CRA Taulbee Survey). The picture in industry also continues to be bleak with women holding only 26% of all computing occupations (U.S. Dept. of Labor, 2012). These numbers decline further when considering women of color. In 2012, African American women and Latinas held only 4% of computing occupations (U.S. Dept. of Labor, 2012).

Effectively reversing these trends requires incorporation of important research perspectives that, to date, have been largely overlooked in gender and computing research. In particular, theory and research in two interrelated areas are key to moving the gender and technology research agenda forward: perspectives in intersectionality studies and in masculinity studies. Below I briefly define these perspectives, identify how they would alter and advance current research in gender and technology, offer sample research questions, and illustrate how the U.S. would benefit from undertaking this research direction.

Intersectionality and Masculinity Studies: What Do They Bring to Gender and Computing Education Research?

Intersectionality Studies
To date, existing research in gender and information technology has primarily focused on girls, as though they form a uniform group. Yet girls differ in terms of race, class, disability, and other aspects of their identities. Meanwhile, a relatively separate line of research has focused on race/ethnicity and the barriers facing underrepresented minorities, or non-dominant youth, when it comes to participating in technology. This research, however, pays little attention to other markers of difference, such as gender and class. As a result, little is known about how multiple intersecting aspects of girls’ and boys’ identities influence their perceptions of themselves and their career potential as technologists.

I contend that, moving forward, we must draw from broader theory and research in intersectionality studies if we are to alter current trends for girls and nondominant youth in computing. In brief, intersectionality
theory (e.g., Collins, 2000; Crenshaw, 1991) calls attention to how our perspectives and experiences are shaped differently as we navigate multiple, shifting categories of identity or belonging (e.g., gender, race, class, religion, ability, among others). We often experience situations differently or are treated differently as we navigate these categories and this shapes our sense of ourselves, who we might become, and our relationship to society at large. Whether we are aware of it or not, rarely do we experience life simply as “women” or “men” but rather as White women, African-American men, poor immigrant, and so on. These nuances significantly shape others’ perceptions of us, our perceptions of ourselves, and our plans for the future. Importantly, the salience of any particular identity shifts given the context, such that in certain contexts gender may be foregrounded while, in another context, race/ethnicity might be most relevant. Intersectionality research, then, calls attention to the importance of teasing out these distinctions by simultaneously addressing multiple, shifting, and sometimes competing aspects of identity (e.g., Acker, 2006; West & Fenstermaker, 2002). This research also calls attention to how educational contexts are affected by and can, in turn, affect these intersecting aspects of identity in positive or negative ways.

Gender and technology research can build on this prior work in intersectionality studies, investigating the complex ways in which girls and women, diverse in race/ethnicity, class, religion, ability, and sexuality, make sense of their intersecting identities and the implications of this for their participation in computing. Indeed, the few existing studies that do focus on girls of color highlight the urgency in attending to these multiple identities and how they shape a diverse range of girls’ perceptions of themselves as technologists (e.g., Kvasny et al., 2009; Yakura, 2006). For example, one study found that in comparison to White girls, fewer African-American girls felt that teachers supported their STEM career interests (Girl Scouts Research Institute, 2012). African-American and Latina girls were also less likely to know someone else in a STEM field than White girls (Girls Scouts Research Institute, 2012; Margolis et al., 2008). These distinctions are particularly interesting in light of additional research showing that girls of color often express more interest for majoring in a computer field than do White girls (Benyo & White, 2009), but this interest does not seem to translate to actual enrollment (Ong, White, Espinosa, & Orfield, 2010). Furthermore, in initial research I have conducted in a culturally relevant technology program targeting girls of color, I document how girls encounter technical design elements (e.g., pale-skinned, light-haired avatars) that do not allow them to adequately represent themselves and how these experiences affect their budding identities as technologists (Ashcraft et al., 2013). These distinctions among girls only begin to shed light on important differences we must understand if we are to design effective educational interventions that increase participation in computing for all girls.

Future Directions, Sample Research Questions, and Ultimate Impact

To incorporate an intersectional perspective into gender and computing studies, we must do at least three things: First, at the very least, whenever possible, we must do a better job of disaggregating empirical data by race, gender, SES, and so on. Second, we also need to encourage more studies consciously focused on a wide range of girls. When these conscious efforts are not made to study a diverse range of girls, the focus tends to fall, even if inadvertently, primarily on White girls (or sometimes low SES girls but without attention to other intersections). To rectify this, we must prioritize studies that ask how a wide range of girls experience and engage with technology and how these experiences shape their perceptions of themselves and future plans. Sample research questions might include the following:

- What kinds of access do girls diverse in race, class, religion, or other markers of difference have to experiences with technology and to role models and mentors working in technology? How do they go about gaining access and how do these experiences and interactions shape their perceptions of technology and themselves as technologists?
- What cultural, linguistic, or geographic factors hinder or discourage a diverse range of girls’ interest and
motivation to pursue computer science education or careers?

✓ To what extent do computing education interventions meet the needs of girls’ diverse in race, class, religion, and so on? How do race, class, religion, and so on affect girls’ participation in these computing education programs? And how can these programs be made more culturally relevant?

Third, while the above questions do consider intersections among various identity categories, they still treat gender, race, and so on primarily as demographic variables or taken-for-granted categories. They do not help us understand how these identity categories come to take on certain meanings or associations (e.g., this is appropriate behavior for a White or African American girl) nor do they help us understand how people come to know and internalize what it means to be a girl or a boy, or a particular race/ethnicity; how these messages vary by settings; how computing education contexts contribute to these messages, or how these dynamics influence the ultimate effectiveness of these educational interventions. In other words, while asking the above questions may help us discern, for example, that “such and such” % of African-American girls associate computing with masculinity, we still have no idea about what they think masculinity or femininity really mean or the everyday processes by which this comes to be their understanding. This gap leaves us guessing how best to address these gender dynamics in educational interventions.

Incorporating an intersectional perspective, however, would help us ask new research questions about these important dynamics -- questions such as: 1) How do girls’ draw from larger societal messages about race, class, and gender (in a particular context) and how does this affect their developing identities and relationship to technology? 2) What messages about race, class, gender are communicated in everyday interactions (e.g., between peers, between teacher and student) in computing education contexts? 3) How do these specific girls interpret specific popular culture texts and messages about race, class, gender and technology? What are the implications of these everyday messages and processes for girls developing technical identities and future plans? Attending to these kinds of social and communicative dynamics is important if we are to design truly effective educational interventions in computing.

Masculinity Studies

As we attend to these various intersections and markers of difference among girls, another overlooked marker of difference in gender and technology research also emerges: the lack of attention given to men as gendered being in technology contexts. To date, the majority of gender and technology research has focused on girls and women – studying their experiences, identifying the barriers they face, examining promising practices and programs to address these barriers (e.g., Cohoon & Aspray, 2008; Hewlett et al., 2008). If and when men (or masculinities) are studied in these contexts, it is primarily in terms of how they contribute wittingly or unwittingly to the existing difficulties or hostile environments women face. Little, if any, attention has been give to why some men choose to support and advocate for these gender reform efforts, to the various roles men play in facilitating and/or stifling these efforts, the differences across racial and ethnic categories of men, and how they themselves are affected or changed by these efforts. This oversight is of particular concern because it can perpetuate the misconception that these concerns are “women’s issues” when, in fact, they are “gender” (and therefore social) issues. And since men are also gendered these efforts necessarily involve and affect them. Further, men sometimes interpret conversations about women’s underrepresentation in a defensive way, understandably responding that they didn’t cause the problem. The field needs a better understanding of ways to reveal and discuss male privilege without creating the impression that men are causing problems for women “victims” (which exacerbates the problem for everyone).
Understanding men’s role in gender and diversity efforts as well as how they are affected by these efforts is essential, then, for at least four reasons:

✓ **Men are often the gatekeepers and power holders computing environments.** Because men typically hold more senior positions, have greater capacity to make and implement policies and programs, and maintain participation in broader professional networks, their participation in gender diversity efforts is critical for the ultimate success of these efforts. (Ashcraft, et al., 2013).

✓ **Gender reform is not a women’s issue; it necessarily involves men.** Changes in femininity and in women’s experiences necessarily affect men and masculinity (e.g., Connell, 2005; Messner, 2004). Research is needed to understand how these changes affect both boys and men, their relationship to technology, their relationships with girls and women, and their perceptions of girl's and women’s role in technology.

✓ **Men stand to benefit from expanding gender norms.** While some men often benefit from existing gender inequities, they also experience myriad difficulties and disadvantages as a result (e.g., pressure to be the “breadwinner”; lack of support or respect for spending time with family) and, therefore, stand to gain important benefits from equity reforms (e.g., Connell, 1995, 2005).

✓ **Women report that exposure and encouragement to pursue and persist in STEM careers often came from men.** For example, in a survey of female professionals in IT, half or more respondents reported that a father, spouse/partner, male professor/instructor, or close male friend encouraged their decision to work in technology (Liston et al., 2008). Knowing what encourages or discourages men from supporting women in technology is vital.

Researchers in the National Center for Women & IT have begun conducting research to better understand what motivates men to participate in advocacy for diversity, what arguments convince them to advocate, how they go about advocating, what challenges and successes they have faced, and how they are affected by changes in gender dynamics, particularly when it comes to negotiating work-life concerns with their spouses (Ashcraft, et al., 2013). But this is just the tip of the iceberg.

The study of computer science education would do well to draw from broader research in masculinity studies – research that does, in fact, provide a framework for examining how changes in femininities necessarily affect changes in masculinities, how men make sense of these changes, what kind of new masculinities and femininities emerge and how these new identities challenge historical inequities or sometimes reproduce these inequities in new and subtle ways (e.g. Connell, 2005; Messner, 2004). More attention to technology and men’s experiences as gendered beings (and, in keeping with intersectionality theory, also their experiences as raced, classed beings) is crucial.

It is also vital to attend to issues of masculinity and technology early on, examining how boys’ participation in technology shapes their developing masculinities and how this, in turn, shapes their perceptions of themselves, of their futures, of their relationships with girls, and their perceptions of girls’ relationships to technology (as well as how these dynamics differ by race, class, and other markers of difference). For example, in a recent study a game design program for boys and girls, we found that while White and Latina middle school girls’ interest in computing stayed the same, White and Latino boys experienced declines in both interest and in their perception that “other students think technology is cool.” One possible explanation is that learning alongside girls subtly challenges stereotypes about who does computing and at the same time, at least for the boys, also poses unconscious challenges to their developing masculinities. In other words, in even subtly challenging the idea that this is “something only boys do,” boys experience it as potentially less “cool.” This explanation is also tentatively supported by prior occupational research in
masculinity studies, as well as research on stereotype threat, (e.g. Murphy et al., 2007). Further research into how these masculinities emerge is important if we are to better understand how to effectively implement educational interventions such as these. For example, in the above scenario, without attending to the question of masculinities, researchers, evaluators, and teachers may think that boys' declines in interest and "coolness" are solely related to problems with the curriculum or educational strategies when it may really be about social dynamics and messages influencing the classroom environment. This is but one example of an important area to explore so that we might address these dynamics with youth, implement more effective interventions, and avoid unintended consequences of these efforts.

**Future Directions, Sample Research Questions, and Ultimate Impact**

When it comes to incorporating masculinity research into gender and computing, we also must do three things. First, as is the case with women, we need to be careful to disaggregate data on men also by race, class, and other markers of difference. Second, we need more studies examining what motivates or hinders a diverse range of men's participation in diversity efforts, what successes and challenges they face, and how they are affected by these efforts and changes in femininity, masculinity, and gender relations. Sample research questions might include:

- How do a diverse range of male undergraduate students (and/or male faculty) perceive diversity efforts in computing? What motivates or hinders them to participate? In what ways are they already advocating for diversity and in what areas are they resistant or hesitant to act and why? What generational differences, if any, exist?
- How do boys and men in technology understand male and female roles when it comes to work-life concerns? How do these understandings shape their decisions about future technology education and careers? How do they negotiate these roles and decisions with (male or female) partners or potential partners?
- How do boys perceive educational interventions for girls in computing? What do they think of and how do they participate with girls in co-educational computing settings?

Finally, as noted in the previous section, we also need to move past research paradigms that treat being male as a taken-for-granted category or demographic variable. We need to investigate how a diverse range of boys and men vary in their perceptions about masculinity and technology. We also need to examine how boys draw on messages about race, class, gender in particular settings (such as the game design program mentioned above) and how this shapes their understandings of technology and themselves as technologists.

**Future Impact**

Incorporating these missing perspectives into research in diversity and computing provides an important framework for advancing future study and will significantly benefit U.S. educational efforts to broaden participation in computing. For example, such research will enable us to overcome the current problem of monolithic recruiting and instead tailor recruiting messages to be more culturally relevant for girls (and boys) from different socio-cultural backgrounds. It will also enable us to determine with more accuracy why certain educational programs may be less effective and how they could be improved. This information will help us design more culturally relevant educational programs that do a better job of engaging and retaining a diverse array of students. This kind of research also is increasingly urgent as the U.S. population rapidly becomes more diverse. This information will also help us effectively articulate the benefits men might enjoy from the expansion of gender norms; likewise, it will help us effectively involve more men in a range of diversity efforts. Finally, this research agenda will help us avoid unintended consequences that may unwittingly thwart our existing educational interventions and perpetuate existing inequalities (such as the
above example about the boys perceiving technology as less “cool”). Given these and other associated benefits, incorporating these missing perspectives is vital for moving the computing education research agenda forward and for the ultimate success of U.S. efforts to diversity computing.

References


