KAPOR CENTER

ASU Center for Gender Equity in Science and Technology
Arizona State University

pivotal VENTURES

DATA BRIEF:

Women and Girls of Color in Computing

TECHNOLOGY AND THE GLOBAL ECONOMY

Technology is a significant driver of economic growth and development across the globe (Dutta, Geiger, & Lanvin, 2015). Technology plays a critical role in the United States economy and workforce, with nearly one-quarter of the country's total economic output produced by high-tech industries (Bureau of Labor Statistics [BLS], 2016, 2017) and nearly 1 million job openings projected in computer and information technology over the next 10 years (BLS, 2017). In addition to being among the fastest-growing, computing occupations are also among the most economically lucrative, with median salaries more than twice the median wage for all other occupations (BLS, 2015b) and significant wealth being generated by technology creators and investors (CB Insights, 2017). Yet, the technology workforce is not representative of the diversity of the United States population, with the vast majority of individuals employed in computer and mathematical occupations being White (63%) and male (75%; BLS, 2015). To ensure the future economic growth and prosperity of the United States, developing a robust, skilled, and diverse national workforce will be essential. Simultaneously, increasing equity in economic opportunity and decreasing inequality will be directly linked to the preparation of individuals from marginalized and underrepresented communities to participate in the rapidly evolving technology economy. Thus, the current and pervasive lack of racial/ethnic and gender diversity in the technology ecosystem presents a significant national challenge.

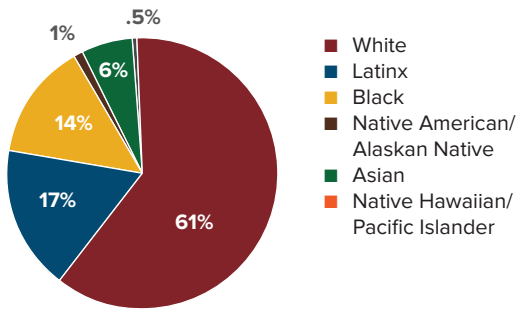
DATA HIGHLIGHTS

- Women of color currently constitute **39%** of the female-identified population in the United States, and will comprise the majority by 2060.
- Just **4%** of all high school students taking AP Computer Science in 2017 were Latinx girls, **2%** were Black girls, and **<1%** were Native American/Alaskan Native girls.
- Women of color make up less than **10%** of all Bachelor's degrees earned in computing, and Latinx women are most underrepresented in computing Bachelor's degree completion rates relative to their population in postsecondary education.
- Women earn **21%** of all doctorates in computing, however, less than **5%** are awarded to Black, Latinx, Native American/Alaskan Native, or Native Hawaiian/ Pacific Islander women.
- Among all women employed in computer and information science occupations, only **12%** are Black or Latinx women; In 177 Silicon Valley firms, less than **2%** of all workers are Black, Latinx, or Native American/ Alaskan Native women.
- While White women and Asian women participate in roughly equal rates in the overall workforce, Asian women are significantly **less likely** to be in leadership positions.
- Less than **1%** of Silicon Valley tech leadership positions are held by Latinx women, and **<0.5%** are held by Black women.
- Women of color account for **80%** of the new female-led small businesses, but in tech, Black women account for less than **4%** of female-led startups.

WOMEN AND GIRLS OF COLOR IN THE UNITED STATES

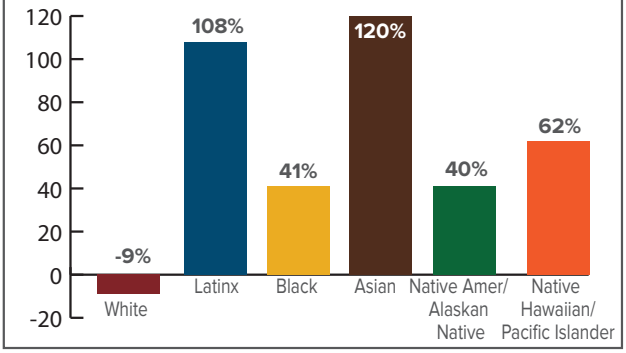
Women of color currently constitute 18% of the overall U.S. population and 39% of the roughly 163 million female-identified population in the United States (Census, 2014; Figure 1). Nearly half of female students in K-12 education are girls of color (U.S. Department of Education, 2013) and by 2060, the census projects that women of color will comprise the majority of the female population in the United States (Census, 2014, Catalyst, 2017; Figure 2).

FIGURE 1
US Female Population by Race, Ethnicity



Source: U.S. Bureau of Census (2014)

FIGURE 2
US Female Population Growth by Race, Ethnicity (2015-2060)



Source: U.S. Bureau of Census (2014)

Further, recent data has also shown that women of color, specifically Black and Latinx women, are the fastest growing group of entrepreneurs in the United States, creating over 80% of the new women-led small businesses and nearly doubling the number of businesses started by women of color since 2007 (AMEX, 2016; MacBride, 2015). Both the rapidly increasing size and entrepreneurial activity of this population indicates significant earning and spending potential. Yet despite the size and projected growth of this important segment of the population, women of color remain vastly underrepresented across the technology pipeline and many of the strategies, interventions and investments to diversify the technology ecosystem have focused on race or gender, overlooking the intersection of race and gender (and other marginalized sexual, cultural, economic, religious, and linguistic identities).

INTERSECTIONALITY IN COMPUTING

Foundational scholarship on Intersectionality theory articulates the ways in which racism and sexism affect educational, social and occupational outcomes of women of color in ways that cannot be fully captured by examining experiences by race or gender separately (Crenshaw, 1989, 1991). Intersectionality describes the complex interactions between multiple identities and dynamics of power, racism, sexism, and oppression (Hill Collins and Bilge 2016; Crenshaw, 1991). Intersectionality theory encompasses not only the intersection between marginalized racial and gender identities, but also additional marginalized identities including sexual orientation, socioeconomic status, religion, age, ability, and linguistic background, among others. Within science, technology, engineering and math (STEM) fields, the unique combined and cumulative challenges of racism and sexism experienced by women of color has been described as the “double-bind” (Malcom et al., 1975; Ong et al., 2011; Williams et al., 2014), which leads to disparities throughout the STEM pipeline. In the technology pipeline, specifically, the double-bind for women and girls of color begins early in access and participation in computing education, persists throughout post-secondary education, and culminates in disparities in participation at all levels of the technology workforce, technology entrepreneurship, and venture capital (Scott et al., 2018).

Intersectionality describes the complex interactions between multiple identities and dynamics of power, racism, sexism, and oppression

Research has documented a multitude of structural and social/psychological barriers facing women and underrepresented people of color throughout the pipeline, including lack of access to rigorous STEM and computer science coursework, lack of diverse peers and role models, unwelcoming classroom and workplace environments, stereotype threat, bias in recruiting, hiring, and promotion, inequitable pay, lack of access to influential social networks and bias in venture capital investment (Scott et al., 2018). While much of this research identifies the barriers facing women and people of color, there is a dearth of research on the specific experiences and outcomes of women of color along the computing pipeline. Without identifying and understanding the specific challenges facing women of color in the computing and technology pipeline, interventions will be exclusionary, insufficient, and ineffective.

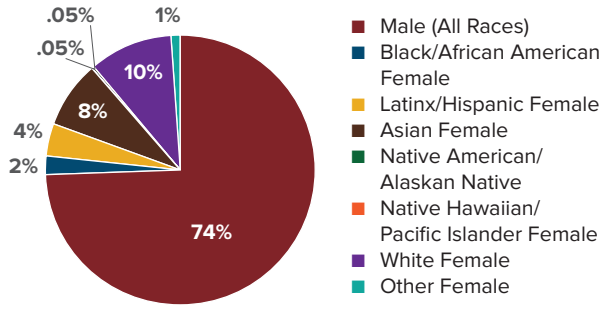
There is a dearth of research on the specific experiences and outcomes of women of color along the computing pipeline.

GIRLS AND WOMEN OF COLOR ACROSS THE COMPUTING PIPELINE

PreK-12 Education

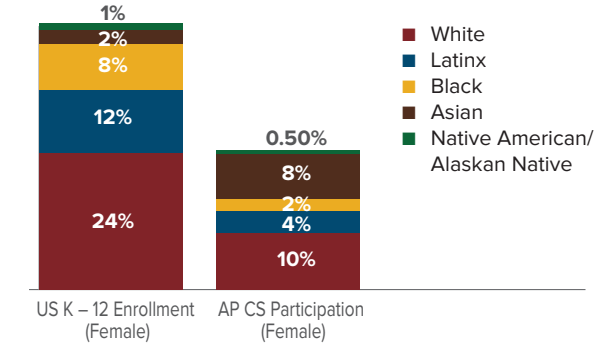
Although 50% of the school-aged population is female and 42% are Black, Latinx, or Native American (NCES, 2017), just 23% of all students taking AP Computer Science in 2017 were female and just 20% were Black, Latinx, or Native American (College Board, 2017). Among all AP Computer Science test takers, just 4% were Latinx girls, 2% were Black girls, and <1% were Native American/Alaskan Native girls, with Asian and White girls each constituting 8% and 10%, respectively (College Board, 2017; Figure 3 and Figure 4). Among the female students taking AP Computer Science, just 23% were Black, Latinx or Native American, with the vast majority being White (38%) or Asian (32%; College Board, 2017; Figure 5). Among the students of color who took AP Computer Science, less than one-third (29%) were female, demonstrating both within-gender and within-race disparities. In 13 states, there were no Latinx or Black female students who participated in AP CS A (Ericson, 2017). Since taking AP Computer Science in high school is a significant predictor of pursuing computing in college, disparities in computing course-taking and availability place girls of color at a significant disadvantage for future computing education and careers (Mattern, Shaw, and Ewing, 2011).

FIGURE 3
AP CS Participation, by Gender and Race/Ethnicity



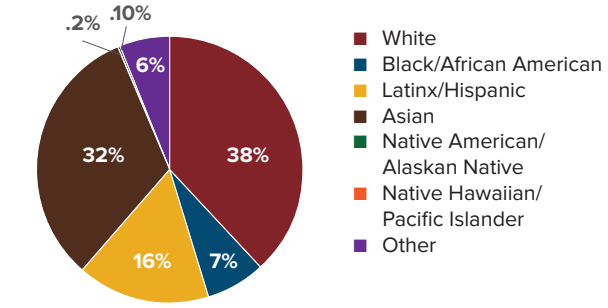
Source: College Board (2017); Includes AP CS A and AP CS Principles.

FIGURE 4
K – 12 Female Enrollment vs. AP CS Participation



Source: College Board (2017); U.S. Department of Education, Office for Civil Rights (2014); Data for Pacific Islander and Native Hawaiian student enrollment unavailable.

FIGURE 5
Female AP CS Participation, by Race/Ethnicity

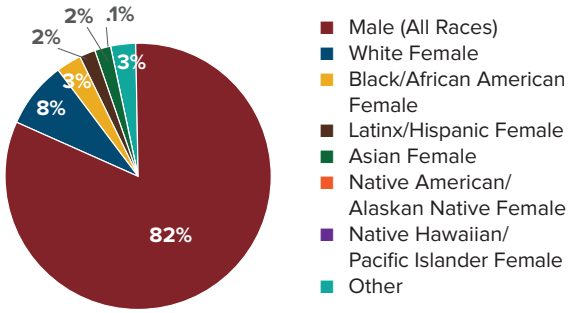


Source: College Board (2017); Includes AP CS A and AP CS Principles

Post-Secondary Education

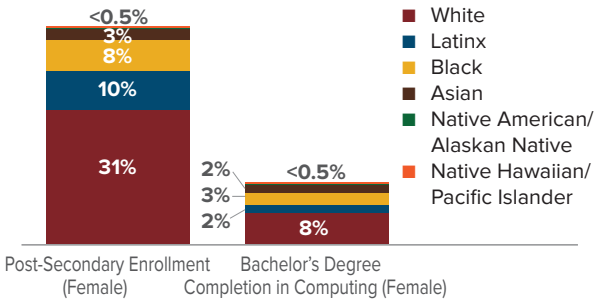
Despite comprising half of the college-aged population, women earn just 18% of Bachelor's degrees in the computer sciences. Women of color combined make up less than 10% of all Bachelor's degrees earned in computing, with Black women constituting 3% of all computing degree earners, and Latinx and Asian women comprising 2% each (Figure 6 and 7; NSF, 2016a). Among all women who earn computing Bachelor's degrees, the majority are White women (50%), followed by Black women (15%), Asian women (12%), Latinx women (11%) and Native American/ Alaskan Native women (<1%; NSF, 2016a). All women are underrepresented in Bachelor's degree completion rates relative to their population in postsecondary education, with Latinx women most vastly underrepresented (Figure 7). In graduate computing education, women comprise a higher percentage of the population earning Master's degrees in computing (27%), but significantly fewer are Black, Latinx, or Native American/Alaskan Native, or Native Hawaiian/ Pacific Islander (NSF, 2016b). Similarly, at the doctoral level, women earn 21% of all doctorates in computer science, however just one-fifth of these are awarded to Black, Latinx, Native American/Alaskan Native, or Native Hawaiian/ Pacific Islander women (NSF, 2016c; Figure 8). The lack of women of color completing degrees in the computer sciences limits access to lucrative careers in technology (and affiliated opportunities to pursue tech entrepreneurship and investments careers) and limits the number of women of color in academia. Without women of color in computing at the higher education stage, the lack of social scaffolding (role models, sponsorship, and support) for girls and women of color will continue to constrain efforts to broaden participation in computing.

FIGURE 6
Bachelor's Degree Completion in Computer Sciences, by Gender and Race/Ethnicity



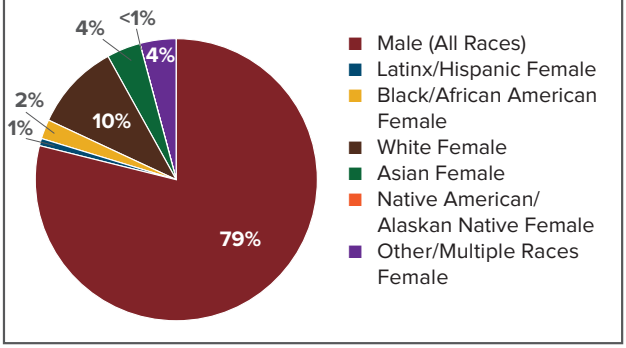
Source: National Science Foundation (2016a).

FIGURE 7
Post-Secondary Enrollment vs. Bachelor's Degree Completion in Computing



Source: National Center for Education Statistics (2013). Percentages reflect the percentage of the total population.

FIGURE 8
PhD Completion in Computer Sciences, by Gender and Race/Ethnicity

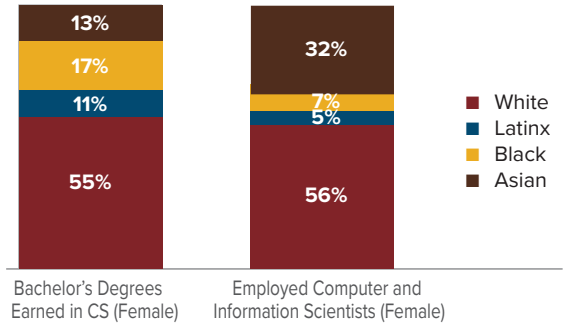


Source: National Science Foundation (2016c)

Technology Workforce

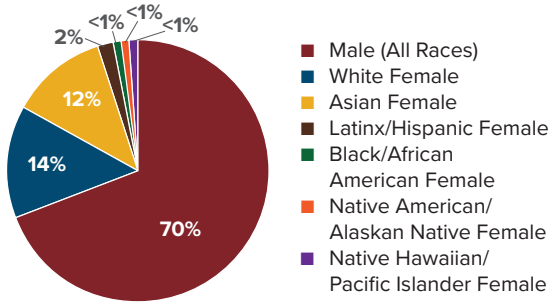
Over the past several decades, the proportion of women in the technology workforce has decreased substantially. While women currently comprise roughly half of the overall workforce, they make up just 35% of the technology workforce (EEOC, 2016). Among all women employed in computer and information science occupations, 56% are white women, 32% are Asian women, 7% are Black women and 5% are Latinx women (Figure 9; NSF, 2015a, 2016a). There are significant disparities between the percentage of Black and Latinx women earning computer science degrees and their percentage in the nationwide computing and information sciences workforce, demonstrating particular challenges with recruiting and retaining women of color (Figure 9; NSF, 2015a, 2016a). In Silicon Valley, men constitute 70% of the workforce, Asian and White women comprise a combined 26% of the professional workforce, while Black, Latinx, and Native American/Alaskan Native women each constitute 2% or less (Figure 10; EEOC, 2016; Hongsdusit & Rangarajan, 2018). These race and gender disparities are even more dramatic when examining the demographic composition of the leadership of Silicon Valley technology companies, where males account for 80% of all tech leaders. While white women and Asian women participate in roughly equal rates in the overall workforce, Asian women are significantly less likely to be in leadership positions (Figure 11; EEOC, 2016; Gee & Peck, 2017; Hongsdusit & Rangarajan, 2018). Less than 1% of Silicon Valley tech leadership positions are held by Latinx women, and less than 0.5% are held by Black women. The lack of representation of women of color in professional and leadership positions limits access to high-wage, high-growth occupations, increases inequality in wealth distribution, and limits the many benefits and contributions of a diverse workforce (Dahlberg & Intel, 2016; Hunt et al., 2018; Lorenzo et al., 2018). These disparities also limit access to networks of social and financial capital and critical experiences necessary to launch or invest in venture-backed technology companies.

FIGURE 9
Disparities between CS Degree Earners and the Computing Workforce by Race and Gender



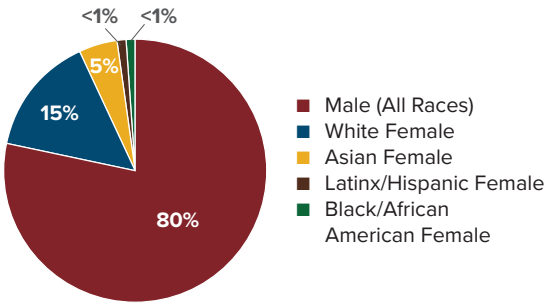
Source: NSF (2015a). Table 9-7; NSF (2016a). Table 5-4. Native American/ Alaskan Native and Native Hawaiian populations were too small to report. The percentages for Other/Multiple Races not reported.

FIGURE 10
Silicon Valley Tech Workforce Participation by Gender and Race/Ethnicity



Source: EEOC, 2016; Hongsdusit & Rangarajan (2018); Includes EEOC category of "professionals."

FIGURE 11
Silicon Valley Tech Leadership by Gender and Race/Ethnicity

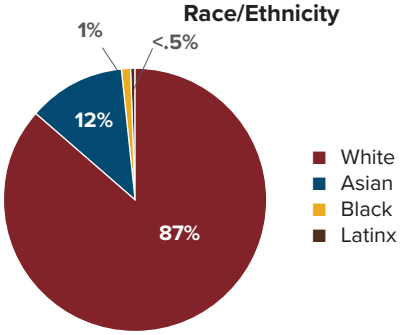


Source: EEOC, 2016; Hongsdusit & Rangarajan (2018); Includes EEOC category of "Executives, Senior Officials & Managers"; The figures for Native American/Alaskan Native/Native Hawaiian females in leadership positions are too small to report.

Tech Entrepreneurship and Venture Capital

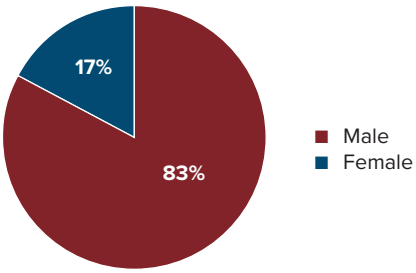
The most recent landscape data on tech entrepreneurs indicates that 83% of startup founders are male, and just 17% are female (Figure 13; CB Insights, 2010). Eighty-seven percent of technology startup founders are White, 12% are Asian, and just 1% are Black (with fewer than 1% Latinx or Native American/Alaskan Native women; Figure 12; Teare, 2017). While there is currently very limited intersectional data on women of color in entrepreneurship, estimates from one study indicate that among the over 6,700 female tech startup founders, Black women account for less than 4% of female-led tech startups (Project Diane, 2018). Large discrepancies are also seen in the amount of money invested in companies, by founder race, ethnicity, and gender, with women-led companies raising one-tenth of the amount of capital as male-led companies ($10B versus $90B in 2016) and all-Asian founding teams raising more than 3 times the amount that all-Black founding teams raise ($4M versus $1.3M; Teare, 2017). An analysis of Black female founders estimated that the average raised by Black female founders was $42,000, over $1M less than the amount raised in the average seed round (Project Diane, 2018). Just 11% of all technology investors are female, and fewer than 25% are Asian, Black or Latinx professionals (Figure 14). A recent study of roughly 1,500 investors found that just 1% of venture capitalists are Black women (and 0% are Latinx women), while White women comprise 11% and Asian women comprise 6% (Figure 14; Kerby, 2018). There is currently no available intersectional data on the percentage of Asian, Latinx or Native American women who launch technology startups, how much funding they secure, and to what extent all women of color invest in technology startups. Without the participation of women of color in the creation of new technology enterprises, products and solutions, women of color will be excluded from opportunities to develop and invest in products intended to solve pressing challenges facing diverse communities, develop wealth in salary, equity, and investment returns, and decrease widening inequality.

FIGURE 12
Technology Startup Founders by Race/Ethnicity



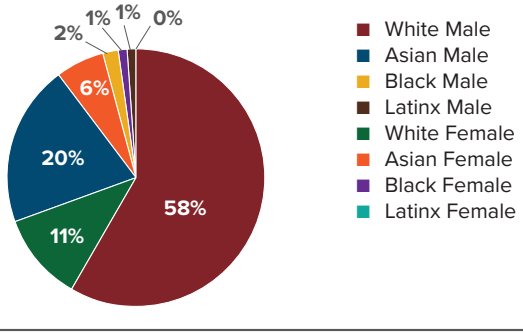
Source: Teare (2017)

FIGURE 13
Technology Startup Founders by Gender



Source: CB Insights (2010)

FIGURE 14
Technology Investors by Race/Ethnicity



Source: Kerby (2018)

THE WOMEN OF COLOR IN COMPUTING RESEARCHER/PRACTITIONER COLLABORATIVE

> Without identifying and understanding the specific challenges facing women of color in the computing and technology pipeline, any interventions made will be exclusionary, insufficient, and ineffective.

Transformation across all levels of the tech ecosystem is needed in order to identify and address obstacles specific to women of color and increase participation, persistence, and success of underrepresented women of color in computing. A critical first step towards this transformation will be to build upon existing theory, research, and data to develop a robust body of literature on women of color in computing. **The Women of Color in Computing Researcher/Practitioner Collaborative** is a new initiative which aims to develop foundational landscape data on the participation of women of color across the computing pipeline, identify obstacles and barriers unique to women of color in computing, and explore the efficacy of interventions to improve the outcomes for women of color in computing.

This project will fund and disseminate research on the following priority topic areas:

Entry, Persistence, and Degree Completion in Computing in Higher Education: Including intersectional and longitudinal data trends on entrance into computing majors and degree completion; strategies to leverage or increase social support networks, including at Minority-Serving Institutions; the efficacy of non-traditional pathways into 4-year colleges and the computing workforce; effective and innovative CS curriculum and pedagogy to increase engagement and persistence.

Participation and Retention of Women of Color in the Technology Workforce: Including intersectional data trends on workforce participation across all levels and company types; strategies to recruit and hire women of color and reduce bias in the hiring process; strategies to retain and promote women of color (e.g., Employee Resource Groups, pay/leave/incentives, sponsorship/mentorship, referral and hiring bonuses, and diverse teams and leaders).

Participation of Women of Color Across the Entrepreneurship and Venture Capital Ecosystem: Including intersectional baseline data trends on startup and venture capital participation and capital received/invested; social, financial, and psychological barriers specific to women of color in launching startups and entering investing; strategies to increase participation of women of color in entrepreneurship (e.g., WOC-specific funds, incubators/accelerators, pitch competitions, small business loans/grants, mentorship).

By developing and disseminating research on trends, barriers, and solutions to increasing participation and persistence in computing among women of color, this collaborative can both increase awareness of the challenges facing women of color and mobilize stakeholders with strategies and solutions to effectively increase their participation across the computing pipeline.

The Women of Color in Computing Researcher/Practitioner Collaborative is a new initiative which aims to develop foundational landscape data on the participation and pathways to success of women of color across the computing pipeline, identify obstacles and barriers unique to women of color in computing, and explore the efficacy of various interventions to improve the outcomes for women of color in computing and technology.

To stay informed about research and interventions for women and girls of color in computing, please join the Women of Color in Computing Researcher/Practitioner Collaborative by visiting: wocincomputing.org.

ABOUT US

Kapor Center: The Kapor Center aims to enhance diversity and inclusion in the technology and entrepreneurship ecosystem through increasing access to tech and STEM education programs, conducting research on access and opportunity in computing, investing in community organizations and gap-closing social ventures, and increasing access to capital among diverse entrepreneurs.

ASU Center for Gender Equity in Science and Technology: As a unique research unit, a diverse and interdisciplinary community of scholars, students, policy makers and practitioners unite to establish best practices for culturally responsive programs for girls/women of color. CGEST hosts three branches: Advocacy, Capacity Building, and Knowledge.

Pivotal Ventures is an investment and incubation company created by Melinda Gates. We partner with organizations and individuals who share our urgency for social progress in the United States. Together, we grow understanding, expand participation, encourage cooperation and fuel new approaches that substantially improve people's lives. Pivotal Ventures believes women as drivers of tech innovation will pave the way to a brighter future. We therefore invest in creating new pathways into tech for women and girls; fostering supportive tech environments for retention, progression of women leaders; and enabling women entrepreneurs as innovators.

Suggested citation: McAlear, F., Scott, A., Scott, K. & Weiss, S. (2018). Data Brief: Women of Color in Computing.

APPENDIX

TERMINOLOGY & DEFINITIONS

Gender: Understanding that gender is a socially constructed identity and that there is great diversity within gender identity and expression, this project focuses on individuals who at least partially identify with an identity of "female," "woman," "girl," "feminine," "womxn" or similar descriptors and identities. Additionally, we intentionally include transgender women, and non-binary individuals within the gender group of focus in this project, as we are most interested in the non-majority gender group within computing. Within a broader focus on intersectionality, we will aim to identify trends and experiences at the intersection of gender identity and racial identity within computing and acknowledge the diversity of gender identities within the scope of work focused on women and girls of color.

Race/Ethnicity: This project uses the Office of Management and Budget (OMB) definitions of race/ethnicity categories for Black/African American, American Indian/Alaskan Native, Asian, Native Hawaiian/Pacific Islander, White, and Latino/Hispanic. This project includes "people of color" or individuals who identify as a racial/ethnic group other than white. Most data sources contain only broad race/ethnicity categories, which limits the ability to disaggregate by important subgroups which demonstrate varying levels of educational attainment and participation in computing (e.g., South Asian, East Asian, Southeast Asian).

Women of Color: The term "women of color" requires careful definition and contextualization for proper use, both in terms of who is included in the definition and why the term is needed to distinguish women of color as a particular subset of the population. The categories of "women" and "people of color" are numerically marginalized gender and racial/ethnic groups in computing (and oftentimes face social disparities and inequity in broader American society). Intersectionality theory describes women of color as experiencing both intersecting identities which exist within structures of power and privilege to compound marginalization by both race/ethnicity and gender. To specifically examine this category, a broad definition is used to define "women of color" as individuals at least partially identifying as women AND identifying as a member of a racial/ethnic group other than white (specifically, Black/African-American, Latinx/Hispanic, Asian, Native American/Alaskan Native, and Native Hawaiian/Pacific Islander). This category is extremely broad, and experiences of women of color can be vastly different based on context and additional intersectional identities including, socioeconomic status, physical ability, sexual orientation, age, religion, immigration status, schooling background, parenting/caregiving status, linguistic background, nation of origin, etc. Where possible, this project will examine and identify experiences of women of color based on intersections with other identities. This project focuses on women of color within the social, cultural, and historical context of the United States, while understanding significant differences exist in definitions, histories, and experiences of women of color across the globe.

Underrepresented Women of Color: Underrepresented women of color are distinguished in this project as women from racial/ethnic groups who are traditionally underrepresented in computing education, degree completion, the tech workforce, and entrepreneurship/VC, in comparison to their representation in the U.S. population and representation among potential pools of candidates (e.g., the total labor force, CS degree-earners). Underrepresentation varies across computing contexts and it is necessary to specify the domain in which underrepresentation is present when categorizing underrepresented women of color. Specifically, Black, Latinx, American Indian/Alaskan Native women are underrepresented across the pipeline, in participation in computing education, completion of computing degrees, participation in entrepreneurship and venture capital, and Asian women as a whole are overrepresented in K-12 computing education and within the tech workforce, but underrepresented in leadership positions within the technology workforce.

Computing and Computer Science: Computing is a broad term defined by the Association for Computing Machinery as "any goal-oriented activity requiring, benefiting from, or creating computers… including five sub-disciplines of computer science, computer engineering, information systems, information technology and software engineering." Computer science is defined by the Association for Computing Machinery as the "study of computers and algorithmic processes, including their principles, their hardware and software designs, their implementation, and their impact on society." Computing and computer science are used interchangeably throughout this project.

Technology Ecosystem: The technology or computing ecosystem is used to describe the environment which prepares students for technology careers, produces and utilizes technology and technology-driven products, and creates and invests in tech companies.

Computing/Technology Pipeline: The term pipeline is used to provide a structure for understanding barriers at various stages and points in time as participants enter, proceed through, and exit, and is a popular metaphor for researchers studying inclusion and exclusion in STEM education and careers. The stages are not intended to solely be linear, and our use of the pipeline metaphor is not intended to suggest that all students and professionals follow a linear trajectory from preschool through entrepreneurship. While some follow a traditional pathway, there are many points of entry to the tech workforce and entrepreneurship, and also many points of exit and re-entry.

LIMITATIONS

Several limitations are important to note in this data brief, specifically related to the lack of rigorous and comprehensive data across all racial/ethnic and gender groups. In many cases the available intersectional data does not contain all racial/ethnic groups included in the definition of women of color (e.g., Native American/Alaskan Native in the tech workforce and entrepreneurship; Latinx and Asian women in entrepreneurship and venture capital). The lack of data on non-binary and transgender individuals does not allow us to report on these gender subgroups. While this project utilizes intersectionality as a framework the lack of available data does not allow for intersectional analyses of women of color by other demographic variables, including SES, sexual orientation, physical ability, etc. This focus on existing data is not intended to overlook the importance of examining other intersectional identities and experiences of women of color in computing, and instead provides a preliminary baseline of the participation rates of women of color across the computing pipeline.

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