Centering Disabled Women in STEM Professions: A Critique of Identity Isolation in STEM Data

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Abstract

The purpose of this WIP research paper is to explore intersectional outcomes of disabled women in the STEM workforce. Our research will focus on how analyzing marginalized identities in isolation may erase effects at their intersections. This approach will serve to better represent individuals with multiple underrepresented identities. In this paper, we examine the effect disability status, race, and sex has on salary in STEM fields. In order to attend to these intersectional identities in our analysis, we will utilize tenants from both the critical quantitative methodology (QuantCrit) and the disability critical race theory framework (DisCrit). This analysis will use data from the National Science Foundation (NSF) National Center for Science and Engineering Statistics (NCSES) *Diversity and STEM: Women, Minorities, and People with Disabilities* biennial report to parse the methods of categorizing and analyzing disabled women within the STEM workforce. Using baseline data provided by NCSES, we will compare salaries across intersectional groupings (i.e., disabled Black women, nondisabled Hispanic men). Reframing this data will shed light on if treating marginalized identities as separate, as how is done in the NSF NCSES Diversity and STEM report, does a disservice to exploring the experiences of disabled women in STEM. Quantitative methods such as chi-square analysis will be used to integrate and combine the race, sex, and disability data and compare those results to the overall averages amongst each population. This article will analyze if the separation of race, sex, and disability in this report is suppressing or erasing the negative implications for these marginalized groups in STEM.

Introduction

The purpose of this WIP research paper is to study the impact an intersectional analysis of disability, race/ethnicity, and sex has on the salary of Science, Technology, Engineering, and Mathematics (STEM) professionals. For almost a century, the United States has made political, academic, and professional pushes to fill a decreasing STEM workforce. Laws have been passed and programs put in place to increase the number of STEM professionals in all areas of industry in the U.S. [1]. In parallel to these changes, academia has tried to improve their STEM programs to increase recruitment and retention within STEM majors [2]. Increased participation in STEM has heavily targeted marginalized groups, like women, people from racially marginalized backgrounds, and disabled students. These marginalized groups have been the focus of many of these initiatives to close the expanding gap of STEM jobs that go unfilled, on average each year [1], [3]. However, despite the increase in STEM participation from these groups, the disparity in salary persists along identity factors regardless of education attainment.

Background

In 1950, the National Science Foundation (NSF) created the National Center for Science and Engineering Statistics (NCSES) as their primary statistical agency to research and distribute analysis on a number of STEM topics [4]. One of NCSES's many reports focuses on marginalized groups in STEM, titled *Diversity and STEM: Women, Minorities, and Persons with Disabilities* [5]. This report is a biennial assessment of the current state of engineering, and was a result of the Science and Engineering Equal Opportunities Act of 1980 [5], [6]. Although this data is valuable to policymakers, researchers, and professionals, the format of this data is not centered on marginalized STEM professionals at the intersection of multiple oppressed identities. Most of the

data in the report is presented by sex, race, and disability status, individually, which we believe limits the ability of the audience to understand the experience of those at the intersection of sex, race, and ability.

A more nuanced view of intersectional discrimination was not acknowledged as U.S. legal precedent until 1980, with the Jefferies v. Harris County Community Action ruling [7], [8]. This ruling found that "discrimination against black females can exist even in the absence of discrimination against black men or white women" and that "recognition of black females as a distinct protected subgroup… is the only way to identify and remedy discrimination directed toward black females" [7], [8]. A similar case pertaining to race and ability was decided in 2011, which acknowledged that discrimination against disabled Black people can happen regardless of the treatment of disabled White people [8], [9]. These and other cases fought for the United States legal system to separate identities when appropriate, and understand that in some cases identities cannot be separated without losing the "particular nature of their experiences" [8], [10].

This shift in the legal attitude toward intersectional identities is what we found missing in the NCSES *2023 Diversity and STEM: Women, Minorities, and Persons with Disabilities Report* and why we approached our study with both Disability Critical Race Theory (DisCrit) and Quantitative Critical Theory (QuantCrit) frameworks. We argue that those in the minority in multiple categories of the *Diversity and STEM* report (i.e., disabled Black women), will be lost amongst the other data without an intersection analysis.

Theoretical Framework
DisCrit and Quantitative Critical Theory
DisCrit presents a conceptual framework that incorporates race into the understanding of disability [11], challenging the conventional dichotomies of normality and oversimplified views of identity. The framework sheds light on the covert integration of ableism and racism within institutional policies and practices. Additionally, it acknowledges the tangible and psychological consequences of being categorized based on race or ability [11]. We combine the tenets of DisCrit with a framework of Quantitative Critical theory or QuantCrit [12]. This framework, drawing upon principles of Critical Race Theory (CRT), seeks to guide humanizing methods for analysis of quantitative data. QuantCrit challenges the notion that data is inherently neutral or natural [13] and encourages us to engage deeply with the ways in which we categorize and analyze data while acknowledging how these methods introduce bias and by creating models that better respect individual identities. While the principles of QuantCrit can be used in isolation, scholars of this framework urge its use in conversation with other tools of critical race analysis [13], in our case the DisCrit framework. Appendix A outlines the elements of QuantCrit mapped across our chosen tenets of DisCrit as the basis of our theoretical framework.

Social identities can be chosen or imposed by the system. In the present study we refer to the ways in which data from the NCSES National Survey of College Graduates [14] impose labels and specific categorizations that further marginalize underrepresented peoples. For example, participants do not self-identify as having a disability or not but rather are assigned as being disabled based on their answers to questions about normative functionality. The ways in which we categorize and subsequently analyze outcomes, particularly for multiply marginalized individuals is often minimized by focusing on singular identities [15]. We use these frameworks in our analysis

to better center those in STEM with more than one marginalized identities and understand the compounding effects of systems of oppression on outcomes like salary when disability is a factor.

Research Question

1. How do the salaries of disabled women in STEM fields vary based on their individual identities, such as race/ethnicity?

Methods
Data Source

This study draws from the 2021 National Survey of College Graduates (NSCG) public access data collected by the United States Census Bureau in partnership with the National Center for Science and Engineering Statistics (NCSES). Participants are individuals who earned at least a bachelor's degree prior to January 1, 2020; are not institutionalized and reside in the United States or Puerto Rico as of February 1, 2021; and are younger than 76 years as of February 1, 2021. This survey provides data on the characteristics of college graduates in the United States with an emphasis on those in the science and engineering workforce.

Sample

The original sample of NSCG 2021 public access data consists of 106,279 participants. Given the centralization of salary in our analyses, participants who did not provide salary information were removed. Thus, our final analytic sample was reduced to 88,995 participants. Participants self-identified their gender as male (n = 50,947) or female (n = 38,048). Additionally, participants self-identified their racial and ethnic status among the limited available options of Asian (n = 18,922), American Indian/Alaska Native (n = 313), Black (n = 6,365), Hispanic (n = 10,151), White (n = 49,978), Native Hawaiian/Pacific Islander (n = 260), and Multiracial (n = 3,006). As far as physical disability status, participants reported whether they do (n = 9,658) or do not (n = 79,337) experience a moderate or higher level of physical difficulty.

Dependent Variables
Salary
Participants were asked "As of the week of February 1, 2021, what was your basic annual salary on your principal job, before deductions?". The salary variable is continuous and salaries ranged from $0 to $749,852.

Independent Variables
Sex/Gender
Participants in this survey were asked to report gender as male or female. For the purposes of this paper, we refer to these terms as sex, as terms for gender are distinct from these choices [16]. We additionally acknowledge that these choices are not inclusive of other identities such as transgender, intersex, or nonbinary.

Race/Ethnicity

Participants self-identified their racial status among the limited available options of non-Hispanic and Asian only, non-Hispanic and American Indian/Alaska Native only, non-Hispanic and Black only, non-Hispanic and White only, non-Hispanic and Native Hawaiian/Pacific Islander only, or non-Hispanic and Multiracial. We acknowledge that these categorizations of race and ethnicity assume homogeneity within groups and more ideally would account for heterogeneity among people who share certain racial or ethnic identities.
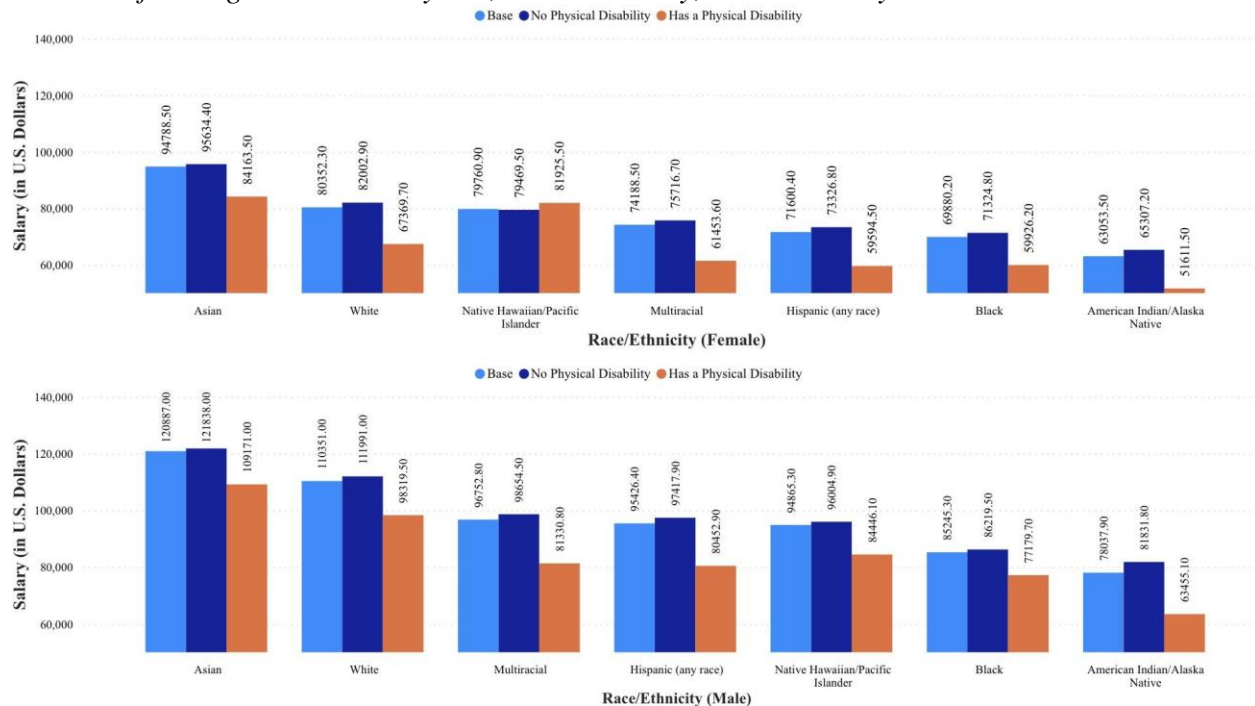
Disability Status

Status of having a physical disability was taken from a question asking participants to indicate any moderate or higher level of difficulty with physical disabilities as a binary (yes/no) category.

Data Analysis

In order to center the experiences of disabled women of color, we use this demographic group as our reference point. Data was analyzed using Stata and data visualizations were created in Microsoft Power BI. To investigate salary discrepancies, a chi-square test (Appendix B) was used to assess the relationship between salary and racial/ethnic identities for females who reported at least a moderate level of physical disability. Here we found a significant relationship between salary and racial/ethnic identity [$\chi2(48, N = 4,108) = 174.64$, p= 0.00].

Figure 1
Salaries of College Graduates by Sex, Race/Ethnicity, and Disability Status

Note: A bar chart displaying the salary of STEM professionals in three bars (base salary, no physical disabilities salary, and has a physical disability salary). The top chart consists of the three bars of all female survey participants divided by race. The bottom chart is all male participants by race.

Findings

Figure 1 shows the average base salary by race/ethnicity and sex, compared to the average salary of those with or without a disability. A chi-square test of independence was performed to examine the relation between STEM workforce salary, sex, and race/ethnicity. The data showed that across both male and female data, all base and nondisabled salaries were higher on average, except for Female Native Hawaiians/Pacific Islanders, who showed a slightly higher salary for disabled STEM professionals than nondisabled or base salaries. However, across all other populations there was a higher than base salary for nondisabled professionals, and at least $9,000 lower than base salary for disabled professionals. With the largest gaps in salary amongst female participants being disabled White women ($14,633) and amongst male participants being disabled American Indian/Alaska Native men ($18,376). However, with Hispanic, Black, and American Indian/Alaska Native women having the lowest base, disabled, and nondisabled salaries on average, the $13,732, $11,398, and $13,695 gaps between disabled and nondisabled pay has more impact than the gaps on higher salaries.

Conclusion

This work in progress demonstrates the necessity for considering intersectionality in our analysis of engineering career outcomes. While literature has previously recognized the salary disparities for women, people of color, and people with disabilities in STEM fields [17], major reports such as the *NCSES Diversity and STEM* report use singular notions of identity, ignoring the unique experiences of multidimensional identities (DisCrit tenant 2). Although the focus of this research paper is on the impact disability status and race have on salary in industry, these findings create considerations in engineering education settings. The culture of inequity in the engineering workforce begins in engineering undergraduate programs with gatekeeping and othering students with marginalized identities and compounds when multiply marginalized individuals are considered. Our research shows that there are interactive effects of identity on the engineering workforce that are reflective of the environments and conditions of our field.

Extensions of this work in progress will explore multiple regression methods to identify significant identity-based interactions related to engineering career success such as salary, employment, and degree attainment. We will also investigate the impacts across different disability type categories provided by the *National Survey of College Graduates*. A particular emphasis in our forthcoming work will be on centering the experiences of women of color with disabilities as a comparative benchmark. This intentional focus aims to disrupt prevailing notions rooted in White, male, able-bodied centrism that have traditionally shaped the narrative surrounding success in engineering careers. By foregrounding the experiences of women of color with disabilities, we seek to unveil the nuanced and often overlooked challenges and successes within this intersectional cohort.

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Appendix A

Elements of QuantCrit mapped across our chosen tenets of DisCrit

Elements of DisCrit	Associated Elements of QuantCrit
DisCrit focuses on the ways that racism and ableism move interdependently, often in neutralized and invisible ways, to uphold notions of normalcy.	The understanding that statistical analyses have no inherent value but they can play a role in struggles for social justice
DisCrit values multidimensional identities and troubles singular notions of identity such as race or dis/ability or class or gender or sexuality, and so on.	The centrality of racism as a complex and deeply rooted aspect of society that is not readily amenable to quantification
DisCrit emphasizes the social constructions of race and ability and yet recognizes the material and psychological impacts of being labeled as raced or dis/abled, which automatically marks one as "other" and on the margins of Western expectations of what it means to be the "norm."	The reality that categories are neither 'natural' nor given and so the units and forms of analysis must be critically evaluated
DisCrit privileges voices of marginalized populations, traditionally not acknowledged within research.	The recognition that voice and insight are vital: data cannot 'speak for itself' and critical analyses should be informed by the experiential knowledge of marginalized groups
DisCrit recognizes whiteness and Ability as Property and that gains for people labeled with dis/abilities have largely been made as the result of interest convergence of White, middle-class citizens.	The acknowledgment that numbers are not neutral and they should be interrogated for their role in promoting deficit analyses that serve White racial interests

Appendix B

Salary	Asian		American Indian/ Alaska Native		Black		Hispanic (any race)		White		Native Hawaiian/ Pacific Islander		Multiracial		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
< $25,000	56	10.02%	4	15.38%	68	15.18%	107	17.57%	353	15.41%	0	0%	23	14.20%	611	14.87%
$25,000-$49,999	99	17.71%	8	30.77%	118	26.34%	155	25.45%	512	22.36%	2	14.29%	48	29.63%	942	22.93%
$50,000-$74,999	123	22.00%	8	30.77%	133	29.69%	185	30.38%	614	26.81%	5	35.71%	41	25.31%	1,109	27.00%
$75,000-$99,999	87	15.56%	4	15.38%	65	14.51%	86	14.12%	396	17.29%	3	21.43%	27	16.67%	668	16.26%
$100,000-$124,999	99	17.71%	2	7.69%	31	6.92%	33	5.42%	203	8.86%	3	21.43%	15	9.26%	386	9.40%
$125,000-$149,999	31	5.55%	0	0%	21	4.69%	27	4.43%	96	4.19%	0	0%	2	1.23%	177	4.31%
$150,000-$174,999	33	5.90%	0	0%	10	2.23%	9	1.48%	53	2.31%	1	7.14%	4	2.47%	110	2.68%
$175,000-$199,999	11	1.97%	0	0%	1	0.22%	1	0.16%	23	1.00%	0	0%	0	0%	36	0.88%
$200,000+	20	3.58%	0	0%	1	0.22%	6	0.99%	40	1.75%	0	0%	2	1.23%	69	1.68%
Total	559	100%	26	100%	448	100%	609	100%	2,290	100%	14	100%	162	100%	4,108	100%

Results of Chi-Square Test and Descriptive Statistics for Salary by Racial/Ethnic Identity of Females with a Physical Disability
Note. $\chi 2(48) = 174.64$, $p < 0.05$