Cutting Edge? Not So Much.

Sexual misconduct, harassment, and discrimination: tackling the outdated treatment of women in STEM Academia

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Abstract

STEM academia, a historically male dominated environment, has brought many bouts of hardship to women pursuing careers in the field. Sexual misconduct, harassment, and discrimination are rampant--the National Academy of Sciences reported in 2018 that the rate of sexual harassment in STEM is second only to that of the military.[1] These cases of sexual harassment are often times overlooked and even condoned by institutions that first and foremost are concerned about their reputations, and the reputations of those who bring them recognition and funding. Perpetuating these behaviors is harmful to society as a whole--having imbalanced representation in STEM research not only negatively impacts the women in the field, but spreads to other areas of society. For example, because clinical trials and medical research have historically been conducted on male populations, women's medical conditions are frequently misdiagnosed and leads to higher rates of mortality in women (i.e. misdiagnosis of heart attacks).[2]

Through the visualization of publicly available sexual misconduct cases, detailed timelines of the careers of prominent investigators felled by sexual misconduct allegations, and a longitudinal look at the numbers of women pursuing careers in STEM academia, I point out the magnitude of the problem and the implications of it that have long hindered women in STEM: many cases of sexual misconduct conclude with little to no action by the institutions, and behind each formal case of sexual misconduct lies multiple unreported allegations of harassment. The pipeline problem for women in STEM academia is severe, with the rates of women pursuing careers in STEM academia dropping to as low as ~8% from ~50% at the undergraduate level. Institutions and national organizations must hold perpetrators of sexual misconduct accountable for their actions in a timely manner, and provide resources to support women who have experienced harassment in order to increase the retention rates of women pursuing STEM academia.

*Though sexual harassment affects male-identifying, gender non-binary, and transgender populations, in this paper I will be focusing predominantly on sexism & sexual harassment pertaining to women and women-identifying populations.

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[1] *Sexual Harassment of Women: Climate, Culture, and Consequences in Academic Sciences, Engineering, and Medicine*(Washington D.C.: National Academies Press, 2018).

[2] Stacie E. Geller et al., "Inclusion, Analysis, and Reporting of Sex and Race/Ethnicity in Clinical Trials: Have We Made Progress?" *Journal of Womens Health* 20, no. 3 (2011): , doi:10.1089/jwh.2010.2469.
"The Invisible Woman? The Challenge at the Doctor's Office Every Woman Needs to Know about," TODAY.com, May 13, 2019, , accessed May 21, 2019, https://www.today.com/health/gender-bias-doctor-how-women-s-heart-disease-chronic-pain-t147692.

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Introduction

Surveying the Landscape

Gender inequality, sexual harassment, sexual assault--in recent years, these terms have been so commonplace in the collective colloquial verbatim that it does not strike as odd to hear a casual conversation about street harassment, or get caught up in a wave of public outrage over the latest figure convicted of sexual assault. And yet, this is but a contemporary phenomenon. Such a visible approach to matters of sexual harassment would have been unthinkable in the past; far from being the potentially empowering and validating act that it is now, to participate in public allegation meant a near complete emotional, social, and career suicide. On one hand, if women had the courage to speak up, their voices were devalued and experiences swept under the rug; on the other, women often barred themselves from speaking out due to the societally enforced burden of self-blame and shame.[3] Shockingly, many women have had trouble even acknowledging their experiences as sexual violence--in a sweeping review conducted over 28 studies of women who were raped after the age of 14, it was found that 60.4% of the 5,917 women in the studies did not recognize their experiences as rape, even though it fit the standard definition.[4] How did these attitudes towards sexual harassment, so entrenched in the cultural manifold our society, begin to shift?

We can attribute one of the movers of our cultural manifold to the now famous #MeToo movement. A term originally coined in 2006 by civil rights activist Tarana Burke, it reemerged in October of 2017 in the Twittersphere, where actress Alyssa Milano used it as a hashtag to highlight sexual abuse by the Hollywood titan Harvey Weinstein, calling out for fellow survivors of sexual violation to step forward and join in on highlighting similar experiences. Though not a new idea by any means, a global phenomenon of viral proportions ensued--similar hashtags popped up in every region of the world, and produced very tangible recognition of the legitimacy of women's voices. We saw Harvey Weinstein and Bill Cosby fall to an uprising of women with the audacity to speak up. We saw incredible media coverage, not in the conciliatory tone often adopted when defending the perpetrator, but in, at the very least, a neutral perspective. In the New York Times, the number of articles that mention sexual harassment has spiked in the wake of the #MeToo movement: the number has tripled from 2016 to 2017, and quadrupled from 2016 to 2018.[5] Indeed, sexual harassment is at last being portrayed by mainstream media as less epidemic than endemic, less isolated than pervasive.

[3] Karen G. Weiss, "Too Ashamed to Report: Deconstructing the Shame of Sexual Victimization," *Feminist Criminology* 5, no. 3 (2010): , doi:10.1177/1557085110376343.
[4] Laura C. Wilson and Katherine E. Miller, "Meta-Analysis of the Prevalence of Unacknowledged Rape," *Trauma, Violence, & Abuse*17, no. 2 (2015): , doi:10.1177/1524838015576391.
[5] New York Times API.

Fig 1. Alyssa Milano's text that ignited the #MeToo movement in 2017 (Twitter)

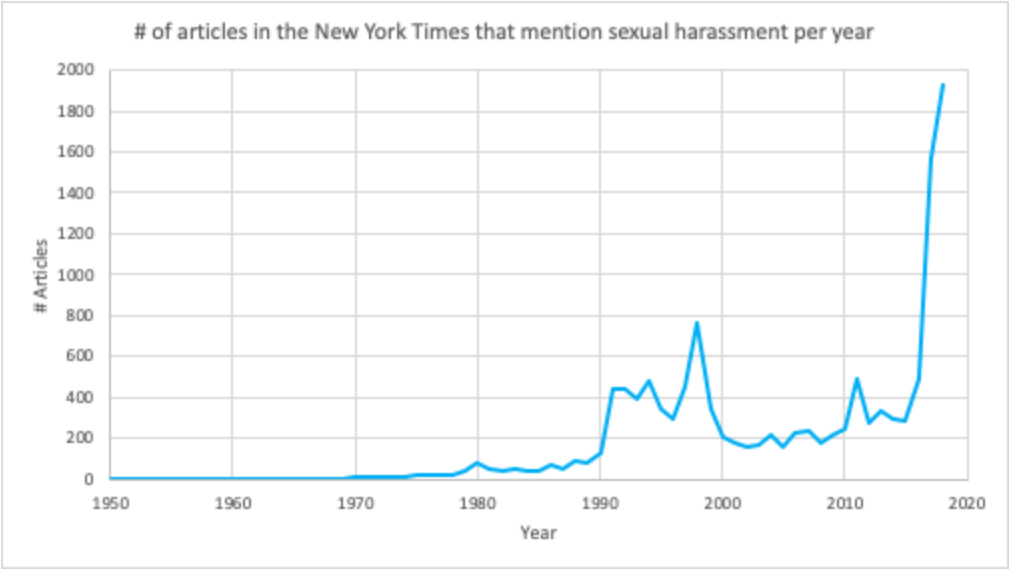

Fig 2. The number of articles in the New York times that mention sexual harassment per year. Interestingly, there is a slight increase in mentions between 1990 and 2000, but nothing comparable to what the numbers are in 2017 and 2018. At more than 300 articles already mentioning sexual harassment in 2019, this year is projected to have similar numbers as the last. (adapted from NYT API)

In addition to jumpstarting the conversation on sexual violation and holding prominent Hollywood accountable for their actions, the #MeToo movement has had its impact felt in all sectors and all pressure points in the spectrum of gender inequality topics. HR Acuity, an employee relations technology company, conducted a survey of companies representing 4.4 million employees in the Fortune 100, 500, and 1000 lists, and found that since the movement

started, 54% of companies state the number of harassment claims have gone up.[6] The number jumps to 84% when looking at large scale companies of more than 20,000 employees. There is a clear development of women feeling more comfortable about coming forward with incidents if they occur.

"Radiating out from sexual harassment to sex inequality as a whole, the movement has stimulated a wider public discussion of equal hiring, equal numbers of women on boards, equal pay, and more women in politics, as well as brought further focus to the role of white supremacy in misogyny. Anyone who doubts that sexual abuse is central to the second-class status of women might consider what taking it seriously on a systemic basis has set off. **Sexual harassment encompasses, parallels, evokes, or echoes many other abuses of women and children, from simple discrimination to other abuses of authority or trust or power.** Sexual harassment is like sexual abuse in childhood, in that the trust of victims is manipulated, dependency exploited, and institutions betray those who report. Sexual harassment often includes rape, and it raises similar issues of sex that is acquiesced to under conditions of unequal power. **Sexual harassment makes all forms of women's work into a form of prostitution: forced trading of sexual access for economic survival.** Sexual harassment turns real work into an arm of the sex trade. The imperative to exchange sex for survival, or the dangled possibility of survival whether real or not, governs women's inequality, hence women's lives, worldwide."

Writes Catharine MacKinnon, Professor of Law at Michigan Law and pioneer of the legal claim of sexual harassment, in an essay commenting on the global effects the #MeToo movement.[7] She makes several poignant points in this passage which are relevant to future considerations: 1) that sexual harassment, in its premise and outcome, parallels other forms of abuse, such as abuses of power (one could comfortably say these two pair enticingly well together), and 2) that sexual harassment inevitably make women's work into a form of prostitution. These claims are worth pondering over, especially when assessing the impact of sexual harassment in environments that are male dominated.

Sexism in STEM fields

Let us consider STEM fields (fields pertaining to science, technology, engineering, or mathematics). Women make up half of the college-educated workforce in the US, but only 29% of the science and engineering workforce.[8] If we probe even further, we find that a mere 15% of engineers, and 25% of computer scientists are women. In STEM, there exists a unique condition where there is a staggering lack of female presence, let alone female empowerment. In the absence of such oversight, support network, and/or mentorship, sexism becomes normalized,

[6] Liz Elting, "A Hard Look At The Hard Numbers Of #MeToo," Forbes, October 15, 2018, , accessed March 26, 2019, https://www.forbes.com/sites/lizelting/2018/10/15/a-hard-look-at-the-hard-numbers-of-metoo/#20f14fde79f9.
[7] Catharine A. MacKinnon, "Where #MeToo Came From, and Where It's Going," The Atlantic, March 24, 2019, , accessed March 26, 2019, https://www.theatlantic.com/ideas/archive/2019/03/catharine-mackinnon-what-metoo-has-changed/585313/.
[8] *Science & Engineering Indicators 2016. National Science Board*(Place of Publication Not Identified: Distributed by ERIC Clearinghouse, 2016).

and toxic environments are left to bloom. Consequently, women in STEM experience the highest rate of sexual harassment of any profession outside of the military.[9]

In order to understand the impact of sexual harassment in these environments, it is important to break down the different types of violations and how exactly it compromises women. Psychologists who study gender-related behavior have developed a three part classification system, which divides sexual harassment into: sexual coercion, unwanted sexual attention, and gender harassment.[10] **Sexual coercion** consists of sexual advances, in which the the conditions of employment or academic standing depend upon sexual cooperation. **Unwanted sexual attention** also consists of sexual advances, but does not include threats or rewards contingent upon cooperation. Examples of this are unwelcome touching, hugging, stroking, persistent requests for dates despite expressed decline, and can include assault. **Gender harassment** includes ‘‘a broad range of verbal and nonverbal behaviors not aimed at sexual cooperation but that convey insulting, hostile, and degrading attitudes about members of one gender”.[11] It can be further separated into two subcategories: **sexist hostility**, which includes demeaning jokes about women, indicating women are not suited for leadership positions, etc, and **crude harassment**, which entails the use of crude terms to reduce women to their gender (i.e. “pussy”, “slut”).

These categories work to disintegrate well being in distinct ways: the first two categories “suggest sexual advances (the goal being sexual exploitation of women) [while] the third category is expressing hostility toward women (the goal being insult, humiliation, or ostracism.)” [12] What is also alarming, as previously mentioned, is the rate at which the public consciousness normalizes gender harassment. If these behaviors are deemed acceptable, what hope do we have of countering malignant practices towards women? Especially in these sectors that are male dominated, there is a necessity to advocate for the equal opportunity and well-being of women. And so we must ask: has the global movement of female empowerment managed to liberate the STEM sectors?

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[9] *Sexual Harassment of Women: Climate, Culture, and Consequences in Academic Sciences, Engineering, and Medicine*(Washington D.C.: National Academies Press, 2018).

[10] Louise F. Fitzgerald, Suzanne Swan, and Karla Fischer, "Why Didnt She Just Report Him? The Psychological and Legal Implications of Womens Responses to Sexual Harassment," *Journal of Social Issues* 51, no. 1 (1995): , doi:10.1111/j.1540-4560.1995.tb01312.x.

[11] Louise F. Fitzgerald, Suzanne Swan, and Karla Fischer, "Why Didnt She Just Report Him? The Psychological and Legal Implications of Womens Responses to Sexual Harassment," *Journal of Social Issues* 51, no. 1 (1995): , doi:10.1111/j.1540-4560.1995.tb01312.x.

[12] Kathryn J. Holland and Lilia M. Cortina, "Sexual Harassment: Undermining the Wellbeing of Working Women," *Handbook on Well-Being of Working Women*, 2016, , doi:10.1007/978-94-017-9897-6_6.

Fig 3. The public consciousness of sexual harassment and specific sexual harassment behaviors. Much of what we perceive as sexual harassment, namely acts in the realm of sexual coercion and unwanted sexual attention, is only a small portion of what encompasses sexual harassment. (adapted from National Academies Report, 2018)

The Academic Environment

The answer is not straightforward, though cautiously promising. Since the advent of the #MeToo movement, there has been a spike in activism within STEM fields as well. Several high-profile investigators have left their positions after sexual harassment investigations, including geneticist Francisco Ayala, cancer biologist Inder Verma, and physicist Lawrence Krauss. Over two years ago, Julie Libarkin, a professor at Michigan State University, started compiling a database of publicly available cases of sexual misconduct in academia.[13] Now, this report includes over 700 cases of misconduct throughout US institutions. Looking at the numbers of cases across the years, there is a definite uptrend in reported cases since 2017, in both STEM and non-STEM fields.

[13] Geocognition Research Laboratory, "The Academic Sexual Misconduct and Violations of Relationship Policies Database," GEOCOGNITION RESEARCH LABORATORY, September 15, 2018, , accessed March 26, 2019, https://geocognitionresearchlaboratory.com/2018/08/20/the-academic-sexual-misconduct-database/.

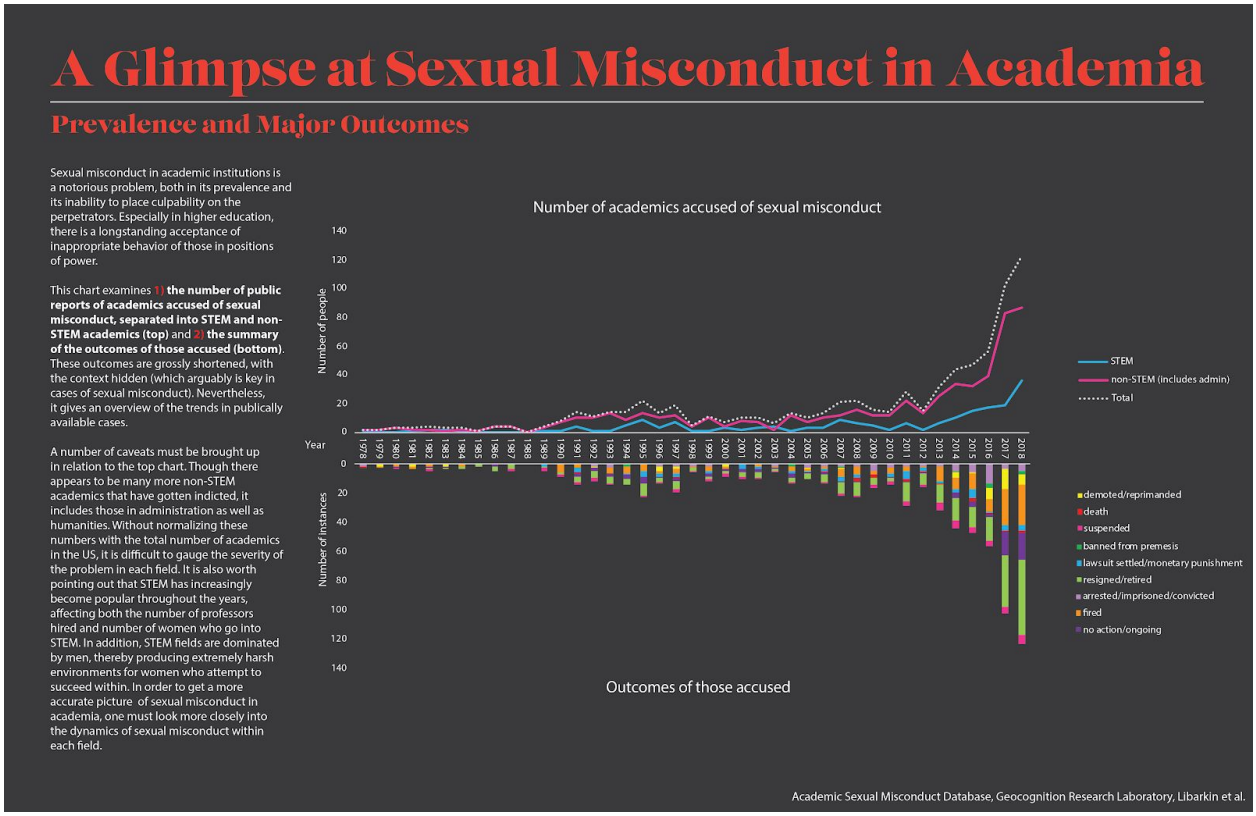

Fig 4. Quantifying public sexual misconduct cases. There is an overall increase in the number of cases in 2017 and 2018, which aligns with when the #MeToo movement began. (data from Libarkin, 2019)

BethAnn McLaughlin, a professor of neuroscience at Vanderbilt University, took to Twitter and the greater online community to start the #MeTooSTEM movement, in an effort to make stories of women in STEM visible, and hold organizations of power accountable for dealing with sexual harassment allegations. This movement has received so much support that it is now acting as a nonprofit organization.[14] She has started various petitions to remove confirmed sexual harassers from the National Academies of Sciences, Engineering, and Medicine, revoke honors from the American Association for the Advancement of Sciences from scientists who commit breaches of ethics, and deny NIH grants and other financial support to scientists who have committed sexual misconduct.

Yet, time and time again, we see that sexism has an undeniable, looming presence over STEM. None of the prominent scientists who left their positions due to sexual misconduct investigations have had their honors or memberships revoked from influential scientific organizations (i.e. the National Academies, the very organization that conducted a sweeping review of sexual harassment in STEM fields, and came up with suggestions on how to counter this). This means that they still have powerful leverage over who gets membership to these organizations, who gets grant approval, who gets recognition for their scientific work. Dr.

[14] Sarah Brown, "This Scientist Was the Architect of #MeTooSTEM. Now Others Are Fighting to Save Her Job.," The Chronicle of Higher Education, March 01, 2019, , accessed March 26, 2019, https://www.chronicle.com/article/This-Scientist-Was-the/245806.

McLaughlin herself has had her tenure bid revoked, after a four year application processing period while her Twitter account activity was being investigated. Her tenure was approved by her department and the executive faculty committee, but was revoked when the medical dean asked them to reconsider after the delay in her application by this investigation. The review was due to a false complaint against her by Aurelio Galli, a former physiology professor, after she served as a witness in an investigation into his alleged misconduct against a female graduate student.

Jef McAllister, a part of Dr. Franklin's legal team, states: "It is ironic, but unfortunately not surprising, that someone with a national reputation for promoting women in STEM at universities finds herself ground down in an opaque and irregular tenure review. It has been a long and demoralizing process of the sort that pushes many women out of academia."[15]

Though there seems to be a clear uprising of women speaking out, there is an equally strong force that seeks to keep what order was had up until now in place. More voices are offering their experiences and recommendations, yet the institutions that have the power to change the perspective of sexism in STEM have done very little.

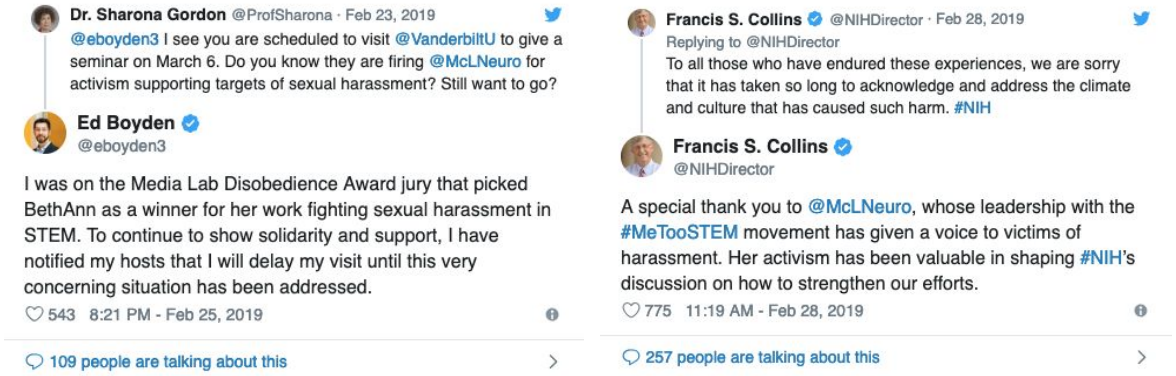

Fig 5. Examples of individuals showing support for Dr. McLaughlin. Ed Boyden is a famous neuroscientist at MIT, Sharona Gordon is a physicist at UW, and Francis Collins is the director of the NIH. In parallel, this also exemplifies that a significant amount of activism and occurs online, and is worth looking into.

Purpose

Despite the laundry list of undesirable statistics on the sexism problem in STEM, I find it curious that I personally have not, if limited to my experience in the academic and workplace environment, experienced sexism of any sort. After studying neuroscience at Brown for my undergraduate studies, I spent a few years at a computational neuroscience lab in Princeton, and now am working at the biotech startup Kallyope. I have experienced STEM in academic, nonprofit, and industry environments, and have been fortunate to have overall positive

[15] Sarah Brown, "This Scientist Was the Architect of #MeTooSTEM. Now Others Are Fighting to Save Her Job.," The Chronicle of Higher Education, March 01, 2019, , accessed March 26, 2019, https://www.chronicle.com/article/This-Scientist-Was-the/245806.

experiences from all. I suspect it is by no small margin due to luck and circumstance--of having the chance to be surrounded by women in science, and men who seek to uplift women pursuing science.

However, the numbers tell a different story. Though the are significant improvements in the treatment of women in STEM due to the global trend of empowerment, and the fortitude of women that have previously paved a path forward, the sexism in STEM is deep-rooted, its reach extensive and insidious. Extensive research has been done by the National Academies and other prominent organizations on the prevalence of sexual harassment in STEM, but these are only numbers. There are stories behind these numbers, nuances to the problem--perhaps best exemplified by the fact that the very organizations who have conducted the research into sexual harassment in STEM have turned a blind eye to the problem when it prompts them to take action.

The objective of this project is to compile data from various types of sources--databases, mainstream media, specialized journals--to drive home the point that sexual misconduct, harassment, and discrimination in STEM academia is a problem that requires change at the institutional and national level, and causes extensive damage to the gender makeup of those who pursue STEM academia as a career. Institutions and national organizations must hold perpetrators of sexual misconduct accountable for their actions in a timely manner, and provide resources to support women who have experienced harassment in order to increase the retention rates of women pursuing STEM academia. Visualizations allow for easier comprehension of dense data points that are difficult to digest, and can lead to awareness where there previously was none--this is the driving force for the movement towards change. My hope is for users of this project to have this opportunity for education and awareness, so that I can contribute my part to the movement towards equal opportunity and treatment in STEM academia.

Methods

Data Collection

I. Sexual Misconduct Overview

Data was collected from multiple sources for each of the major issues covered in this project. Details of sexual misconduct in academia were obtained by a database compiled by the Geocognition Research Laboratory at Michigan State university, helmed by Julie Libarkin, a professor of Earth and Environmental Sciences. This database, titled “The Academic Sexual Misconduct and Violations of Relationship Policies Database”, lists all publicly available cases of sexual misconduct and violation of relationship policies at US institutions, starting as early as 1987.[16] For each case mentioned, the database lists the name, institution, discipline, outcome,

[16] Geocognition Research Laboratory, "The Academic Sexual Misconduct and Violations of Relationship Policies Database," GEOCOGNITION RESEARCH LABORATORY, September 15, 2018, , accessed March 26, 2019, https://geocognitionresearchlaboratory.com/2018/08/20/the-academic-sexual-misconduct-database/.

and links to media sources outlining details of the case. From this, only cases pertaining to perpetrators in STEM disciplines were extracted for use in the visualization.

II. Sexual MIsconduct Case Studies

In order to obtain details of case studies of academics accused of sexual misconduct, I turned to reports in the media. I chose to research famous cases that were well documented and already substantially exposed by the media, to make sure that evidence was accounted for and I was not publishing false claims. The first case I looked into was that of Dr. Inder Verma, a renowned cancer biologist who resided at the prestigious Salk Institute in San Diego. His case was covered by multiple news outlets across the US after several sexual discrimination lawsuits were filed against the institute, citing his name, in 2017. Subsequently, *Science*, a distinguished journal of scientific discoveries published by the American Association for the Advancement of Science (AAAS), the world's oldest and largest general science organization, conducted a four month investigation into allegations of sexual misconduct by Verma that spanned from 1976 to 2016. Five women agreed to be named in the resulting story, as well as three who requested to remain anonymous. I used this article, "A Hidden Story", as my primary source.[17]

The second case I researched was that of Dr. Francisco Ayala, a famous evolutionary biologist who was on the faculty at the University of California, Irvine. This case was also covered by many news outlets at the time of its , but I was able to obtain the official investigation report by the Office of Equal Opportunity and Diversity of UC Irvine.[18] This report includes statements from four complainants, who have all agreed to be named. The last case covers Dr. Lawrence Krauss, a celebrity physicist, prominent atheist, and leader of the skeptical movement. Though Krauss' behavioral misconduct had been publicly exposed in the past, Buzzfeed News published a comprehensive report of the allegations and complaints against him in February 2018, which I used as my primary source for Krauss.[19] For all three of these cases, I have cross checked multiple news sources to confirm the details of the allegations to minimize the chances of false data points.

III. Retention Rates of Women in STEM Academia

To gather data about the numbers of women in STEM academia, I looked to faculty equity reports published by universities--I was pleasantly surprised to see that quite a few universities have started publishing equity reports, some beginning their efforts as far back as 1990. I chose to use those of Columbia University and New York University for my study. It seemed reasonable to compare two reputable schools in New York City given the time constraints of the project; I would have liked to compare top schools across the US, but this would have taken a significant amount of time due to the variable nature of the data formatting in each report.

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[17] Meredith Wadman, "A Hidden History.", Science, May 04, 2018, Accessed May 07, 2019, http://science.sciencemag.org/content/360/6388/480.full.

[18] Erik Pelowitz and Karen Bell, Findings of the Office of Equal Opportunity and Diversity (OEOD), Report, Office of Equal Opportunity and Diversity, University of California Irvine, May 16, 2018.

[19] Peter Aldous, "Celebrity Atheist Lawrence Krauss Accused Of Sexual Misconduct For Over A Decade," BuzzFeed News, October 13, 2018, Accessed May 07, 2019, https://www.buzzfeednews.com/article/peteraldhous/lawrence-krauss-sexual-harassment-allegations.

Fortunately, the Columbia reports were very well organized and spanned enough years to allow for longitudinal examination.[20] The NYU reports were overseen by Dr. Carol Shoshkes Reiss, one of the women I interviewed for this project.[21] Though data was abundant in these reports, I focused on the datasets that described the numbers of women in STEM academia, and how they have changed over time and stature.

Data Processing and Modeling

I. Sexual Misconduct Overview

From the sexual misconduct database, I imported only the cases that were of academics in STEM disciplines into a .csv file. The data points given are as follows: “Last updated”, “Year of first incident”, “Year”, “Name”, “Multiple Institutions/Positions (repeat misconduct)”, “Administrator, Department, Faculty, Researcher, Coach”, “Position title”, “Discipline or domain”, “Institution and/or Professional Society”, “Details of outcome” and “Links”. For the sake of consolidation, I summarized the “Details of outcome” in a one word summary that best categorized the outcome, which I listed in a new column. If there were multiple outcomes, I chose the outcome with more serious implications. Initially, I had around 16 categories, which I merged down to nine; though merging further would have aided in ease of comprehension, I decided to keep the nine categories because they were distinct enough to merit separation. I then assigned colors to each category, and inputted these colors into another column.

For the visualization, it was necessary to find a way to represent each individual case in the context of a whole. I turned towards a dot plot histogram after being inspired by the way it was used in the Pudding article, “Film Dialogue”, to visualize individual film screenplays across a spectrum of the rate of words allocated to men vs women.[22] In D3, I plotted the dots in bins corresponding to years from 1980 to 2018. Each dot represents an individual case: the outcome is indicated by the color, while additional details of the case can be obtained by hovering over it (Name of perpetrator, discipline, institution). I also made it possible for users to be taken to a news article that covered the case upon clicking the dot.

The histogram served its purpose of allowing for interaction with each individual case, but it was difficult to visually observe the numbers of cases that came to each outcome in the stacked chart. I decided to remedy this by allowing the user to filter results by outcome. I inserted buttons for each outcome category, which upon clicking, updates the histogram to

[20] Advancement of Women Through the Academic Ranks of the Columbia University Graduate School of Arts and Sciences: Where Are the Leaks in the Pipeline? Report, The Commission on the Status of Women, Columbia University, November 2001.

Maya Tolstoy,. 2004-2013 Update: Advancement of Women Through the Academic Ranks of the Columbia University Graduate School of Arts and Sciences: Where Are the Leaks in the Pipeline? Report, Commission on the Status of Women, Professor Daniel Rabinowitz (Dept of Statistics), Columbia University Senate, Columbia University, April 20, 2015.

Policy and Planning Committee Equity Reports.Report. Policy and Planning Committee, Columbia University. October 2018.

[21] Carol Shoshkes Reiss and Andre Fenton, Faculty of Arts and Sciences Equity Committee Executive Summary of Data to End of 17/18 Academic Year and Recommendations, Report, Faculty of Arts and Sciences Equity Committee, New York University.

[22] "The Largest Analysis of Film Dialogue by Gender, Ever," The Pudding, , accessed May 21, 2019, https://pudding.cool/2017/03/film-dialogue/.

include only the dots for the selected category. This made tracking the numbers of cases in each category over time a little easier.

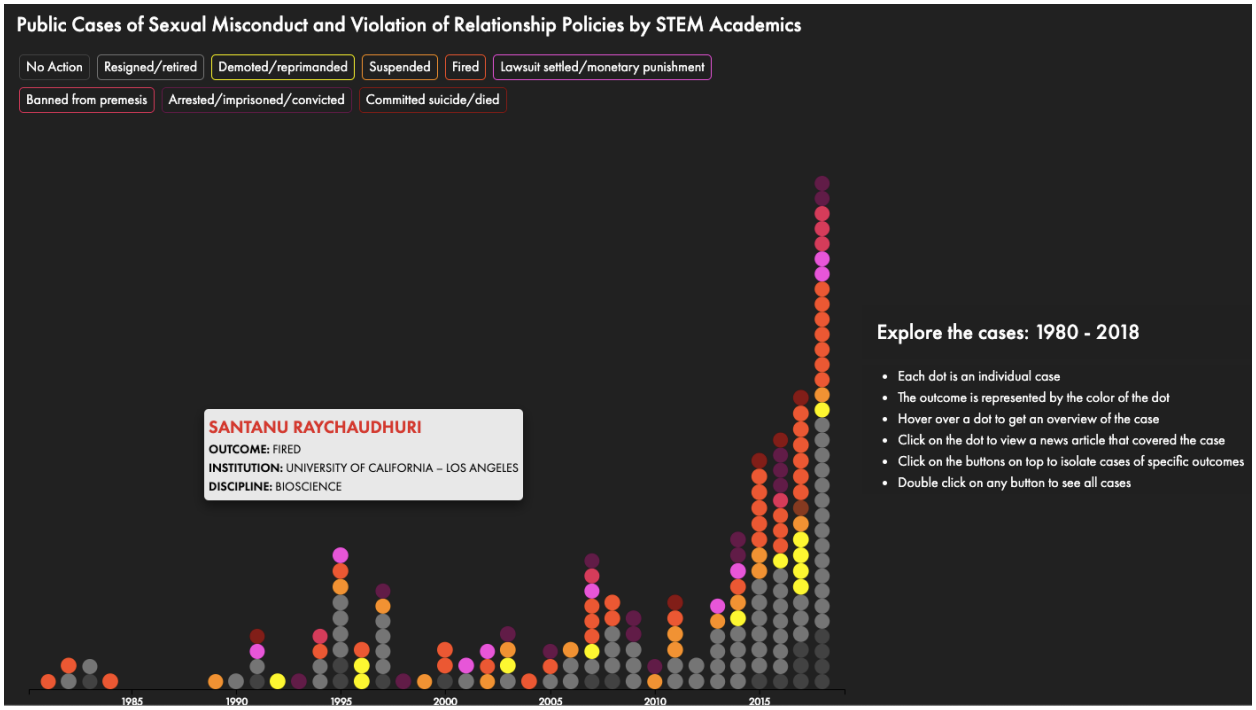

Fig 6. Dot plot histogram depicting individual cases of sexual misconduct

II. Sexual Misconduct Case Studies

I wanted to visualize each of the three case studies I selected on its own timeline--for each timeline, I wanted to compare incidents of sexual misconduct vs notable career achievements over time. To organize the data in a form that would be callable, I inputted the text data obtained from the media articles mentioned above in .csv files. I recorded the year, name of complainant (if any), and description of the incident. The timeline was made with D3.

Each timeline was represented by a rectangle, one end being 1970 and the other end 2019. Each incident was indicated by a line on the rectangle. It was easiest to do this by converting the year of each incident into a start date and an end date to use as coordinates for very thin rectangles that looked like lines. I encoded the type of incident by the color of these lines, which I encoded in the .csv as numbers: “0” for white, representing notable career achievements,, “1” for red, indicating incidents of sexual misconduct, and “2” for yellow, indicating official complaints made and their results. The details of the incidents could be seen by hovering over the lines.

Though this was a workable visualization, it was necessary to have some data points that were static, so users could get a general overview of each person’s timeline without interacting with the data. In order to do this, I picked a few incidents to represent at static text captions, and encoded this in the .csv under a “status” column: “0” for not visible, “1” for static. These incidents were then plotted on the timeline, depending on their category type--career

achievements and official complaints were plotted on top, while incidents of harassment were plotted on the bottom. The aim was to create a sort of dichotomy of “good” vs “bad” across the timeline of each person’s career.

Fig 7. One of three case studies covered, showing career achievements in parallel with incidents of sexual harassment by the perpetrator.

III. Retention Rates of Women in STEM Academia

To paint an easily comprehensible picture of the numbers of women in STEM academia, I consolidated the data from the Columbia and NYU faculty equity reports into two graphs: one, which compared the rates of female tenured/tenure-track professors in STEM to other disciplines, and two, which compared the rates of females at each step in the academic career ladder in STEM academia. The former required some data processing in order to match the data from Columbia to that of NYU. The percent rates had to be calculated by raw numbers of people, and the years used were only the years that had complete data from both datasets--Columbia published numbers for 2000 and every year from 2004 to 2016, while NYU published every five years from 2000 to 2010, and every two years from 2010 to 2018. The latter graph was made only by data from Columbia, because it was not possible to extract this data from the NYU reports. This required combining information found from three Columbia reports into one graphic, although no additional calculation was necessary to clean the data. The first graph was made in Excel then edited in Illustrator, while the second graph was made and edited in Illustrator.

Fig 8. Chart depicting percentages of women at each step of the academic ladder, from 1990 to 2015.

Easy Access to Main Data Sources	
Sexual Misconduct Overview	
Geocognitive Research Laboratory, Michigan State University	https://geocognitionresearchlaboratory.com/2018/08/20/the-academic-sexual-misconduct-database/
Sexual Misconduct Case Studies	
Inder Verma	https://sci-hub.tw/http://science.sciencemag.org/content/360/6388/480/tab-pdf
Francisco Ayala	http://ulum.es/wp-content/uploads/2018/07/Informe-Ayala.pdf
Lawrence Krauss	https://www.buzzfeednews.com/article/peteraldhous/lawrence-krauss-sexual-harassment-allegations
Retention Rates of Women in STEM Academia	
Columbia University	https://fas.columbia.edu/files/fas/content/Columbia-ArtsandSciences-PPC-Equity-Reports-2018.pdf

	http://senate.columbia.edu/archives/reports_archive/14-15/csw_pipeline%20report_2004-13.pdf http://senate.columbia.edu/archives/reports_archive/01-02/Advancement.pdf
NYU	http://as.nyu.edu/content/dam/nyu-as/as/documents/2018EquityStudy.pdf

Results

My aim for these visualizations was to have users understand the gravity of the problems that exist within STEM academia caused by sexual misconduct and harassment; to give users a visual basis for the arguments and observations being presented by advocates in society. However, I was able to obtain new insights just by interacting with data that I hadn't properly grasped beforehand, even when doing the groundwork research leading up to the visualizations.

Around 45% of publicly reported cases of sexual misconduct end with little to no action by the institution, and/or with a voluntary resignation or retirement from the perpetrator. Frequently, even when the institutions do suspend the perpetrators, it is under paid leave. Some lawsuits are settled by the institution on behalf of the perpetrator.

Though this is not surprising, from the case studies, I found that institutions take a long time to act on complaints. In some cases, they tell women who come forward to drop their complaint, or discourage them from doing so. The women who have been harassed are afraid to come forward because these men have such powerful influences on the institution, and on the careers of faculty within these institutions. And even when they have resigned from the institution, they continue to hold power as members of distinguished national STEM organizations and have a say in funding allocation and promotion of scientists all over the US.

Through the faculty equity reports, I confirmed that female faculty in the sciences are consistently lower than that of social sciences or humanities. The percentage of female tenured/tenure-track professors in the sciences has never gone above 22% in NYU or Columbia. When looking at the percentages of women in each stem up the academic career ladder in the sciences, there is an obvious drop off of women on the faculty level--especially women on the tenured faculty level. The percentage of women majoring in the sciences on the undergraduate level is consistently around 50%, in some years going above that. It is shocking that the retention rate for women in STEM academia is so low, even with so many women choosing to delve into the sciences.

Discussion

During the course of this project alone, a number of significant studies, articles, and investigative reports were published, related to the prevalence of sexual harassment and discrimination in STEM academia. An extensive piece on the sexual discrimination lawsuits against the Salk Institute was published by the New York Times in April, titled “I Want What My Male Colleague Has, and That Will Cost a Few Million Dollars”.[23] This piece dug into the institutional gender discrimination faced by three of the four female full professors (out of 32 full professors) at the Salk. A new paper in *Physics Review Physical Education Research*, also published in April, found that approximately three quarters of undergraduate women majoring in physics have experienced sexual harassment in their field.[24] They additionally found that these incidents of sexual harassment have had substantially negative personal and professional consequences. In the realm of social media and public advocacy, Dr. BethAnn McLaughlin has continued her crusade to combat sexual harassment in science, despite losing her tenure bid and potentially her job. She is now raising money for her nonprofit organization, MeTooSTEM, and is traveling across the US to give anti-harassment talks at institutions and advocating for accountability by STEM organizations such as the NIH.

When I mentioned that I was investigating this topic, people from STEM and non-STEM backgrounds alike pointed me towards articles they saw online, or incidents on Twitter under the hashtag #MeTooSTEM. Visibility of the issue of sexual harassment in STEM has steadily increased to the point where it has piqued mainstream attention. As more and more issues are exposed into the open and discontent rises, it becomes necessary to have a plan that organizes this anger into actionable change. Based on the collected data and recommendations of advocates of women in STEM academia, the following are general focus points that should be addressed:

1) **Accountability by institutions**: institutions must hold perpetrators of sexual misconduct accountable for their actions, and assign appropriate consequences in a timely manner
2) **Accountability by national STEM organisations**: national organizations such as NIH and NASEM must revoke honors, awards, and funding from investigators found guilty of sexual misconduct
3) **Educational opportunities that increase awareness of sexual harassment and discrimination at a younger age**: especially in an environment such as STEM where sexism is ingrained, educational opportunities are necessary to mitigate the negative effects of such an environment.
4) **Better institutional support for those who have experienced harassment**: institutions must provide support for survivors of harassment, not protection for the perpetrators

[23] Mallory Pickett, "'I Want What My Male Colleague Has, and That Will Cost a Few Million Dollars'," The New York Times, April 18, 2019, , https://www.nytimes.com/2019/04/18/magazine/salk-institute-discrimination-science.html.
[24] Lauren M. Aycock et al., "Sexual Harassment Reported by Undergraduate Female Physicists," *Physical Review Physics Education Research* 15, no. 1 (2019): , doi:10.1103/physrevphyseducres.15.010121.

5) **Promotion of more women to leadership roles**: without women in leadership roles, we will continue to have biases against women when considering promotions
6) **Educational opportunities for allies of women in STEM**: it is important for women in STEM to have support networks, and male allies should be educated on how best to support women who have experienced harassment and/or discrimination

One of the first steps towards change is awareness, in any situation, no matter how big or small--sexual harassment in STEM academia is no different. My hope is that these visualizations provide a conduit for this awareness through easily accessible data, without the obstacle of finding these sources and going through dense and often times incomprehensible reports. At the very least, this project has given me so much more insight into the problem than I ever would have had otherwise, and has pointed me towards inspiring female figures in science who are leading the fight towards equality.

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