

STATEMENT OF
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BEFORE THE
COMMITTEE ON THE JUDICIARY
SUBCOMMITTEE ON INTELLECTUAL PROPERTY
UNITED STATES SENATE
FOR A HEARING ON
“TRAILBLAZERS AND LOST EINSTEINS:
WOMEN INVENTORS AND THE FUTURE OF AMERICAN INNOVATION”
PRESENTED ON APRIL 3, 2019

Chairman Tillis, Ranking Member Coons, and Members of the Committee, thank you for the opportunity to testify before you today.

Within academic technology transfer and commercialization, there is a significant gender disparity. More males than females are disclosing and patenting their ideas and research despite a steady growth in female faculty members across universities.

The recent study by the US PTO, “Progress and Potential: A profile of women inventors on U.S. patents” provides a number of statistics on the growth and status of women in STEM (Science, Technology, Engineering & Math)¹ positions but also as inventors on patents:

- The number of patents with at least one woman inventor increased from about 7% in the 1980s to 21% by 2016.
- Despite this increase, the percentage of all patent inventors that are women, or the annual “women inventor rate,” reached only 12% in 2016, even though women represent close to 30% of the total science and engineering workforce.
- Across nearly all STEM occupations, women participate in a much higher rate than is demonstrated in their numbers of patented inventions.
- Women inventor rates are higher in technology-intensive states, but also in states where more women participate in the overall workforce

¹ United States Patent and Trademark Office, *Progress and Potential: A profile of women inventors on U.S. patents* available at <https://www.uspto.gov/sites/default/files/documents/Progress-and-Potential.pdf>.

Academic Specific Statics

- Men are 35-40% more likely to submit an invention disclosure²
- Female academics patent 40% less than male counterparts³
- 18% of university-owned patents have female inventors⁴
- However, there is no difference in the likelihood of an invention disclosure being licensed⁵
- In a report by AUTM⁶, patents with at least one woman inventor made up 24% in 2015 and 26% in 2016
- For Duke, patents with a least one women inventor over the past five years made up 33%

As an aside, we should note that not all inventions are, or should be patented, so the number of patents and women inventors on patents provides only one snapshot of the overall innovation enterprise and women's involvement in it.

The fact that not all innovations are patented may have contributed to Kaufman Foundation's finding that the share of new entrepreneurs that are women has consistently been well above the women patent inventor rate. According to the Kauffman Foundation startup activity index, women constituted roughly 35–40% of new entrepreneurs in the 2014–2016 period.⁷

Entrepreneurship Gap

Other interesting statistics include:

- 11% of university start-ups had a female scientific co-founder in the Osage University Partner review (similar to Duke at 14%)⁸
- Women founded companies get less investment – an average of \$77 million compared with \$100 million for male-led startups⁹
- Data from 2009-2015 showed that only 7% of companies receiving greater than \$20M in financing were women led¹⁰

² Thursby JG, Thursby MC. Gender patterns of research and licensing activity of science and engineering faculty. *J Technol Transf.* 2005;30(4):343-53.

³ Ding WW, Murray F, Stuart TE. Gender difference in patenting in academic life sciences. *Science.* 2006;313(5787):665-7.

⁴ Colyvas JA, Snellman K, Bercovitz J, Feldman M. Disentangling effort and performance: a renewed look at gender differences in commercializing medial school research. 2012; 37(4): 478-89

⁵ Sugimoto CR, Ni C, West JD, Lariviere V. The academic advantage: gender disparities in patenting. *PLoS ONE.* 2015; 10(5): 1-10.

⁶ Association of University Technology Managers (AUTM) Gender Analysis Report, Jan 2019

⁷ Kauffman Index Reports, available at <https://www.kauffman.org/kauffman-index/reporting/startup-activity>.

⁸ Stehman S. The Mother of Invention? Not Exactly. available at , Kauffman Index Reports, available at <https://www.kauffman.org/kauffman-index/reporting/startup-activity>.

⁹ Meisler et. al, Who Gets Venture Capital Funding?, Bloomberg report, 2016, available at <https://www.bloomberg.com/graphics/2016-who-gets-vc-funding/>

¹⁰ Meisler, 2016

- Survey of 350 tech start-up leaders showed 3 gender differences: lack of female role models; perception of failure as a greater factor in female entrepreneurs; and financing gaps for women¹¹

We note that North Carolina is listed as the 11th highest state for women inventor rate; arguably our major research universities contribute to this rating along with our health sciences and biotech economy. When I first arrived at Duke University not quite three years ago from the University of Michigan, I, like others who have moved here from other universities, had the impression that Duke was different. Recently my office set about [celebrating](#) women inventors in coordination with International Woman’s Day. When we began to pull the information, we were surprised at the diversity of technologies being developed all across campus from cybersecurity to new therapeutics, from women early in their career to those much older as well as women pursuing their technologies through creating startup entities to getting the technology commercialized through existing firms.

How is Duke Different?

Is Duke really different and why? The Duke environment is very conducive to innovation. There are fewer walls between schools and departments, a collaborative spirit across disciplines, little red tape in collaborative and interdisciplinary work, and leadership that builds bridges and supports faculty development and creativity. Working together, all of this makes innovation easier for everyone.

Recently, we surveyed as many women faculty and students that we could access to ask *them* how they thought Duke might be different. The results are as follows.

Background Statistics

At research universities across the United States, males make up the majority of faculty even though woman account for 50.8%¹² of the population and earn almost 60% of undergraduate degrees and 60% of master’s degrees¹³.

In US academic medicine, women comprise 37% of all physicians and surgeons¹⁴ but only 16% of permanent medical school deans.¹⁵ In academia, women represent 31% of full professors

¹¹ Wadhwa V, Chideya F. (2014). *Innovating Women*. New York: Diversion Books

¹² Bureau of the Census, “QuickFacts: United States,” available at <https://www.census.gov/quickfacts/table/PST045216/00> (last accessed March 2019).

¹³ National Center for Education Statistics, “Table 318.30. Bachelor’s, master’s, and doctor’s degrees conferred by postsecondary institutions, by sex of student and discipline,” available at https://nces.ed.gov/programs/digest/d16/tables/dt16_318.30.asp (last accessed March 2019).

¹⁴ Bureau of Labor Statistics, *Women in the labor force: a databook* (U.S. Department of Labor, 2015), available at <https://www.bls.gov/opub/reports/womens-databook/archive/women-in-the-labor-force-a-databook-2015.pdf>.

¹⁵ Association of American Medical Colleges, “Table 10A: 2013 Benchmarking – Permanent Decanal Positions” (2012), available at https://www.aamc.org/download/411898/data/2014_table10a.pdf.

and 27% of college presidents.¹⁶ According to a College and University Professional Association for Human Resources (CUPA-HR) report¹⁷, roughly half of higher education administrators are women. However, they make up only 30% of top executive positions.

At Duke, fully **seventy percent** of the university's 10 deans are female – many of them innovators in their own right. Our Provost is a woman (and a co-inventor on a patent) and 65% of Duke University and Duke University Health System employees are women, compared to the national average of 47%. We have women chairs in a variety of STEM fields: Chemistry, Pediatrics, Statistics, Medicine, and Evolutionary Anthropology. The Vice Chair of Research in one of our largest departments (Surgery) is a woman. In the past, Duke's Pratt School of Engineering has nearly a third more undergrad women than the average U.S. engineering school. For this year's entering first-year class, the ratio is nearly 1:1.

Faculty and Students Speak

From a recent poll of Duke women innovators (71), having women at the highest levels of administration matters: nearly 85% of female faculty responded that having women in the highest levels of administration contributed to a supportive environment for innovation at Duke. The next highest contributors to a supportive environment were funding resources for innovation (68%) and mentorship programs and having access to mentors (56%).

A similar survey of our women students (119) indicated that while they originally were attracted to Duke for its ranking and reputation in their field of study, nearly 95% of them thought Duke provided a supportive environment for innovation and close to 45% of them have already participated in some form of innovation or entrepreneurship program

Interestingly, in almost identical fashion to our faculty, women students also identified mentorship programs (79%) and evidence of women in leadership (68%) as the top two contributors to the supportive environment at Duke. Next was student groups and professional societies (56%) followed by other choices such as funding for startups (42%) and innovation programs (36%)

Below are comments from the women innovators at Duke when specifically asked what policies or changes they would suggest:

- More supportive policies in place for work-life balance such as extended paid maternity leave; improved technology infrastructure for all e.g., high speed broad band internet services in rural areas

¹⁶ Heather L. Johnson, "Pipelines, Pathways, and Institutional Leadership: An Update on the Status of Women in Higher Education" (Washington: American Council on Education; Center for Policy Research and Strategy, 2016), available at <http://www.acenet.edu/news-room/Documents/Higher-Ed-Spotlight-Pipelines-Pathways-and-Institutional-Leadership-Status-of-Women.pdf>.

¹⁷ Jacqueline Bichsel, Jasper McChesney, *A CUPA-HR Research Brief* available at https://www.cupahr.org/wp-content/uploads/cupahr_research_brief_1.pdf

- Continued funding such as NSF ADVANCE programs
- Ensure diverse representation in areas such as: grant reviews, editorial boards, promotion and tenure and hiring decisions
- Increase female representation in leadership positions from government to C-suite
- Build community initiatives that support women in innovation
- Initiatives that mitigate bias against women in innovation (similar to what the newest group of women inventors are doing with the [AAAS-Lemelson Invention Ambassadors](#) initiative)
- Innovation grants that are not solely focused on technology

Duke Programs

Across campus a number of programs targeted at both students and staff seek to encourage all innovation and entrepreneurship, but some have special emphasis on women.

Medical School: Duke's medical school curriculum emphasizes discovery and innovation explicitly with the third-year experience; this culture allows women to be immersed in that culture rather than having to seek it out. Second, Duke's Institute for Health Innovation (DHI) has been instrumental in engaging young faculty and students, and at this level, the number of women is largely proportional (as opposed to programs that focus on senior faculty where the gender disparity is more skewed). There is a conscious effort to promote women scientists and clinicians as role models for students and residents.

Within the Medical school, the ALICE program (Academic Leadership, Innovation, and Collaborative Engagement) is targeted to mid-career women faculty and provides in-depth opportunities for leadership skill development, personal reflection and goal setting, peer-mentoring, and structured 360 feedback. Faculty also have the opportunity to engage with leadership experts outside of Duke to help set and refine their personal goals.

Duke Technology Scholars (D-Tech): Noticing statistics similar to those identified in the US PTO report, Duke launched D-Tech in 2016 in part because the tech industry has experienced a [precipitous national decline](#) in women and diverse populations majoring specifically in computing disciplines. For example, just one in four individuals working in the profession is female. Although diverse groups of Duke undergraduates start out choosing courses in computing, some proportion drop out and do not chose careers in tech. *A key challenge is sustaining students' interest and enthusiasm for tech throughout four years of college.*

Through a partnership between Duke's Trinity College of Arts & Sciences, Pratt School of Engineering, in particular through the departments of computer science and electrical & computer engineering, the [D-Tech program](#) is a comprehensive effort to inspire a more diverse group of Duke students to choose careers in computer science and electrical & computer engineering and to provide support such that the students stay in these careers. D-Tech's goal is to create a pipeline of tech-savvy individuals who will thrive in an industry that is the backbone of our society and economy. *The program centers around the idea that **relationships**,*

mentorship and hands-on experience make the difference in recruiting and retaining such individuals in technology fields.

The program starts with a personal and professional development leadership day. Each scholar is then paired with a **one-on-one mentor** from the tech world who will help extend her individual technical skills, build confidence and professional networks, and help her envision how to create a rewarding career. Groups of scholars share experiences, learning together, and participate in summer programming with technology industry leaders. Internships with Silicon Valley or Research Triangle Park technology companies—many of whom include Duke University Alumni—give D-Tech Scholars the opportunity to discover their potential to have an impact in the tech industry. By providing these signature D-Tech mentorships and internship opportunities as early as sophomore year, the D-Tech Scholars program increases the probability that these individuals will choose tech for their careers and ultimately thrive in the tech industry.

Real-World Design: While traditional engineering curricula start off with years of analytical coursework, the new First-Year Design Experience at Duke’s Pratt School of Engineering gives students opportunities to think and work like engineers from the start. Part of Pratt’s high female attendance is attributed in part to the introduction of this hands-on design class giving students the opportunity to work on engineering projects with real clients early on—so they see the difference they can make in the world as engineers and be encouraged to persist in the field vs. traditional curriculum, which doesn’t get to applied engineering until late in the undergrad experience.

Engineering Scholars Program: Recently endowed with a \$15M gift from James and Alice B Clark Foundation, the Clark Scholars program is a component of Duke Engineering’s initiative to encourage an entrepreneurial mindset among all its undergraduate students, but especially to reach out and support a more diverse group of engineering students. Ten Clark Scholars will be selected each year based on financial need, academic accomplishments, engagement in engineering and leadership skills. They will receive support over four years to help offset loans, work-study and summer earnings requirements, allowing them greater freedom to participate in unpaid service, extracurricular and internship opportunities.

Engineering in Service to Society: Duke’s Pratt School of Engineering offers a variety of outreach programs to encourage girls in STEM activities. These programs encourage conversations around math and science while also discussing gender and bolstering young girls’ confidence. Among the many programs are Problem-based Learning for Girls, Girls STEM Day, Females Excelling More in Math, Engineering, and Science, Global Women’s Health Technologies, and Student Engineers Network, Strengthening Opportunities in Research (SENSOR).

Triangle Women in STEM: Co-founded by Duke, the Triangle Women in STEM initiative is a partnership between women in industry, academia, government, and non-profits that aims to build an ecosystem in the Triangle through activities and programs that will make the Triangle a destination for women in STEM.

Fuqua's Association of Women in Business (AWIB): As the largest club at Fuqua with over 400 members, AWIB plays an integral role in fostering conversation with the broader Duke community regarding the unique challenges that women face from starting up a new company to developing industry partnerships. AWIB connects women through mentorship & career opportunities by increasing intersectional awareness around all women's needs and facilitating mentorship between alumni and current students with programming such as "Dinner with Six Strangers" to provide opportunities for women to build ties with each other.

Melissa & Doug Entrepreneurs Program: (16 women/30%) Duke alumni, Melissa & Doug Bernstein are lifelong entrepreneurs who have been in business for 30 years, have created over 2,000 proprietary products, and have sold over a billion dollars in toys. The Melissa & Doug Entrepreneurs program, launched five years ago, is a year-long intensive fellowship program at Duke in which undergraduate students create their own great startup. The program exists to give startup teams the support they need to quickly and effectively create their company.

Annual Woman's Conference: The Innovation and Entrepreneurship Initiative (I&E) hosts an Annual Women's Conference- about 120 students attend and see panels/workshops with alumnae entrepreneurs

I&E Certificate Program: (136 women/49.6%) undergraduate certificate in Innovation and Entrepreneurship (I&E) is designed to provide students with a pathway to pursue a rigorous cross-disciplinary study of innovation and entrepreneurship that will be complementary to any major and will enable students to be innovative and entrepreneurial in their pursuit of knowledge in service of society.

Professional Societies

One of AUTM's (Association of University Technology Managers) strategic initiatives this year is to develop a Board position and accompanying strategy on Diversity and Inclusion to complement AUTM's existing Women Inventors group. The current goal is to develop an official position this year and begin with at least one initiative during 2019. The problem is not so much a lack of female representation in tech transfer offices, but the lack of participation from women inventors. Although depending on the field, the percentage of women may be historically low (e.g. engineering) even accounting for that, we don't get the number of invention disclosures that we should.

Programs at Other Universities

This is not meant to be a complete review of other academic programs, but simply a listing of example programs across the country.

Washington U. Started about five years ago a program called Women in Innovation and Technology. Link to the most recent symposium is [here](#), with participation increasing from 27 people 5 years ago to 160 registrants.

Ohio State: With funding from NSF's ADVANCE program, Ohio State's [ADVANCE](#) mission is to increase the representation, advancement and recruitment of women faculty in STEM careers and contribute to the development and success of global research leaders. One of the programs includes REACH for Commercialization™ 2019. REACH is a year-long program designed to help women faculty and post-doctoral scholars explore commercialization as a means of expanding the impact of their research.

Columbia University: Columbia Tech Ventures has been running an initiative called the [Columbia Women Inventors Network \(Columbia WIN\)](#) for almost 3 years now. The program organizes and hosts events featuring Columbia's prominent women entrepreneurs, as well as partners with external organizations to host events on our campus. Videos covering some of them on our webpage: <https://techventures.columbia.edu/inventors/columbia-women-inventors-network>

University of Florida: The [Collaboratory for Women Innovators](#) seeks to inspire, educate, and empower women to attain leadership in all phases of the innovation lifecycle. The Collaboratory seeks to bridge that gap in women inventors and entrepreneurs by supporting participants at various stages of personal and professional development. A portfolio of resources and training opportunities ranging from structured programming to informal networking, workshop and special topic speakers are offered, designed to address diverse goals and objectives. Programs and resources are designed to support women starting their own companies as well as increase participation of female inventors/researchers. Additional activities provide opportunities for women to learn more about innovation, entrepreneurship and leadership and connect with like-minded people and mentors. The [EWITS](#)® (Empowering Women in Technology Startups) provides educated women with hands-on entrepreneurial training and skills that will empower them for the rest of their lives. EWITS® leverages women's unique skills and perspectives for new business creation and transforms them from employees to employers.

Yale University: Programs at Yale include: [Women Entrepreneurs](#), a cross-campus community that supports women innovators and entrepreneurs providing skill-building and story-telling workshops; coaching and mentorship for Yale students; and community-building opportunities through our events and programs. The goal is to help 500 women launch new ventures and projects over the next 5 years. A weekly Yale Innovator speaker series is designed to foster community discussion, idea sharing, best practices, business fundamentals, networking, and team-building opportunities in support of Yale women students, alumni, faculty, and staff interested in entrepreneurship and innovation at any level. The series includes a mix of breakfast and afternoon talks, each of which includes time for Q&A. Women Innovators monthly breakfast with the biggest women innovators networking event occurring a breakfast prior to the start of our annual [Yale Innovation Summit](#).

University of Illinois: Funded by NSF to support entrepreneurship training, counseling and networking, the [AWARE](#) (Accelerating Women and Underrepresented Entrepreneurs) program

is a collaboration among the [College of Engineering](#), the [Office of Technology Management](#), and the [EnterpriseWorks incubator](#) at the University of Illinois Research Park. AWARE offers resources and an enhanced infrastructure that make the current entrepreneurial ecosystem more accessible to all. Those resources include:

- a dedicated [entrepreneur-in-residence](#) familiar with the needs of those from underrepresented groups.
- small proof-of-concept grants for teams
- targeted mentorship, training, and networking opportunities

Princeton University: Princeton promotes a number of clubs including the Women in Computer Science club and Alumni Entrepreneurs Fund (AEF) which has a very high percentage of female founders (approximately 47%). The AEF invests up to \$100,000 in recent alumni startups and provides AEF founders with mentorship from experienced Princeton alumni and staff. Alumni who receive AEF support serve as mentors to students, helping to advance the University's educational mission and cultivate its entrepreneurial ecosystem.

New Jersey Institute of Technology: NJIT has a number of initiatives to help female faculty and student commercialize their research. NJIT is an NSF I-Corps Site and for the last 4 years has worked with 150 teams to explore the commercialization potential of their inventions. Knowing that women have fewer linkages into the funding community they believe that this personalized 1:1 support is critical to helping advance commercialization.

Recently NJIT received a supplement from the NSF to pilot a program for female life sciences PhDs from any NJ university to participate in a summer accelerator. WE collaborated with the NJ Chapter of the Association for Women in Science (AWIS).

This year the NJIT Murray Women's Center and the New Jersey Innovation Institute @ NJIT have started a series of roundtables for women faculty to discuss commercialization of research. We have had case studies of faculty that have started businesses and provided a general overview of what commercialization is all about. AWIS national participated in the last session.

Each year the Murray Center also hosts a Women Designing the Future Conference. NJIT generally have successful entrepreneurs as part of the program along with NJIT researchers and other describing their work, with a usual attendance of 350.

Federal and State Programs

NSF has been a leader in promoting women in innovation thru the [ADVANCE](#) program which is geared towards increasing the number of women in STEM careers. A number of the innovation and entrepreneurship programs grew out of ADVANCE grants to become more focused on innovation and entrepreneurial activities. Note that NSF also funds the AWARE program mentioned previously at U Illinois.

Massachusetts Next Generation Initiative: The Massachusetts Next Generation Initiative (MassNextGen) is a five year, over \$2 million commitment to ensure greater gender parity in the next generation of life science entrepreneurs. Increasing the number of successful entrepreneurs is in the best interest of the entire life science industry and as such, this initiative is a public-private partnership between the Massachusetts Life Sciences Center and our corporate sponsors Takeda, King Street Properties, and Sanofi.

Each year, following a competitive program, women-led early-stage life science companies will be awarded a year-long customized package of support, which includes non-dilutive grant funding and access to a network of seasoned Executive Coaches from the life sciences ecosystem to refine their business strategies and effectively raise capital.

SUMMARY

While women inventors face challenges on the path to disclosing and protecting their innovations, we must also recognize that there are many components to creating a supportive innovation and entrepreneurship ecosystem for all innovators such that there is likely no one solution.

From our experience at Duke, the visibility of women innovators at all levels of leadership combined with available mentorship programs for both faculty and students seem to be important factors in our growth in women participation in innovation and entrepreneurship. In addition, in recognition that, especially for women students, there are significant social and environmental challenges that push them away from continuing in STEM, both universities and government should continue to develop programs to give them the support and mentorship such that they reach their goals of STEM careers.