

**SPIE.**

THE INTERNATIONAL SOCIETY  
FOR OPTICS AND PHOTONICS

# **GENDER EQUITY**

IN THE OPTICS + PHOTONICS WORKPLACE



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# GENDER EQUITY REPORT

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**SPIE.**

The International Society for  
Optics and Photonics

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**SPIE.** WOMEN  
IN OPTICS

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# Introduction

Dear Colleagues,

Since 2015, the SPIE Gender Equity Task Force has been working to identify how the professional environment and culture of the optics and photonics community can better enable equal opportunities, rewards, and recognition for its members, independent of gender. The Task Force focuses on identifying and recommending specific steps our community can take to improve ongoing advocacy and career assistance for women, and attract more women to pursue optics and photonics careers. For an overview of previous work on this topic, visit [www.spie.org/GE](http://www.spie.org/GE).

This report uses a mix of qualitative and quantitative data to explore a variety of gender equity themes, including compensation, promotion, leadership, work/life balance, mid-career interruptions, and parenting. On the qualitative side, SPIE staff conducted 16 personal interviews, asking men and women at various stages in their careers to talk about their professional and personal lives. I hope you enjoy these personal interviews as much as I did. I also want to thank our interviewees for their willingness to participate and provide valuable insight into what are often very personal topics.

Quantitative data is provided by 2016 and 2017 editions of the SPIE Optics and Photonics Global Salary Survey, which included questions probing childcare, mid-career transitions, and other gender equity themes. The survey is the largest of its kind in the optics and photonics community, receiving nearly 10,000 valid responses and representing 105 countries and a wide range of disciplines. Full salary survey results are available at [www.spiecareercenter.org/survey](http://www.spiecareercenter.org/survey).

This is an exciting time for gender equity in optics and photonics, in STEM, and in our world. Thank you for reading and sharing this booklet, for posting on social media, and for everything else you do to contribute to this effort. Continue the conversation on Twitter by following @WomenInOptics – we want to hear from you. I can feel the momentum growing, and I hope you can too.

Kind Regards,



**Julia Craven**

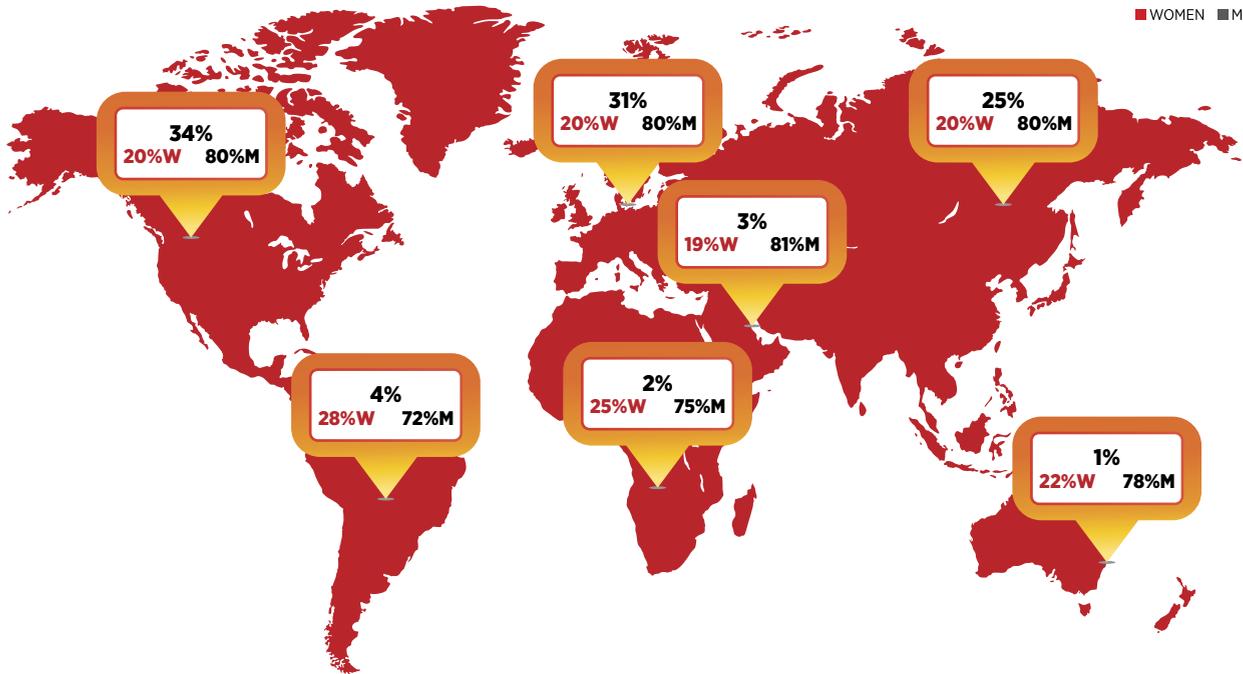
Chair, SPIE Gender Equity Task Force  
(Formerly the SPIE Women in Optics Task Force)

PS: *Tell us what you think and where you want us to go next!*  
@WomenInOptics or #WomenInOptics



## Survey Responses by Region and Gender

■ WOMEN ■ MEN



### Data Overview

9,993 valid responders	291 part-time employees	145 retired	7,630 men
6,717 full-time employees	262 unemployed	2,578 students	1,985 women

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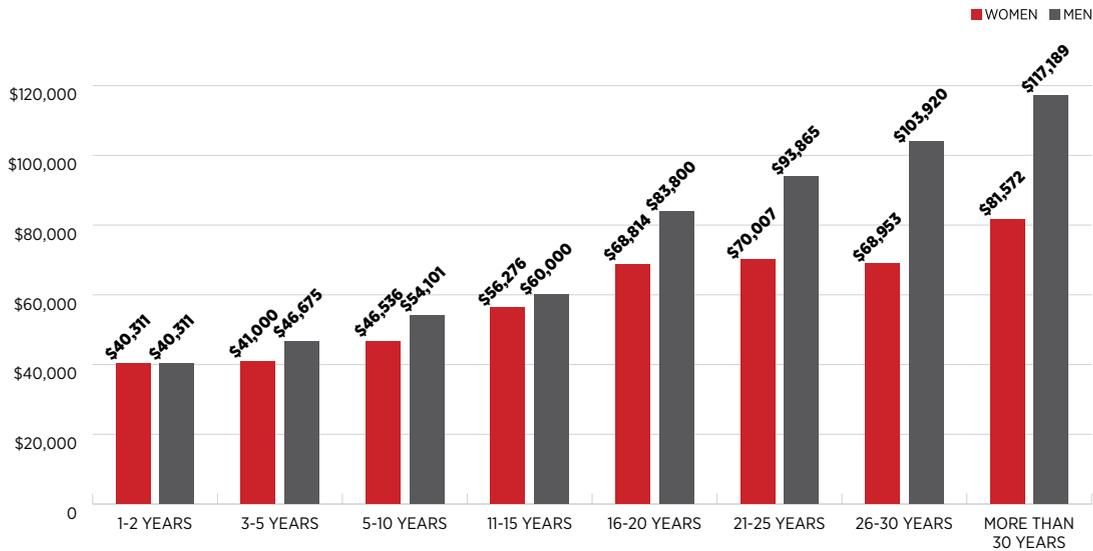
## Key Findings

- Women represent a minority in the optics and photonics community, accounting for 21% of the respondents to the 2017 SPIE Optics and Photonics Global Salary Survey.
- Median salaries are 37% higher overall for men than for women. The salary gap is smallest early-career and grows over time.<sup>1</sup>
- Women's representation in the workplace declines over time. At the earliest career stage, 21% of workers are women, but participation drops with increasing years on the job, dropping to 10% for employees with thirty or more years at work.
- At most career stages, higher percentages of men are represented in management and in senior academic ranks. Gaps are largest at later career stages.
- On average, men report working more hours per week than women, though there is very little gender difference in the highest-hour per-week categories.
- Women take mid-career breaks more often than men, with 69% citing childcare as a primary motivation versus 9% of men.
- Women in the optics and photonics workplace are less likely to have children than men. This finding is particularly strong at mid-career stages, suggesting that many women leave the workforce after having children.
- Women take much more parental leave than men, with European and Asian women taking more time off than their North American colleagues.

# Pay and Representation

Women make up 21% of the respondents in the 2017 SPIE Optics and Photonics Global Salary Survey. Women earn less than men overall, with respective median salaries of \$50,500 and \$68,953. At early career stages, earnings are similar for both genders, but the gap grows with increasing years on the job.

## Salary by Gender and Years Employed



*"If there were an equal number of men doing the caretaking of children and parents, then there wouldn't be such a disparity in salaries between men and women or a disparity in level of career."*

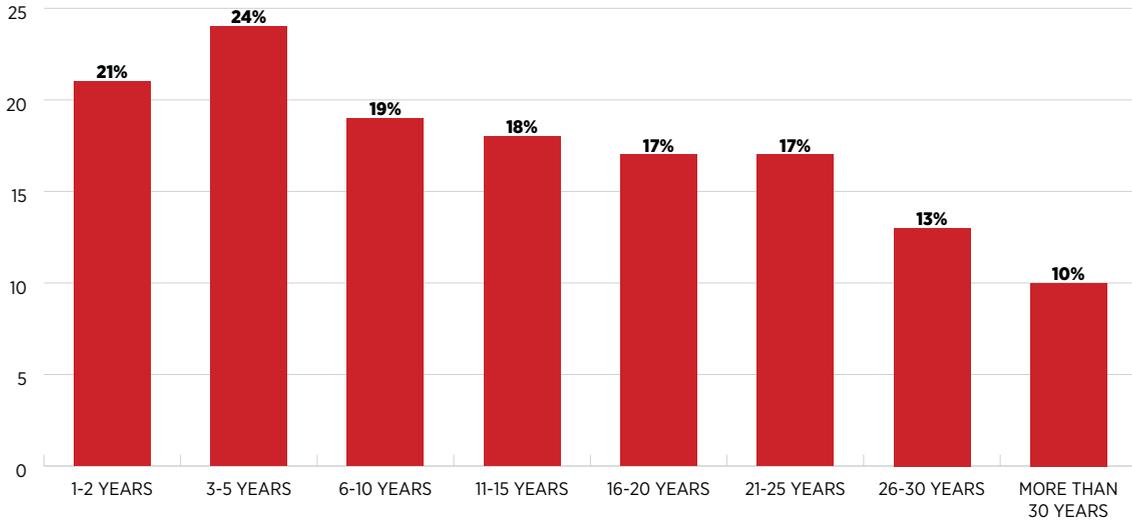
**-Christina Willis**, Laser Scientist,  
Fibertek, USA



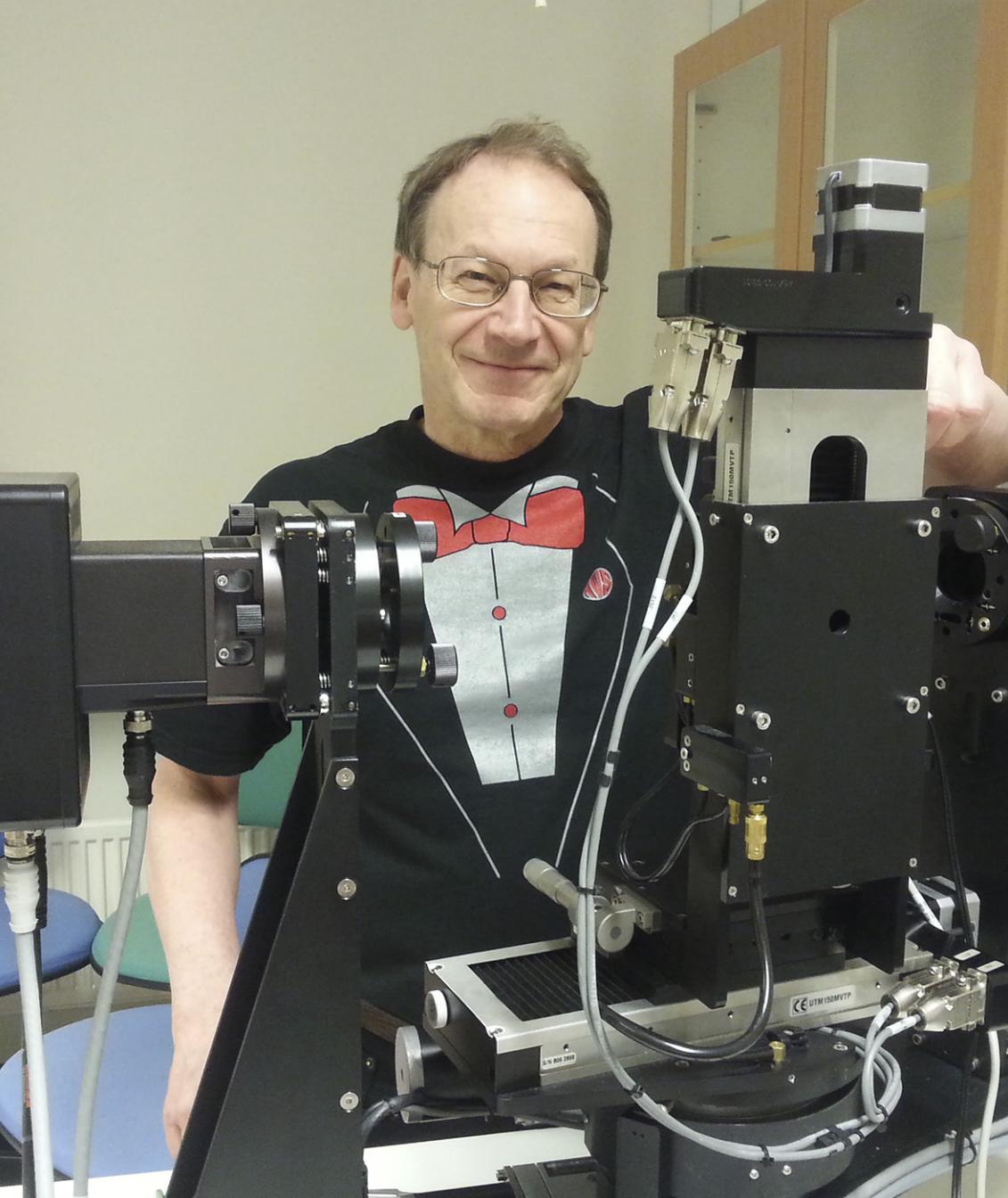
“Out of 28 students in my Physics BSc program, there were only two females. People think that physics is more for men than for women and this causes systemic discrimination. If this is the cultural mindset, there will be different treatment between males and females in the classroom. I think that the classroom environment can play a big role... Even with this difference in number, I only felt discriminated against because of my gender once and it was after my PhD. At that time, my male boss believed he was superior just for being a man, he stated he did not trust women. When I started proposing ideas, discussing my opinions, and showing my skills, my work was considered of poor quality. In such cases, we need to work harder to make other people aware of what we are.”

**-Claudia Valdés,**  
Advanced Imaging Specialist,  
Zivot, Colombia

### Women as Percentage of Workers, by Years Employed



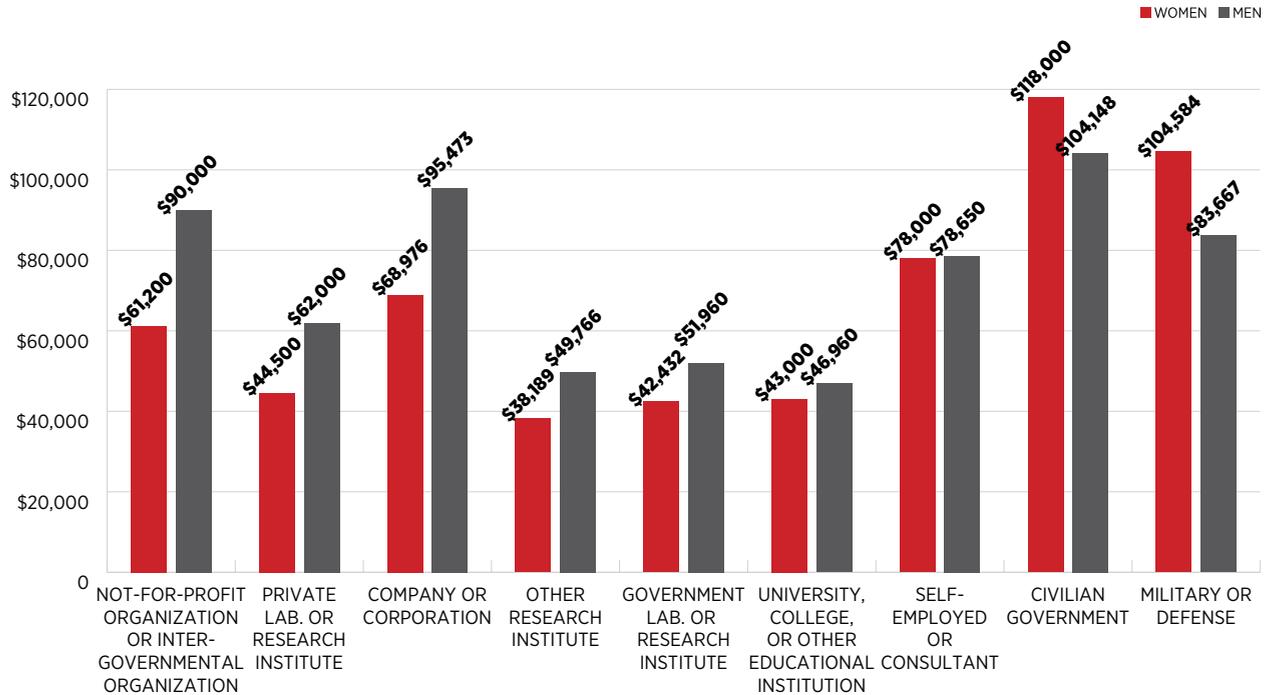
The percentage of women in the workforce declines over time. At the earliest career stage, 21% of workers are women, but participation declines to 10% for workers with thirty or more years of employment. Data presented on pages 16–18 suggest that this decline may be related to women leaving their jobs after having children.



*“I think that a lot of it has to do with expectations. I see so many female faculty asked to be on committees, because the committee wants to be “diverse”. The woman faculty member when asked to be on a committee in most cases consider this to be favorable for her career. Then the female faculty members in many cases become so overloaded with commitments, that they don’t have time to focus on their research or teaching classes. They are, in a sense, punished for being a woman in a field dominated by men.”*

**-Hans Arwin**  
Professor Emeritus,  
Linköping University, Sweden

## Median Salary by Gender and Employer Type



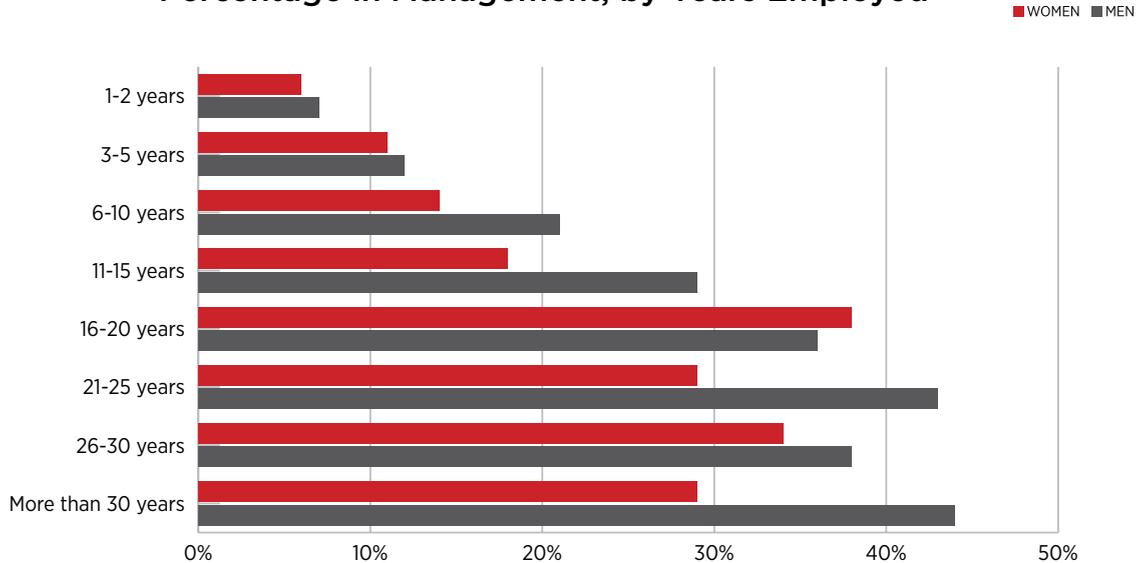
*“The wage disparity in North America is one of the highest, which says a lot about gender bias on this continent. Perhaps the most significant point can be seen in the figure that describes the median salary by gender and years employed. As a more senior level academic and researcher in North America, with 20+ years experience, it is critical that we see some sweeping changes to close this gap soon!”*

**- Anita Mahadevan-Jansen,**  
Orrin H. Ingram Professor of Biomedical Engineering,  
Vanderbilt Univ., USA

# Leadership and Promotion

At most career stages, higher percentages of men are represented in management and in senior academic ranks. Gaps are largest at later career stages.

### Percentage in Management, by Years Employed



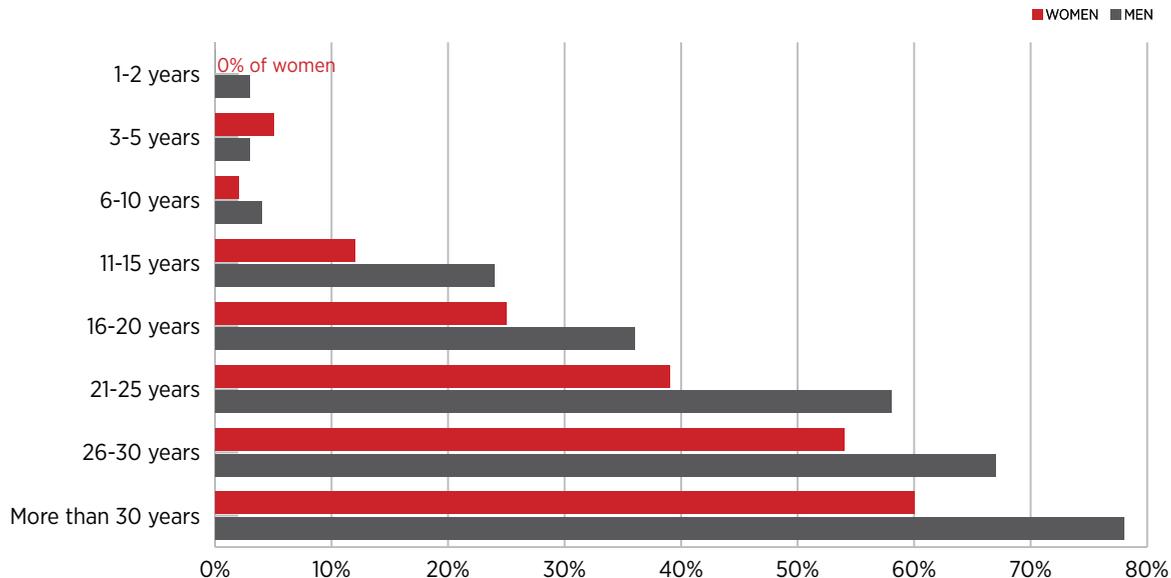
*"Management" is composed of C-level/senior executive, vice president, director, or supervisor/manager.*



*"It often takes a mentor who recognizes your talents to propel you to the next level. Perhaps not surprisingly in a male dominated field, all of my mentors have been male. They were the ones in positions of leadership or power that were able to make a difference. It is up to the men to help women progress."*

**-Elka Koehler**, Principal Systems Engineer,  
Raytheon, USA

## Percentage at Senior Academic Rank, by Years Employed



“Senior Academic Rank” is composed of academic dean, provost, or full professor.



“There exists an unconscious bias towards women within academic research. Women can automatically be recognized as stereotypical multitaskers with higher emotional intelligence based solely on their gender. As such, they can be delegated more administrative tasks and assigned a more caregiver status relative to their male counterparts. For example, female researcher joins group, group asks female researcher to help with admin work, female researcher has comparatively less time for her research because she is helping to manage the group. This feels like a leadership role, but ultimately, she isn't getting published as much or she is getting overworked because she becomes the one responsible for all organizational tasks. Whilst other group members may rise in rank and salary, she will have less opportunity and success due to her lack of academic output.”

—Marie-Louise O'Connell, Medical Physicist,  
Researcher, Lecturer, Ireland

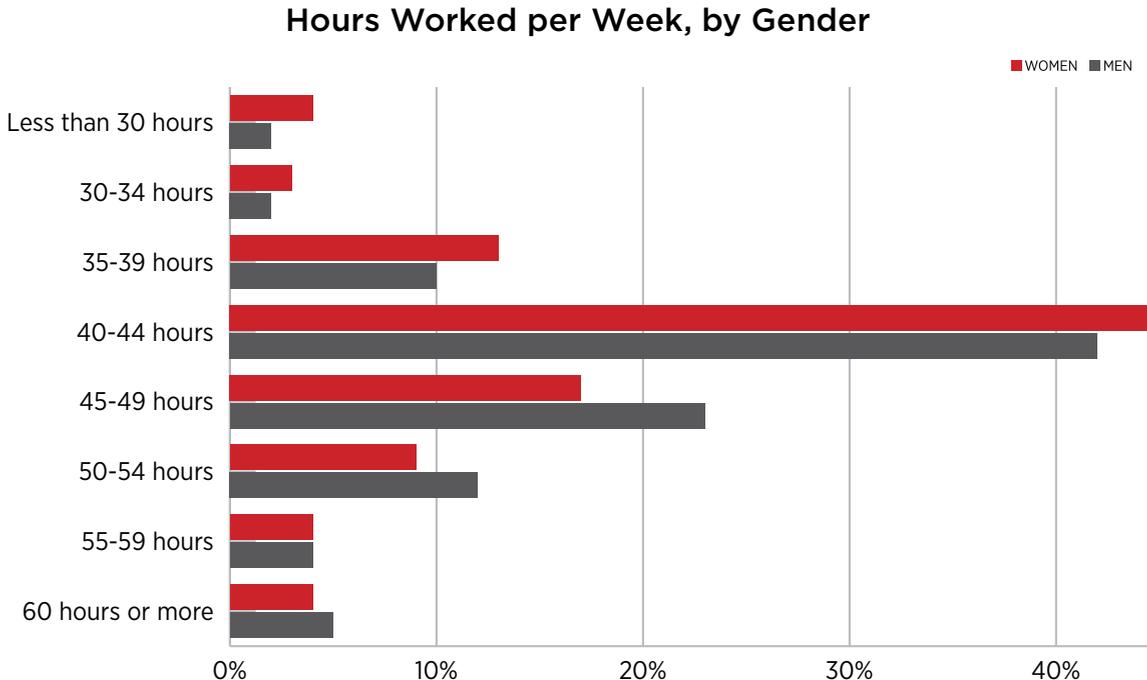


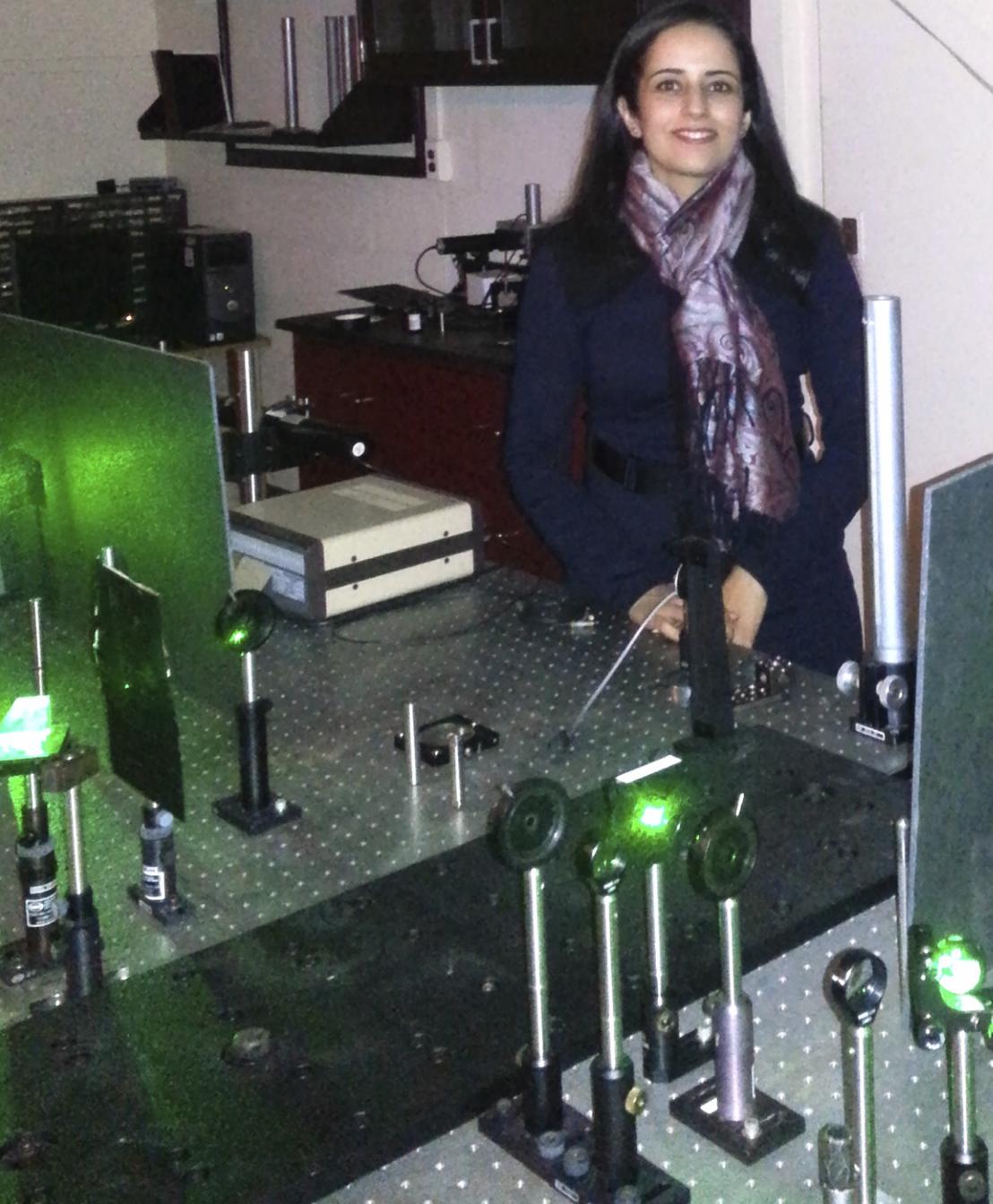
*“raises depend on merit. If you work hard, publish papers, attend conferences, then you are more likely to receive a raise. Promotions are dependent on whether or not your department gets permission from the university to open up that position for you, and that depends not exclusively on your merits but also on the promotion directions of the university. It is different from a company.”*

**-Maria Sánchez-López,**  
Associate Professor,  
Universidad Miguel Hernández,  
Spain

## Work/Life Balance

On average, men report working more hours per week than women, though there is very little gender difference in the highest-hour per-week categories. Among employees working 45 or more hours per week, men are happier than women with their work/life balance—62% of men agree or strongly agree that they have an excellent work/life balance, versus 47% of women.





*“My priority is my baby. A leadership position demands too much time. I am an Associate Professor and teach for approximately 5 hours a week and supervise undergraduate and graduate students. Much of my work can be done from home... I chose to not seek a higher position at this point, because I know it will require more time than I want to spend at work. I may choose to go that route in the near future and get a promotion to full-professor. Right now, my position is a good fit for me... IWhen my child is older, I may be interested in a leadership role. I would like to get more funding for international projects and do more outreach.”*

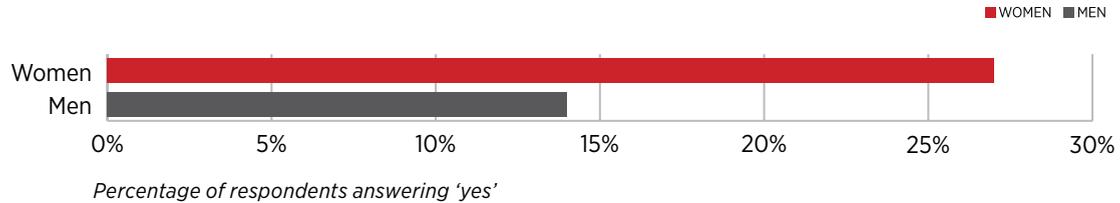
**-Rim Cherif,**  
Head of Research Group,  
SupCom, Tunisia

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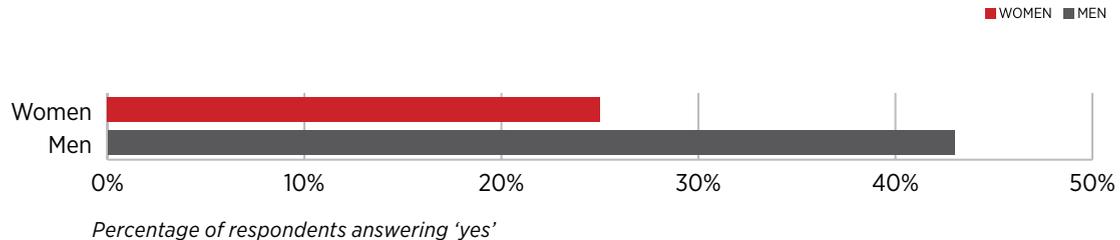
## Returning to Work/Re-entering the Workforce

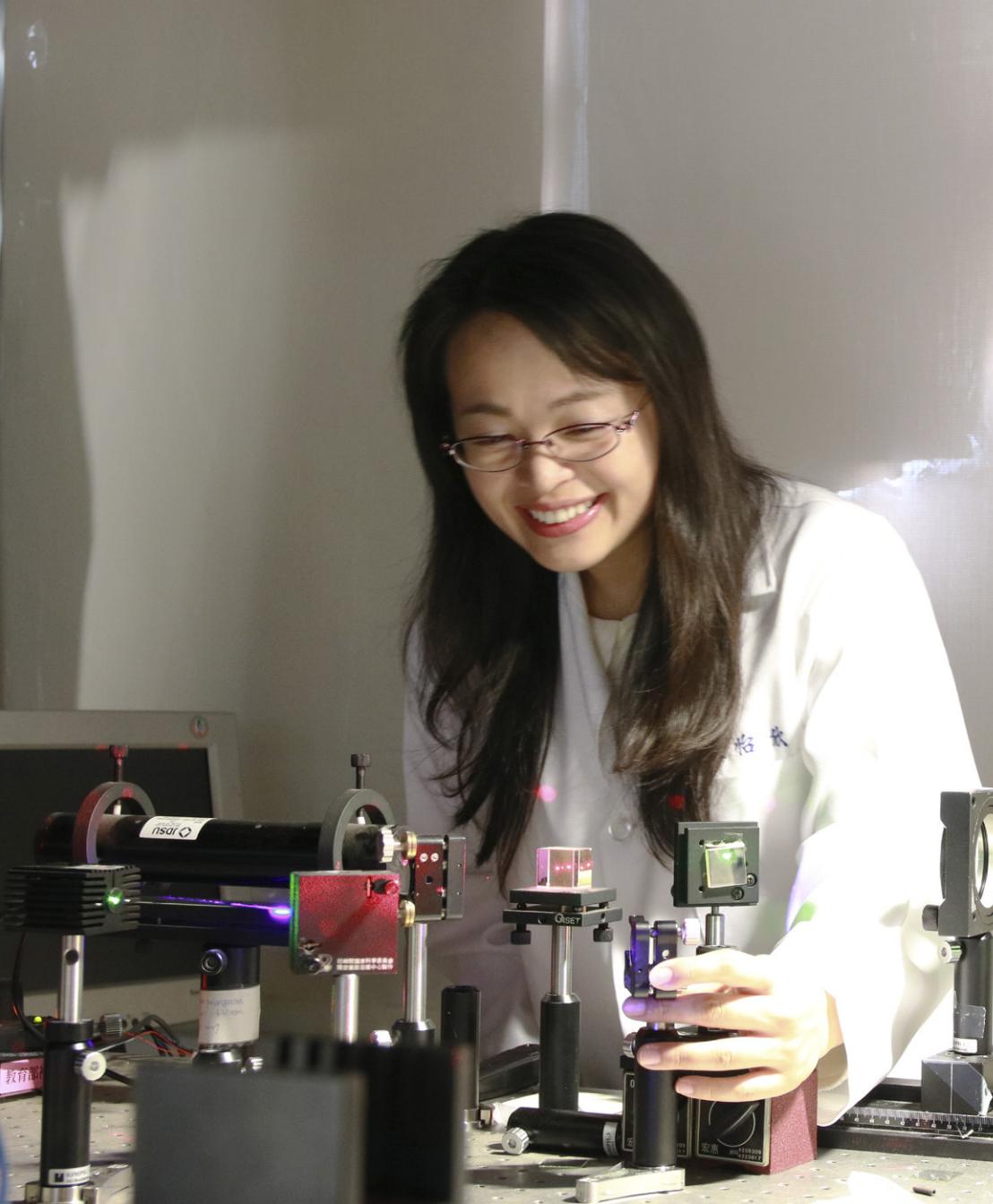
Women take mid-career breaks more often than men, with most citing childcare as a primary motivation. Just over one-in-four women report taking a mid-career break of six months or more, versus 14% of men.

**Since starting your career,  
have you taken a mid-career break of 6 months or more?**



**Was the main reason for your mid-career break that you lost a job?**

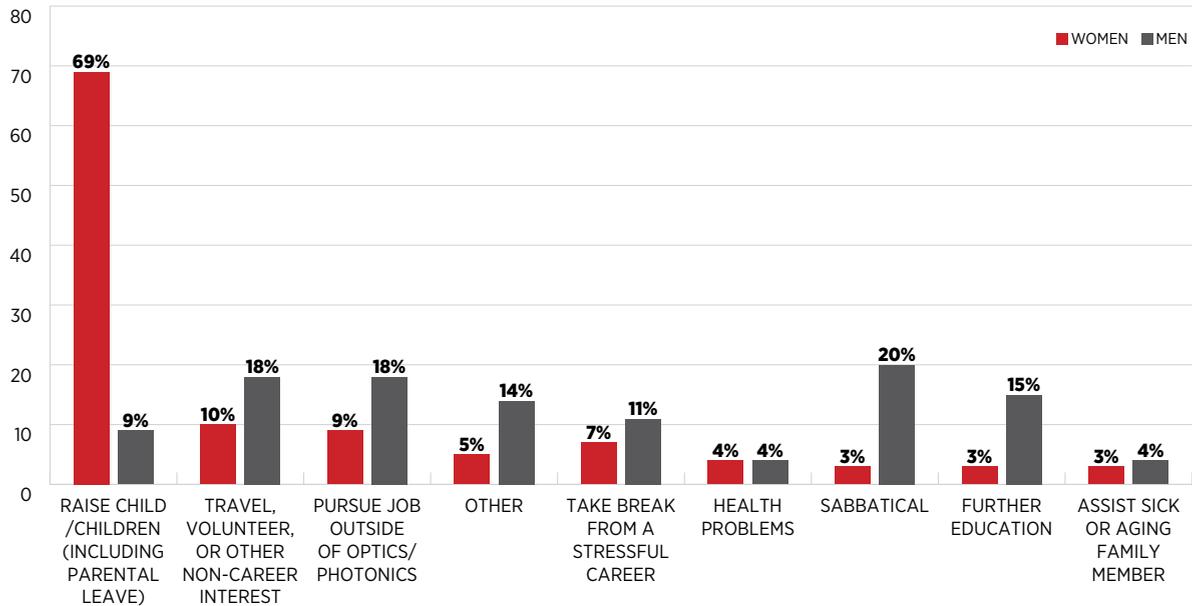




“When I was pregnant in 2010 and 2011, I had to do research, teach courses, advise students, write proposals, midterm reports of projects, and a midterm presentation of projects. I still remembered that I submitted a manuscript before I went to a hospital to have my C-section for my first baby. I did not want to delay the submission. I also remembered that I revised a manuscript and uploaded the files with my PhD student in the hospital one day after my C-section for my second baby. I did not want to delay my work because of maternity leave. During my maternity leave, I was still working: revising my students’ theses and dissertations, reviewing manuscripts for journals, and writing proposals at home. Even though I have a mother-in-law to help me out and house keeper to help me clean the house, I still needed to do my research job.”

**-Yi-Hsin Lin,**  
Professor, National Chiao Tung  
University, Taiwan

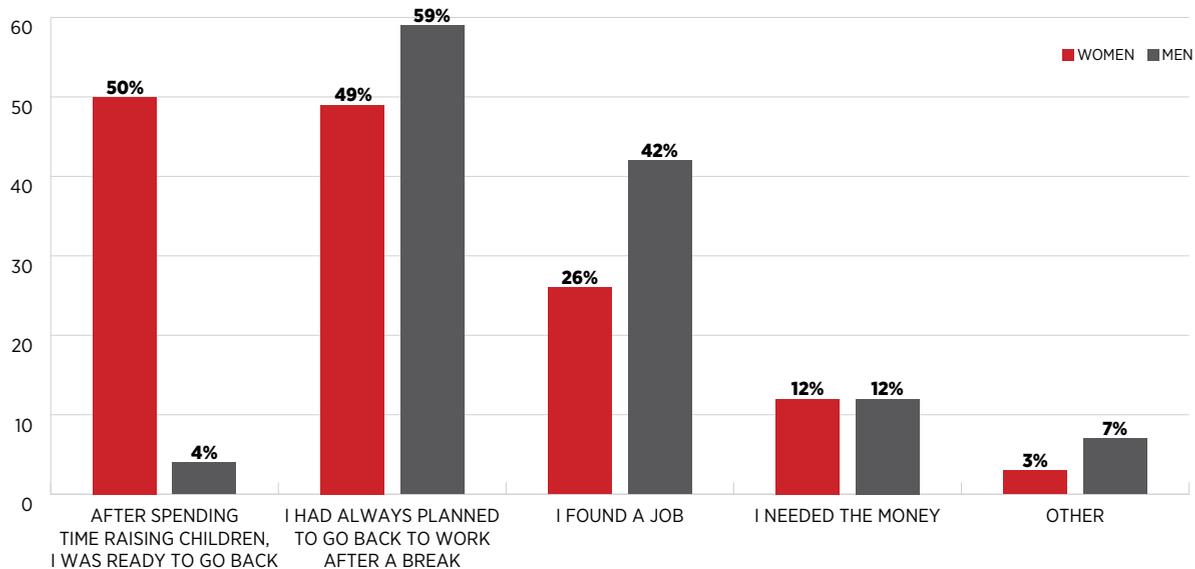
## Other than job loss, what were the main reasons for your mid-career break?



Almost half of the men taking mid-career breaks did so due to a job loss, while one quarter of women took leaves for this reason. For people taking leaves for reasons other than job loss, 69% of women site childcare as a main reason, as opposed to 9% of men.

When asked about why they returned to work after mid-career breaks, half of women report being ready after a period caring for children, versus 4% of men.

## Why did you return to your optics and photonics career?



*"Finding the balance is very hard. Our friends and family joke, saying that our daughter is growing up in a single-parent household; it is just that the parent is always changing. As scientists, both Patricia and I travel about once a month. We fill out our calendar for the year and it is amazing to see how often we are gone and juggling each other's responsibilities."*

**-Andrew Forbes**, Professor, University of Witwatersrand, South Africa

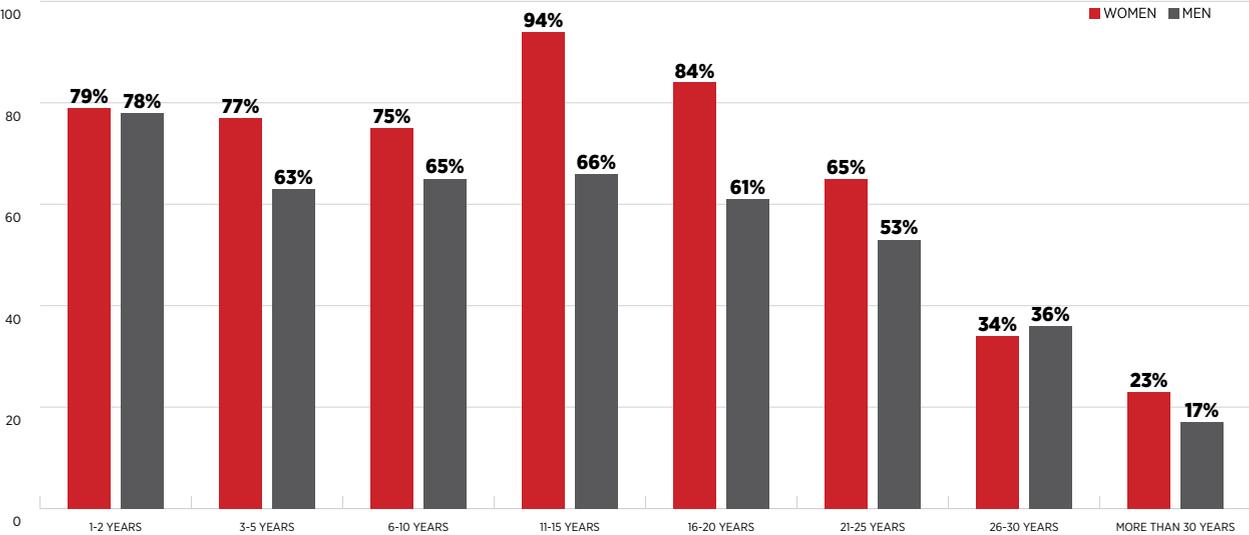
# Children and Caregiving

Men in the optics and photonics community are more likely than women to be parents—66% of male survey respondents have children versus 50% of women. Of those respondents with children, 68% of the women are the primary caregivers of children under 18, compared to 50% of men. The likelihood of women being the primary caregivers of children holds true throughout all regions.

These results, coupled with the finding on page 6 that women’s participation in the workforce declines over time, strongly suggest that a large number of women leave their optics and photonics careers after having children.

## Primary Caregiver, by Years Employed

*This question was displayed only to people indicating they have children under 18.*



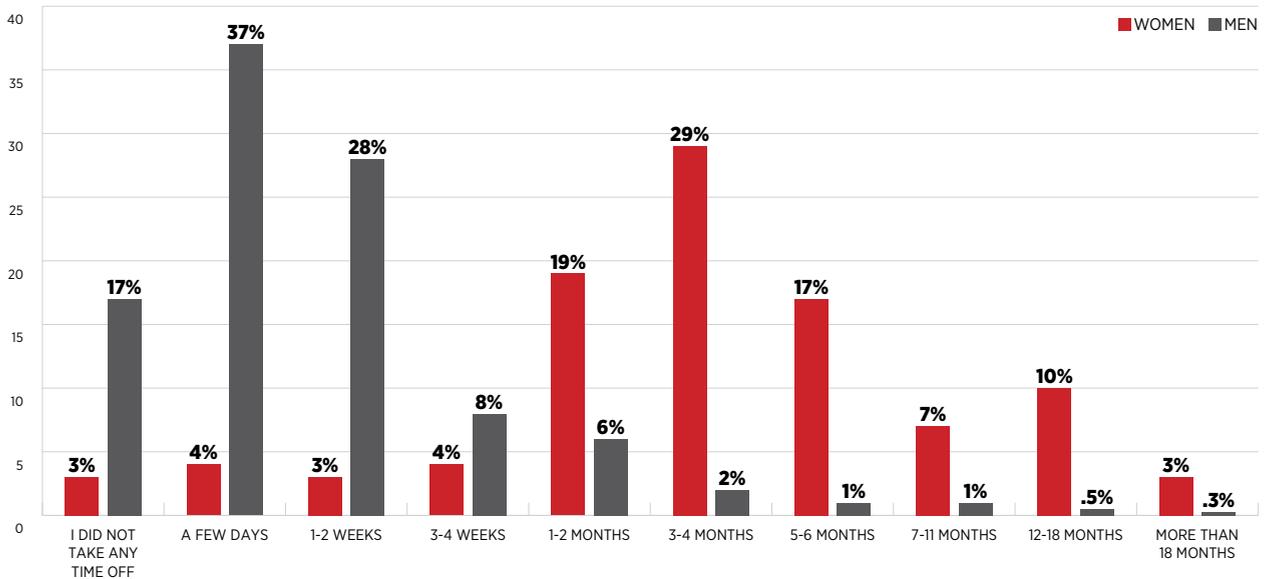


*“My maternity leave went pretty smoothly, in part because I am bad at divorcing myself from my work. I would have my students meet me at my home while the baby was napping to talk about their projects. Time management was challenging. Prioritizing between the hours of 8 – 5 was difficult, because when you get home, you want to be fully present with your family... In academia, I find it is easier for moms to return to their position if they can manage to take off a semester or quarter and return during the following semester or quarter. This is harder in research-heavy roles or in industry.”*

**–Jennifer Dionne,**  
Associate Professor, Stanford  
University, USA

Men take far less parental leave, on average, than women. Women in higher-income European countries took far longer leaves than their female colleagues in North America or lower-income Asian countries.<sup>2</sup> For instance, 64% of higher-income European women took five or more months off versus 19% of North American and 25% of lower-income Asian women. A majority of North American women (59%) wish they could have taken more time off, while smaller percentages of higher-income European (36%) and lower-income Asian (38%) women share that feeling.

### Thinking about the birth of your last child, how much time did you take off from work for maternity/paternity leave?



## Parental Leave, by Region

Table includes regions with 20 or more women in the sample.

	ASIA, LOWER INCOME		EUROPE, HIGHER INCOME		NORTH AMERICA	
	Women	Men	Women	Men	Women	Men
I DID NOT TAKE ANY TIME OFF	2%	15%	0%	16%	3%	16%
A FEW DAYS	5%	38%	4%	26%	4%	38%
1-2 WEEKS	0%	24%	2%	29%	4%	33%
3-4 WEEKS	7%	9%	1%	12%	7%	7%
1-2 MONTHS	11%	5%	7%	10%	36%	5%
3-4 MONTHS	50%	5%	23%	4%	28%	1%
5-6 MONTHS	16%	1%	25%	2%	10%	1%
7-11 MONTHS	2%	1%	12%	1%	5%	.1%
12-18 MONTHS	7%	1%	21%	.4%	4%	0%
MORE THAN 18 MONTHS	0%	1%	7%	0%	0%	.2%

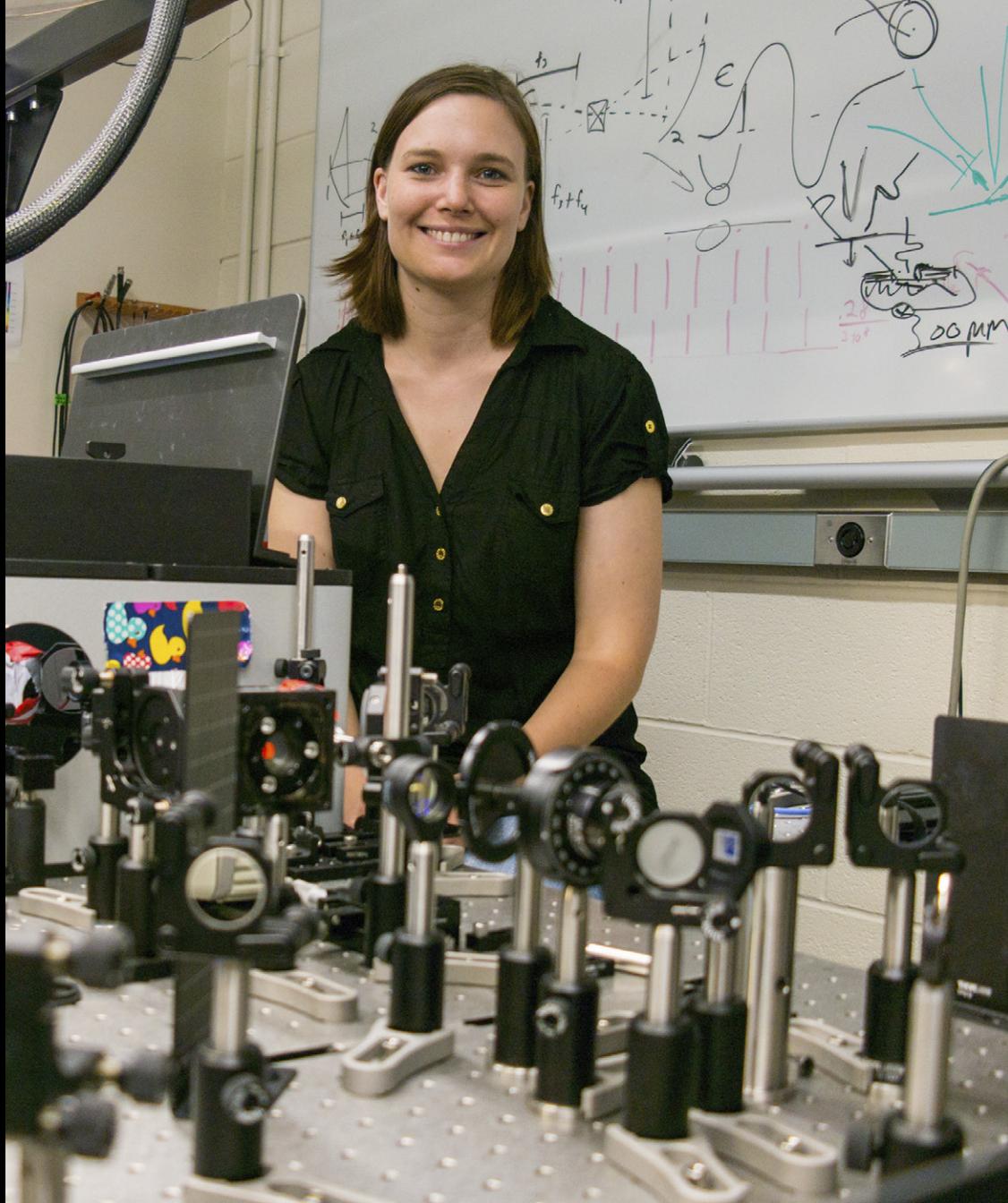


*"It can be hard to completely leave work when you are on parental leave. It's a double-edged sword because if you do completely turn the switch off and don't keep up on emails or other items, you are so far behind when you return; if you do choose to completely avoid work, you spend more time with your child – the whole purpose of your leave. But when you return to work there are major workload repercussions."*

**-Boris Lange**, Manager Imaging Europe,  
Edmund Optics, Germany

“One thing that is intimidating about a career in academia is how competitive it can be. I think that this may keep some women from pursuing careers in the field after they receive their PhDs. I don't think that being a professor requires this sort of competitive attitude. Being a good manager, being able to collaborate, being able to effectively lead a group and a project. These are much more important to me. When you think about an academic lifestyle, you are spending much more time doing those things than presenting your groups' work at a conference or trying to prove yourself as the best in your field.”

**-Pernille Perderson,**  
Post Doc, Brown University,  
USA/Denmark



## Advice From the Field



"In my career talks, I often mention what I call 'the switch.' I am quite busy so when I am at work, I try hard not to worry about family life. When I am at home, I switch again and I try not to allow myself to worry about work. You can waste so much of your life worrying; if you spend that same amount of energy on your family or your work when you are there, it is transformative to your habits and well-being."

**-Maryellen Giger,**

A. N. Pritzker Professor of Radiology/  
Medical Physics, University of Chicago, USA



"Don't be afraid to say 'No.' When you get a position, a raise, or a promotion, know that you have earned it. Be confident in your own expertise and skills. Set the right expectations for you and for your group/employee. This is the biggest favor you could ever do for yourself."

**-Marie-Louise O'Connell,**

Medical Physicist, Researcher, Lecturer, Ireland



"Taking care of yourself is an investment. View it that way. It is an investment in yourself that boosts your productivity and your success in the long-run... One should take opportunities as they are presented. Go out on a limb. Pursue all avenues. Plant more seeds and see which ones produce the most fruit."

**-Christina Willis,**

Laser Scientist, Fibertek, USA



"We as women in science need to be determined and have a strong character to achieve what we want. We have to believe we are capable of everything men are. In my case, it has been very useful and encouraging to meet women who have been successful in their careers and in their personal lives, to continue through my career."

**-Claudia Valdés Escobar,**

Advanced Imaging Specialist, Zivot, Colombia



"Everyone needs to take risks to move ahead. There is a perception that men are aggressive in negotiations and seeking promotion, while women are more reserved or even passive... Perhaps it's true, but my advice to anyone is: take a risk and push beyond your comfort level. It's hard. It often won't work out the way you want it to. But, you'll learn something about yourself, your situation and your employer. And it just may pay off after all!"

**-Tanya Kosc,** Scientist,

University of Rochester Laser Facility, USA

"There is a perception that women need to be protected. I don't want to protect the women in my group. I want to empower them! I want to give them the skills and authority to push back when they aren't receiving fair treatment. This is far more valuable than continuing to perpetuate the idea that women need to be protected and can't stand up for themselves."

**-Anonymous**

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## Methodology and Endnotes

Quotations are drawn from 16 interviews conducted by staff in early 2017. Interview subjects included 13 women and 3 men from Africa, Asia, Europe, Latin America, and the United States. Industry, academia, and government are represented, including early-, mid-, and late-career stages. One quotation is provided anonymously, based on the preference of the interview subject.

Quantitative data are drawn from 2016 and 2017 editions of the SPIE Optics and Photonics Global Salary Survey. These surveys yielded 6,793 and 9,993 valid responses, respectively. Full methodology is available at [www.spiecareercenter.org/survey](http://www.spiecareercenter.org/survey).

### ENDNOTES:

1. U.S. dollars are used throughout. Local currencies were converted using January 2017 market exchange rates. Salary figures include total yearly compensation, including base pay and bonuses. Full-time employees are those who indicated working 35 or more hours per week. Unless otherwise noted, all data on pay is drawn from full-time employees.
2. North America is comprised of the United States and Canada. Europe and Asia are composed of countries spanning a wide range of income levels, even when subdivided into higher- and lower-income groups. For example, the European higher-income category includes the Czech Republic and Norway, at \$18,140 and \$93,740 per capita Gross National Income (GNI), respectively. Higher- and lower-income subcategories are based on the World Bank's threshold for high income countries, \$12,736 per capita GNI. This threshold is used throughout this report when referring to "higher-income" and "lower-income" countries. For data on per capita GNI, see [www.data.worldbank.org/indicator/NY.GNP.PCAP.CD/countries](http://www.data.worldbank.org/indicator/NY.GNP.PCAP.CD/countries). For World Bank country income categories, see [www.data.worldbank.org/about/country-classifications](http://www.data.worldbank.org/about/country-classifications).



## Fight Bias, Embrace Diversity

SPIE seeks to cultivate a culture of openness and inclusivity. Help us eradicate bias and make the world of optics and photonics a shining example of all minds coming together to innovate regardless of gender, race, nationality, culture, educational background, politics, sexuality, body-type, and age, for the betterment of life.

Educate yourself on the issues faced by a diverse workforce, challenge your own assumptions, and tap into the rich pool of talent, perspectives and ideas offered by people different from you.

# SPIE is the international society for optics and photonics

CONNECTING MINDS.  
ADVANCING LIGHT.

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## **ABOUT SPIE**

SPIE is the international society for optics and photonics, an educational not-for-profit organization founded in 1955 to advance light-based science and technology. The Society serves nearly 264,000 constituents from approximately 166 countries, offering conferences and their published proceedings, continuing education, books, journals, and the SPIE Digital Library in support of interdisciplinary information exchange, professional networking, and patent precedent. SPIE provided more than \$4 million in support of education and outreach programs in 2016.

For more information, visit [www.SPIE.org](http://www.SPIE.org).

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