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Physics PhDs Ten Years Later:

Success Factors and Barriers in Career Paths

Results from the PhD Plus 10 Study

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Using data from our 2011 PhD Plus 10 Study of mid-career physics PhD recipients, we explored the supporting factors and barriers to success experienced by PhD physicists throughout their careers. We examined the career experiences of respondents working in three different sectors (academia, government, and the private sector) and compared experiences between men and women. We present the data in two sections: Career Success Factors and Career Barriers. Highlights of our findings are shown below.

Career Success Factors:

- Out of 1,407 PhD physicists' quotes about factors related to career success, the most frequently discussed factors were hard work, problem-solving skills, interpersonal skills, persistence, and education.
- Private sector physicists more frequently attributed career success to their skills and abilities (e.g., interpersonal, problem solving, computing, and analysis skills).
- Government and academic physicists more frequently attributed career success to hard work, persistence, and social support (e.g., mentors and colleagues).
- Men more frequently attributed career success to skills and abilities, while women more frequently attributed career success to social support.

Career Barriers:

- Out of 1,321 PhD physicists' quotes about barriers to their careers, the most frequently mentioned barriers were a lack of funding, overwork, family obligations, lack of interpersonal skills, and difficulty obtaining employment.
- Private sector physicists more frequently discussed their lack of skills (e.g., interpersonal and business skills) and a lack of career opportunities (e.g., issues obtaining employment due to economic conditions or biases against hiring PhD graduates) as barriers to their careers.
- Government and academic physicists more frequently discussed issues within their organization or employer (e.g., lack of funding/resources, and unsupportive administration) and social issues (e.g., balancing work and family life, negative interactions with mentors or managers) as barriers to their careers.
- Men more frequently discussed organization issues and their lack of skills as career barriers, while women more frequently discussed social issues and gender bias.

Data Analysis Approach

We conducted an inductive, qualitative analysis to identify themes that emerged in the responses for two open-ended questions: "What has helped you succeed in your career up to this point?" and "What have been the barriers to your career up to this point?" A theme is a category that represents a collection of respondents' quotes discussing a specific concept. In this inductive approach, we did not create a list of themes before the analysis. Instead, we identified themes during the analysis process when a concept repeated across multiple quotes. For example, we identified that multiple quotes discussed how physicists succeeded by persisting when they encountered challenges, and we labeled any quotes discussing that concept with the "Persistence" theme. A single quote could be labeled with multiple themes, and themes were continuously added, merged and revised until all the quotes were reviewed. For this report, we organized the individual themes into broad categories such as "Social support" or "Skills and abilities." We also listed the most frequently discussed themes by employment sector and gender.

There are two limitations to consider when interpreting these results. First, the data within this report was collected in 2011, and quotes reflect career experiences at that time. Second, the respondents providing the open-ended responses used in this analysis are not representative of all PhD physicists, so it is important to not generalize the perspectives provided. Despite this limitation, we aim to help physics students, employees, and employers better understand what factors may help or hinder professional careers by sharing the perspectives of the PhD physicists in this study.

Career Success Factors for PhD Physicists

We asked respondents, "What has helped you succeed in your career up to this point?" Using the quotes from 1,407 respondents, we identified 47 themes describing factors that helped PhD physicists succeed in their careers. All themes are listed in order of frequency in the Appendix. Below are the ten most frequently reported themes of career success:

1. Hard work
2. Problem-solving skills
3. Interpersonal skills
4. Persistence
5. Education experience
6. Supportive mentors
7. Previous experience in certain fields
8. Supportive colleagues and collaborations
9. Flexibility in job fields, positions, or tasks
10. Passion for work

In the following section, we discuss all the identified themes and provide sample quotes to demonstrate their meaning. To categorize the themes more effectively, we have organized all 47 themes into six broad categories:

- Personal drive
- Education and career background
- Career opportunities
- Social support
- Organizational support
- Skills and abilities

Personal drive

Hard work and **persistence**. Two of the most common success factors in PhD physicists' careers were hard work and persistence. Physicists worked long hours or extra hours, sometimes without compensation or overtime pay, to complete their work. They persisted in their work despite any difficulties, failures, or adversities they encountered.

"Willingness to work intensely hard."

"Sheer determination. The will to succeed, to never give up even when the going is tough."

"Ability to keep trying in the face of failure."

Motivation to succeed. Many physicists attributed their persistence to their ambition and motivation to perform excellent work.

"A drive for excellence in my work, which pushes me to always do the right thing, and to do a good job."

"Drive for advancement that has helped move me up in the company."

Passion for work. Other physicists discussed how their motivation stemmed from an intrinsic passion and interest for their job. Individuals were passionate about physics, teaching, research, business, technology, and programming.

"Deep love of physics, astronomy, and teaching."

"Enthusiasm for all research."

"Interested in the business I'm in–particularly in understanding the customers."

"Passion for technology and its ability to make a difference."

Intellectual curiosity. Physicists were also driven by their inherent curiosity and love of learning.

"Always interested in learning and doing something new."

"Constantly asking open-minded questions about technology and business."

Focus. An important part of physicists' personal drive was their ability to clearly understand their own goals. This helped them succeed by avoiding distractions and focusing on what they wanted to accomplish.

"Knowing what I want and being candid about those wishes/goals."

"Routinely assess what I am doing with respect to what I need to accomplish."

Education and career background

Education experience. For many PhD physicists, success along their career paths began with education. Physicists valued the training that their undergraduate and graduate education provided in physics, research, teaching, math, computing, collaborating, and problem solving.

"My education gave me a solid foundation in research and problem-solving."

"An experimental physics degree prepared me well to take on a very wide range of technical and planning challenges."

"Research experience for undergraduate programs."

"The combination of mathematical, computer science and physics skill obtained during my PhD."

"My success has to do with a good attitude for teamwork developed during my grad school experience."

"Wide exposure to use of scientific and engineering computing in academia, and several opportunities to explore cutting edge hardware and software during my education."

"Skills I developed as a teaching assistant in graduate school."

Previous experience in certain fields. In addition, physicists discussed how their backgrounds in fields such as physics, math, and statistics helped their careers. These physicists spoke about their background experience in general and did not attribute it to their education or a particular job.

"My basic physics and math background was critical in getting me in the door and allowed me to take on an engineering position with little additional learning."

"Knowledge of math and numerical analysis allows me to perform data analysis and algorithm development."

"Broad understanding of the basic physics which made learning and comprehending new subjects much easier."

"General applicability and versatility of training in physics allowed me to teach many courses, even in chemistry."

"My understanding of my subject area, and interdisciplinary expertise."

Previous postdoc and **job experience.** Lastly, many physicists appreciated the training during their postdocs and previous job positions at teaching institutions, private companies, or military organizations.

"Further training as a post-doc in not just experimental nuclear physics but also in project management, including resource allocation."

"Experience teaching also helped me develop communication skills which are crucial for success in business."

"My first employer offered terrific training on professional behavior in the private sector."

"The military experience I gained while working for my first employer has provided me credibility when working with military clients."

"Leadership positions were important to get experience in setting directions for a group."

Career opportunities

Flexibility in job field, research, and tasks. Flexibility and adaptability seemed to be important traits for success in PhD physicists' careers and enabled them to take advantage of more career opportunities. Physicists stated that they were more successful when they were willing to work in a different scientific field, research area, location, or type of position. In the private sector, several physicists were flexible about transitioning into management roles from technical roles.

"A willingness to switch fields: of the three positions I've held since completing my postdoc, two were in fields where I had no prior experience."

"Transitioning away from technical career paths to people management."

"Flexibility about the kind of research I am willing to do."

"Willingness to expand into new areas of expertise, such as statistical analysis and simulation."

"[Being] open to new positions, even if I had not worked in those areas before."

Flexibility also meant broadening and diversifying their skills and interests, rather than focusing on narrow and technical tasks.

"Being a generalist instead of a specialist."

"Being willing to accept less-technical tasks has built relationships that have grown into more technical projects."

"Seek (and make known that I am seeking) growth opportunities, including ones that increase my professional breadth rather than depth."

Changing employers. For some PhD physicists, their success was determined by decisions to actively pursue new job opportunities and change employers when they were not satisfied.

"If you are unhappy in your current job, take steps to change the situation. For me that has always meant finding a new job, sometimes at the same company, sometimes at a new one."

“Soon as a position stagnates (in terms of salary), I move on."

“Taking increased responsibility by changing jobs (new companies and diverse roles).”

Luck. Physicists believed that luck and good fortune played a role in their career success. They felt fortunate to obtain certain opportunities or to work in certain research fields at the right time.

“I've been rather fortunate to have had opportunities arise at key times.”

“Hot research area that helps getting grant funding."

“Being in a high-demand field (medical physics)."

“Lucky to have chosen a thesis that produced important results.”

Social support

Supportive colleagues and **collaborations.** Many PhD physicists attributed social relationships to their career success. Colleagues, collaborators, and team members who were helpful, talented, and dedicated provided support for many physicists, especially when performing research or improving their teaching skills.

“Support and collaboration with intelligent and generous colleagues.”

“Colleagues at more research-focused institutions who have supported me in maintaining my research program at a small liberal arts college.”

“Concerned and supportive colleagues who helped me learn how to teach.”

Supportive mentors and **managers.** Physicists discussed how graduate school advisors, postdoc mentors, senior colleagues, managers, and supervisors provided support in their careers in research, teaching, business, and management.

“Working for management that allows me to pursue my research interests and learn new techniques.”

“Links to senior scientists that I have formed during my research career. They have taught me not only how to hone my scientific skills, but also how to promote my science and formulate clear ideas for proposals.”

“Career advice regarding how to succeed in the classroom and in research from postdoc advisors and PhD advisors has been a big help.”

“Having a mentor at another institution–she is at an R1 and I am at a comprehensive, teaching 4 courses per semester. She drives the research agenda because she has the time and resources.”

“Learning lessons on project development and management from mentors.”

“A friend who was a business mentor advised me on some of the aspects of my business.”

Professional networks and contacts. Several physicists stated the importance of maintaining and building connections with colleagues, clients, and friends throughout their education and career.

"Knowing the right people."

"Network of friends and colleagues in the industry."

"Connections to personnel at national labs."

"Critical contacts made throughout time and the collaboration experiments that have resulted from them."

"Contacts with clients for the instruments we have built."

Supportive family and **friends.** Outside of their workplace, other social relationships with family, significant others, friends, students, and community members helped physicists succeed in their careers.

"A wonderful wife and family."

"The support of my husband, with whom I collaborate, has been crucial to my success."

"Encouragement from students."

"My family and the support of the community have helped me succeed. I have had some support from my significant other, which enabled me to travel for work."

Organizational support

Funding and **resources.** Funding was by far the largest source of organizational support in PhD physicists' careers. Physicists received funding from federal grants, science organizations, and internal budgets to obtain better instrumentation, equipment, and lab space.

"Basic research support by US government."

"Grant funding from NSF and other organizations."

"Excellent resources (equipment, lab space, and research funds) from my employer."

"The advanced instrumentation available at my laboratory has helped me obtain grant proposals."

"Excellent support in the form of private foundation funding at my institution."

Supportive work environments. Company workplaces and academic departments also supported careers by providing positive, challenging environments that recognize employee accomplishments, gave employees the autonomy to pursue their research interests, and provided administrative support to further research or teaching goals.

"Freedom to do the research of my choosing."

"Working in challenging and stimulating environments."

"I have been at schools that have generally valued teaching as much as research, if not more so."

"Support from administration to purchase needed equipment to upgrade lab activities…create new courses and teach advanced topics."

Skills and abilities

Problem solving skills. The second most common success factor discussed by PhD physicists was their ability to use problem-solving skills when they needed to address complex or challenging issues.

"Problem solving is the single most important skill that my physics education helped to develop."

"Ability to recognize problems, define a strategy for solving the problems and communicate action plans for resolution."

"My work in physics has helped me understand how to break large problems into manageable chunks."

"Ability to construct creative solutions to challenging problems, and then implement the details."

"Solve problems in new fields outside of my formal training."

Interpersonal skills. Another common theme discussed by physicists was the use of interpersonal skills to succeed in their careers. Interpersonal skills include a broad range of abilities, such as communicating technical concepts to various audiences, collaborating in teams across disciplines and positions, navigating interpersonal politics, and leading others.

"Communication and relationship skills to deal with subordinates, managers, executives, suppliers and customers."

"How to communicate my ideas to non-technical people. You can be the smartest person in the world, but if you cannot communicate you have no value."

"Being able to work with large groups of people on complicated projects."

"Cross-discipline communications. Ability to work with people from all walks of life."

"Learning how to navigate the interpersonal politics of scientists."

"Lead a team and define group missions… [and] guide group projects to align with company goals."

Ability to learn new things. A third useful skill in physicists' careers was the ability to learn and acquire new knowledge about skills, subjects, fields, and technologies during their work.

"The most helpful thing I learned during my PhD is that I am capable of learning pretty much anything no matter how complex it is. It takes time and it takes effort."

“Ability to learn new technologies quickly.”

“Learning new skills and topics as needed.”

Other skills. Various other technical and scientific skills were useful to PhD physicists in their careers. Physicists found it helpful to have skills in presenting, writing, business, programming, teaching, research, and analysis.

“Capability to give clear presentations of scientific findings and proposals.”

“Writing well so that I could attract grant funding.”

“A good grasp of business and economic fundamentals: knowing how to evaluate initial ideas for economic return.”

“Skills in computer programming developed on my own have been very important.”

“Ability to design and draw conclusions from experiments.”

“Ability to lead and inspire students.”

“Good statistics and data analysis skills.”

Personality traits and **abilities.** A multitude of different personality traits and abilities were attributed to physicists’ career success, such as creativity, self-confidence, independence, intelligence, willingness to take risks, patience, integrity, and having a positive attitude.

“Innovative outside-the-box thinking.”

“Confidence in my own abilities."

“Ability to work independently.”

“Fearlessness. I'm willing and unafraid to tackle any challenge.”

“Respect and care for coworkers.”

Career Success Factors by Employment Sector

To compare success factors in PhD physicists' careers across employment sectors, we examined the frequency of how often the six broad categories emerged among the themes in the responses of private sector, academic, and government employees (Table1). According to the results, private sector and government physicists more often attributed career success to their skills and abilities. Academic and government physicists more often attributed career success to social support and personal drive.

Table 1

Frequency of Categories Related to Career Success Reported by PhD Physicists Employed in the Private Sector, Academia, and Government, 2011

Career Success Factor	Private Sector	Academia	Government
Career opportunities	8%	8%	11%
Education and career background	16%	12%	10%
Organizational support	< 1%	4%	4%
Personal drive	18%	30%	22%
Skills and abilities	53%	27%	37%
Social support	5%	19%	16%

AIP Statistics aip.org/statistics

We also listed the ten most frequent themes of career success by sector (Table 2). In academia and government, the most common success factors were hard work and persistence, while in the private sector, the most common success factors were problem-solving skills and interpersonal skills. Academic and government employees also highlighted the helpfulness of colleagues and mentors more often than private sector employees.

Table 2

Ten Most Frequent Themes Related to Career Success Reported by PhD Physicists Employed in the Private Sector, Academia, and Government, 2011

Private Sector (Number of Times the Theme was Mentioned)	Academia (Number of Times the Theme was Mentioned)	Government (Number of Times the Theme was Mentioned)
Problem-solving skills (140)	Hard work (122)	Hard work (34)
Interpersonal skills (90)	Persistence (84)	Persistence (31)
Previous experience in certain fields* (71)	Education experience (71)	Interpersonal skills (30)
Education experience (69)	Supportive colleagues and collaborations (70)	Supportive mentors (26)
Hard work (63)	Supportive mentors (64)	Problem-solving skills (25)
Persistence (48)	Passion for work* (52)	Education experience (22)
Flexibility in job field, research, and tasks (46)	Interpersonal skills (44)	Flexibility in job field, research, and tasks (21)
Computing skills (e.g., programming and modeling) (46)	Luck* (39)	Supportive colleagues and collaborations (16)
Research and analysis skills* (45)	Problem solving skills (33)	Computing skills (e.g., programming and modeling) (14)
Ability to learn new things* (36)	Supportive workplace and administration* (24)	Oral and written communication skills* (12)

* This theme is also mentioned by employees in the other two sectors, but not often enough to appear in the 10 most frequent themes.

There were more respondents employed in academia and the private sector; therefore, themes were mentioned more often by employees in these sectors.

AIP Statistics aip.org/statistics

There were several other sector differences as well. Private sector physicists more often attributed their success to their ability to learn new skills on the job and their background experience in fields such as physics, math, and engineering. Academic physicists more often attributed their success to their passion, luck, and a supportive administration in their

department. Lastly, government physicists more often attributed career success to their oral presentation and written communication skills.

Overall, in our sector comparison, respondents in the private sector attributed career success to skills (interpersonal, research, and computing), while respondents in the academic sector attributed career success to work ethic, passion, and social support. Respondents from government seemed to be in the middle of the other two, highlighting both skills and work ethic as factors of success.

Career Success Factors by Gender

We compared the six thematic categories of career success factors between men and women with physics PhDs (Table 3). Men discussed the role of education and skills in their career success more often, while women more often discussed how social support helped their career.

Table 3

Frequency of Categories Related to Career Success Reported by Men and Women With Physics PhDs, 2011

Career Success Factor	Men	Women
Career opportunities	8%	8%
Education and career background	14%	8%
Organizational support	2%	4%
Personal drive	23%	25%
Skills and abilities	41%	32%
Social support	12%	23%

AIP Statistics aip.org/statistics

We also examined the ten most frequent success themes by gender (Table 4). Men and women reported almost identical themes, and both most often attributed hard work to their success. We found one difference. Men more often attributed their experience in certain fields to their career success, while women more often attributed their family's support to their career success. Overall, men and women seemed to report similar factors for career success.

Table 4

Ten Most Frequent Themes Related to Career Success
Reported by Men and Women With Physics PhDs, 2011

Men (Number of Times the Theme was Mentioned)	Women (Number of Times the Theme was Mentioned)
Hard work (187)	Hard work (32)
Problem-solving skills (177)	Supportive mentors (30)
Education experience (150)	Persistence (27)
Interpersonal skills (144)	Supportive colleagues and collaborations (26)
Persistence (136)	Problem-solving skills (21)
Previous experience in certain fields* (93)	Interpersonal skills (20)
Supportive mentors (77)	Supportive friends and family* (13)
Flexibility in job field, research, and tasks (77)	Passion for work (13)
Supportive colleagues and collaborations (71)	Education experience (12)
Passion for work (68)	Flexibility in job field, research, and tasks (10)

*Within this table, this theme only appears for this gender. This theme is reported by both men and women, but not often enough to appear in the 10 most frequent themes.

There were more men than women among respondents; therefore, themes were mentioned more often by men.

Career Barriers for PhD Physicists

We asked respondents, "What have been the barriers to your career up to this point?" Using quotes from 1,321 respondents, we identified 40 themes that described career barriers. All themes are listed in order of frequency in the Appendix, and the ten most frequent career barriers are listed below:

1. Lack of funding
2. Overworked
3. Family obligations
4. Lack of interpersonal skills
5. Difficulty obtaining employment
6. Unsupportive administration and infrastructure
7. Difficulty advancing at workplace
8. Lack of interest in work
9. Negative interactions with management
10. Negative interactions with mentors

We categorized the 40 themes into seven broad categories, including a category discussing gender and racial bias experiences.

- Personal drive barriers
- Education and career background barriers
- Career opportunity barriers
- Social barriers
- Organization barriers
- Skill and ability barriers
- Gender, race, or ethnicity barriers

Personal drive barriers

Lack of interest in work. The most common influence on personal drive for PhD physicists was being uninterested in their current job, sector, or research field.

"Working in industry, it is difficult to always steer your career to the projects you are most interested in tackling."

"I entered another field that I wasn't interested in and have done no research since getting my PhD."

"Lack of enthusiasm for writing slows things down a bit."

"Lack of passion for basic research."

"Boredom. Lack of interest in corporate world."

For private sector physicists, many were not interested in managing people and preferred technical roles, which greatly limited upward mobility in their career path.

“In a large corporation, the top-level direction tends to steer employees toward management positions, but my interests lie in technical pursuits.”

“I haven't been interested in managing people, and career advancement is geared towards that.”

Lack of focus. Other physicists felt unmotivated due to a lack of career direction. They had difficulty focusing on fewer interests, determining career goals, or selecting research topics.

“Lack of direction for where I wanted to go with career.”

“Difficulty in committing to a particular subject area.”

“Lack of inspiration for a big research project that might help me earn a tenure track job.”

“Struggling to come up with proposal ideas.”

“Trying to find something to start my own company around. Entrepreneur's block, or something like that.”

Education and career background barriers

Issues with education experience. PhD physicists discussed issues with their education experience, which negatively impacted their career. Graduate school did not adequately prepare them for jobs outside academia, and some physicists regretted pursuing a physics degree.

"Graduate training in physics leaves most students with advanced degrees unprepared for the jobs most will eventually end up with.”

"Lack of understanding of job options coming out of graduate school."

“No useful skills learned in school.”

“Studying engineering from the beginning would have much better for me career-wise.”

“Inappropriate degree for my career. A computer science or engineering degree would have been more suitable.”

Academic pedigree also had an influence on obtaining good employment, and some physicists felt that graduating from a lesser known institution limited their postdoc and employment options.

“Dominance of big-name universities at each stage of the postgraduate hiring process.”

“Having a PhD from a state University, I see sometimes people from Ivy league Universities preferred.”

Lack of previous experience in certain fields. Other physicists reported that they did not have enough experience working in fields outside of physics. They did not attribute this lack of

experience to their education or any particular job but wanted more training in these fields at some point in their career.

"Not sufficiently well versed in the details of my current fields, compared to people directly trained in them."

"I could have benefitted from some more formal training in computer science."

"Lack of experience in the fields outside of Physics."

"Lack of in-depth background in engineering principles and algorithms."

Issues with postdoc experience. A few physicists discussed issues during their postdoctoral experience. Some regretted not taking a postdoc position, while others wished they had not taken a postdoc or had spent less time working in postdoc positions.

"Not having done any post-doc."

"A less than satisfactory postdoc."

"Spending too much time as a post-doc."

Career opportunity barriers

Difficulty obtaining employment. There are many factors that affect opportunities during a physicist's career path. After graduating with a PhD, the first challenge many physicists encounter is the lack of job opportunities available, sometimes due to a poor economy, low turnover, or job experience requirements.

"Economic difficulties affecting the companies where I work or want to work."

"Getting an entry level job without direct job experience is difficult."

"There are not many jobs in physics in my current location."

"The fact that death is typically the only thing that brings about an opening in a physics department faculty."

"There are too few tenure-tracked positions in my field, thus it is nearly impossible to end up with tenure."

Bias against hiring PhDs. Private sector physicists encountered negative attitudes toward PhD recipients during job searches. When applying and interviewing, some companies viewed PhD holders as overqualified or not useful.

"Physics degree seen as an overqualified 'brain in a jar' by the business world."

"The general perceptions of academic science that accompany a doctorate in physics is a huge barrier. I was once told by a manager in the aerospace industry that I had 'no useful skills for the aerospace industry and I should go find a place with white lab coats.'"

"Many feel I'm 'too smart' to even hire me for a job in the first place."

"Having a Physics PhD was a hinderance in my early career. I asked an acquaintance, once, why I wasn't getting any responses from my job submissions. I was told, point blank, that many companies don't want to bring on PhDs as they can be 'too disruptive.' It is perceived that they will be difficult, too smart, or too bored."

Difficulty working as a non-US citizen. Physicists who are non-US citizens experienced unique issues in obtaining job opportunities, specifically, language barriers and difficulties getting work visas.

"Not being a native English speaker."

"In the first 5 years, it was definitely not having Permanent Residency in the US (Green Card). I would have quit the first company I worked at after graduate school much sooner (after 2 years) than I actually did (after almost 6 years), if it hadn't been for the visa issue."

Difficulty relocating. Job location was another limiting factor when physicists were trying to obtain career opportunities. Due to family obligations or other circumstances, some physicists were unwilling or unable to move or travel.

"Desire to be in a particular city for family reasons."

"The cultural expectation that one should move from institution to institution in order to advance one's career. I needed to stay in one geographic location."

"I made it my personal principle to never relocate just for the sake of a job. This obviously reduces the number of career advancement opportunities I get."

Difficulty getting published. Publications play a large role in obtaining job opportunities, and several academic physicists reported difficulty obtaining publications or research grants. Government physicists were unable to publish due to clearance and intellectual property limitations.

"Difficulty in getting my papers published or accepted to conferences hurt my early career opportunities."

"Inability to discuss or publish work due to government requirements, proprietary issues, and internal politics."

"I do not write quickly, so my relatively low number of publications has made it hard to compete for the few tenure-track jobs."

Difficulty switching fields or sectors. Switching fields or sectors was another barrier when pursuing new career opportunities, as it required physicists to learn new skills, make new connections, and adapt to a different culture.

"Breaking into private industry with a fairly traditional academic background was difficult and took several attempts."

"Switching fields means not having the legacy support that others may have."

“Having changed fields requires a lot of new training and slows down the entire process.”

Previous choices that limited career. Physicists have regretted some decisions that have limited their career paths, such as their choice of research topics or focusing on money more than job satisfaction.

“Poor choices of research topics.”

“Further loss of opportunities resulting from choosing an initial career outside Physics.”

“I allowed money, rather than personal satisfaction, to direct my career choices.”

“Not considering all of the options well enough when I was younger.”

“I got a much later start than most people in this field (defense engineering).”

Social barriers

Family obligations. Balancing work and family life were commonly discussed barriers in PhD physicists’ career paths. Many physicists experienced the “two-body” problem, in which two partners work in the same field and have difficulty finding positions in the same geographical area or institution.

"Being a member of a dual (physics!) career couple has limited my employment choices.”

“Finding jobs for two PhDs in the same area.”

Having children was another challenge. Some physicists took a career break for parental leave or to become stay-at-home parents, which created difficulty when returning or progressing in their careers. Working parents also struggled with the expenses and limitations of child care services.

“Having children is very difficult as a physicist–it is nearly impossible to take a break and still have a job in physics.”

“When you have small children at home, it's very difficult to put in any extra time (40 hours/week is hard enough).”

“As a woman in the field, if I wanted to have kids (and I did) it was almost necessarily a career ender. You can't work 60–70 hours a week and be a decent parent of small children, unless you use a nanny or have a stay at home spouse."

“Having a child in daycare that opens at 7 and closes at 5:30. While these challenges make it harder for me to work on research or grading, I get significant benefits from them–being able to live with my family, and see my child while she is still awake.”

However, while physicists admitted that balancing work and family life is challenging, they also discussed how rewarding it can be.

"Family responsibilities have taken a large chunk of my time, but with no regrets.”

“I have chosen to limit my career in recent years because I prefer to spend extra time with my family. That decision has made my career more rewarding than ever.”

Negative interactions with management. Difficult experiences with managers were an often-discussed barrier by physicists. Physicists discussed how managers failed to recognize accomplishments, micromanaged employees, and created unstable environments by moving employees into different positions. In the private sector, some managers did not appreciate or understand research.

“Being managed by individuals who cannot see the importance of preliminary basic research.”

“Constantly getting shuffled around our organization because some management guide says it's a good idea.”

“Micromanagement of how we do research in the lab."

“Some really bad senior administrators (president, dean) who have no clue about sciences and view science faculty as annoying expenses rather than important resources.”

Negative interactions with mentors. Mentors are very important in a PhD physicist’s career, and many physicists had a weak or negative relationship with their mentors during graduate school and postdoc positions. Mentors have given bad advice, treated them poorly, or attempted to steal credit for their work.

“I've lacked the mentorship that was needed to teach me how to understand and survive in the area of physics research.”

“I expected mentoring or an apprenticeship atmosphere (old-fashioned, I guess). Instead I was on my own from day one.”

“An advisor who feared competition for a very limited pool of research money. He is a bitter competitor with his former advisor and expected the same from me.”

“Many postdoc advisors don't care about their postdocs.”

Lack of professional networks and contacts. Several physicists felt isolated in their careers and did not have access to colleagues to build collaborations, especially at smaller institutions or departments.

“No one at my college that I can collaborate with on research, but I overcame that by collaborating with a university 1 hour away.”

“Being at a small, somewhat isolated college, I have found it difficult to collaborate with others.”

“No colleagues in my current department or any nearby university are in a research field closely related to mine.”

Negative interactions with colleagues. Colleagues were a source of difficulty in physicists' work environments. Some coworkers held negative attitudes and biases against their physics degree or research field. In academia, specifically, some physicists reported tension between junior and senior faculty members.

"Petty rivalries in the field. Navigating the murky waters of large collaborations."

"A strong tendency of co-workers to devalue basic research in favor of applied research."

"In engineering there's always a bias against physicists (too broad, not enough specific experience)."

"Biologists being mistrustful and skeptical of the relevance of theory in general and of a physicist specifically."

"My senior department members use the junior faculty to do the extra departmental work so that they can spend more time on their scholarship at our expense."

"I also often feel that I am being held back by the more senior scientists. I have volunteered for proposal review panels and other community panels, but I have often been told that I am too young to serve."

Organization barriers

Lack of funding. PhD physicists discussed several different barriers from their employers or outside organizations. Overall, funding for research, projects, travel, and students was the number one concern for physicists. They reported a lack of external funding from government organizations, grants, and a lack of internal funding when working for their employers.

"Lack of funding for research program (difficult to get NSF money when you are not at an R1)."

"Funding is too difficult to get (requires too much prep time and has low rate of success– especially NSF and SBIRs)."

"Issues involving funding from NASA. NASA has failed to invest the necessary resources to mature new technology for infusion in new instruments and missions."

"The only real problems I have encountered are significant, funding related delays at the national lab facilities."

"I am finding it extremely difficult to get enough funding to even support one postdoc and one student."

"Our travel budget is very small and not very helpful in getting to meetings that are not within driving distance."

In addition to funding, physicists lacked important project resources such as personnel, equipment, and skilled postdocs or students.

"Difficulty in finding new staff with excellent technical, team, and management skills to expand research activities."

"Working with aging equipment and facilities and lack of resources to properly maintain equipment and people."

"Difficulty of finding good grad students at my institution."

Overworked. The second most common barrier for physicists was being overworked on the job. For academic physicists, many felt that they spent too much time teaching at the expense of research.

"Struggling to balance a heavy teaching load with finding time for research."

"Stamina to continue to work 12-hour days."

"I work a 60–70 hr week teaching, mentoring, being the physics lab super, directing the observatory, and being chair of the dept. I have no time to do any meaningful research that will keep me competitive in my field."

Lack of autonomy. Some physicists, particularly in government and the private sector, felt a lack of autonomy in their current jobs, including the inability to choose their research topics and job tasks.

"Lack of freedom to pursue own research."

"Decisions about my duties and assignments were outside my control."

Difficulty advancing at employer. There were limited opportunities to advance for many physicists at their place of employment. In academia, physicists did not advance because they could not obtain tenure or a tenure-track position. This was due to office politics influencing the tenure process, not being given enough time to research and publish, or becoming trapped in part-time or adjunct positions.

"Office politics. I was denied tenure after being recommended for it by everyone including the provost because the dean wanted a hiring committee to change its 'recommendation.'"

"I have not been able to meet the scholarly expectations for promotion to Full Professor (I am meeting the teaching and service expectations, but not the scholarship expectations."

"I can't get a tenure-track position because I have no recent publications, and I can't get grants to do research because I [am] not in a tenure-track position."

For private sector or government physicists, their inability to get promoted was due to a lack of skills or an inability to transition into management positions.

"Limited advancement opportunities for non-management technical personnel."

"Companies that only let you rise if you become a manager and do less research."

"I am viewed as an 'analyst' by my clients, and have limited options to enter management."

"Not being 'corporate' enough, seen as too technical to successfully manage."

Not valued by employer. According to physicists, some companies or academic departments had work cultures that did not appreciate or value their contributions.

"Incomplete appreciation of my contributions to success at my organization."

"I do not feel valued by my own department (although I do feel valued by other workers in my field around the world), which sometimes makes me want to quit."

In the private sector, science and research were not always seen as valuable, and physicists were assumed to have difficulty with less technical tasks.

"Pigeon-holed as the 'technical' guy… There is a common expectation that if you are a skilled technical problem solver you must by extension be bad with people."

"I faced much skepticism in running a company as a scientist with limited prior commercial experience."

"Make it work is more important than understand what is happening. It is very frustrating that research is not valued."

In academia, some physicists did not appreciate that teaching was valued less than research.

"The disproportionate value placed by Colleges and Universities on research expertise at the expense of teaching expertise."

Across all sectors, physicists encountered biases against their physics background or research subfield within their work environment.

"At least at my company, there is a tendency by the computer scientists to 'look down on' someone trained in another field (i.e., physics) when it comes to issues of computer software."

"Working for a company that caters to engineers rather than scientists."

"Finding an organization willing to take a chance on someone educated in physics instead of computer science."

"Strong institutional bias against pure research."

"Hard to find academic jobs that understand or welcome my subfield (accelerator and beam physics)."

"Interdisciplinary research (combining physics, acoustics, biomedical engineering, & clinical research) that doesn't quite fit into a traditional academic physics department."

"I believe social barriers still exist for people working in theoretical & computation physics. Computational physics is somehow seen as being of lesser importance at universities."

Unsupportive administration and infrastructure. Bureaucratic processes and infrastructure at their workplaces interfered with the careers of several physicists. This could be due to a lack of administrative support or navigating too many regulations and procedures. Government physicists, in particular, encountered limitations due to clearance restrictions.

“Primarily the lack of infrastructure at a small liberal arts college.”

“Bureaucratic hurdles and excessive red tape.”

“Lack of secret clearance prevents me from working for many government contractors.”

“Difficult relationships with administrators who don't understand science or science education.”

Corporate instability. Lastly, private sector physicists faced unique barriers related to company functioning. Their jobs were negatively impacted when companies experienced quickly changing goals or policies, mergers, delays, and business closings.

“Both previous employers went out of business.”

“Sometimes volatile and ever-changing missions of governmental institutions.”

“Tech companies don't last long, or go through huge attrition.”

“Numerous corporate mergers (3 of the companies I have worked for have been bought out). When you are on the losing side of a merger and decide to stay on with the new company (as I have done) you need to prove yourself all over again to new colleagues.”

“Institution is not nimble, and starting new projects is very difficult.”

Skill and ability barriers

Lack of interpersonal skills. Lack of interpersonal skills was one of the most commonly reported career barriers by PhD physicists. This includes the lack of ability to train and manage personnel, network with other professionals, navigate office or department politics, and communicate with nontechnical audiences.

“Lack of skills to manage a group of people.”

“Inability to adequately train my own replacement.”

“I am introverted and have a hard time networking and working with other researchers.”

“How to play departmental politics.”

“I could do better communicating my ideas in simple non-technical language.”

Lack of business skills. For private sector physicists, many wished they had obtained more business skills before entering the private sector. Understanding marketing, finance, sales, operations, and project management would have helped their careers progress more smoothly.

"Lack of education in entrepreneurship, corporate finance, and project and people management. A graduate course in these would have been awesome.”

“Learning the corporation culture. How to prioritize projects and tasks based on corporation needs.”

“Lack of business skill training (marketing, finance, management) has meant I have needed to learn a lot on-the-job.”

Lack of other skills. A variety of other discrete skills could have benefited physicists earlier in their careers. A lack of programming and other computing skills was a limiting factor for several physicists. Other physicists would have appreciated having more skills in teaching, research, presenting, and grant writing.

"My programming skills have been limiting, while I have deep knowledge of numerical algorithms and I program every day, I'm not a software engineer and this severely limits the type of jobs I can be useful in."

"When changing over to programming, the main barrier was not knowing the specific languages and tools required for the area."

"Insufficient teaching experience for my first teaching job."

"Trained as a theorist, but need more experimental skills and experience."

"More experience with presenting/public speaking would have helped immensely."

"In all my training and experience, a key skill is totally absent: how to apply for grants."

Lack of self-confidence. Lastly, difficulty in promoting oneself and showing self-confidence was a barrier for some physicists.

"Not assertive enough about self-promotion."

"I don't like selling my projects or myself."

"Somewhat shy personality."

"I am not comfortable making bold, definite statements when I have not investigated the facts, or statements that distort or excessively simplify a complex situation. I find that colleagues without such inhibitions and with more self-confidence (justified or not) are able to move up more easily in their careers."

Gender, race, or ethnicity barriers

Out of the 213 comments provided by women, 14% discussed how their gender has negatively affected their careers. Women reported how they struggled with the isolation of being the only female physicist in the workplace.

"Being the only woman in a group of 40 or so physicists was extremely difficult for me."

"Being the only female faculty in the department."

Other women discussed difficulties obtaining resources at their employer or getting hired for a position.

"Being female seemed to be a disadvantage when applying to the same institutions as my male spouse."

"Male dominated control of instrumentation facilities and other research resources."

Most of the reports from women discussed how colleagues dismissed, disrespected, or harassed them during their career.

“The inability of male peers to see me as an intellectual equal.”

“General negative attitude toward female physicists by some people above a certain age.”

“Poor attitude towards women–she's successful because she's a woman, not because she's good.”

"Being a woman. I am beyond worrying about this. Even today, I find I am treated to a different standard than my male colleagues.”

“I really struggled with a personnel issue for several years of having a colleague who was harassing me due to my gender, but it was really hard to show when you are the only woman in the department. The feeling was that he is just a jerk.”

“I do not always feel that I am respected by other scientists in my field. My female colleagues and I have endured some rather unprofessional and even sexist behavior from men in our field.”

Out of the 1,227 comments given by men, only one man reported experiencing a gender issue during his career, in which he had difficulty obtaining a position at a company due to hiring practices.

“It was nearly impossible for me to get the job. As a white male, diversity hiring practices required the VP of research to override the HR dept. in order for me to get hired.”

1% of the comments from both men and women reported that their race or ethnicity negatively affected their careers. These respondents identified as African-American, Asian, and Hispanic.

“Being a non-white woman in a mostly white male dominated field.”

“The nature of the discipline is off-putting to minorities, this has been the biggest barrier.”

“Management at this laboratory seems to side towards employees from European countries.”

“Foreign origin that impedes growth in the mainstream US business hierarchy.”

Career Barriers by Employment Sector

We compared the seven thematic categories across sectors and reported how often these categories emerged in quotes from private sector, academic, and government physicists (Table 5). Most notably, private sector physicists more often reported a lack of skills and difficulties acquiring job opportunities as career barriers, while academic and government physicists more often reported barriers at their organization or employer, and issues with other individuals such as mentors, managers, or coworkers.

Table 5

Frequency of Categories Related to Career Barriers Reported by PhD Physicists Employed in the Private Sector, Academia, and Government, 2011

Career Barrier	Private Sector	Academia	Government
Career opportunity barriers	22%	12%	15%
Education and career background barriers	8%	3%	4%
Gender, race, or ethnicity barriers	1%	6%	4%
Organization barriers	23%	46%	38%
Personal drive barriers	8%	5%	10%
Skill and ability barriers	27%	8%	8%
Social barriers	11%	20%	21%

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We also listed the ten most frequent themes by sector (Table 6). Private sector physicists mentioned several barriers that were not in the list for the other two sectors. Physicists in the private sector more often reported lacking interpersonal and business skills, as well as lacking experience in fields outside of physics such as engineering and computer programming. They also reported more difficulties in getting hired due to their PhD status, economic conditions affecting their job opportunities, and not being valued by their employers.

Academic and government employees most often struggled with obtaining funding. Unlike the private sector, physicists in these sectors more often discussed overwork, issues with mentors, gender bias, and family obligations as career barriers.

Table 6

Ten Most Frequent Themes Related to Career Barriers Reported by PhD Physicists Employed in the Private Sector, Academia, and Government, 2011

Private Sector (Number of Times the Theme was Mentioned)	Academia (Number of Times the Theme was Mentioned)	Government (Number of Times the Theme was Mentioned)
Lack of interpersonal skills* (45)	Lack of funding (83)	Lack of funding (27)
Lack of business skills* (27)	Overworked (68)	Negative interact ons with management (18)
Not valued by employer (23)	Family obligations* (51)	Unsupportive administrat on and infrastructure (12)
Lack of interest in work (23)	Difficulty obtaining employment (26)	Lack of interest in work (10)
Difficulty advancing at employer (21)	Lack of staff and equipment (26)	Not valued by employer (9)
Lack of previous experience in certain fields* (20)	Unsupportive administrat on and infrastructure (25)	Difficulty obtaining employment (9)
Difficulty obtaining employment (19)	Negative interact ons with mentors (23)	Lack of professional networks and contacts (8)
Economic issues in the US* (18)	Not valued by employer (23)	Negative interactions with mentors (7)
Negative interact ons with management (16)	Difficulty advancing at employer (20)	Gender bias (7)
Bias against hiring PhDs* (15)	Gender bias (20)	Overworked (6)

*Within this table, this theme only appears for this sector. This theme is also mentioned by employees in the other two sectors, but not often enough to appear in the 10 most frequent themes.

There were more respondents employed in academia and the private sector; therefore, themes were more often mentioned by employees in these sectors.

Career Barriers by Gender

We compared the frequency of the seven thematic categories related to career barriers between men and women with physics PhDs (Table 7). Men more often reported their lack of skills as barriers to their success, while women more often reported social relationships with their mentor, colleagues, or family as career barriers. Furthermore, women more often reported experiencing racial and gender bias during their careers.

Table 7

Frequency of Categories Related to Career Barriers Reported by Men and Women With Physics PhDs, 2011

Career Barrier	Men	Women
Career opportunity barriers	17%	12%
Education and career background barriers	6%	4%
Gender, race, or ethnicity barriers	2%	15%
Organizational barriers	38%	25%
Personal drive barriers	8%	4%
Skill and ability barriers	15%	9%
Social barriers	14%	31%

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Unlike the career success section in this report, men and women reported many different themes within the ten most frequent career barriers (Table 8). Men more commonly reported issues with funding and overwork, while women more commonly reported issues with gender bias and family obligations like childcare.

There were several other differences between men and women. Within the ten most frequent themes, only men reported career barriers such as a lack of interpersonal skills, not being valued by their employer, not being interested in their work, and difficulties advancing/getting promoted at their workplace. Within the same list of themes, only women reported career barriers such as negative interactions with their mentors, a lack of job resources, and a lack of professional networks. Women also reported difficulties relocating for work, which may be related to family obligations.

Table 8

Ten Most Frequent Themes Related to Career Barriers Reported by Men and Women With Physics PhDs, 2011

Men (Number of Times the Theme was Mentioned)	Women (Number of Times the Theme was Mentioned)
Lack of funding (109)	Family obligations (29)
Overworked (70)	Gender bias (29)
Lack of interpersonal skills* (54)	Negative interactions with mentors* (17)
Not valued by employer* (50)	Lack of funding (14)
Difficulty obtaining employment (48)	Overworked (12)
Unsupportive administration and infrastructure* (43)	Difficulty relocating for work* (9)
Difficulty advancing at employer* (42)	Negative interactions with management (8)
Lack of interest in work* (39)	Lack of staff and equipment* (8)
Family obligations (37)	Difficulty obtaining employment (6)
Negative interactions with management (33)	Lack of professional networks and contacts* (6)

*Within this table, this theme only appears for this gender. This theme is reported by both men and women, but not often enough to appear in the 10 most frequent themes.

There were more men than women among respondents; therefore, themes were mentioned more often by men.

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Overall, our gender comparisons suggest that men and women have different experiences with career barriers. More often, women in our sample had issues with gender bias, family obligations, and negative mentor relationships. Men more often struggled with a lack of skills needed in their work, especially interpersonal skills, and not feeling valued at their workplace due to their field or degree.

Conclusion

In summary, PhD physicists in mid-career have encountered a wide range of experiences that have helped or hindered their success during the past 10–15 years of their careers. Their experiences reveal that personal, social, organizational, and societal factors all play roles in professional careers, and the impact of these factors depends on whether one pursues a career in the private sector, academia, or government. For example, job-related skills (e.g., problem solving, communication, teamwork, analysis) and experience in certain scientific fields (e.g., physics, engineering, computer science) seem to have more influence on success in the private sector, while work ethic and social relationships (e.g., mentors, colleagues, family) have more influence on success in academic and government sectors.

The quotes from PhD physicists also demonstrate that men and women have different career experiences. For men, job-related skills and a healthy work environment (e.g., supportive administration, promotion opportunities, recognition for work) seemed to be more influential in their career success; whereas for women, social relationships and gender bias seemed to have more influence on their careers.

Appendix

Table 9

Frequency of All Themes Related to Career Success Reported by PhD Physicists, 2011

Career Success Theme	Category	Number of Times the Theme was Mentioned (%)
Hard work	Personal drive	219 (9%)
Problem-solving skills	Skills and abilities	198 (8%)
Interpersonal skills	Skills and abilities	164 (7%)
Persistence	Personal drive	163 (7%)
Education experience	Education and career background	162 (7%)
Supportive mentors	Social support	107 (4%)
Previous experience in certain fields	Education and career background	103 (4%)
Supportive colleagues and collaborations	Social support	97 (4%)
Flexibility in job field, research, or tasks	Career opportunities	87 (4%)
Passion for work	Personal drive	81 (3%)
Research and analysis skills	Skills and abilities	74 (3%)
Computing skills (e.g., programming, software, modeling)	Skills and abilities	72 (3%)
Luck	Career opportunities	61 (3%)
Ability to learn new things	Skills and abilities	55 (2%)
Oral and written communication skills	Skills and abilities	55 (2%)
Intellectual curiosity	Personal drive	41 (2%)
Supportive family and friends	Social support	39 (2%)
Creativity	Skills and abilities	38 (2%)
Motivation to succeed	Personal drive	38 (2%)

Career Success Theme	Category	Number of Times the Theme was Mentioned (%)
Professional networks and contacts	Social support	38 (2%)
Planning and organization skills	Skills and abilities	38 (2%)
Previous job experience	Education and career background	36 (1%)
Good opportunities	Career opportunities	34 (1%)
Supportive employer culture and administration	Organizational support	34 (1%)
Critical-thinking skills	Skills and abilities	33 (1%)
Natural talent and intelligence	Skills and abilities	33 (1%)
Teaching skills	Skills and abilities	27 (1%)
Funding and resources	Organizational support	26 (1%)
Ability to work independently	Skills and abilities	24 (1%)
Previous postdoc experience	Education and career background	24 (1%)
Ability to focus on goals	Skills and abilities	23 (1%)
Agreeableness with others	Skills and abilities	18 (1%)
Willingness to take risks	Skills and abilities	16 (1%)
Management and leadership skills	Skills and abilities	16 (1%)
Changing employers	Career opportunities	15 (1%)
Self-confidence	Skills and abilities	15 (1%)
Patience	Skills and abilities	13 (1%)
Supportive students	Social support	10 (< 1%)
Religion and faith	Social support	9 (< 1%)
Integrity	Skills and abilities	8 (< 1%)
Positive attitude	Skills and abilities	8 (< 1%)
Supportive managers	Social support	7 (< 1%)
Business skills	Skills and abilities	6 (< 1%)
Resourcefulness	Skills and abilities	4 (< 1%)

Career Success Theme	Category	Number of Times the Theme was Mentioned (%)
Ability to act responsibly	Skills and abilities	4 (< 1%)
Common sense	Skills and abilities	3 (< 1%)
Sense of humor	Skills and abilities	3 (< 1%)

This list only includes themes that were reported by at least three respondents. We asked respondents, “What has helped you succeed in your career up to this point?”

Table 10

Frequency of All Themes Related to Career Barriers Reported by PhD Physicists, 2011

Career Barrier Theme	Category	Number of Times the Theme was Mentioned (%)
Funding	Organization barriers	123 (10%)
Overworked	Organization barriers	82 (7%)
Family obligations	Social barriers	66 (5%)
Lack of interpersonal skills	Skill and ability barriers	59 (5%)
Not valued by employer	Organization barriers	55 (4%)
Difficulty obtaining employment	Career opportunity barriers	54 (4%)
Unsupportive administration and infrastructure	Organization barriers	48 (4%)
Difficulty advancing at employer	Organization barriers	47 (4%)
Lack of interest in work	Personal drive barriers	42 (3%)
Negative interactions with management	Social barriers	41 (3%)
Negative interactions with mentors	Social barriers	38 (3%)
Lack of staff and equipment	Organization barriers	38 (3%)
Lack of professional networks and contacts	Social barriers	31 (3%)
Gender bias	Gender, race, or ethnicity barriers	30 (2%)

Career Barrier Theme	Category	Number of Times the Theme was Mentioned (%)
Lack of business skills	Skill and ability barriers	29 (2%)
Negative interactions with colleagues	Social barriers	29 (2%)
Lack of previous experience in certain fields	Education and career background barriers	28 (2%)
Lack of focus in career	Personal drive barriers	23 (2%)
Difficulty relocating	Career opportunity barriers	22 (2%)
Economic issues in the US	Career opportunity barriers	21 (2%)
Difficulty getting published	Career opportunity barriers	21 (2%)
Lack of self-confidence	Skill and ability barriers	21 (2%)
Previous choices that limited career	Career opportunity barriers	20 (2%)
Difficulty switching fields or sectors	Career opportunity barriers	20 (2%)
Difficulty working as a non-US citizen	Career opportunity barriers	20 (2%)
Corporate instability (e.g., mergers, changing goals, bankruptcy)	Organization barriers	18 (1%)
Bias against hiring PhDs	Career opportunity barriers	16 (1%)
Lack of computing skills (e.g., programming)	Skill and ability barriers	16 (1%)
Issues with education experience	Education and career background barriers	15 (1%)
Personal health issues	Personal drive barriers	12 (1%)
Race/ethnicity bias	Gender, race, or ethnicity barriers	12 (1%)
Lack of oral and written communication skills	Skill and ability barriers	12 (1%)
Issues with postdoc experience	Education and career background barriers	11 (1%)

Career Barrier Theme	Category	Number of Times the Theme was Mentioned (%)
Lack of autonomy at employer	Organization barriers	10 (1%)
Degree earned from a less prestigious institution	Education and career background barriers	9 (1%)
Lack of teaching skills	Skill and ability barriers	9 (1%)
Lack of work ethic	Personal drive barriers	7 (1%)
Difficulty with project schedules	Organization barriers	6 (< 1%)
Bad luck	Career opportunity barriers	4 (< 1%)
Lack of research skills	Skill and ability barriers	4 (< 1%)

This list only includes themes that were reported by at least three respondents. We asked respondents, “What have been the barriers to your career up to this point?”

Methodology

During 2011, we contacted over 3,400 physics PhD recipients from the classes of 1996, 1997, 2000, and 2001, and who graduated from US institutions. We received responses from a total of 1,860 individuals. Of those who responded, 90% were working in the US and 10% were working outside the US at the time of the survey. We know that the respondents are not representative. It was easier to find members of the more recent classes than the earlier classes, and based on an analysis of the respondents by contact wave, we believe that it was harder to contact individuals employed in industry than those in academia or the government. So, academics are over-represented among our respondents. 45% of respondents were working in academia, 34% were working in the private sector, 15% were working in government, and 6% in another sector. For this report, we did not analyze any quotes from respondents working in another sector. Lastly, 14% of respondents identified as female and 86% identified as male.

For a complete overview of the methodology, please see the Appendix in *Common Careers of Physicists in the Private Sector* by Roman Czujko and Garrett Anderson. This report is available online here (or at https://www.aip.org/statistics/reports/common-careers-physicists-private-sector).

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