Some Thoughts about the Changing Demographics of the Scientific Workforce

Michael S Lauer, MD
Deputy Director for Extramural Research
National Institutes of Health

Federal Demonstration Partnership (FDP) Plenary Speaker
Thursday, May 11, 2017
Hyatt Regency Capitol Hill, Washington, DC
Disclosures: None

Signs of Stress

NEWS FEATURE

YOUNG, TALENTED AND FED-UP

BY KENDALL POWELL

Martin Tingley was coming undone. It was late autumn 2014, just over a year into his assistant-professor job at Pennsylvania State University in State College, and he was on an eight-hour drive home after visiting his wife in Boston. He was stressed, exhausted and close to tears. As the traffic zipped past in the dark hours of the early morning, the headlights gave him the surreal feeling that he was inside a video game.

Usually, Tingley thought of himself as a "pretty stoic guy" — and on paper, his career was going well. He'd completed a master's degree in statistics and a PhD in Earth science, both at Harvard University. With these, and four years of postdoctoral experience, he had landed a rare tenure-track faculty position. He thought he would soon be successfully combining statistics and climate science to produce the type of interdisciplinary research that funding agencies say they want.

In fact, scientific life was proving tough. He found himself working 60–80 hours per week doing teaching and research. His start-up funding had run out, he had yet to secure a major grant and, according to a practice com-

Scientists starting labs say that they are under historically high pressure to publish, secure funding and earn permanent positions — leaving precious little time for actual research.

an opportunity to direct their own creative,

Young scient
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find themselves
after paper. The
is harming scien
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the US National
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is stifling creativ
mediocre scien
and uninteresti
who do someth
Our inform
situation is alre
coming career
principal inves
looks horrible,"
the United Stat

FUNDING

Tingley has al

"The funding cycle is brutal."
MARTIN TINGLEY

Nature 2016;538:446-9

What They're Saying

SUFFERING IN SCIENCE

We asked young scientists to tell us their concerns. This is what they said.

- Desperate pursuit of grants
- No time for science
- Extreme competition … to cut corners
- Dependence on senior scientists
- Administrative overload ... No help
- Long hours

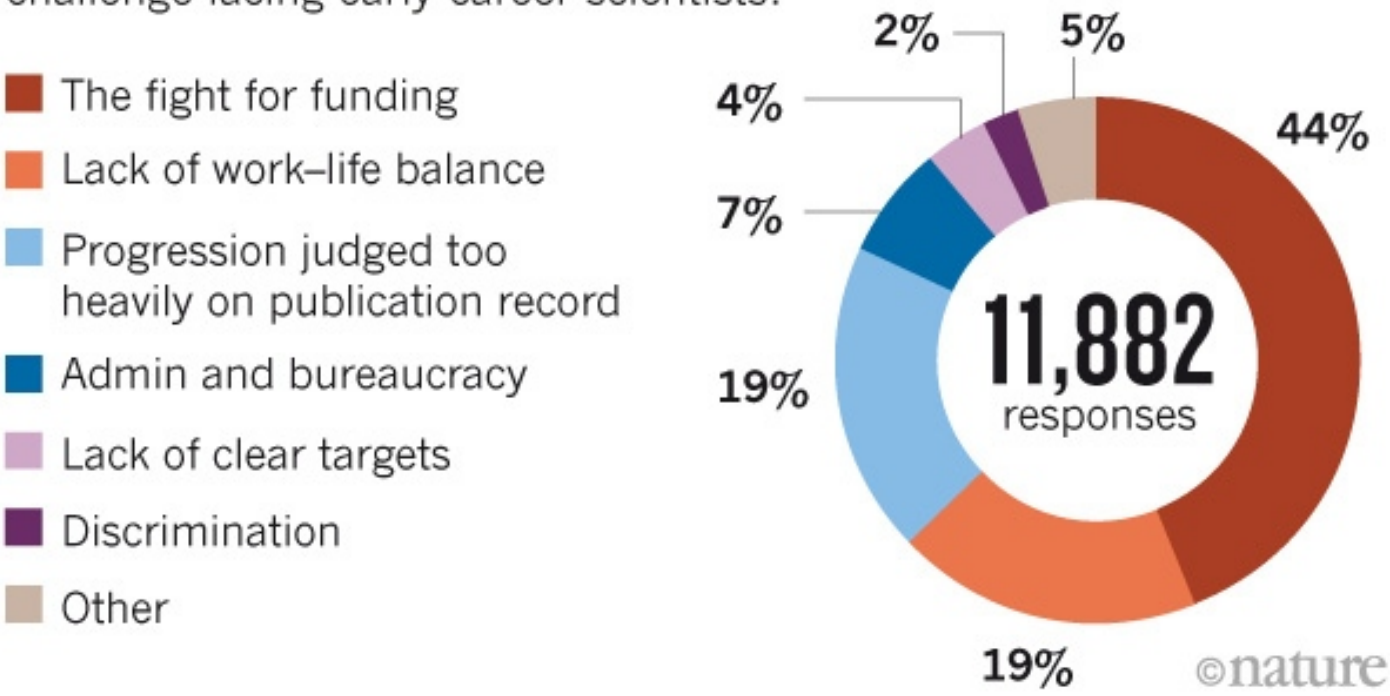
Nature 2016;538:446-9

The “Fight for Funding” Is The Biggest Concern

FIGHT FOR FUNDING

The biggest challenge facing early-career scientists is the struggle to get grants, *Nature*’s readers say.

Poll question:
What do you think is the biggest challenge facing early-career scientists?



Powell K. Nature (November 4, 2016)
http://www.nature.com/news/hard-work-little-reward-nature-readers-reveal-working-hours-and-research-challenges-1.20933

"What the Data Show"

UNDER PRESSURE

YOUNG RESEARCHERS ARE HAVING TO FIGHT HARDER THAN PAST GENERATIONS FOR A SMALLER SHARE OF THE ACADEMIC PIE.

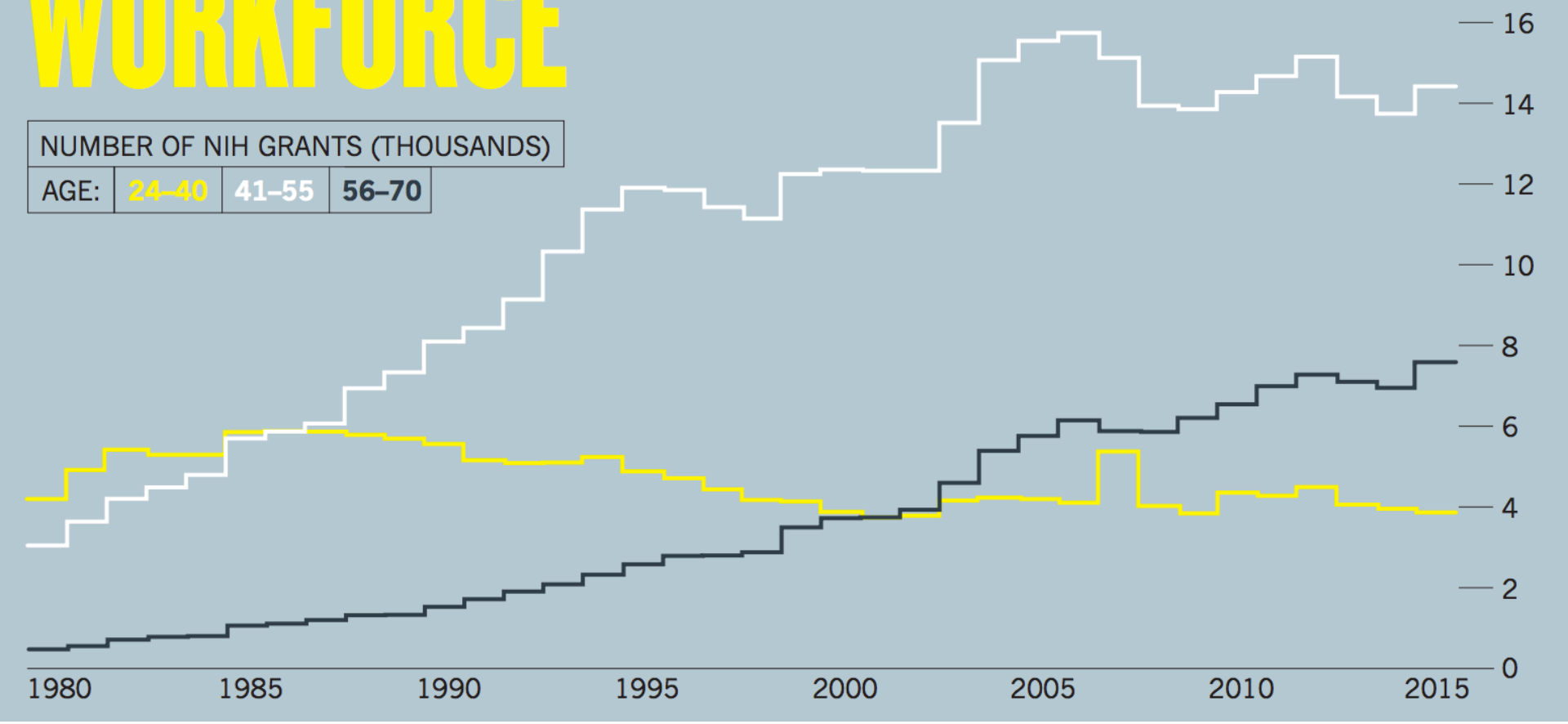
BY BRENDAN MAHER AND MIQUEL SUREDA ANFRES
DESIGN BY JASIEK KRZYSZTOFIAK

Scientists and policymakers around the world increasingly worry about the plight of young researchers in academia, and for good reason. Competition for tenure-track positions has surged, and some early-career researchers face tough odds in the quest for funding. As a result, many see lower pay–offs for their efforts in preparing and writing grant applications. Although everyone is under pressure, those just starting out seem to feel the impacts more acutely.

Nature 2016;538:444-5

AGEING WORKFORCE

Older scientists get the vast majority of grants, a huge change from 30 years ago. Even though the National Institutes of Health (NIH) managed to even out its success rate by giving first-time applicants a boost, the average age at which PhD scientists earn their first major grant has been around 42 since 2000.



Nature 2016;538:444-5

Media

The Upshot

FOLLOW US:
GET THE UPSHOT IN YOUR INBOX

LOST IN ACADEMIA

So Many Research Scientists, So Few Openings as Professors

Gina Kolata @ginakolata JULY 14, 2016

352

"The average age at which the lucky few actually get a grant has steadily increased — it is now 42, up from 35 in 1980, which means biomedical scientists in academia are essentially apprentices until middle age. And the tendency is for the grants to go to scientists who already have them, making it harder and harder to break into the system."

Emmanuelle Charpentier, who became leader of the Max Planck Institute for Infection Biology last year, spent the previous 25 years moving through nine institutions in five countries. Karsten Moran for The New York Times

https://www.nytimes.com/2016/07/14/upshot/so-many-research-scientists-so-few-openings-as-professors.html?_r=0

Root Causes of our Stress …

FEATURE ARTICLE

POINT OF VIEW

Strategies from UW-Madison for rescuing biomedical research in the US

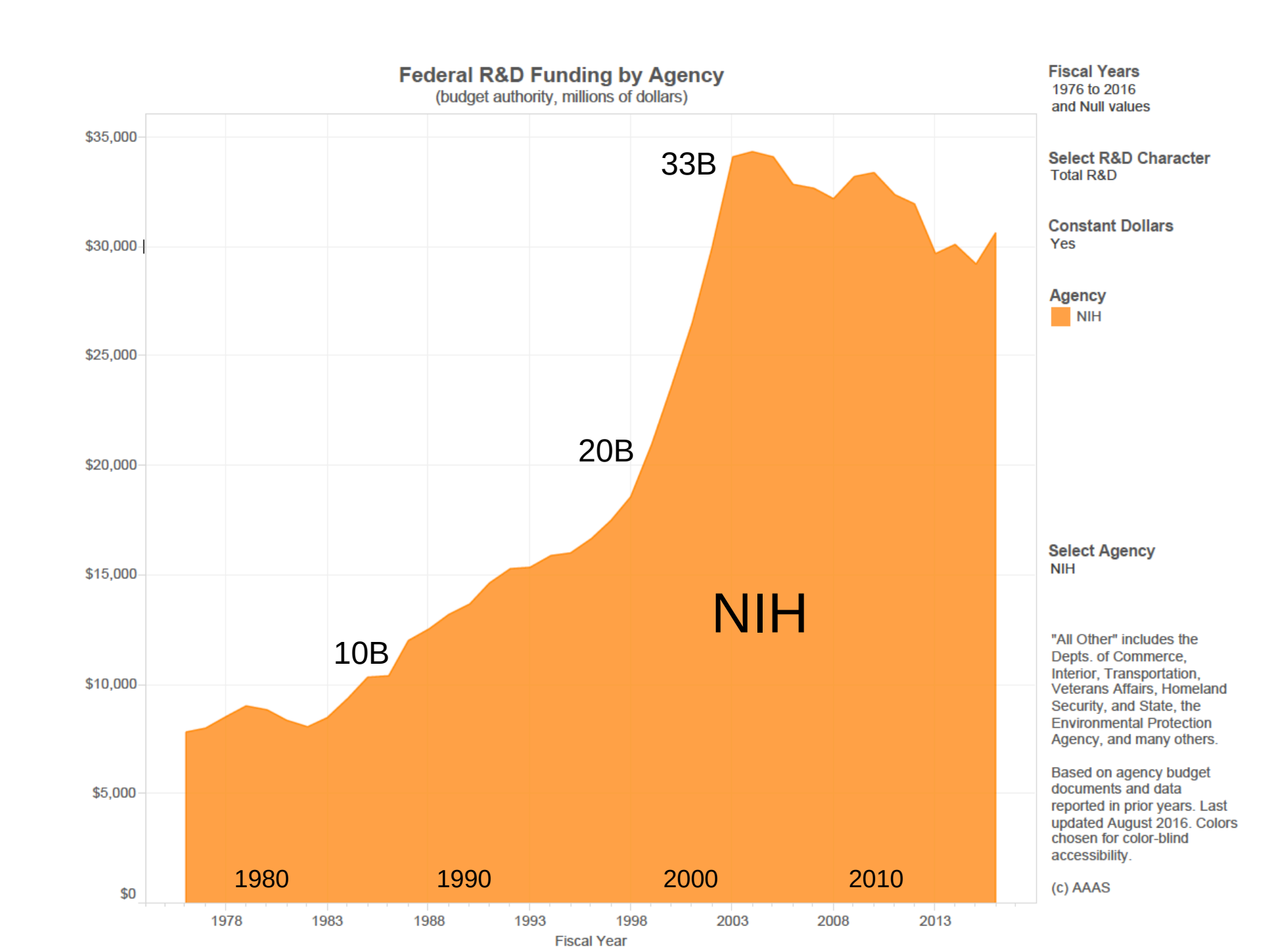
Abstract A cross-campus, cross-career stage and cross-disciplinary series of discussions at a large public university has produced a series of recommendations for addressing the problems confronting the biomedical research community in the US.

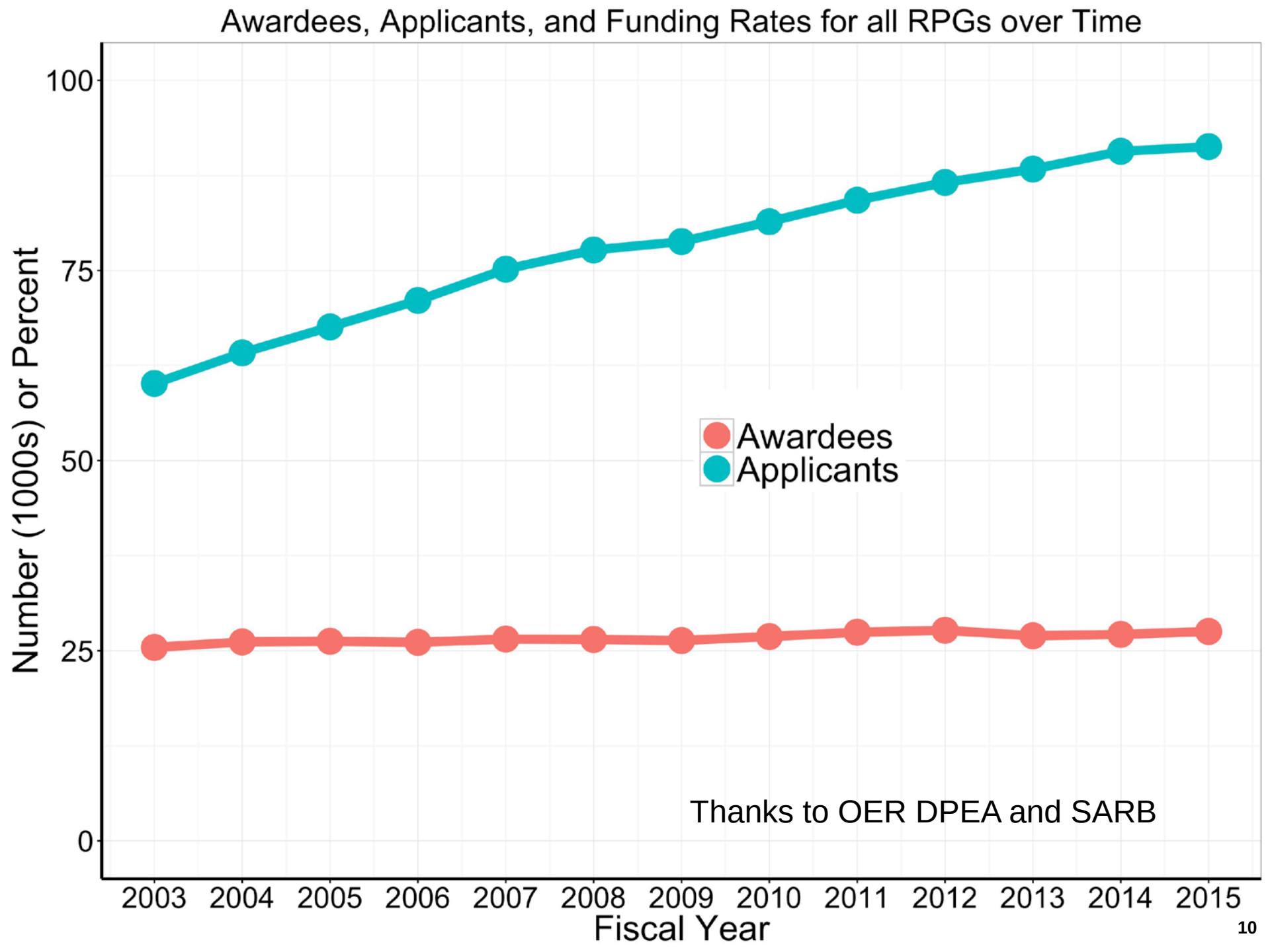
DOI: 10.7554/eLife.09305.001

"We identified two **core problems**:

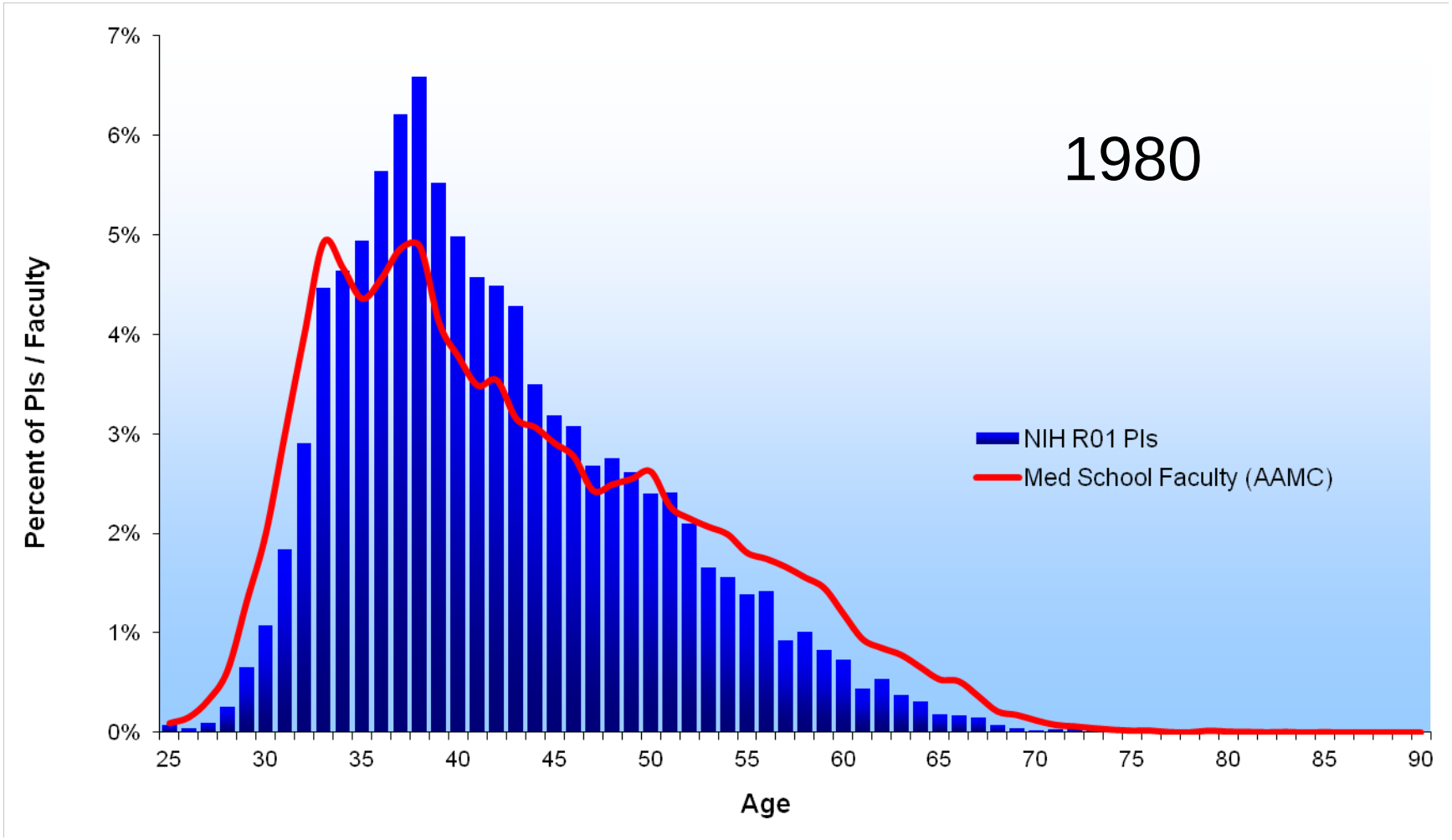
- **Too many researchers** vying for too few dollars.
- Too many postdocs competing for too few positions.

Most other issues can be viewed as symptoms."


Federal R&D Funding by Agency
(budget authority, millions of dollars)
$35,000
$30,000
$25,000
$20,000
$15,000
$10,000
$5,000
$0
33B
20B
10B
NIH
1980
1990
2000
2010
1978
1983
1988
1993
1998
2003
2008
2013
Fiscal Year
Fiscal Years
1976 to 2016
and Null values
Select R&D Character
Total R&D
Constant Dollars
Yes
Agency
NIH
Select Agency
NIH
"All Other" includes the Depts. of Commerce, Interior, Transportation, Veterans Affairs, Homeland Security, and State, the Environmental Protection Agency, and many others.
Based on agency budget documents and data reported in prior years. Last updated August 2016. Colors chosen for color-blind accessibility.
(c) AAAS

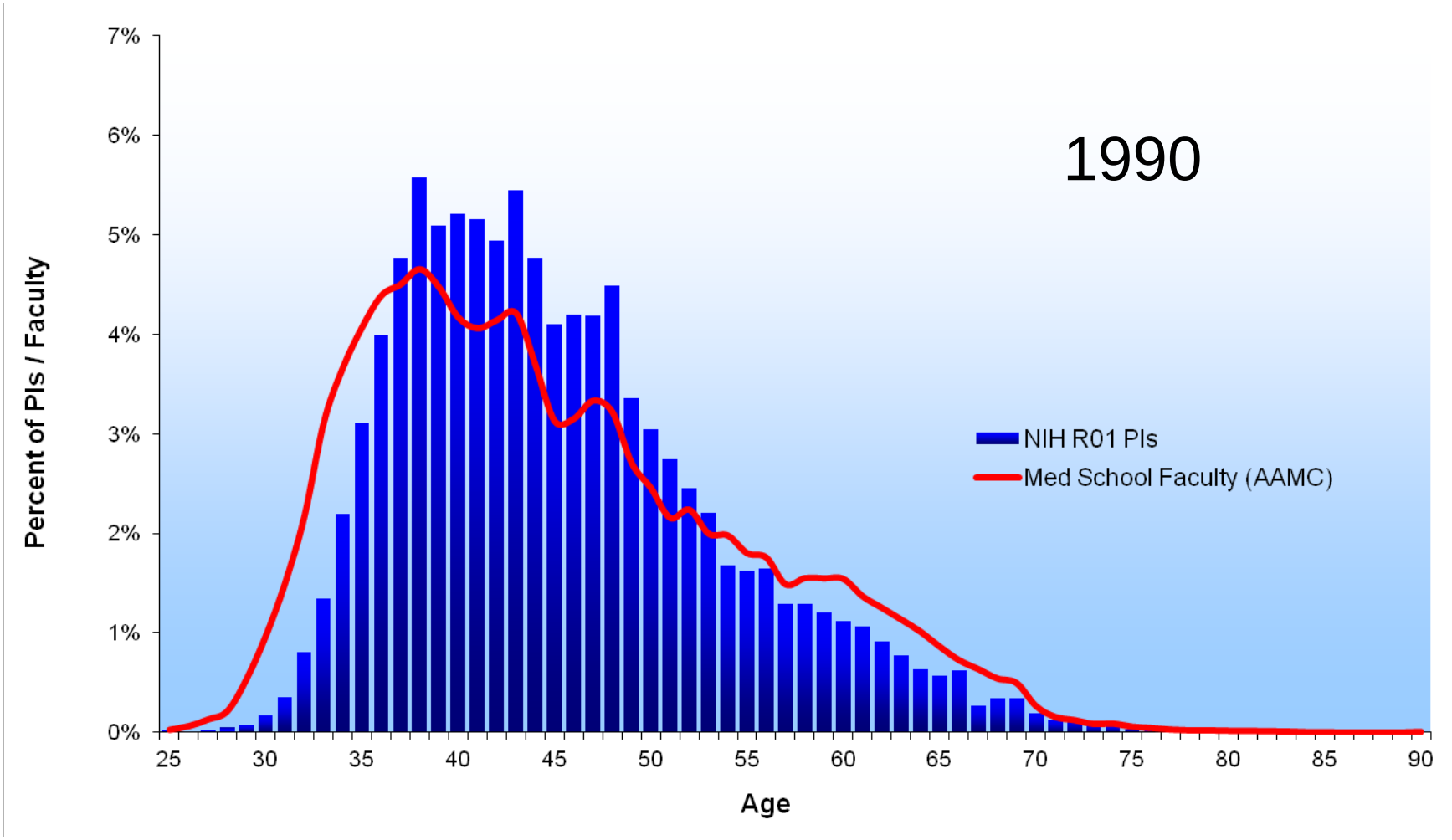

Awardees, Applicants, and Funding Rates for all RPGs over Time
Number (1000s) or Percent
100
75
50
25
0
Awardees
Applicants
Thanks to OER DPEA and SARB
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Fiscal Year

Look a Little Deeper – Who's Being Funded



Rockey S.
https://nexus.od.nih.gov/all/2012/02/13/age-distribution-of-nih-principal-investigators-and-medical-school-faculty/

1990



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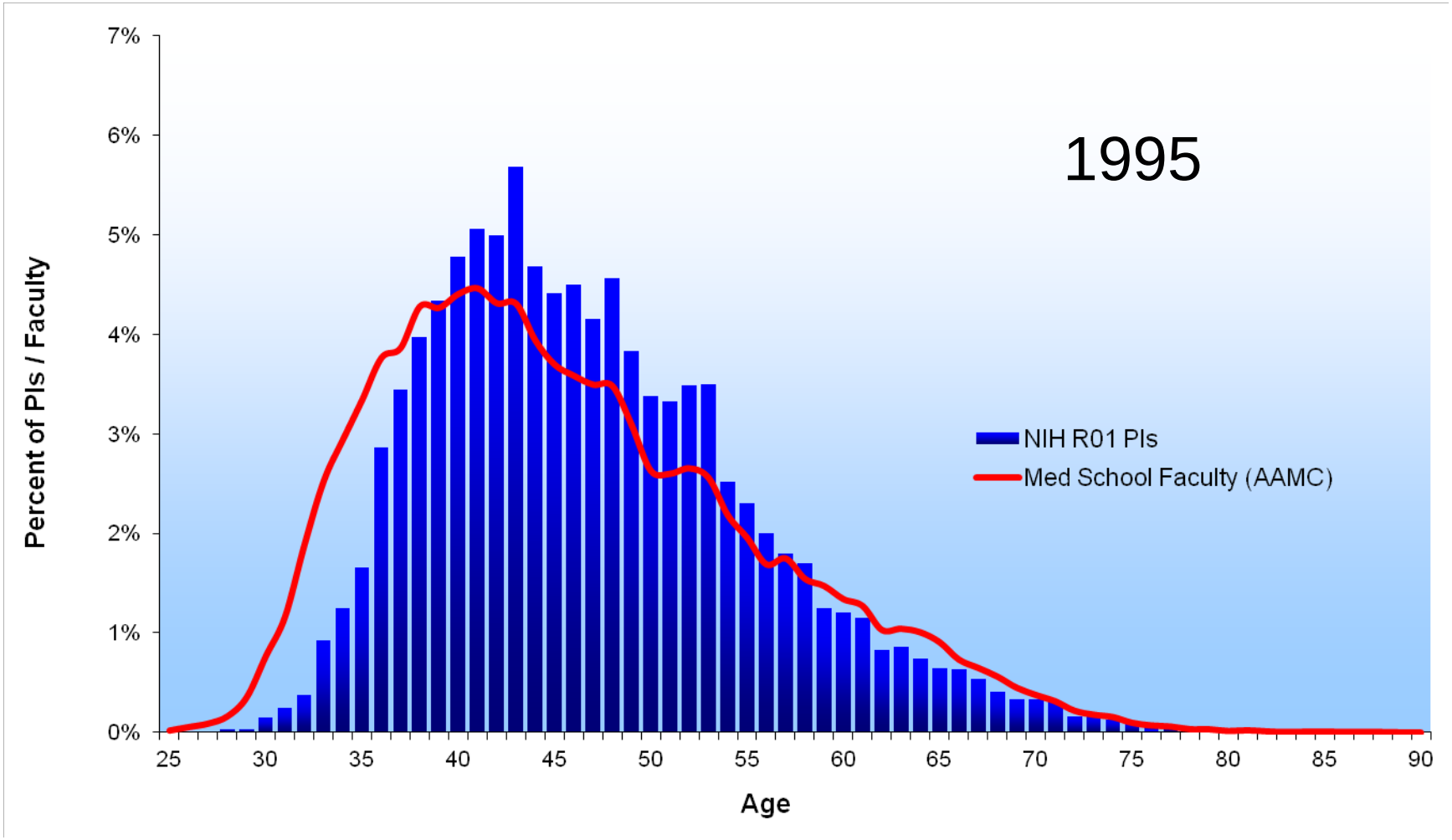

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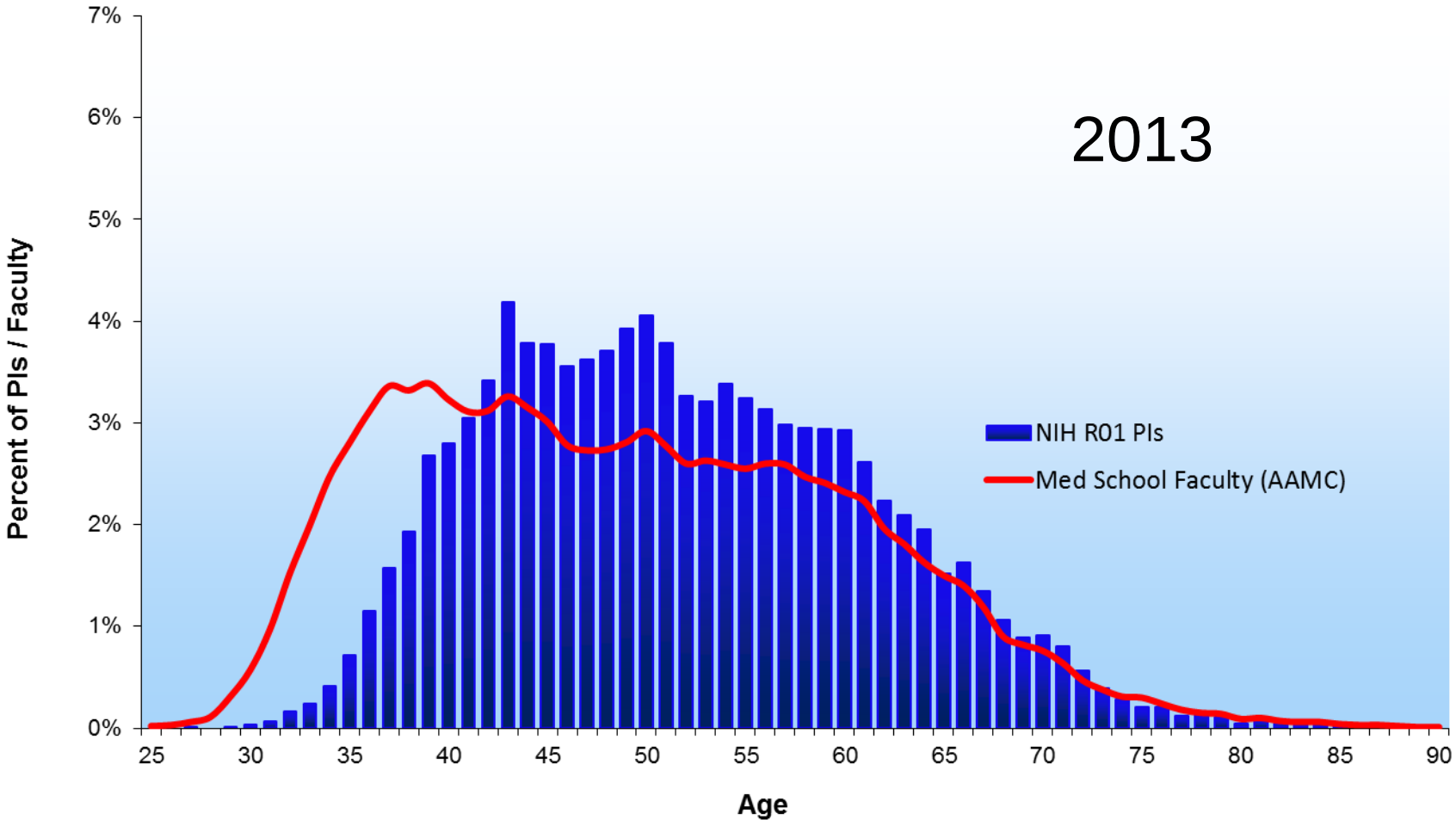

Rockey S.
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And a Bit Deeper

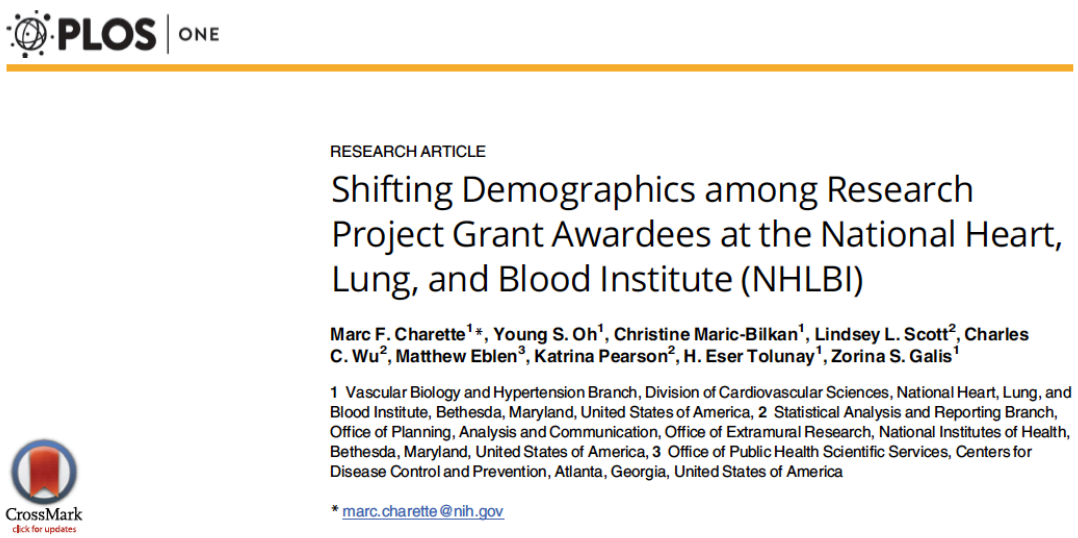
RESEARCH ARTICLE

Shifting Demographics among Research Project Grant Awardees at the National Heart, Lung, and Blood Institute (NHLBI)

Marc F. Charette[1]*, Young S. Oh[1], Christine Maric-Bilkan[1], Lindsey L. Scott[2], Charles C. Wu[2], Matthew Eblen[3], Katrina Pearson[2], H. Eser Tolunay[1], Zorina S. Galis[1]

PLOS ONE | DOI:10.1371/journal.pone.0168511

New Investigators Includes Mid-Career



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1 Vascular Biology and Hypertension Branch, Division of Cardiovascular Sciences, National Heart, Lung, and Blood Institute, Bethesda, Maryland, United States of America, 2 Statistical Analysis and Reporting Branch, Office of Planning, Analysis and Communication, Office of Extramural Research, National Institutes of Health, Bethesda, Maryland, United States of America, 3 Office of Public Health Scientific Services, Centers for Disease Control and Prevention, Atlanta, Georgia, United States of America

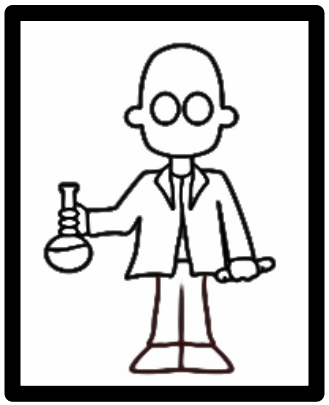
* marc.charette@nih.gov

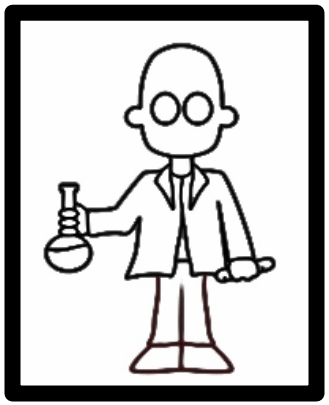
CrossMark click for updates

"[There are] properties within the RPG award system that promote more established awardee[s]. [There is] a reduction in the number of RPG awards received by mid-career investigators and [fewer] independent laboratories."

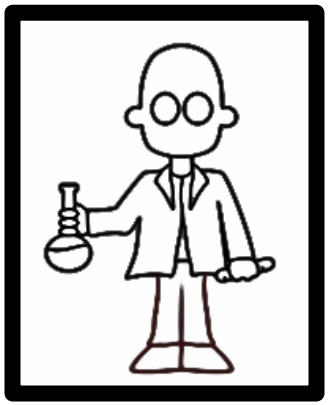
Charette M et al. PLOS ONE 2016; DOI:10.1371/journal.pone.0168511

There are Three Types of Players





RPG Grant Award



RPG Grant Award

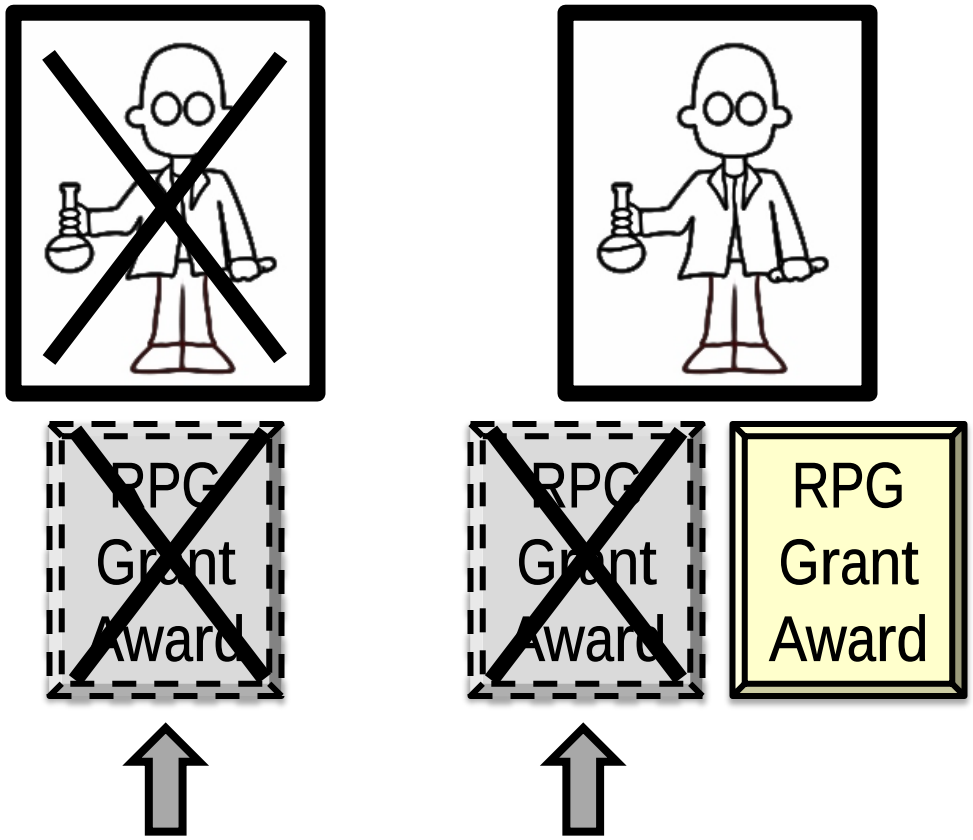
RPG Grant Award

Those with no grants, those with only one grant, and those with more than one grant

Thanks to Marc Charette

Consequences of Failing to Renew

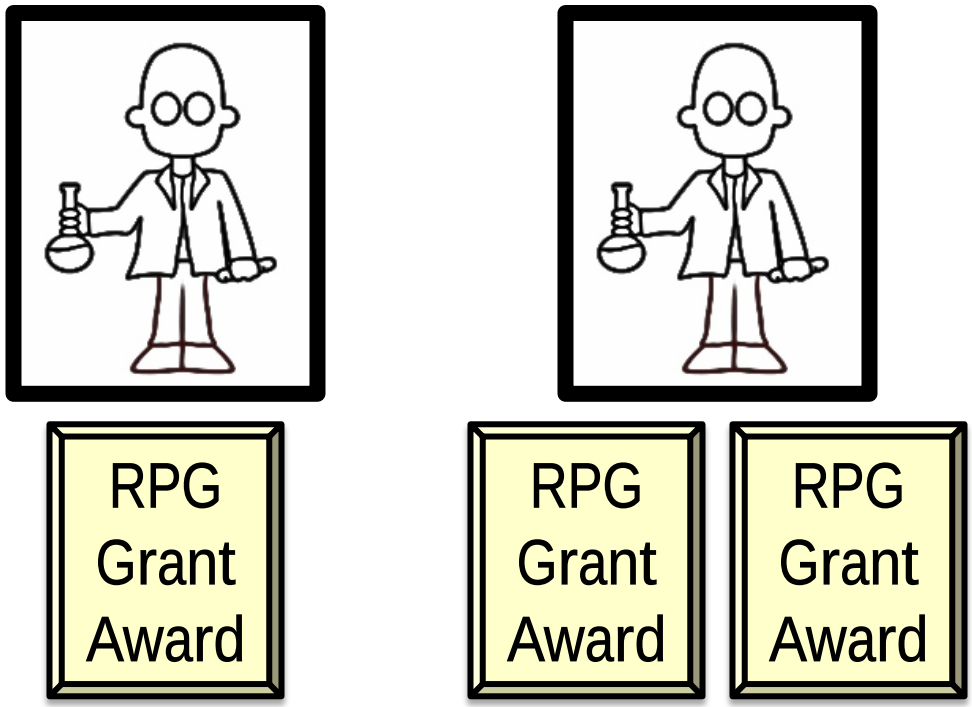
Players, who have only one award and fail to renew their award, may be forced from the game



Thanks to Marc Charette

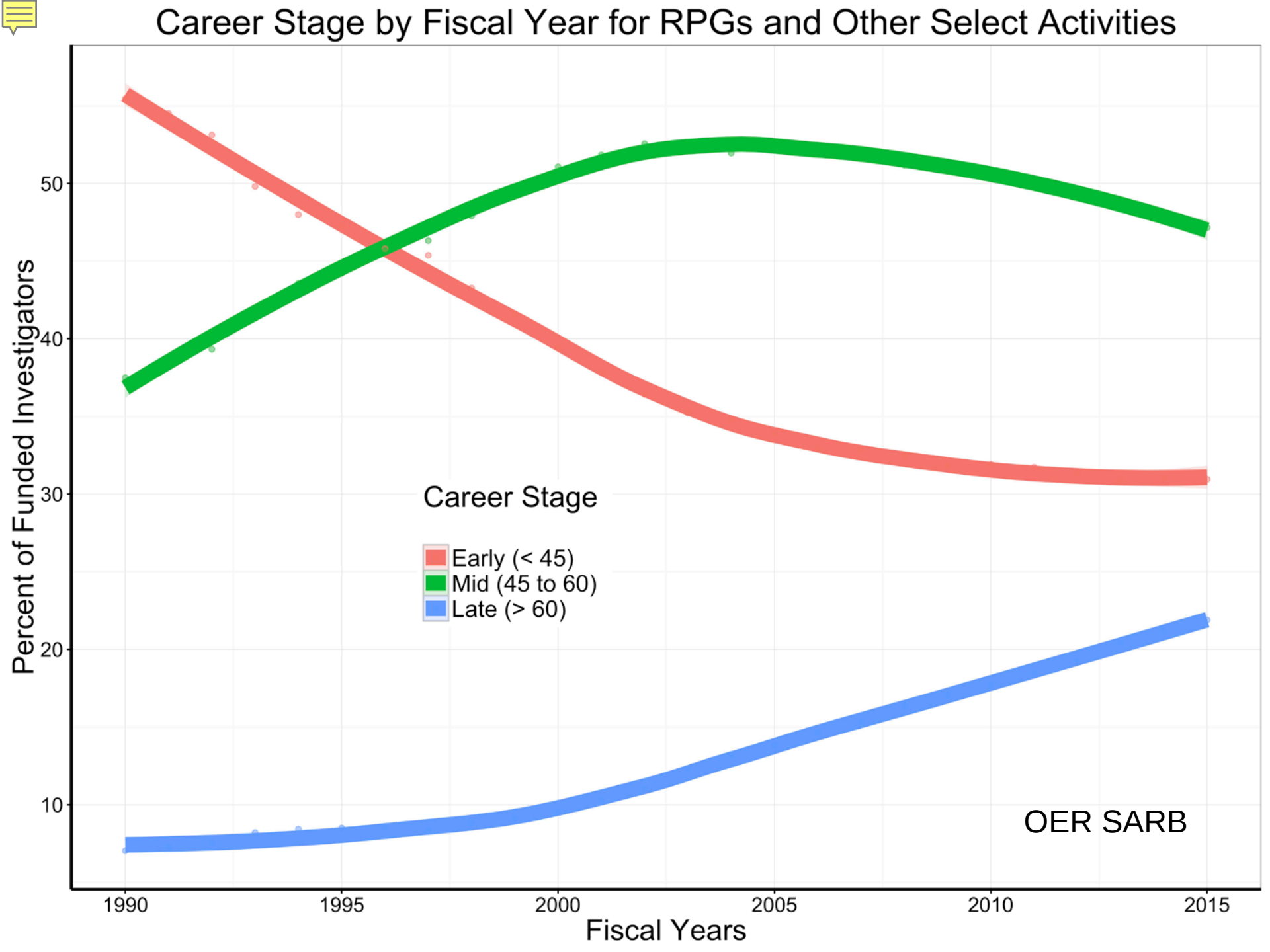
Multiple Grants confer Survival Enhancement

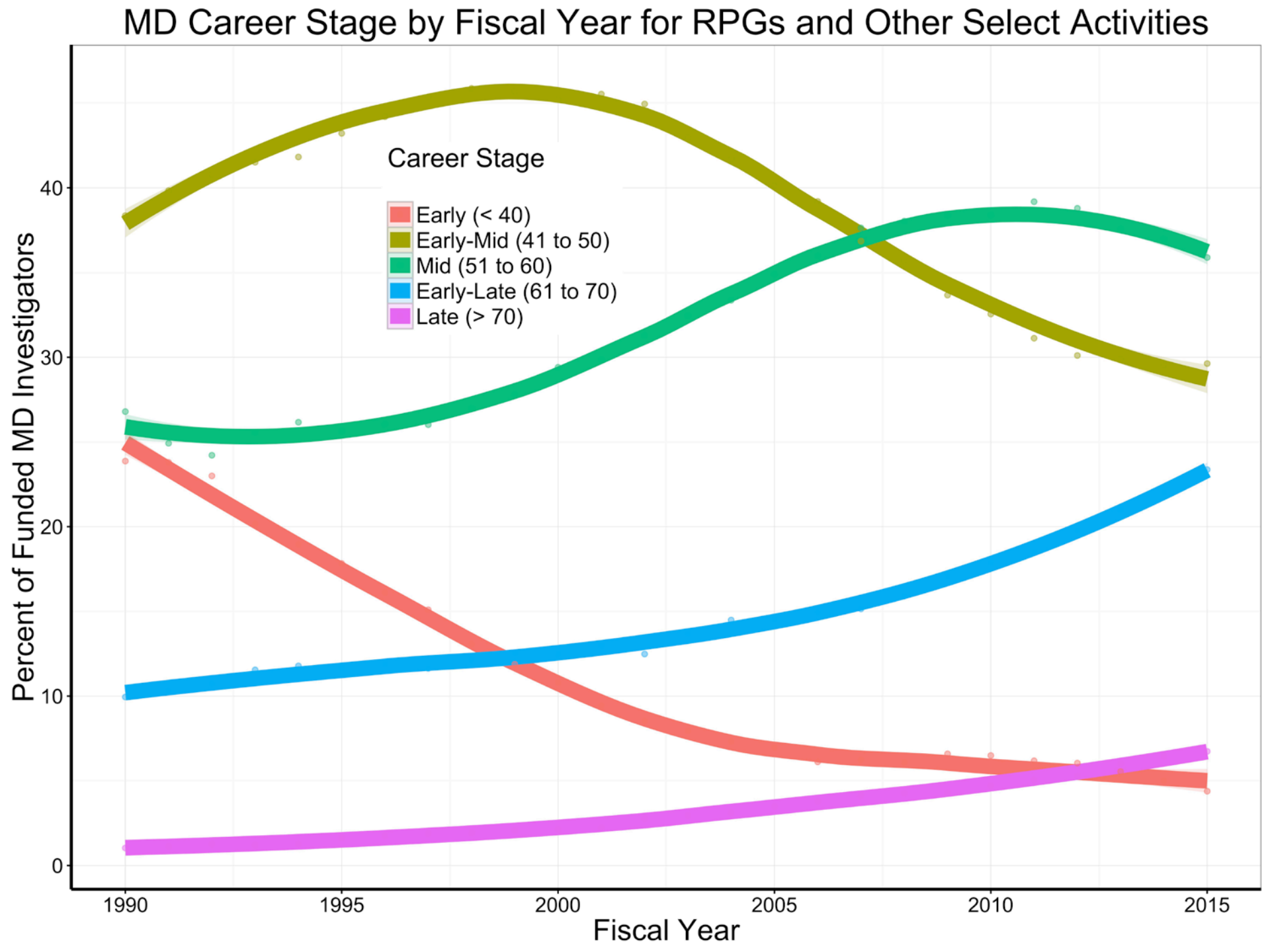
Player with selective disadvantage ⇨



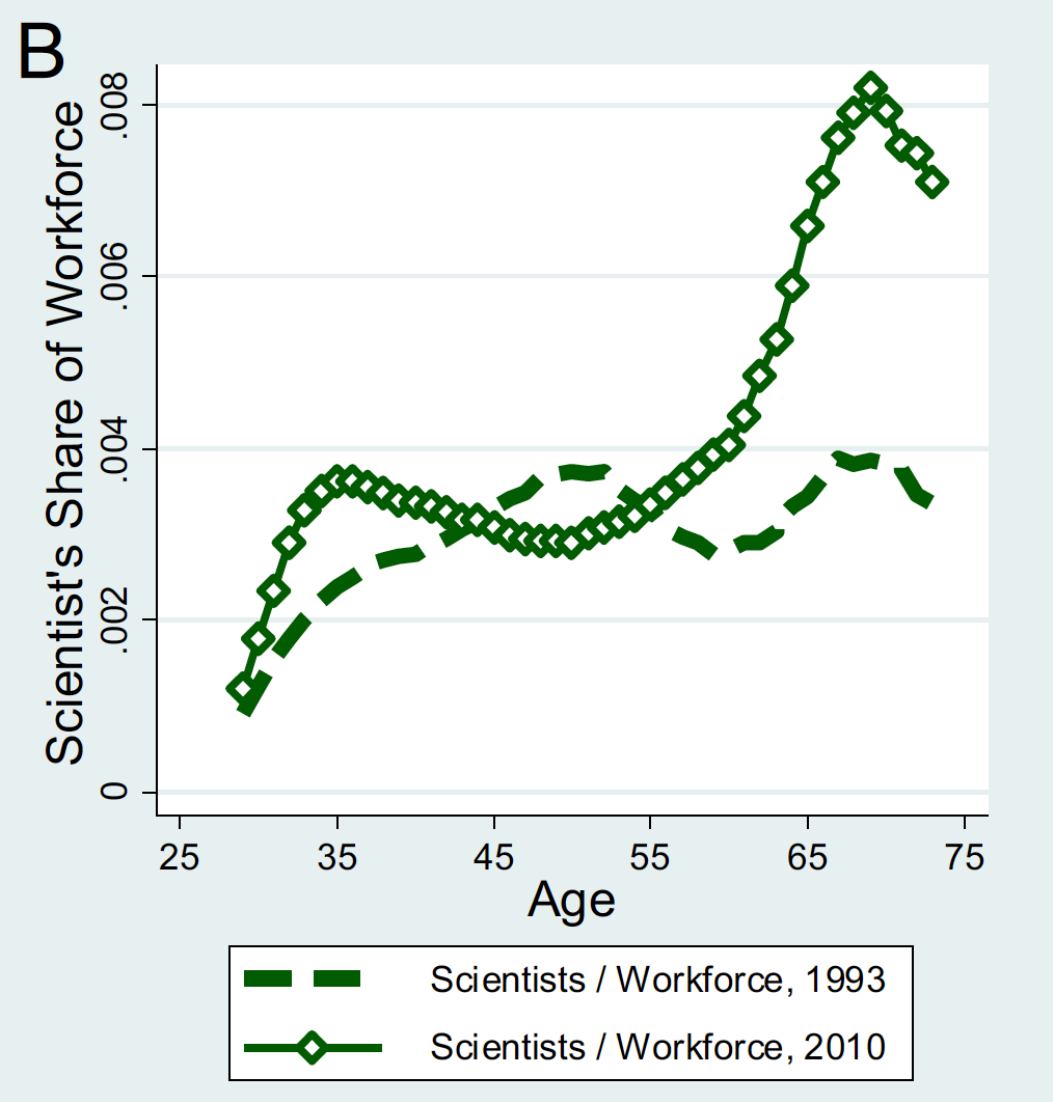
Repeated cycles of the RPG Award Renewal game will gradually diminish the population of players who have only one grant

Thanks to Marc Charette


Career Stage by Fiscal Year for RPGs and Other Select Activities
Percent of Funded Investigators
50
40
30
20
10
Career Stage
Early (< 45)
Mid (45 to 60)
Late (> 60)
OER SARB
1990
1995
2000
2005
2010
2015
Fiscal Years


MD Career Stage by Fiscal Year for RPGs and Other Select Activities
Career Stage
Early (< 40)
Early-Mid (41 to 50)
Mid (51 to 60)
Early-Late (61 to 70)
Late (> 70)
Percent of Funded MD Investigators
0
10
20
30
40
1990
1995
2000
2005
2010
2015
Fiscal Year

What's Happening? Scientists and Everyone Else



Blau, Weinberg

www.pnas.org/cgi/doi/10.1073/pnas.1611748114

What's Happening? Now … in Words

Why the US science and engineering workforce is aging rapidly

David M. Blau[a,b,1] and Bruce A. Weinberg[a,b,c]

[a]Department of Economics, Ohio State University, Columbus, OH 43210; [b]Institute of Labor Economics (IZA), 53113 Bonn, Germany; and [c]National Bureau of Economic Research, Cambridge, MA 02138

"Our major findings are that (i) the scientific workforce has aged rapidly in recent years relative to the workforce as a whole; (ii) the main causes have been a decline in the retirement rate of older scientists, which occurred after the elimination of mandatory retirement, and a convergence … as the baby boom cohort has aged; and (iii) current trends imply a further substantial increase in the age of the scientific workforce in coming years."

www.pnas.org/cgi/doi/10.1073/pnas.1611748114

Root Causes of our Stress …

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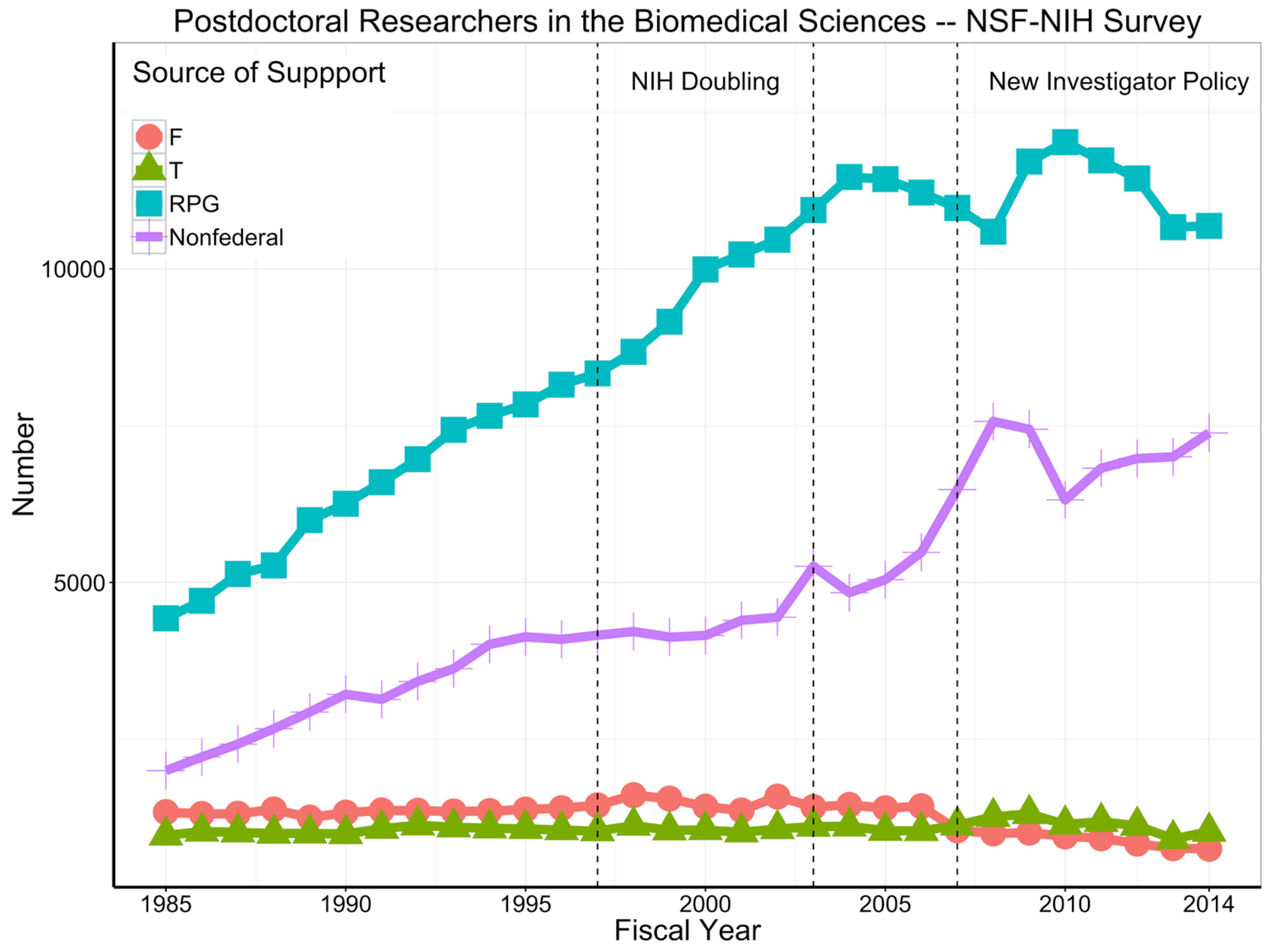

Postdoctoral Researchers in the Biomedical Sciences -- NSF-NIH Survey
Source of Suppport
F
T
RPG
Nonfederal
NIH Doubling
New Investigator Policy
10000
5000
Number
1985
1990
1995
2000
2005
2010
2014
Fiscal Year

Does it Help?

CAREERS AND RECRUITMENT

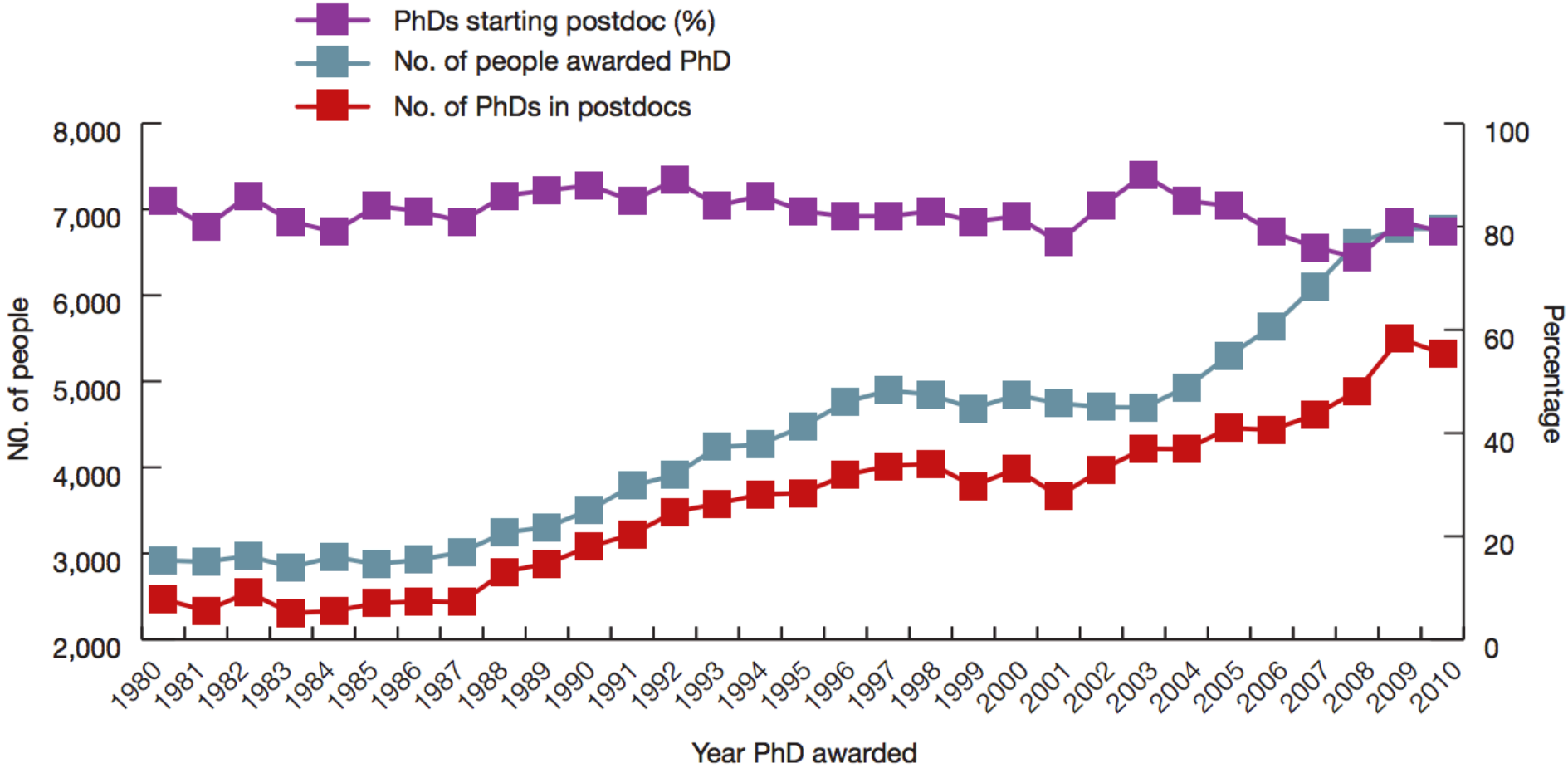
The impact of postdoctoral training on early careers in biomedicine

Shulamit Kahn & Donna K Ginther

While postdocs are necessary for entry into tenure-track jobs, they do not enhance salaries in other job sectors over time.

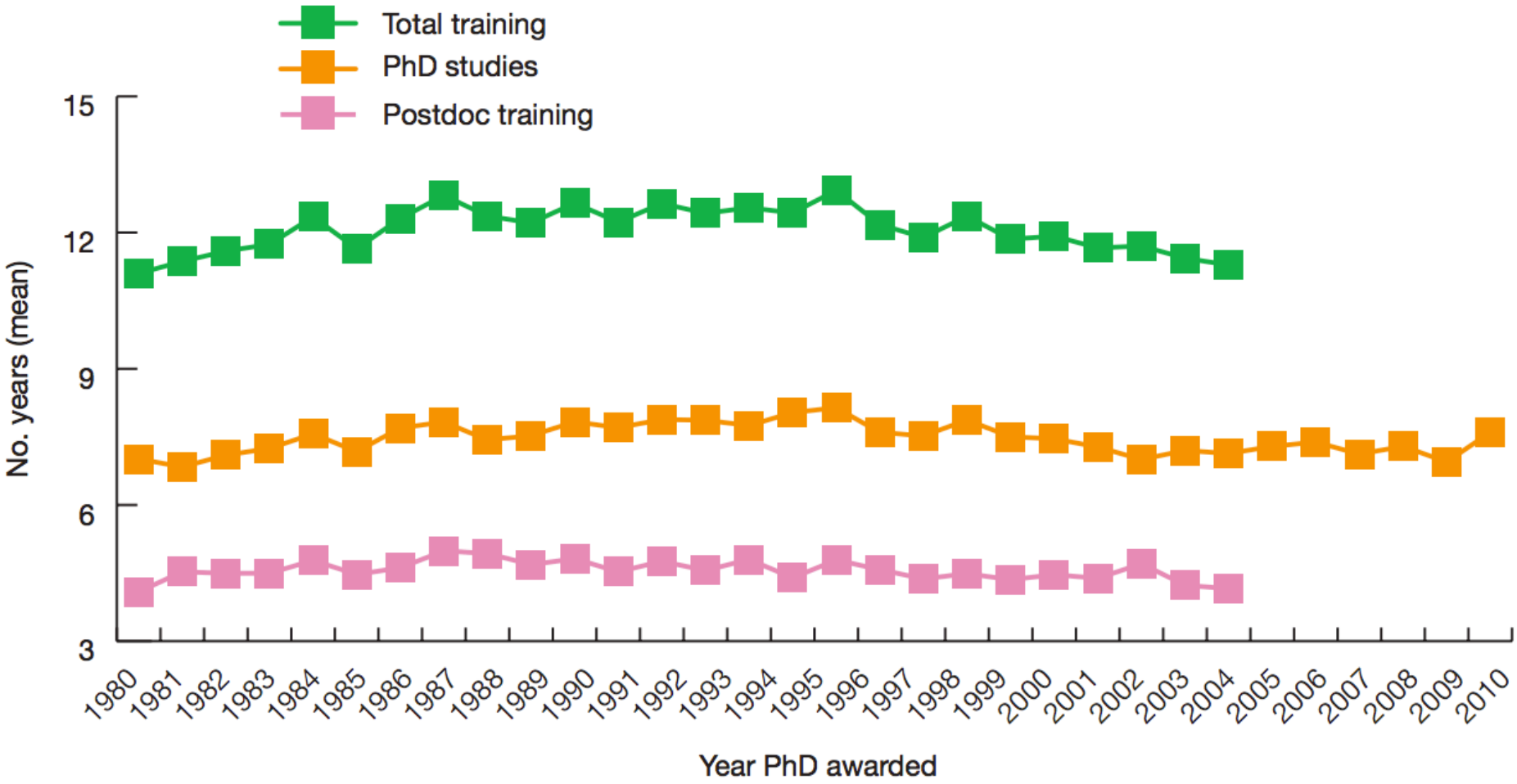
Nature Biotechnology. 2017;35:90-3

More PhDs and More Post-Docs



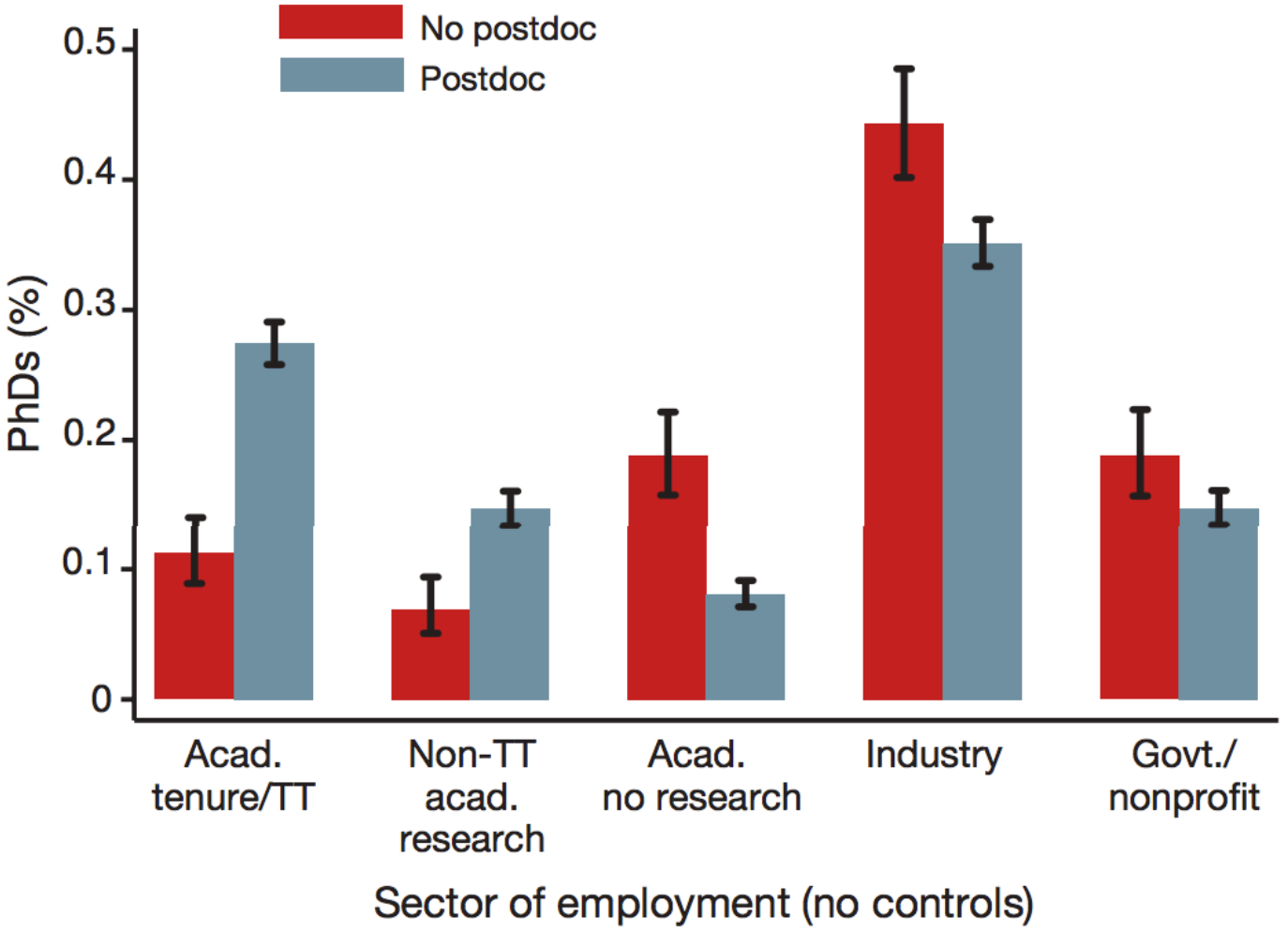
Nature Biotechnology. 2017;35:90-3

Years of Training



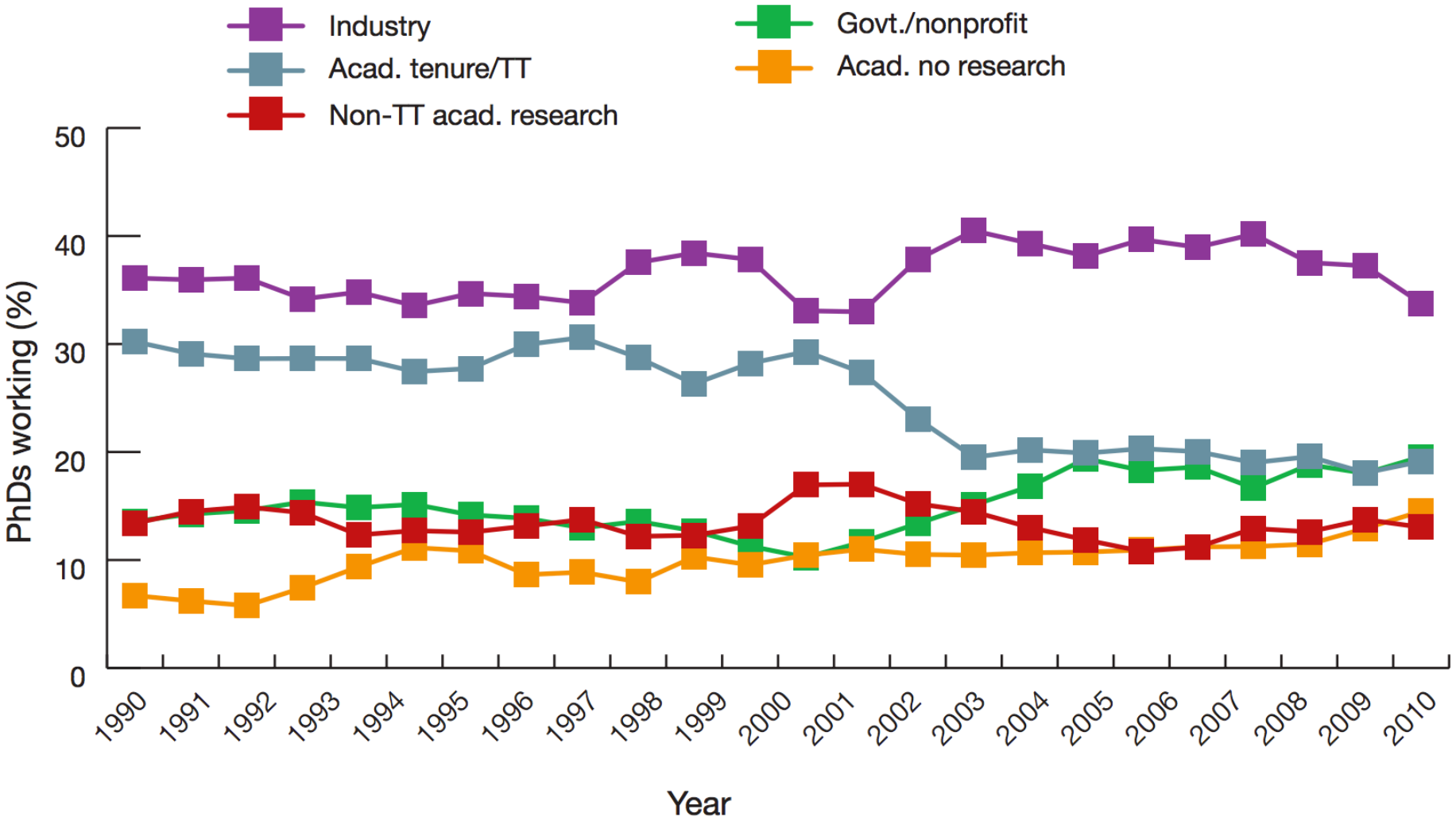
Nature Biotechnology. 2017;35:90-3

Where They Work



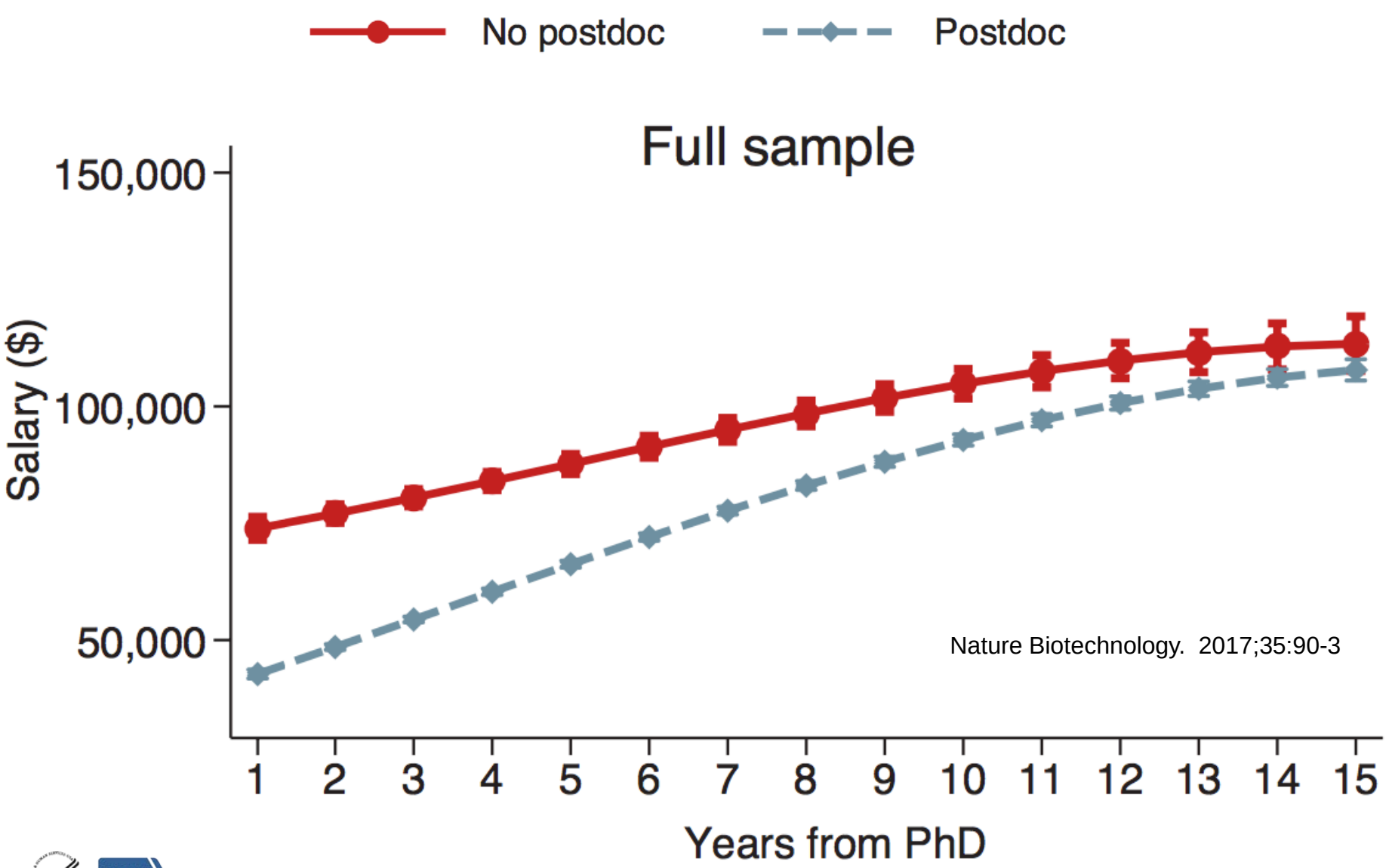
Nature Biotechnology. 2017;35:90-3

Where are Biomedical PhDs Working?



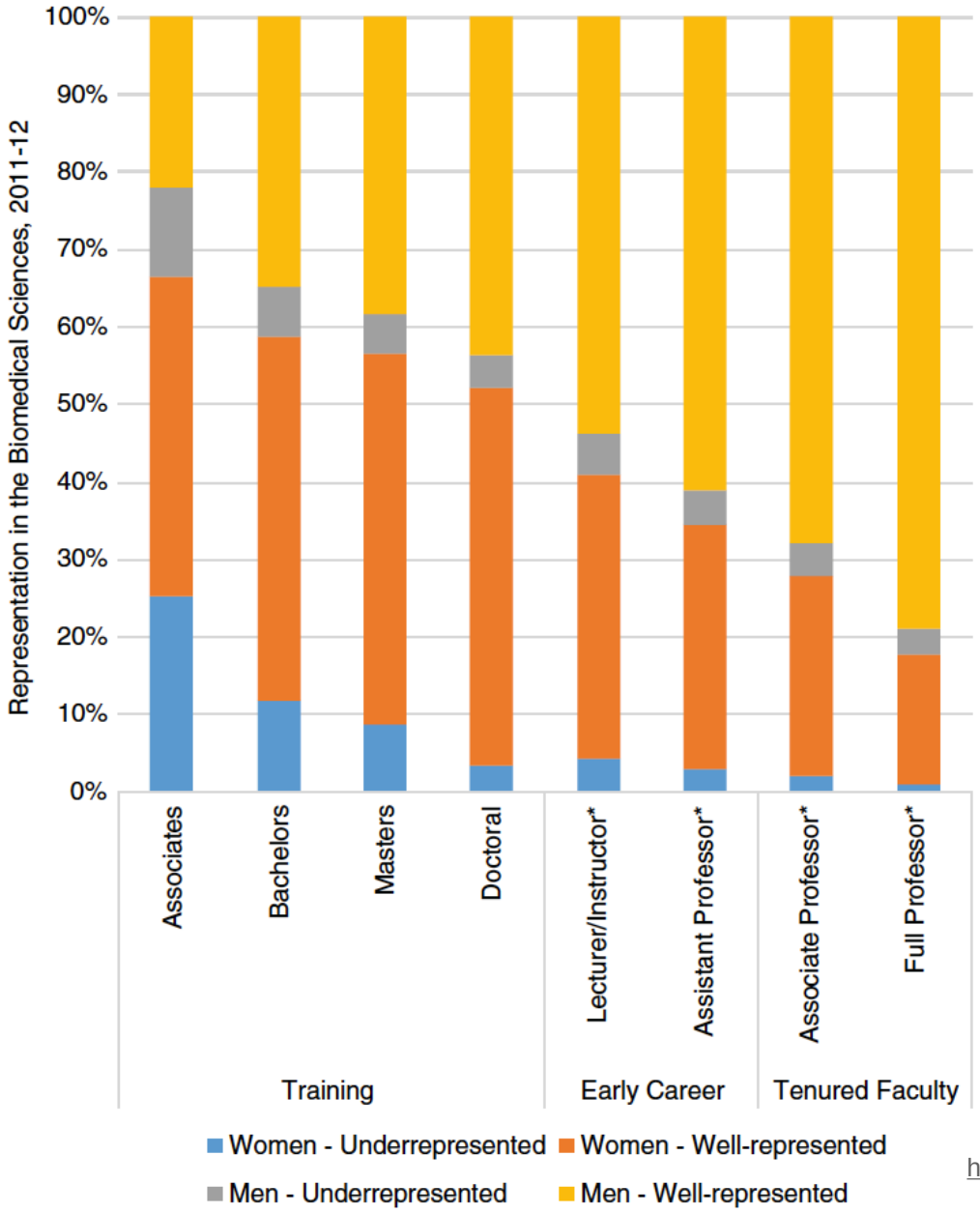
Nature Biotechnology. 2017;35:90-3

The “Penalty”



Nature Biotechnology. 2017;35:90-3

Diversity



From the NIH: A Systems Approach to Increasing the Diversity of the Biomedical Research Workforce

Hannah A. Valantine,[†*] P. Kay Lund,[†] and Alison E. Gammie[‡]
[†]Office of the Director and [‡]National Institute of General Medical Sciences, National Institutes of Health, Bethesda, MD 20892

"We can build through more focus on the nodes where attrition is most common. [Focus] on retention, continuity, flexibility, and innovation across the career pathway."

Hannah Valantine, Kay Lund, and Alison Gammie

http://nces.ed.gov/programs/digest/2013menu_tables.asp

CBE—Life Sciences Education • 15:fe4, 1–5, Fall 2016

Efficiency: Maybe It Makes Sense?

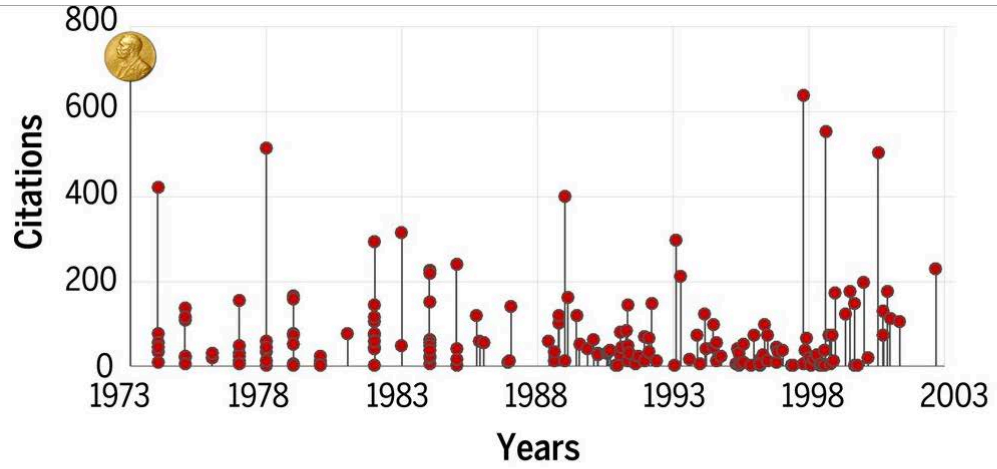
RESEARCH

RESEARCH ARTICLE SUMMARY

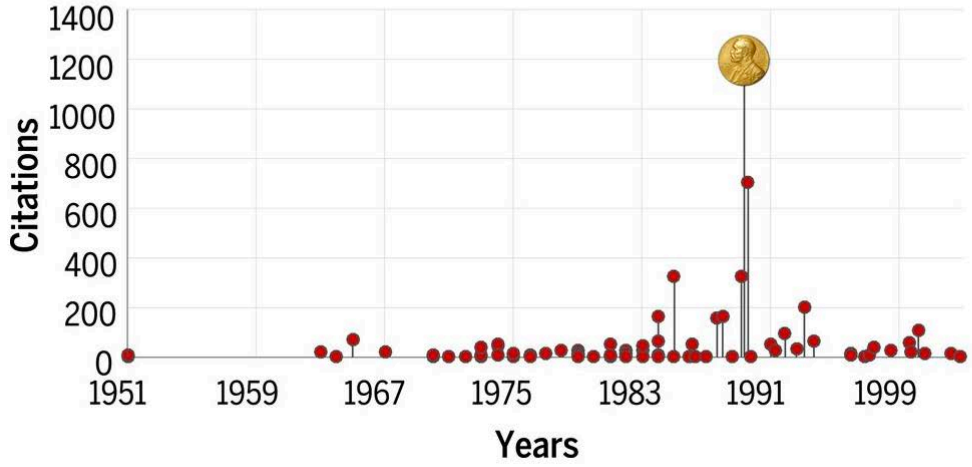
SCIENCE COMMUNITY

Quantifying the evolution of individual scientific impact

Roberta Sinatra, Dashun Wang, Pierre Deville, Chaoming Song, Albert-László Barabási*



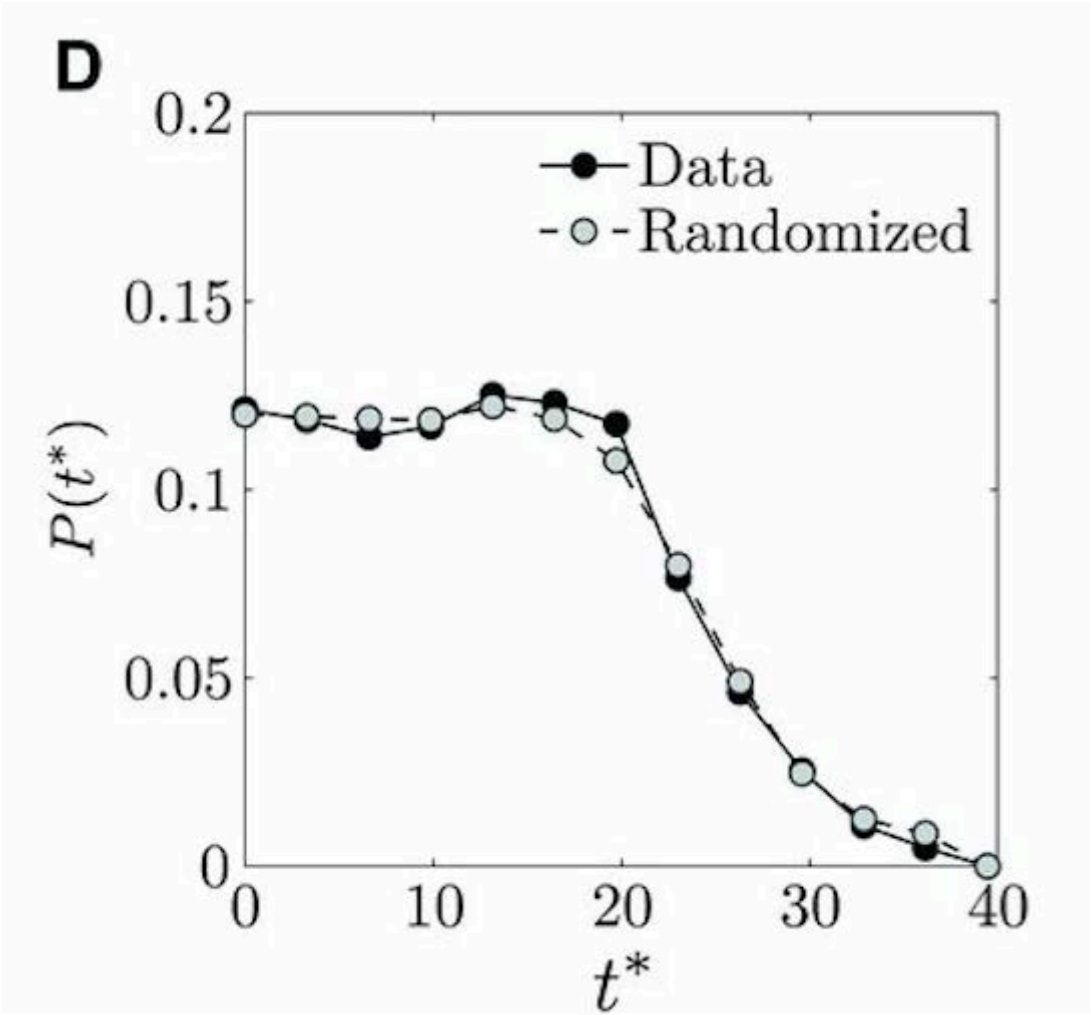
Frank A. Wilczek
Physics Nobel,
2004



John B. Fenn
Chemistry Nobel,
2002

Sinatra R et al. Science 2016;354:596

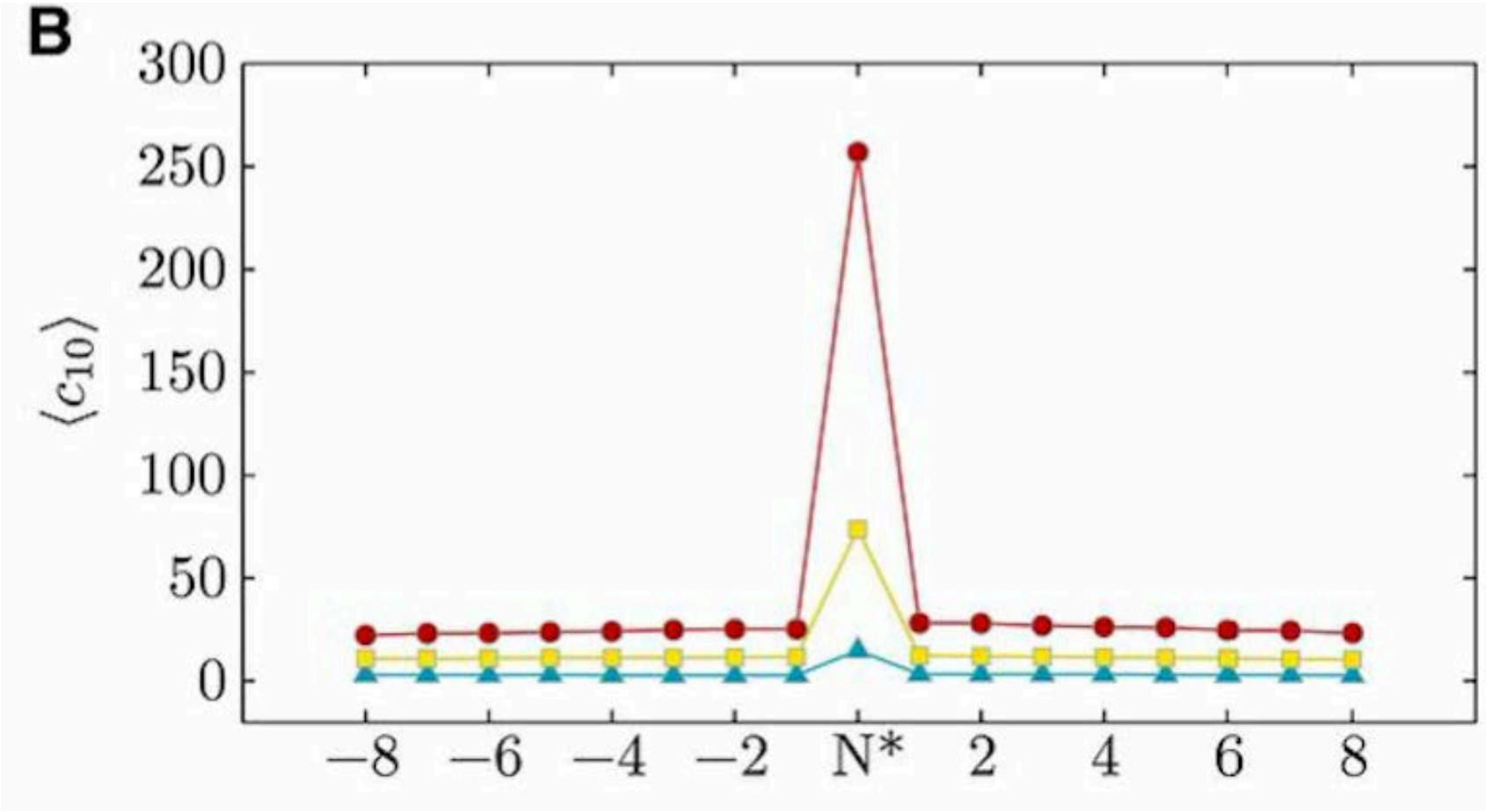
“Random-Impact Rule”



“Impact is random within a scientist’s sequence of publication.”

Sinatra R et al. Science 2016;354:596

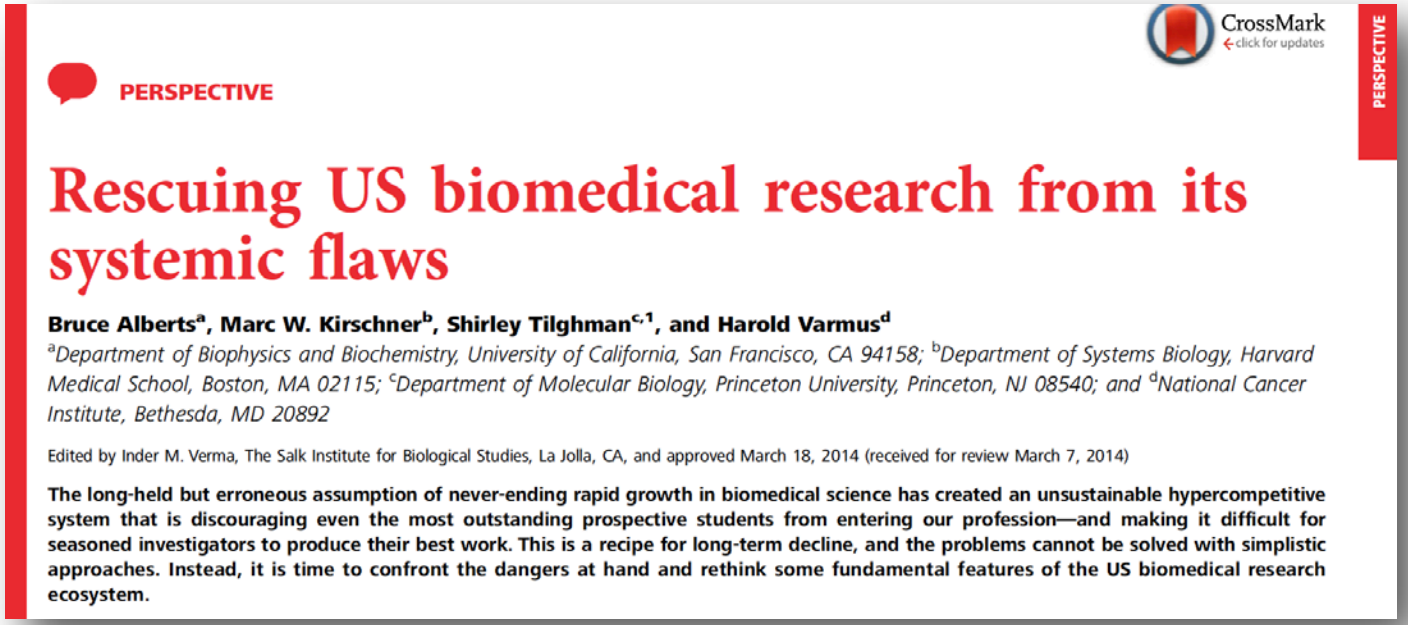
“Random-Impact Rule”



“There are no discernible changes in impact before or after a scientist’s highest-impact work.”

Sinatra R et al. Science 2016;354:596

Distribution of Dollars to Awardees …



PERSPECTIVE

Rescuing US biomedical research from its systemic flaws

Bruce Alberts[a], Marc W. Kirschner[b], Shirley Tilghman[c,1], and Harold Varmus[d]

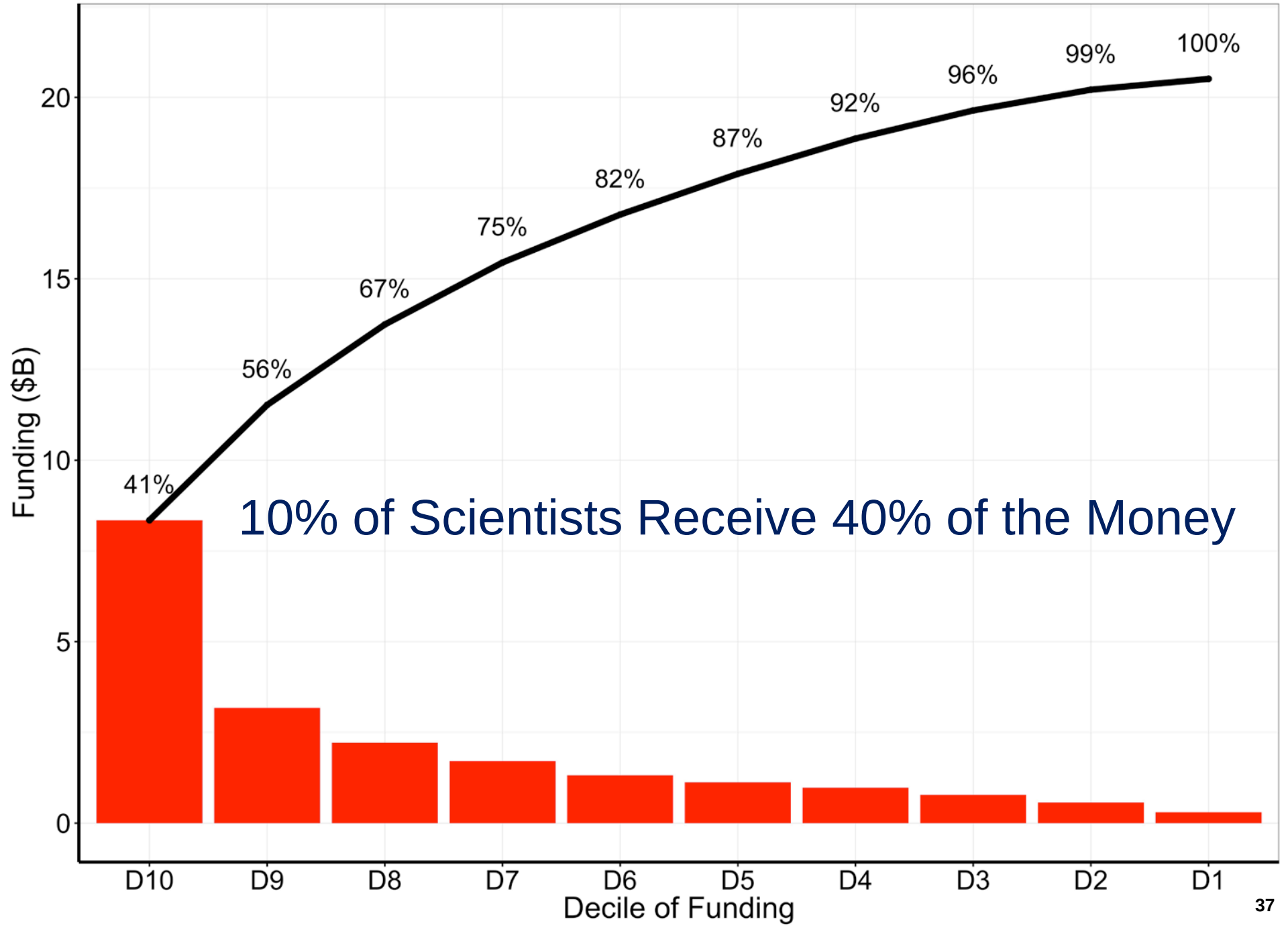
[a]Department of Biophysics and Biochemistry, University of California, San Francisco, CA 94158; [b]Department of Systems Biology, Harvard Medical School, Boston, MA 02115; [c]Department of Molecular Biology, Princeton University, Princeton, NJ 08540; and [d]National Cancer Institute, Bethesda, MD 20892

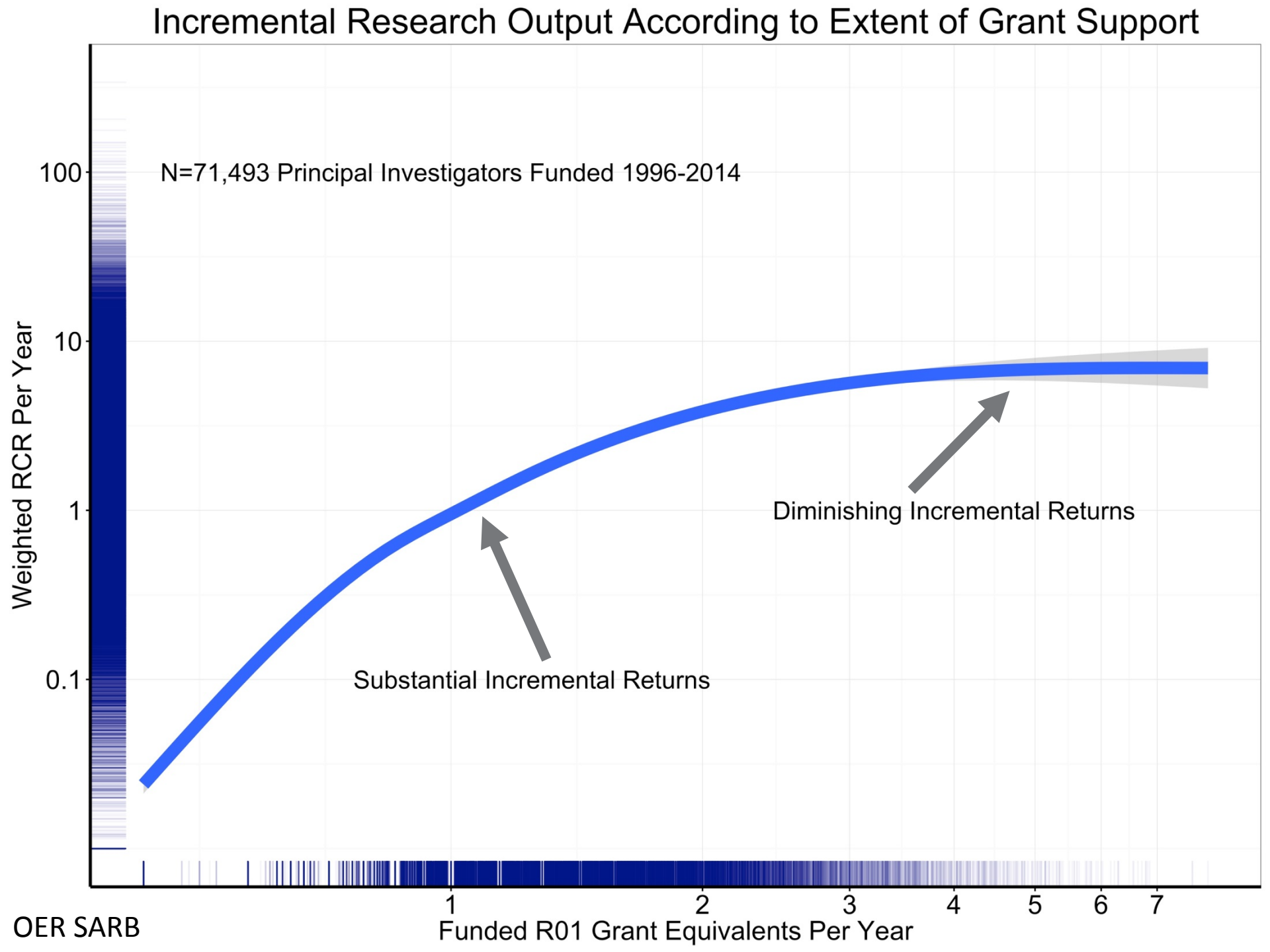
Edited by Inder M. Verma, The Salk Institute for Biological Studies, La Jolla, CA, and approved March 18, 2014 (received for review March 7, 2014)

The long-held but erroneous assumption of never-ending rapid growth in biomedical science has created an unsustainable hypercompetitive system that is discouraging even the most outstanding prospective students from entering our profession—and making it difficult for seasoned investigators to produce their best work. This is a recipe for long-term decline, and the problems cannot be solved with simplistic approaches. Instead, it is time to confront the dangers at hand and rethink some fundamental features of the US biomedical research ecosystem.

"Agencies should be sensitive to ***the total numbers of dollars granted to individual laboratories***…—although different research activities have different costs—at some point, ***returns per dollar diminish***. We applaud the recent decision by the NIH to examine grant portfolios carefully before increasing direct research support for a laboratory beyond $1M per year."

Alberts B et al. PNAS. 2014;111:5773-7


Funding ($B)
20
15
10
5
0
41%
56%
67%
75%
82%
87%
92%
96%
99%
100%
10% of Scientists Receive 40% of the Money
D10
D9
D8
D7
D6
D5
D4
D3
D2
D1
Decile of Funding


Incremental Research Output According to Extent of Grant Support
N=71,493 Principal Investigators Funded 1996-2014
Weighted RCR Per Year
100
10
1
0.1
Substantial Incremental Returns
Diminishing Incremental Returns
1
2
3
4
5
6
7
Funded R01 Grant Equivalents Per Year
OER SARB

Described Elsewhere

Research Evaluation, 25(4), 2016, 396–404
doi: 10.1093/reseval/rvw007
Advance Access Publication Date: 25 March 2016
Article

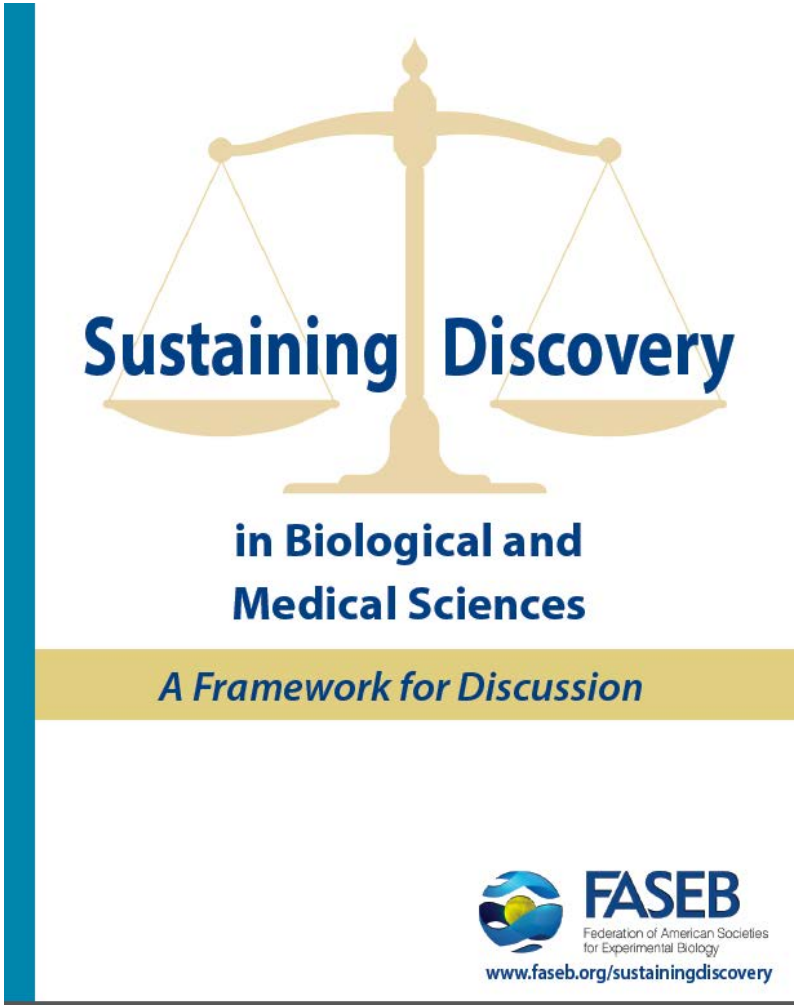
OXFORD

Concentration of research funding leads to decreasing marginal returns

Philippe Mongeon[1,*], Christine Brodeur[2], Catherine Beaudry[3,4] and Vincent Larivière[1,5]

"The main determinant of scientific production is not so much the money invested but rather the number of researchers at work, and that by **funding a greater number of researchers, we increase the overall research productivity**. Furthermore, there is a certain degree of serendipity associated with scientific discoveries and **funding the work of as many researchers as possible increases the likelihood that some of them make major discoveries**."

More People in Research



"Research sponsors should monitor … Limiting the amount of funding awarded to any individual scientist would enable **more people to be actively engaged in research** … Might enhance productivity overall ..."

CONGRESS.GOV | Legislation

H.R.34 - 21st Century Cures Act

114th Congress (2015-2016) | Get alerts

Subtitle C—Supporting Young Emerging Scientists

SEC. 2021. INVESTING IN THE NEXT GENERATION OF RESEARCHERS.

(a) IN GENERAL.—Part A of title IV of the Public Health Service Act (42 U.S.C. 281 et seq.) is amended by adding at the end the following:

"SEC. 404M. NEXT GENERATION OF RESEARCHERS.

What the Law Calls For

"The Director of the National Institutes of Health shall … develop, modify, or prioritize policies, as needed … to promote opportunities for new researchers and earlier research independence, such as policies **to increase opportunities for new researchers to receive funding**, enhance training and mentorship programs for researchers, and **enhance workforce diversity**."

New, Mid-, & Established Investigators: Right Path?

Science AAAS

The National Institutes of Health is worried that middle-aged investigators are being crowded out of the research workforce.

Cultura Creative (RF)/Alamy Stock Photo

NIH discusses curbing lab size to fund more midcareer scientists

By **Jocelyn Kaiser** | Dec. 15, 2016 , 4:00 PM

"[NIH Director Francis Collins] worries that the current system may delay the desired progression of early-career scientists. 'If the model is that the senior investigator continues to be the principal investigator, and the junior scientist is not quite independent, then what are we propagating?' he asked."

Looking Forward to Open Dialogue …

NIH National Institutes of Health
Office of Extramural Research

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Open Mike

Helping connect you with the NIH perspective, and helping connect us with yours

Posted on **May 2, 2017** by **Mike Lauer**

Implementing Limits on Grant Support to Strengthen the Biomedical Research Workforce

Dr. Michael Lauer is NIH's Deputy Director for Extramural Research,

https://nexus.od.nih.gov/all/2017/05/02/nih-grant-support-index/