Next Generation Investigators NAS Initiative: NIH Perspectives

Michael S Lauer, MD

Deputy Director for Extramural Research, National Institutes of Health

Many thanks to Jon Lorsch (NIGMS) and to OD/OER/OPAC/DPEA/Statistical Analysis and Reporting Branch

First Committee Meeting on the NAS

Next Generation Investigators Initiative

Monday, January 9, 2017

NAS Room 120; 2101 Constitution Avenue NW, Washington, D.C.

Longstanding Interest

"New investigators are the innovators of the future - they pioneer new areas of investigation. Entry of new investigators into the ranks of independent, NIH-funded researchers is essential to the health of our country's biomedical research enterprise."

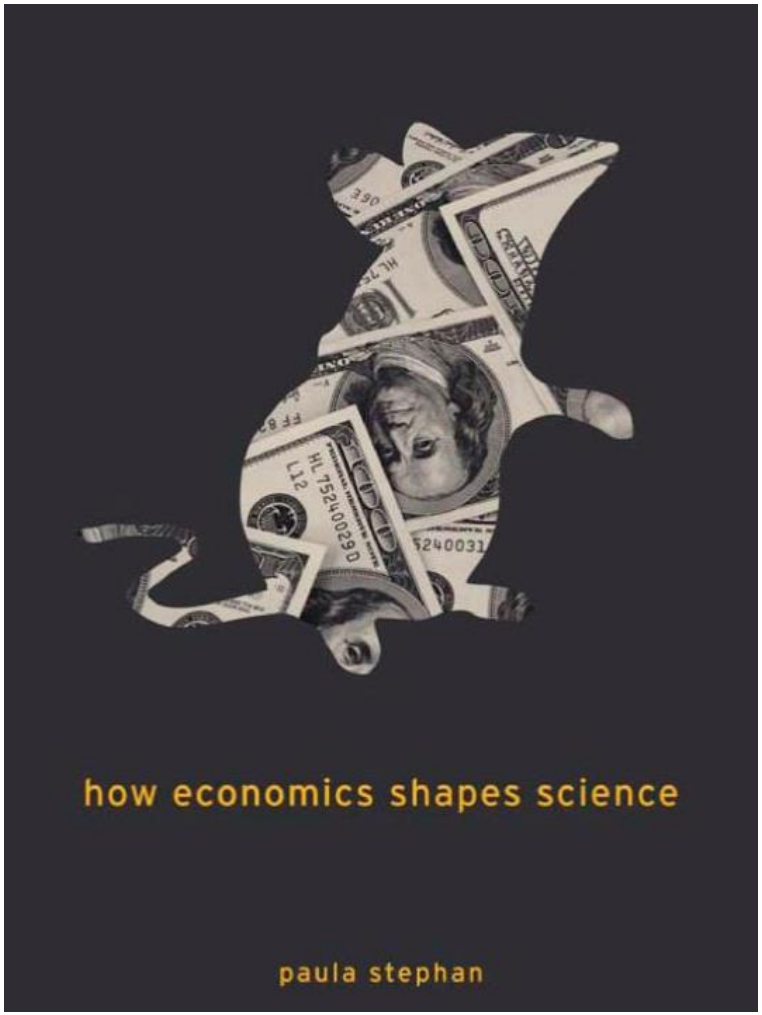
Sally Rockey, PhD

http://grants.nih.gov/policy/new_investigators/history.htm

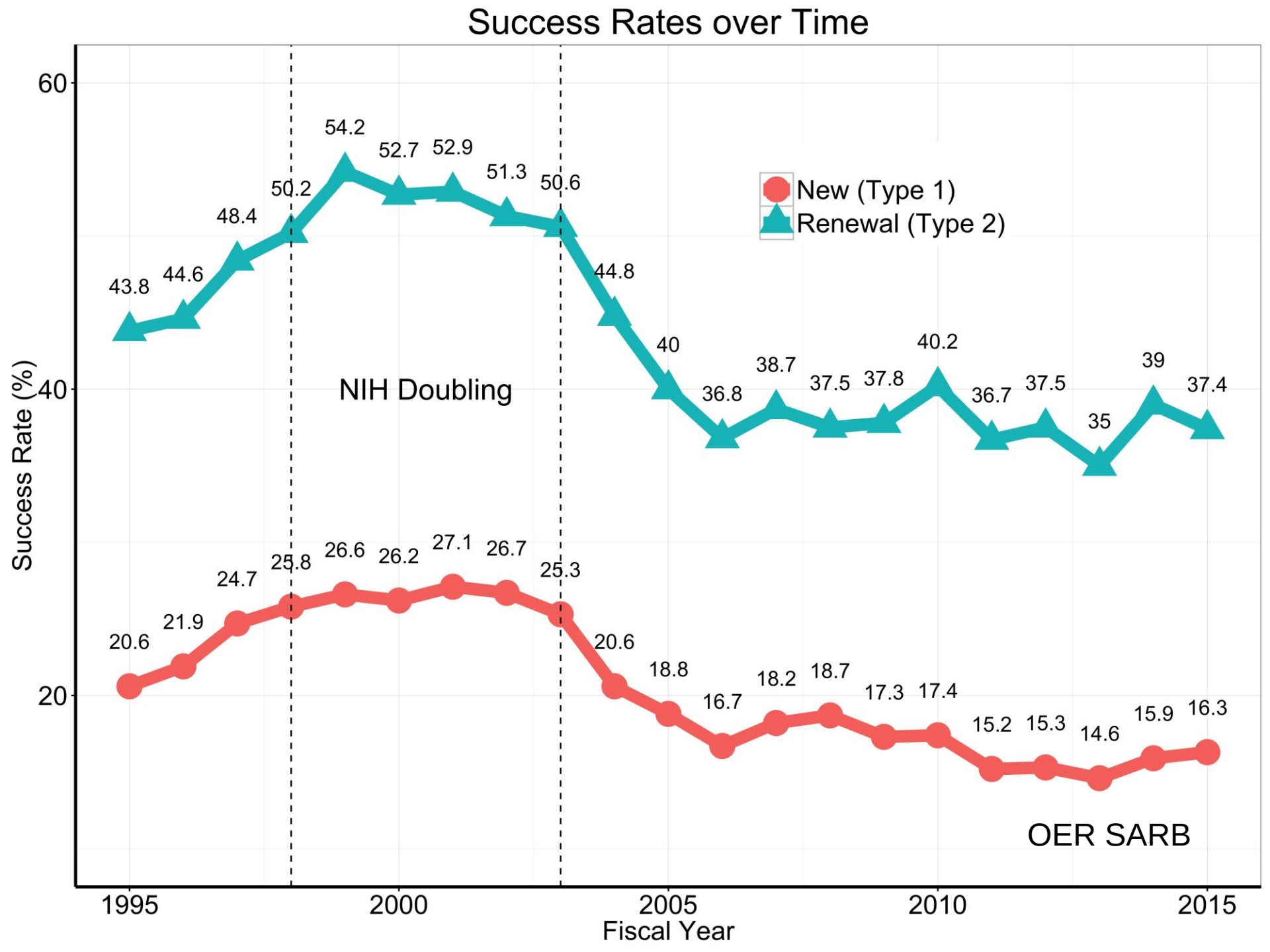
Not Just a Matter of Money

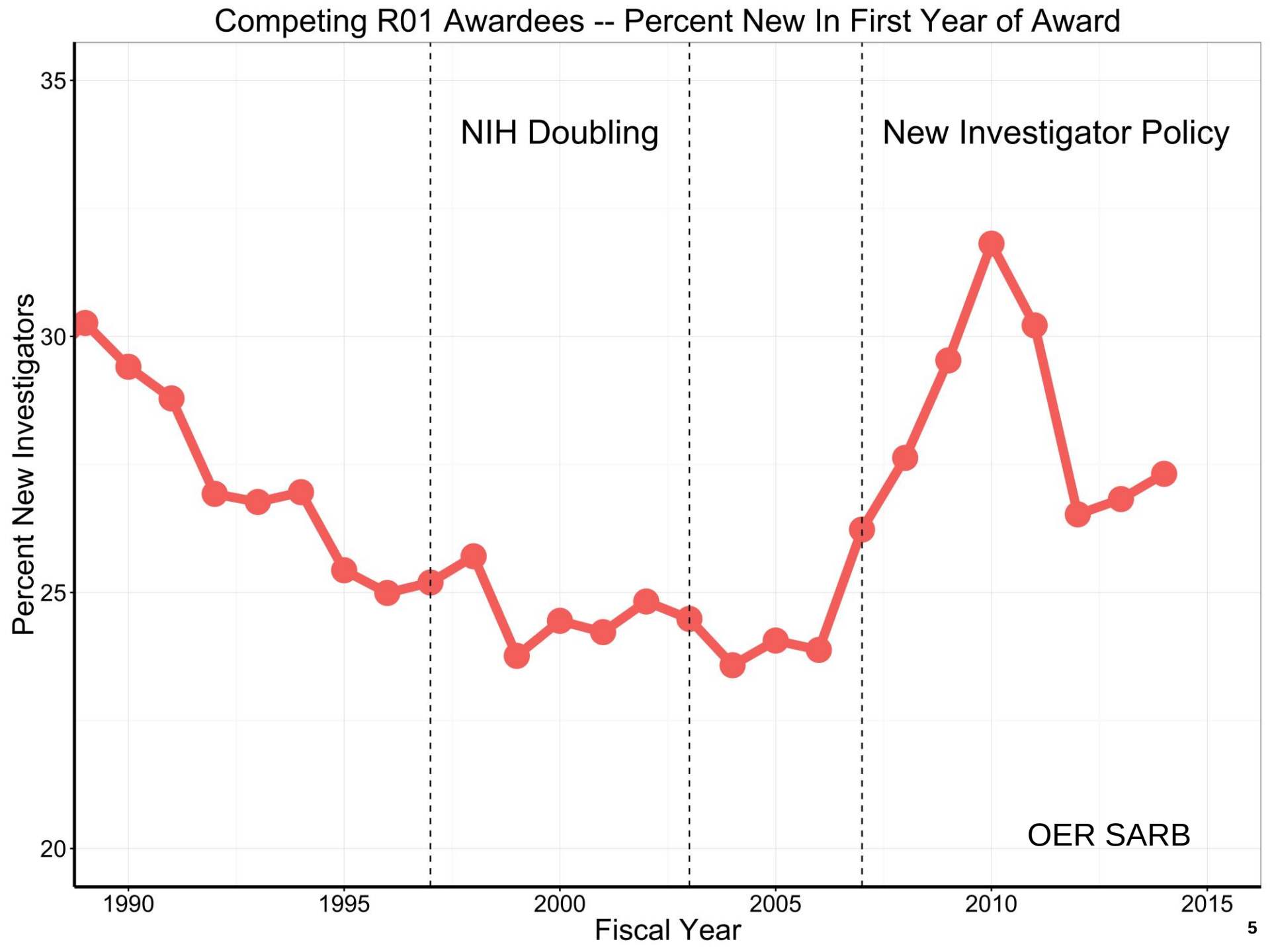
"It is tempting to assume that money is the answer... Additional funds should translate into higher success rates ... [and] should also mean more jobs and grants for young researchers."

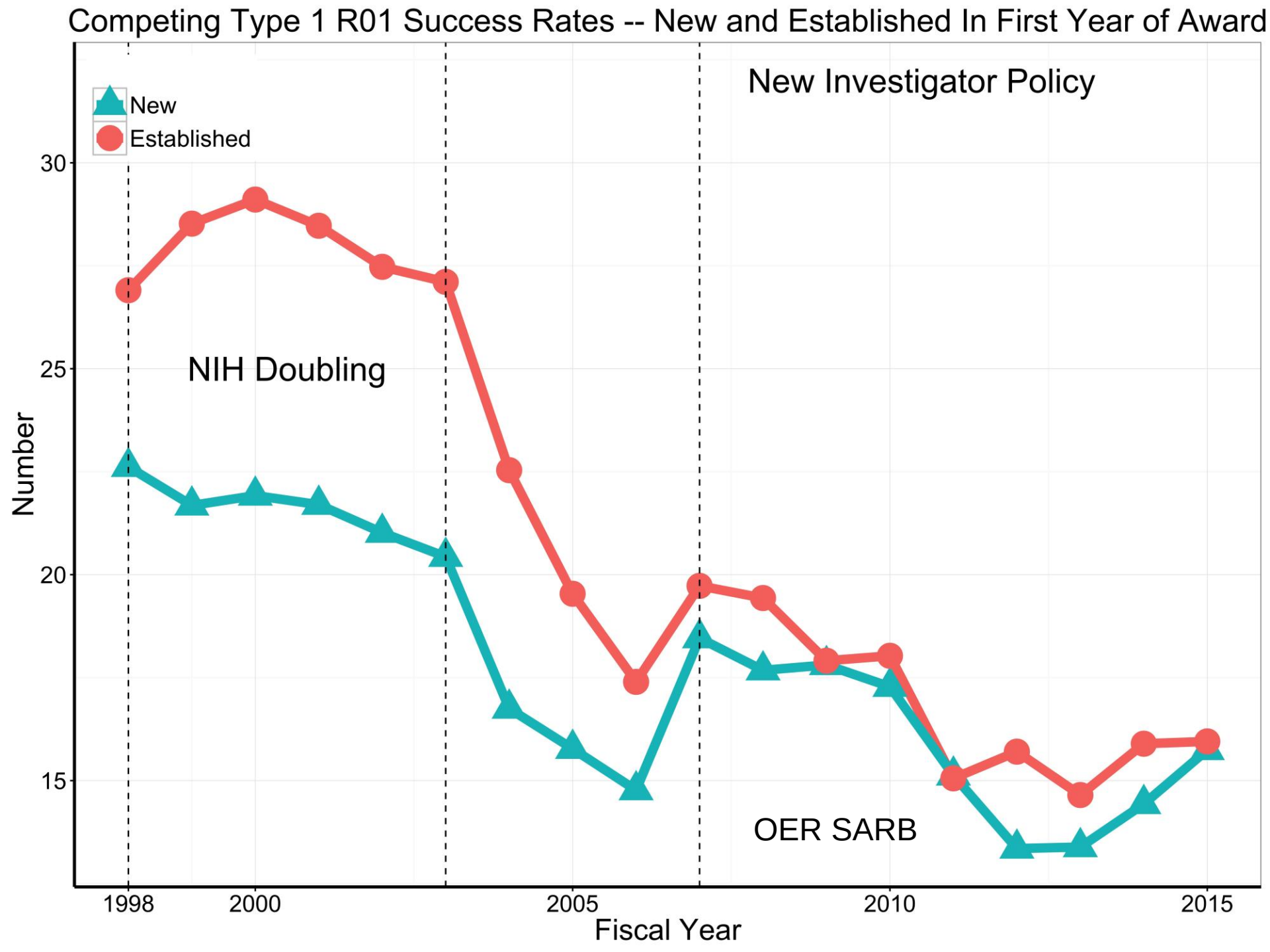
- Paula Stephan

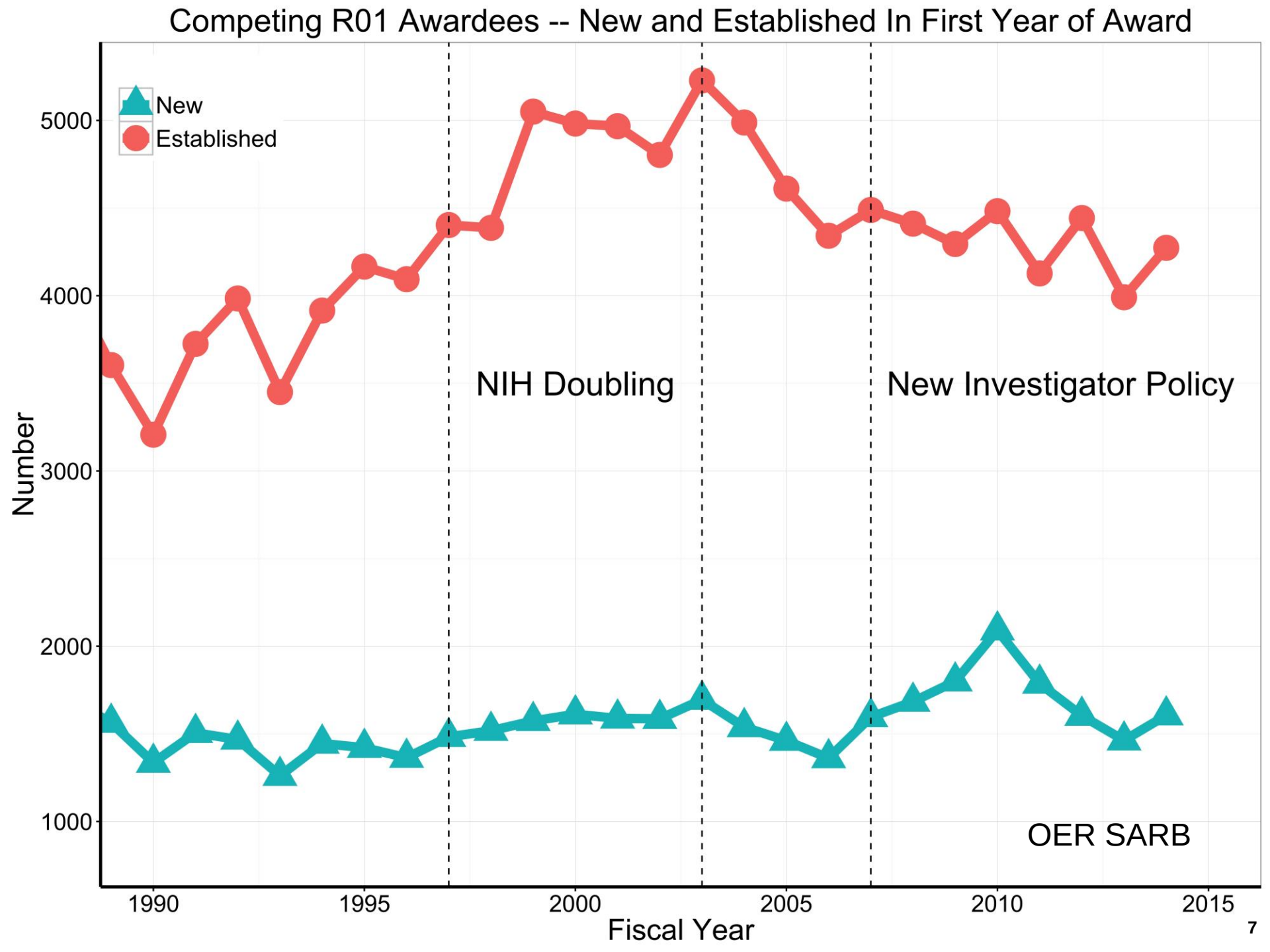


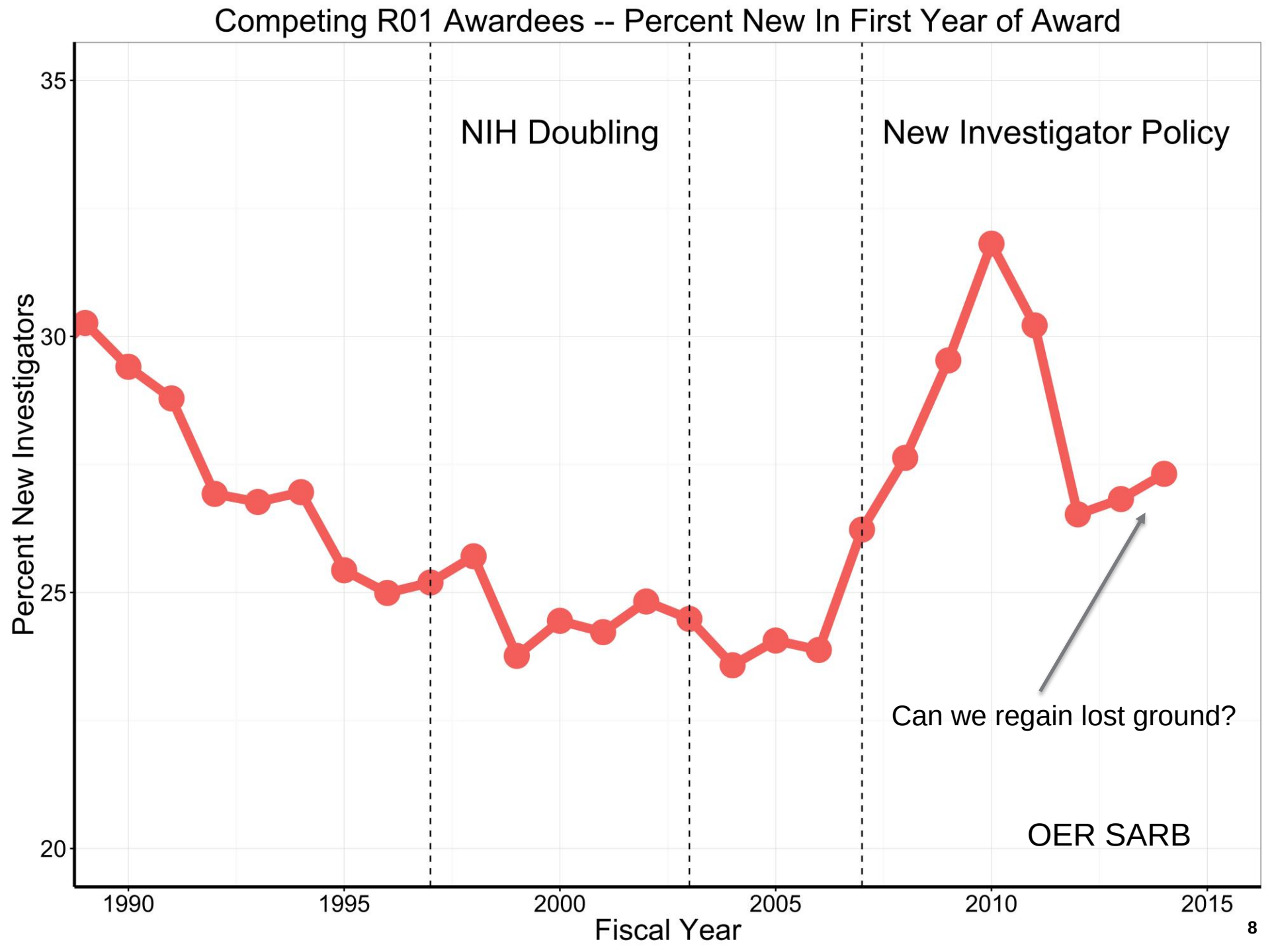
https://www.amazon.com/Economics-Shapes-Science-Paula-Stephan/dp/0674088166


Success Rates over Time
60
40
20
Success Rate (%)
New (Type 1)
Renewal (Type 2)
NIH Doubling
OER SARB
43.8
44.6
48.4
50.2
54.2
52.7
52.9
51.3
50.6
44.8
40
36.8
38.7
37.5
37.8
40.2
36.7
37.5
35
39
37.4
20.6
21.9
24.7
25.8
26.6
26.2
27.1
26.7
25.3
20.6
18.8
16.7
18.2
18.7
17.3
17.4
15.2
15.3
14.6
15.9
16.3
1995
2000
2005
2010
2015
Fiscal Year


Competing R01 Awardees -- Percent New In First Year of Award
NIH Doubling
New Investigator Policy
OER SARB
Percent New Investigators
35
30
25
20
1990
1995
2000
2005
2010
2015
Fiscal Year


Competing Type 1 R01 Success Rates -- New and Established In First Year of Award
New
Established
New Investigator Policy
NIH Doubling
OER SARB
Number
30
25
20
15
1998
2000
2005
2010
2015
Fiscal Year

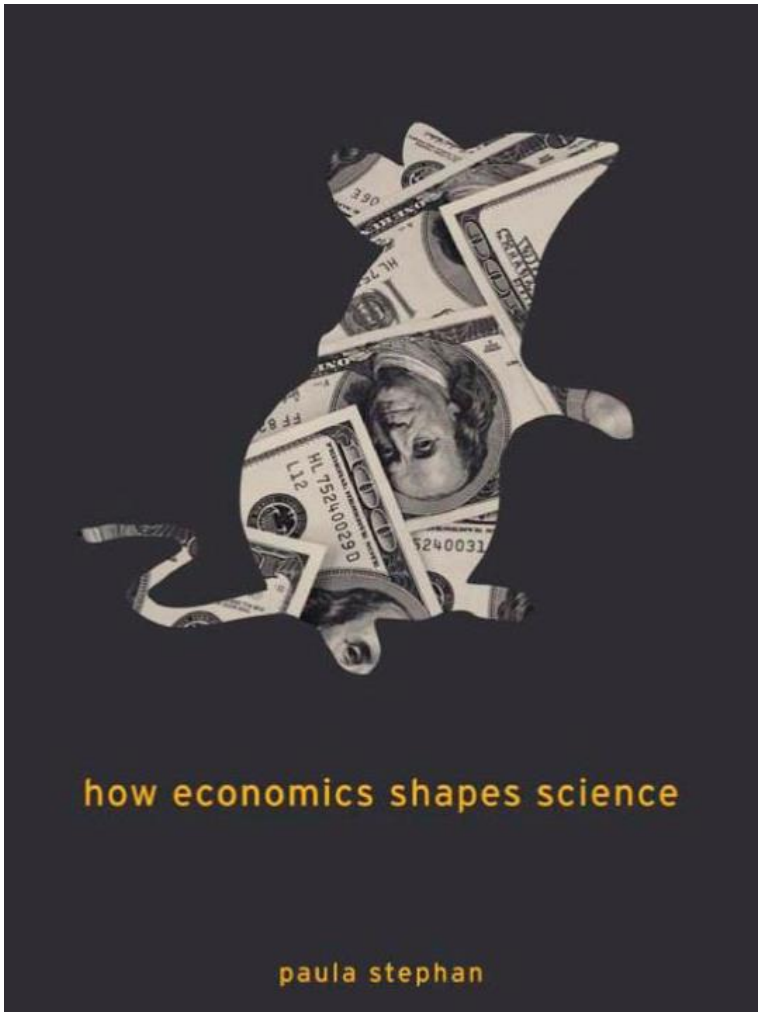

Competing R01 Awardees -- New and Established In First Year of Award
New
Established
5000
4000
3000
2000
1000
Number
NIH Doubling
New Investigator Policy
OER SARB
1990
1995
2000
2005
2010
2015
Fiscal Year


Competing R01 Awardees -- Percent New In First Year of Award
NIH Doubling
New Investigator Policy
Can we regain lost ground?
OER SARB
Percent New Investigators
35
30
25
20
1990
1995
2000
2005
2010
2015
Fiscal Year

Not Just a Matter of Money

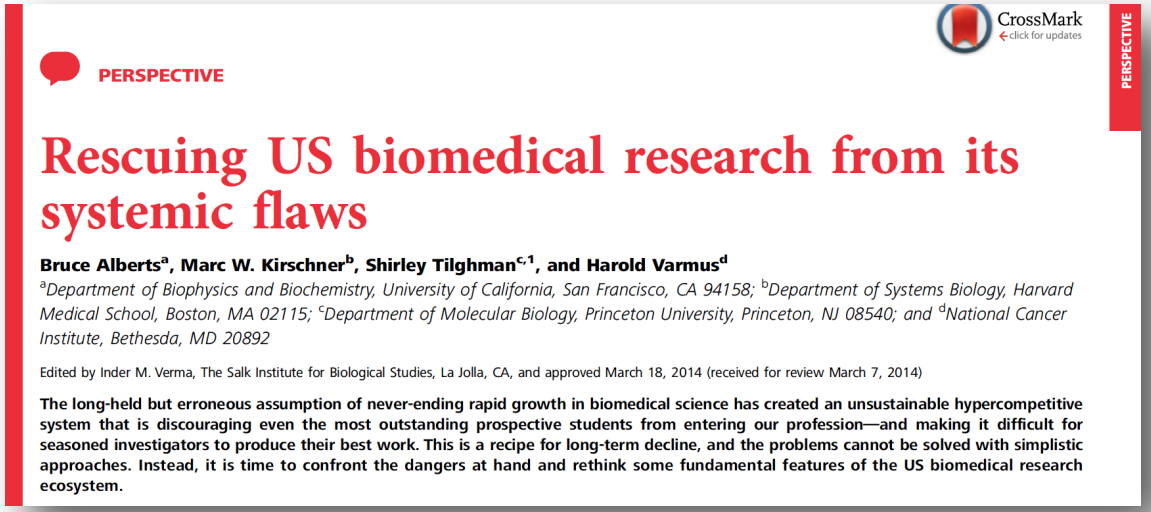
"More money should also mean grants for young researchers ... The end result was that the majority of research universities went on an unprecedented building binge ... [to recruit] senior faculty."

- Paula Stephan



https://www.amazon.com/Economics-Shapes-Science-Paula-Stephan/dp/0674088166

Root Problem: Era of Hypercompetition



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.

"The erroneous assumption of never-ending rapid growth 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."

Alberts B, Kirschner MW, Tilghman S, Varmus H. PNAS 2014;111:5773-7

Core Problems Underlying an Unstable System

eLIFE elifesciences.org

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."

eLife 2015;4:e09305

Growing Recognition of the Problem

"In the United States, for example, **funding success rates for all age brackets are less than half what they were in 1980**, so researchers have to spend more time seeking funds. That **burden falls most heavily on new faculty members … makes them conservative rather than ambitious**."

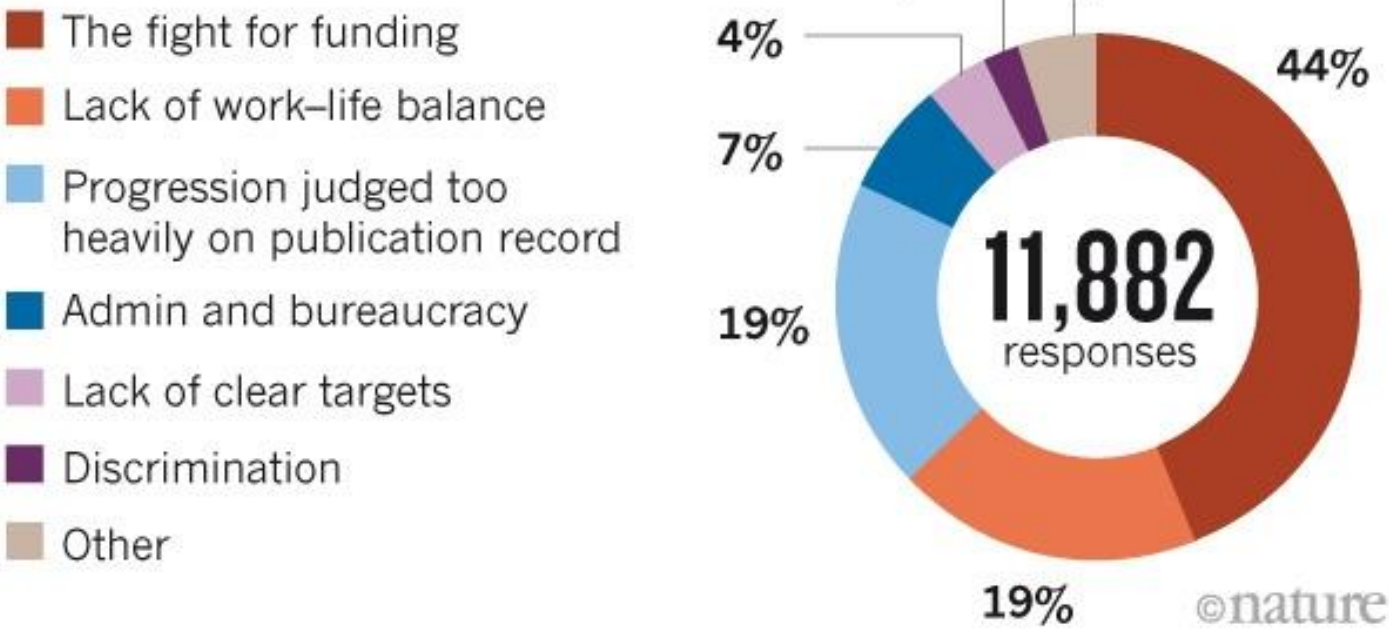
Nature 2016;538:427

The “Fight for Funding” Is The Biggest Concern

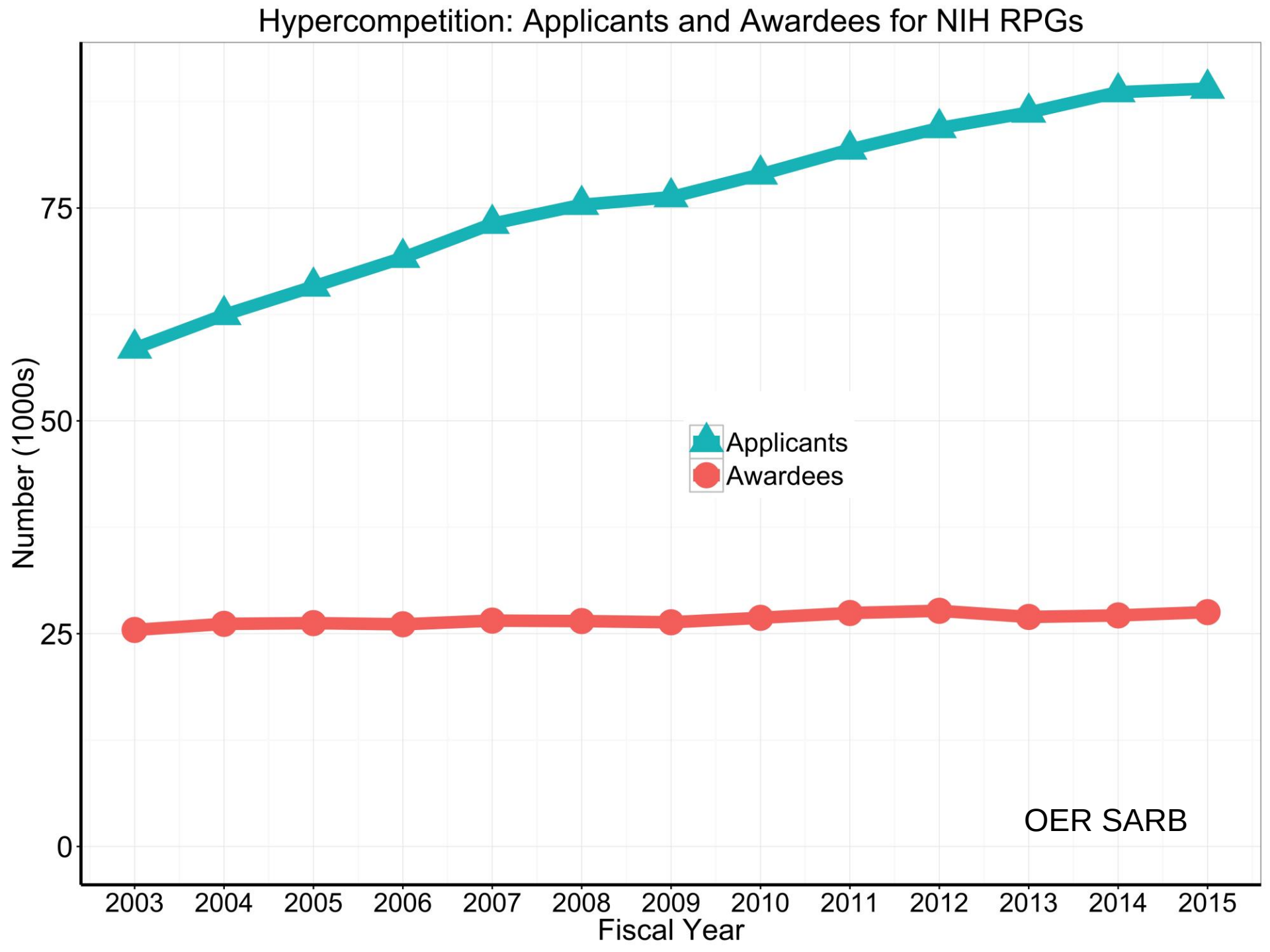
FIGHT FOR FUNDING

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

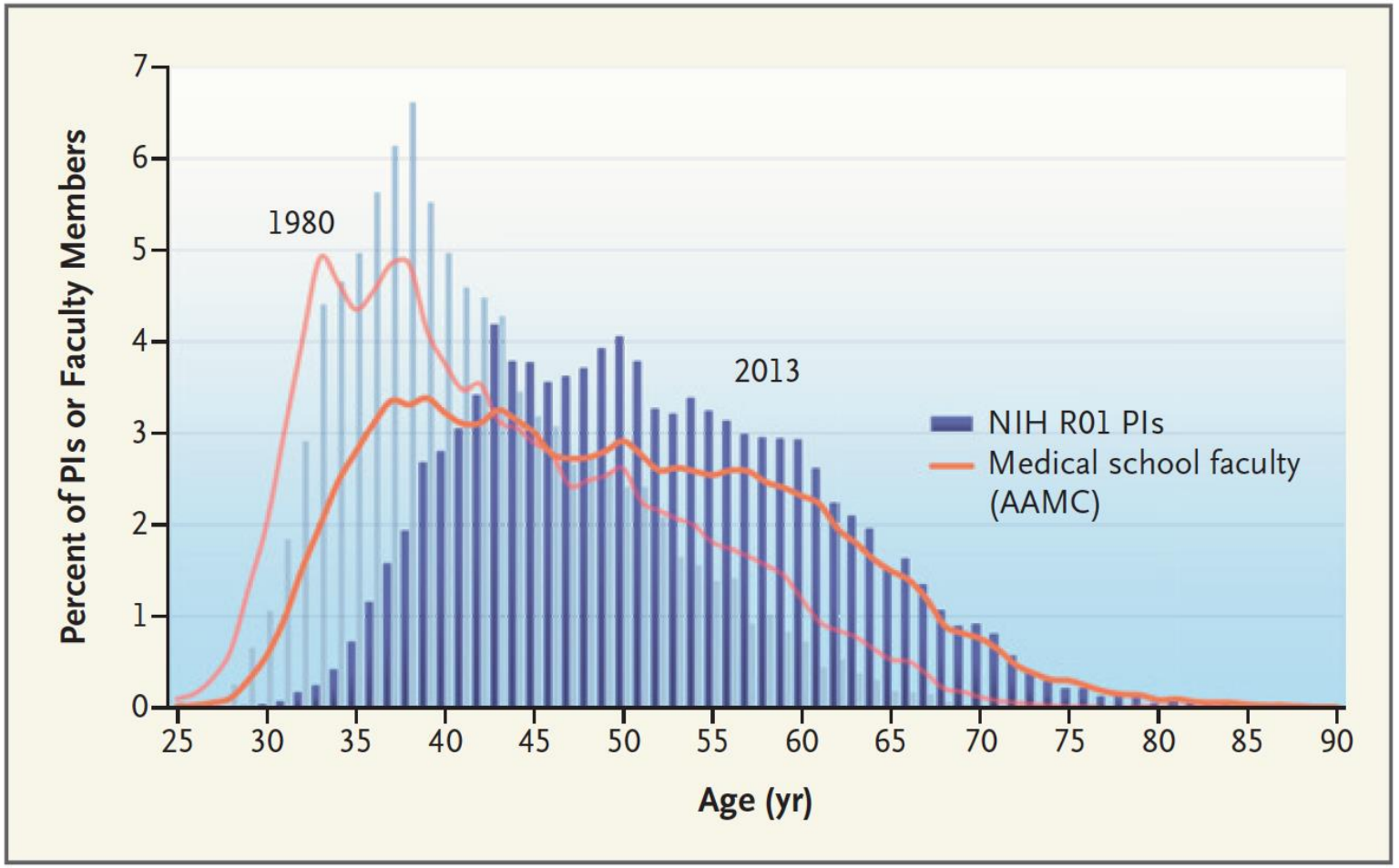
Poll question:
What do you think is the biggest challenge facing early-career scientists?



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

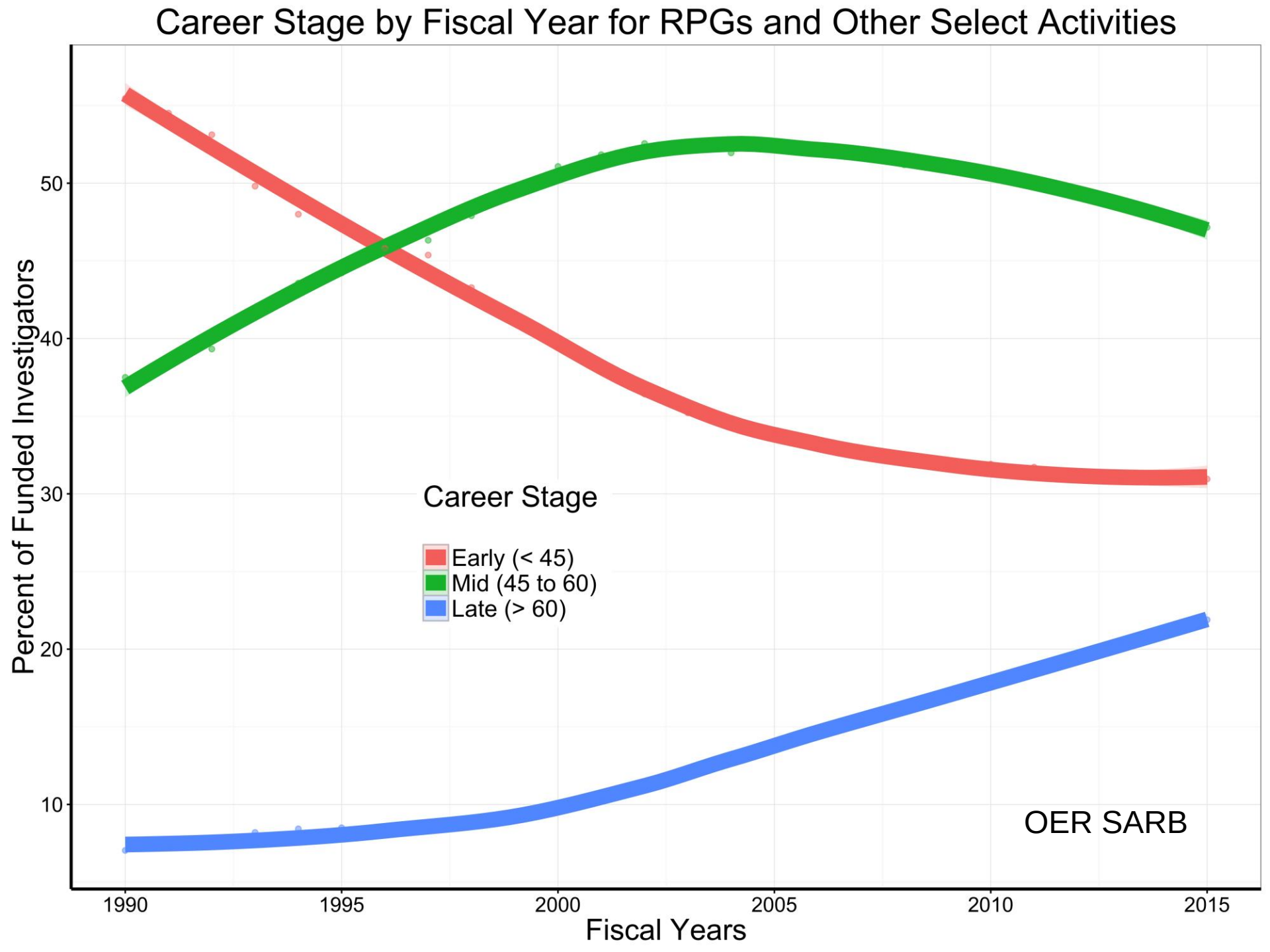

Hypercompetition: Applicants and Awardees for NIH RPGs
Number (1000s)
75
50
25
0
Applicants
Awardees
OER SARB
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Fiscal Year

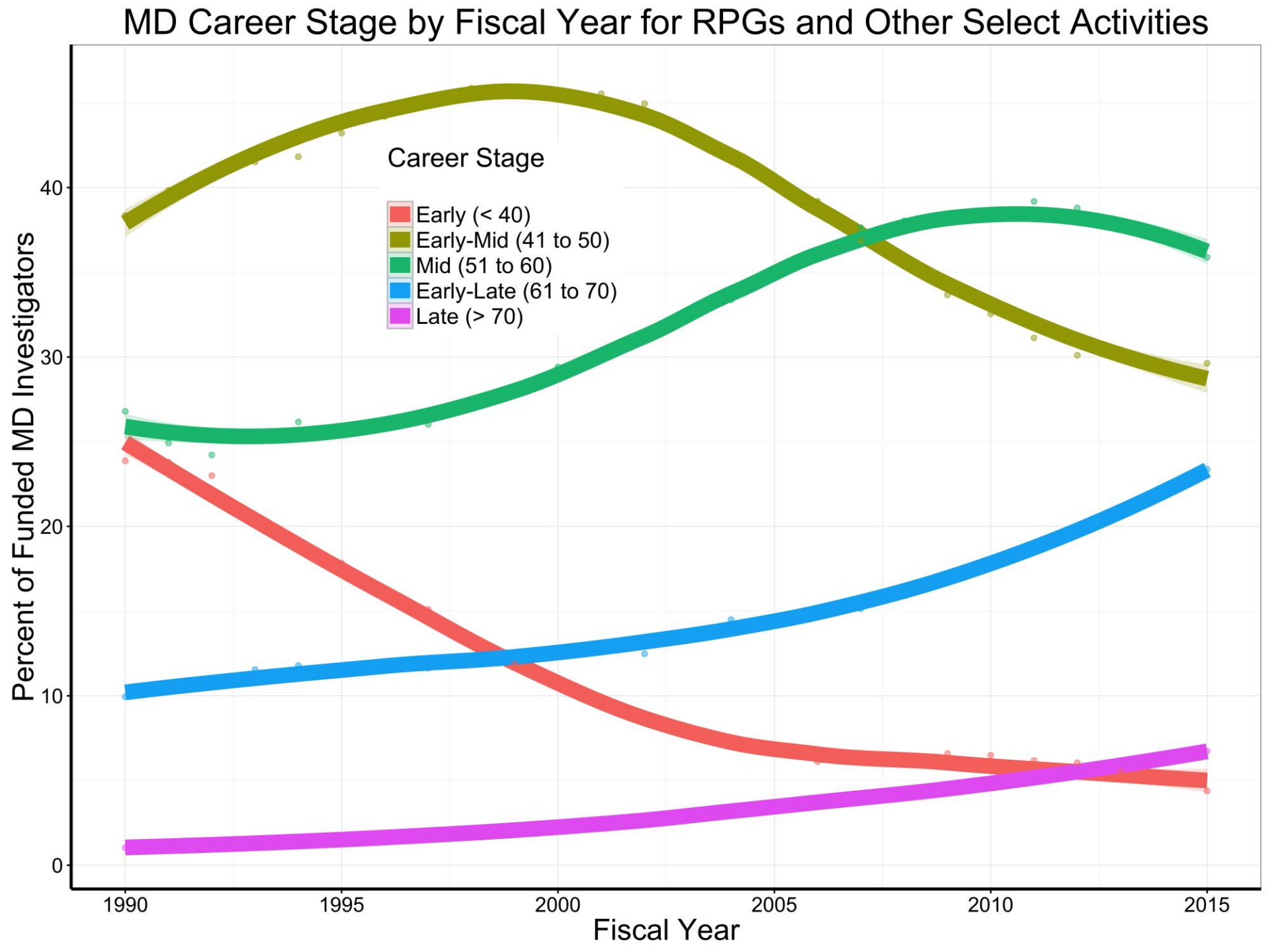
We Also Know That …



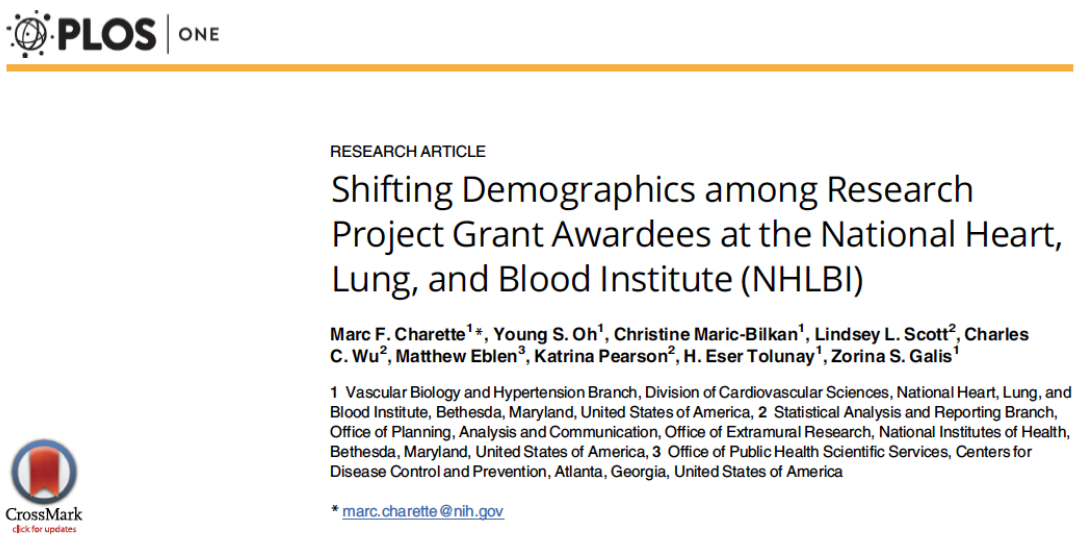
Age Distribution of NIH Principal Investigators (PIs) and Medical School Faculty, 1980–2010.

Orwoll E. N Engl J Med 2016;374:2514-7


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

New Investigators Includes Mid-Career



PLOS ONE

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]

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

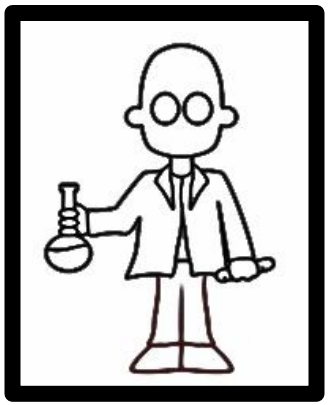
* marc.charette@nih.gov

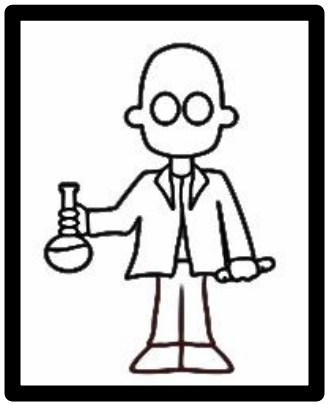
CrossMark click for updates

"[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."

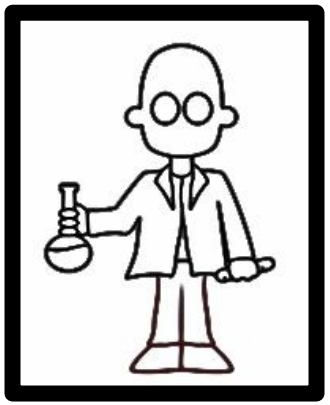
Charette M et al. PLOS ONE 2016; DOI:10.1371/journal.pone.0168511

There are Three Types of Players





RPG Grant Award



RPG Grant Award

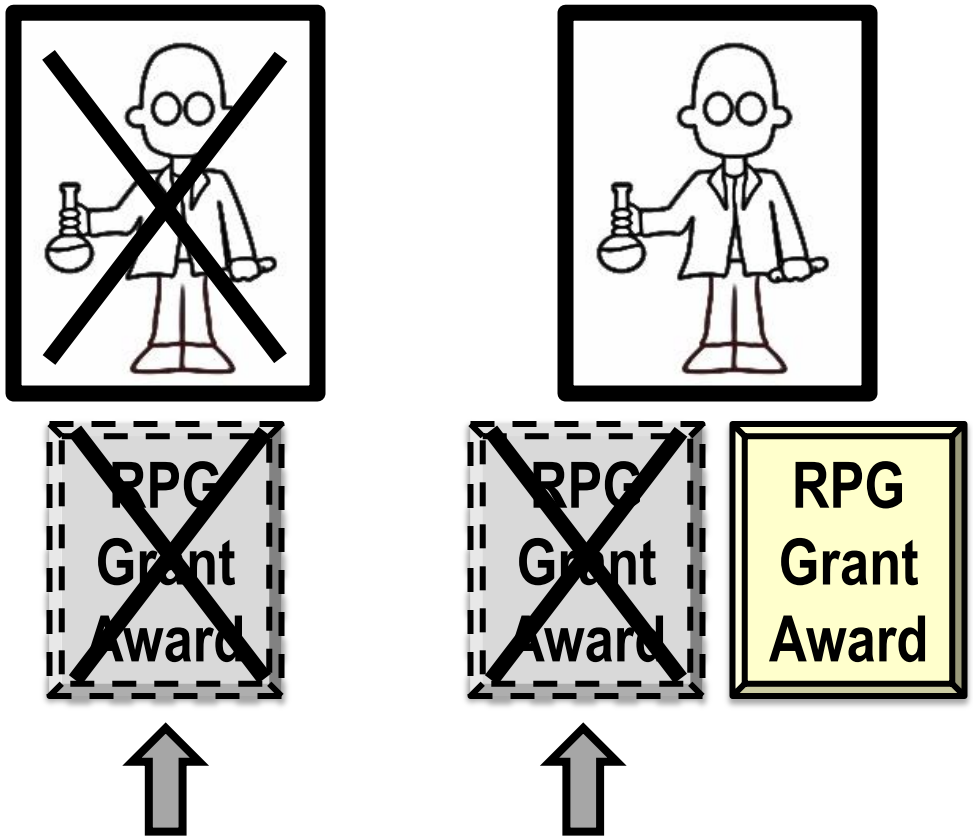
RPG Grant Award

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

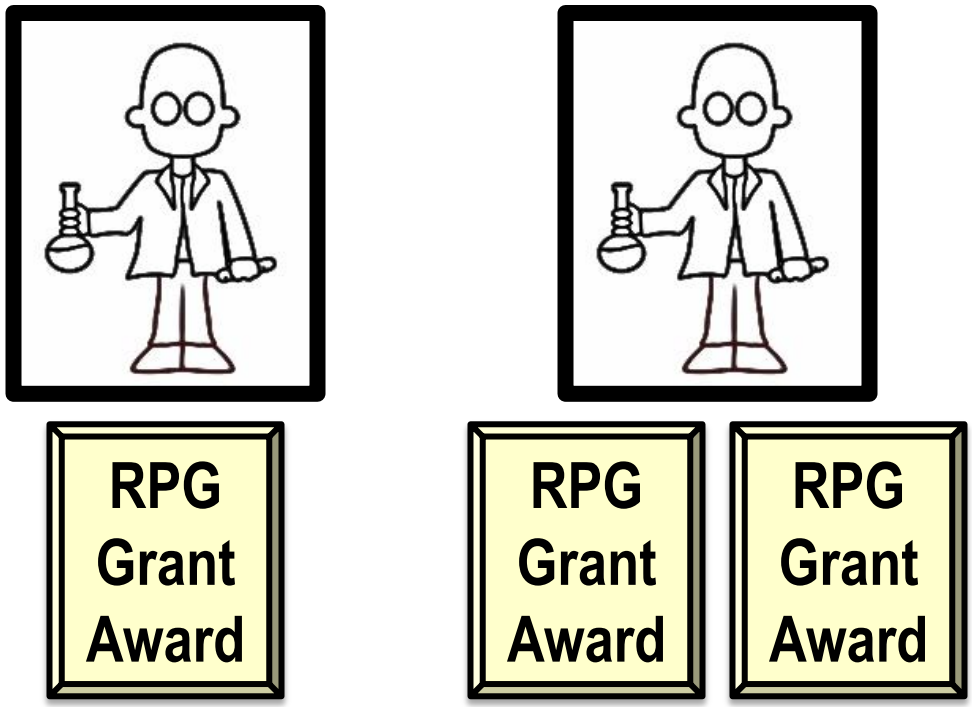
Players, who have only one award and fail to renew their award, may be forced from the game



Thanks to Marc Charette

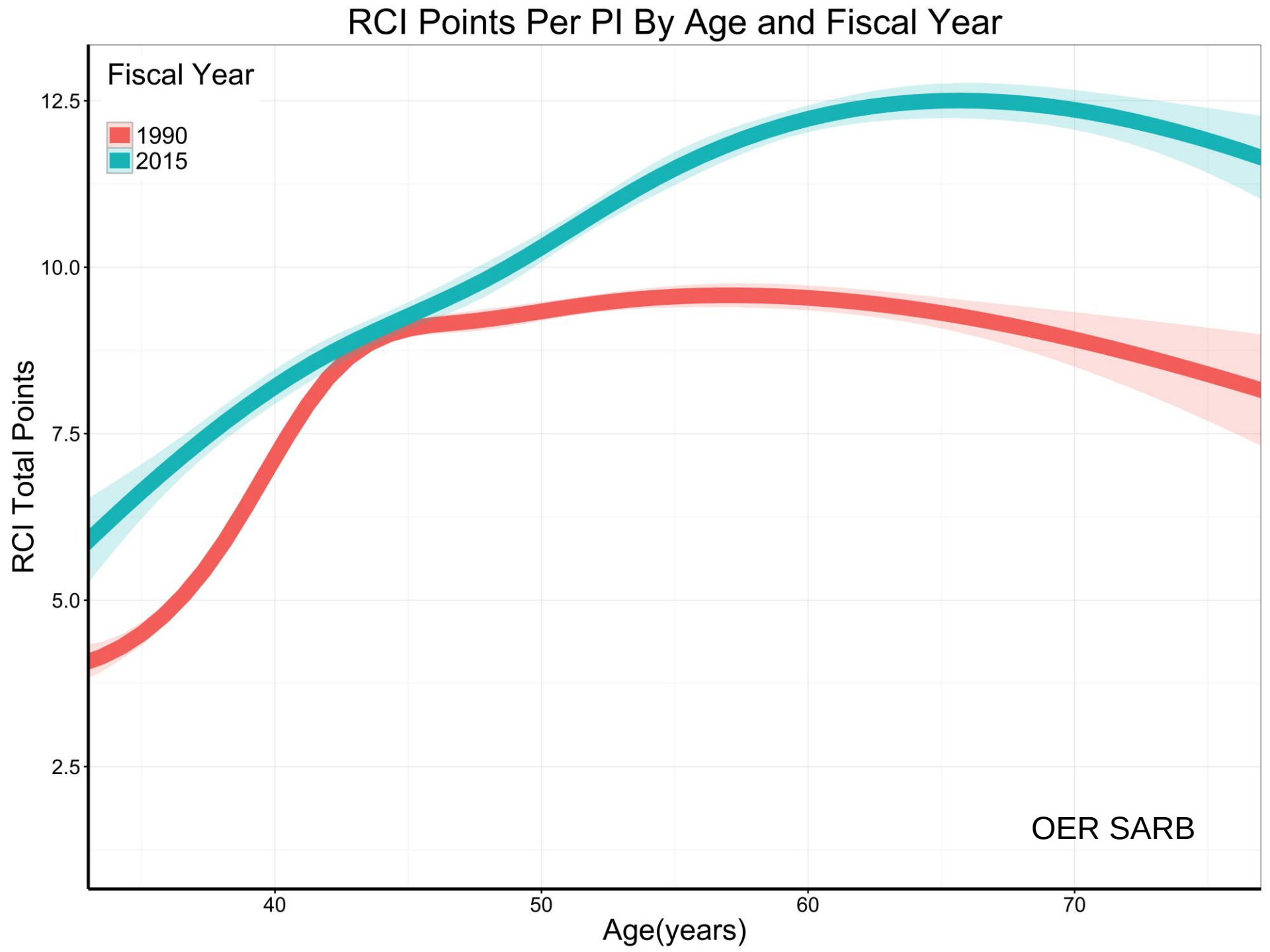
Multiple Grants confer Survival Enhancement

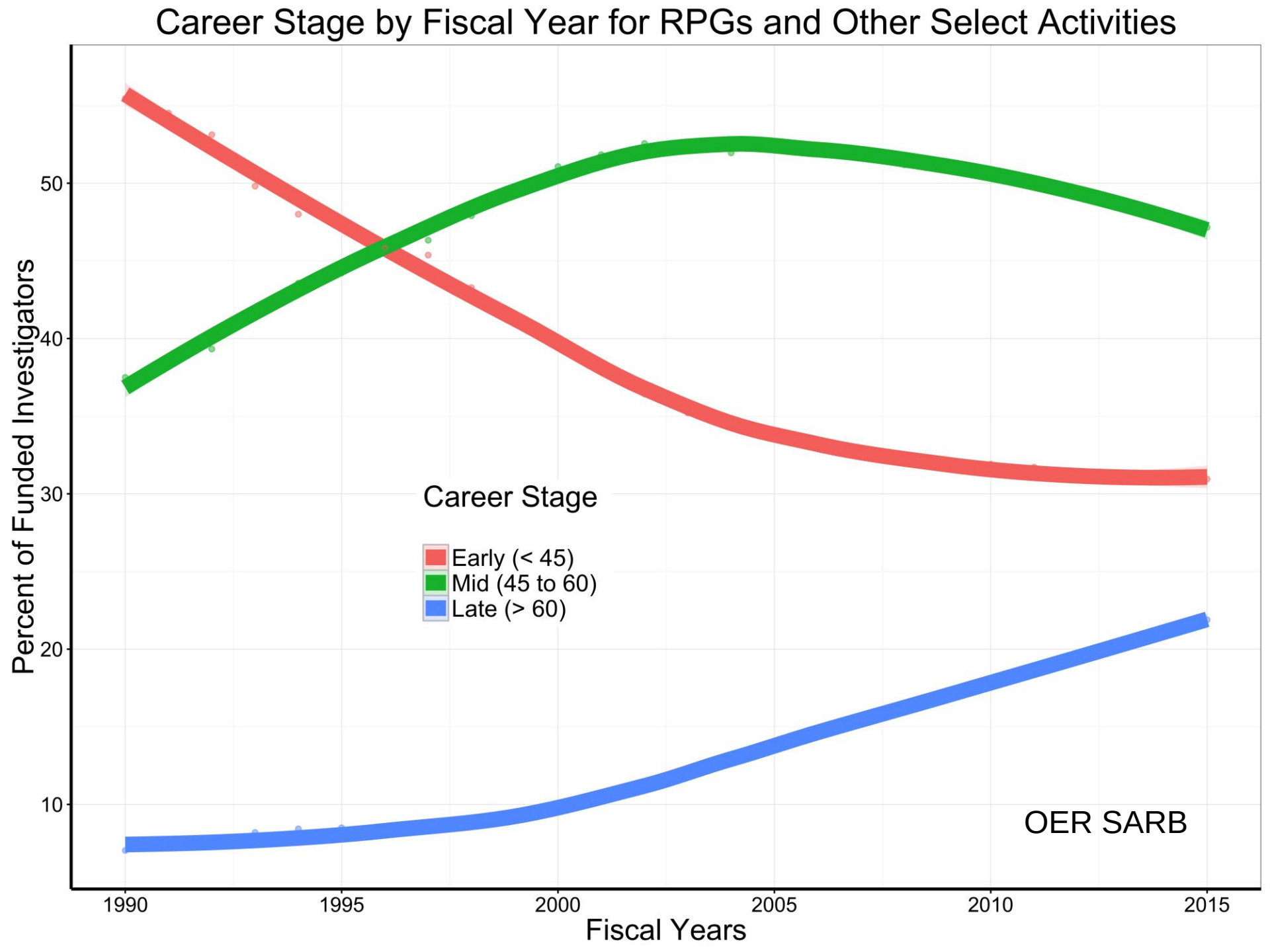
Player with selective disadvantage ⇨



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

Thanks to Marc Charette


RCI Points Per PI By Age and Fiscal Year
Fiscal Year
1990
2015
12.5
10.0
7.5
5.0
2.5
RCI Total Points
40
50
60
70
Age(years)
OER SARB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50
40
30
20
10
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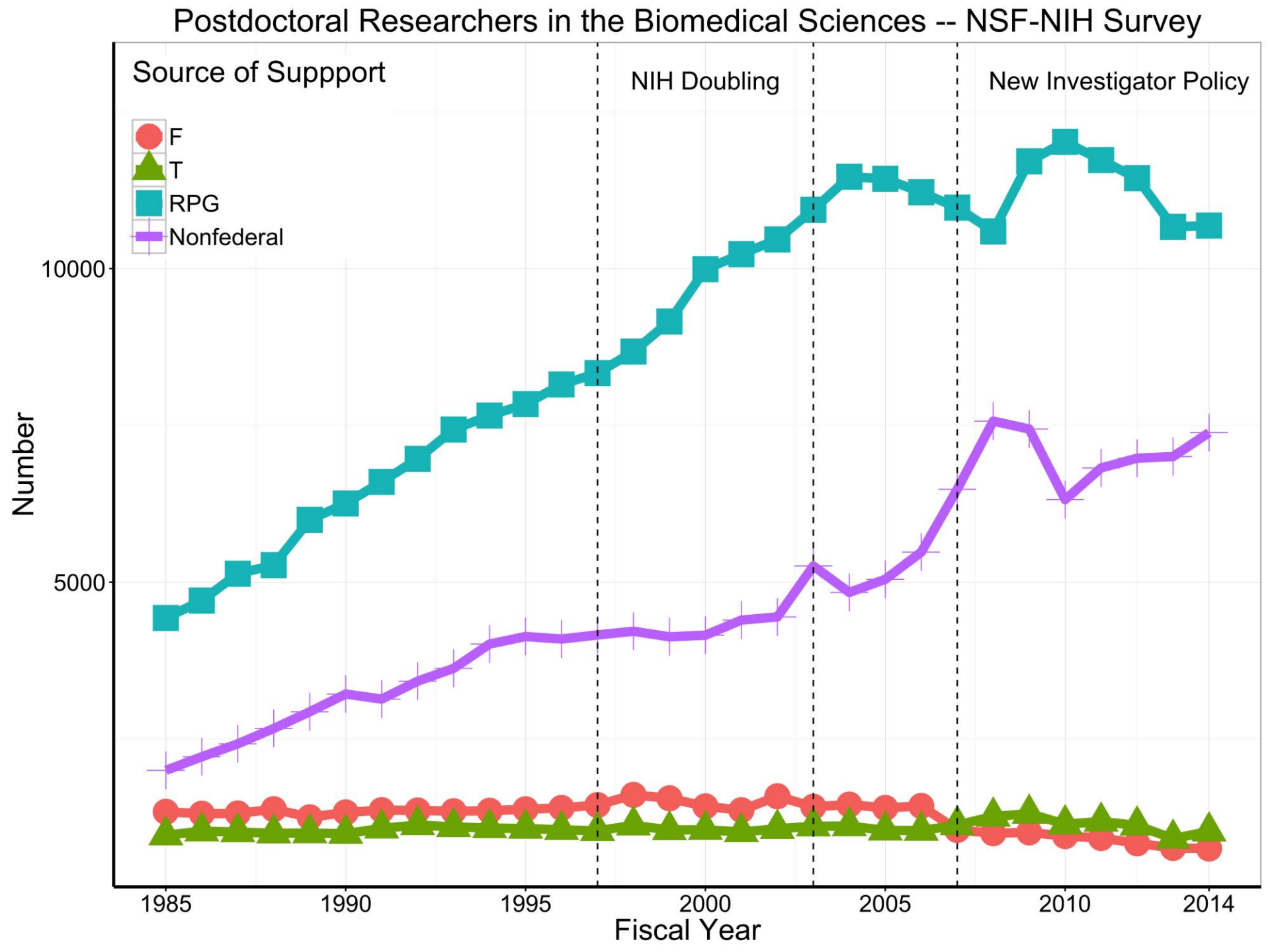
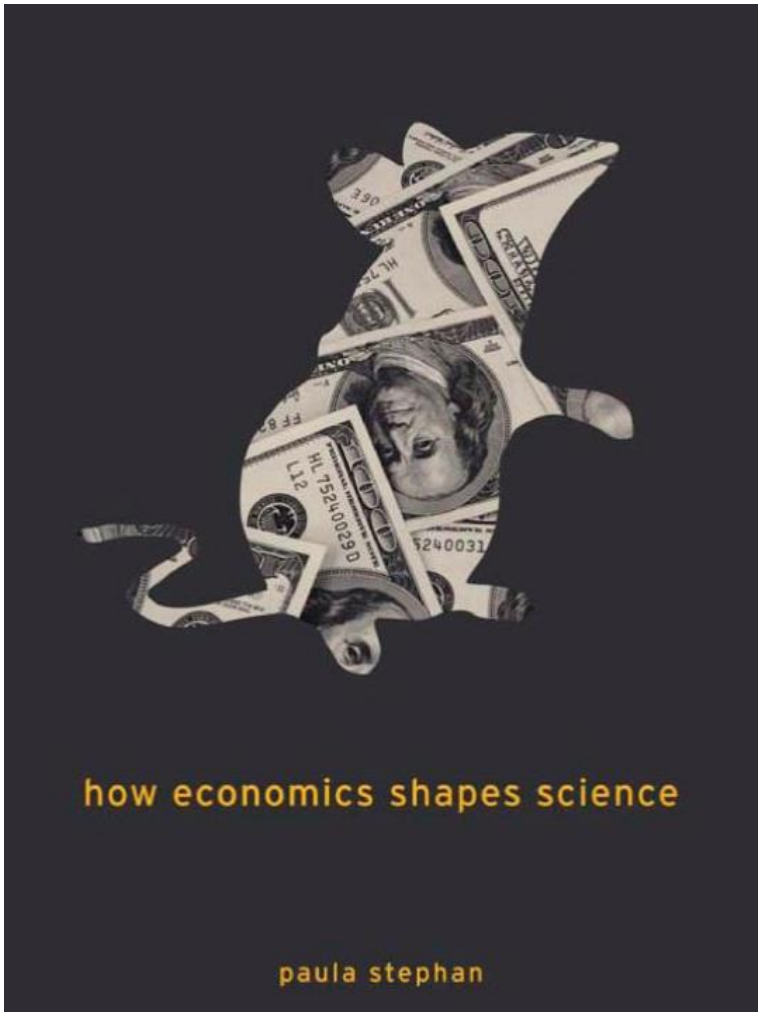
Early (< 45)
Mid (45 to 60)
Late (> 60)
OER SARB
1990
1995
2000
2005
2010
2015
Fiscal Years


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

Postdoc Problems

"There is almost unanimous agreement that there is not a shortage of postdoctoral fellows. Growth ... increased availability of research funds ... Cost advantage from staffing labs with postdocs ..."

- Paula Stephan



https://www.amazon.com/Economics-Shapes-Science-Paula-Stephan/dp/0674088166

Efficiency: Maybe It Makes Sense?

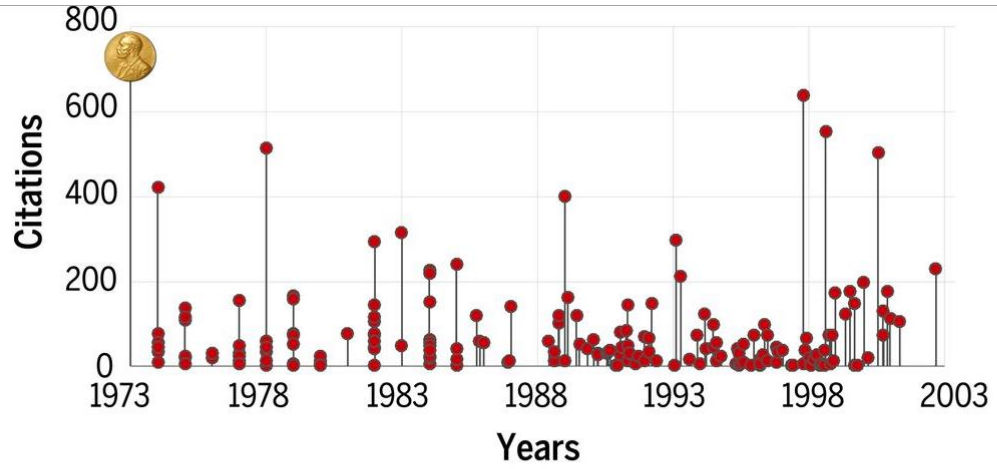
RESEARCH

RESEARCH ARTICLE SUMMARY

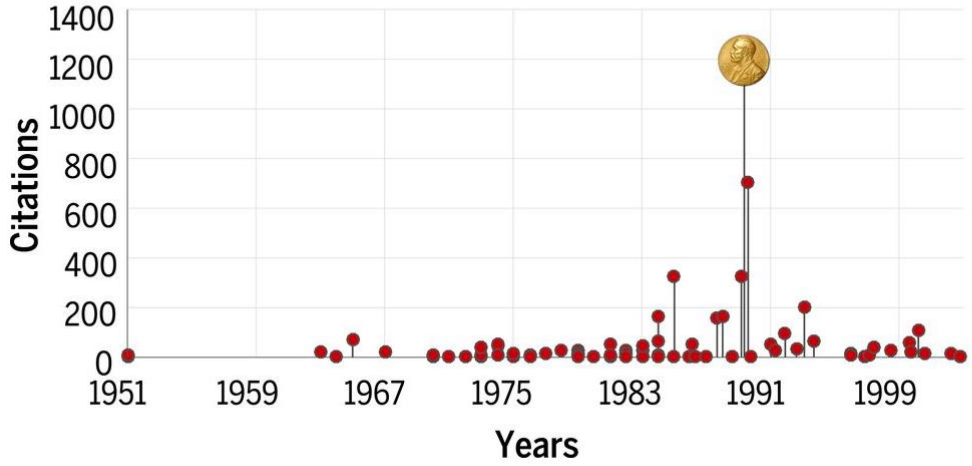
SCIENCE COMMUNITY

Quantifying the evolution of individual scientific impact

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



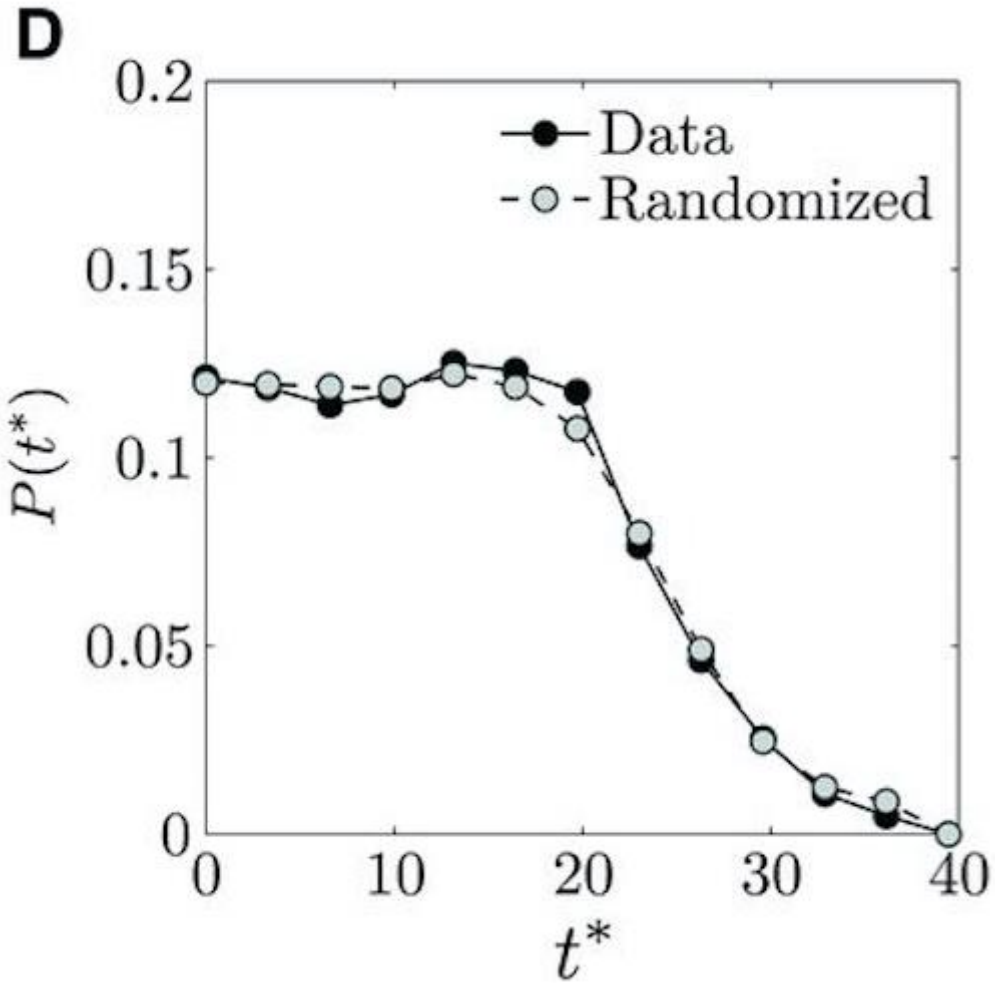
Frank A. Wilczek
Physics Nobel,
2004



John B. Fenn
Chemistry Nobel,
2002

Sinatra R et al. Science 2016;354:596

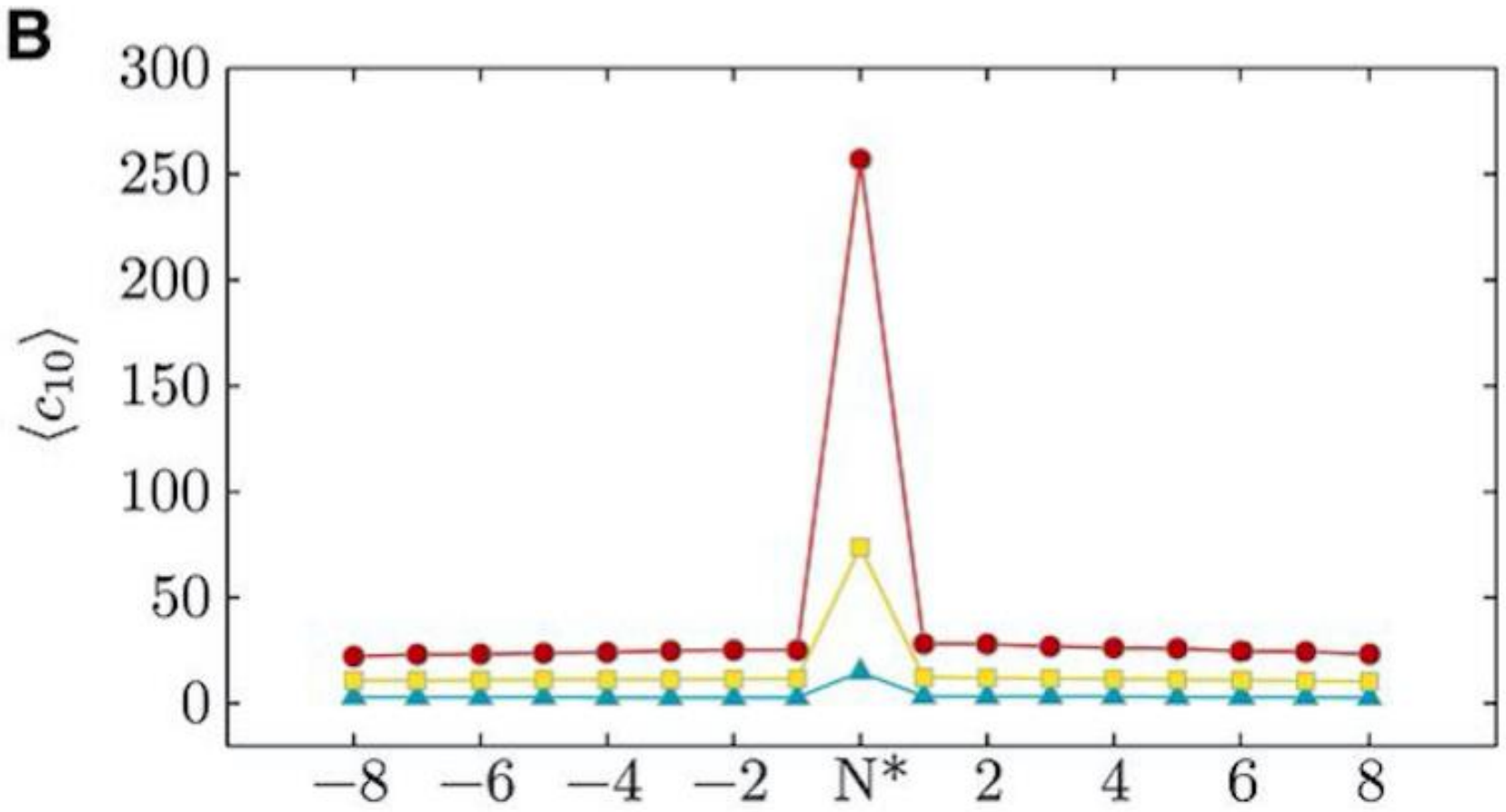
“Random-Impact Rule”



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

Sinatra R et al. Science 2016;354:596

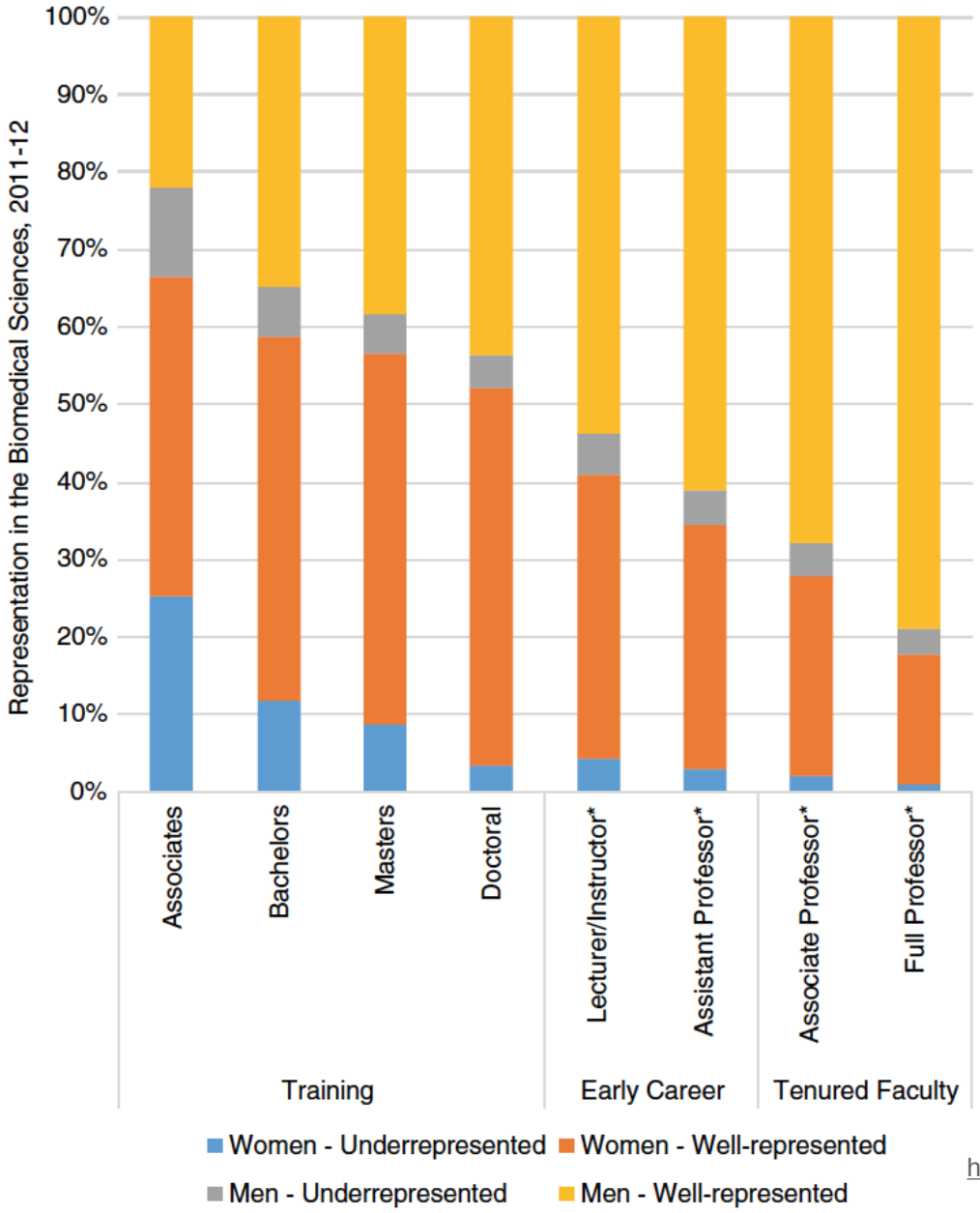
“Random-Impact Rule”



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

Sinatra R et al. Science 2016;354:596

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

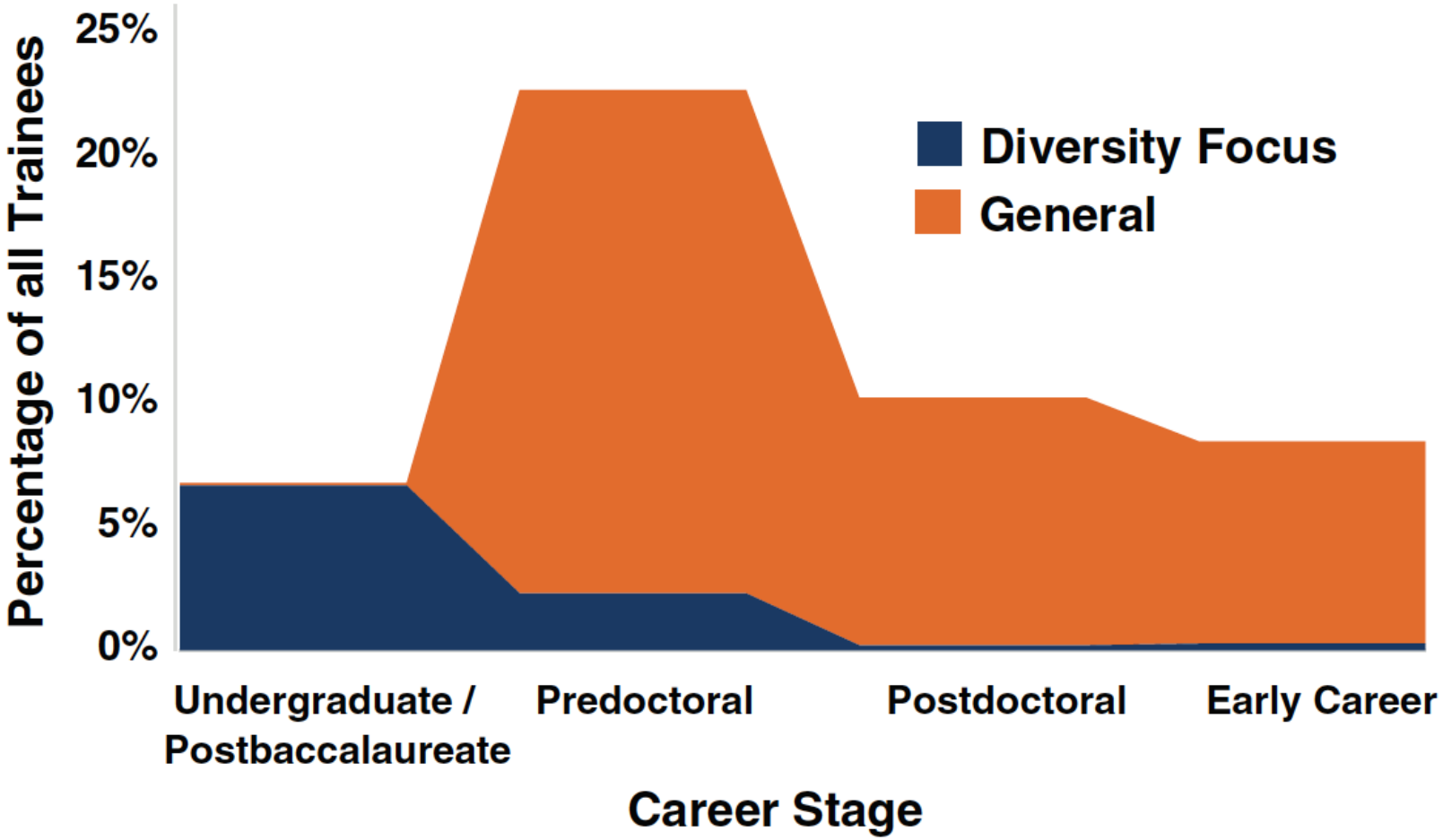
"We can build through more focus on the nodes where attrition is most common. [Focus] on retention, continuity, flexibility, and innovation across the career pathway."

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

Training and Diversity Focus



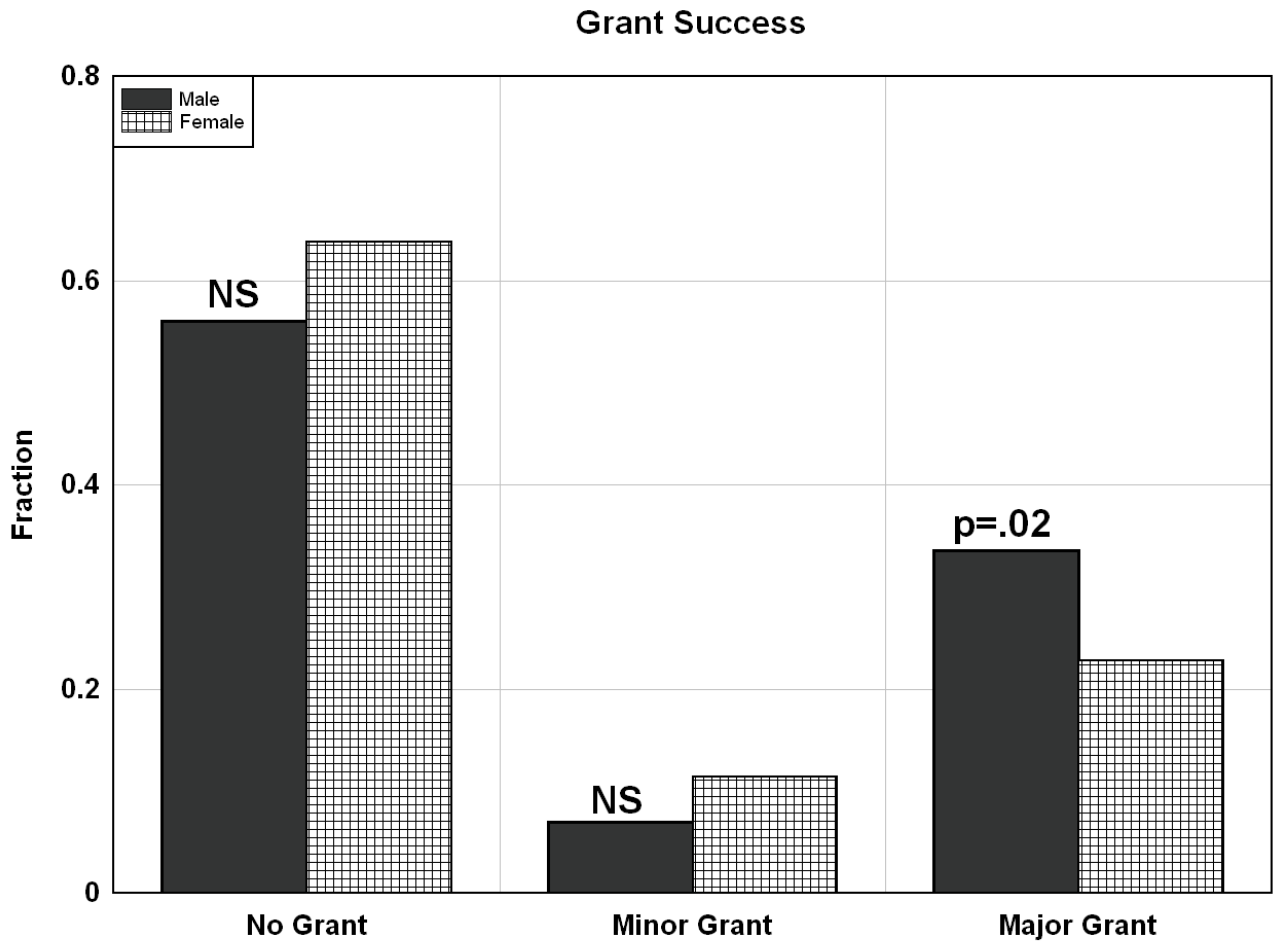
CBE—Life Sciences Education • 15:fe4, 1–5, Fall 2016

Long-Term Outcomes?

RESEARCH ARTICLE Open Access

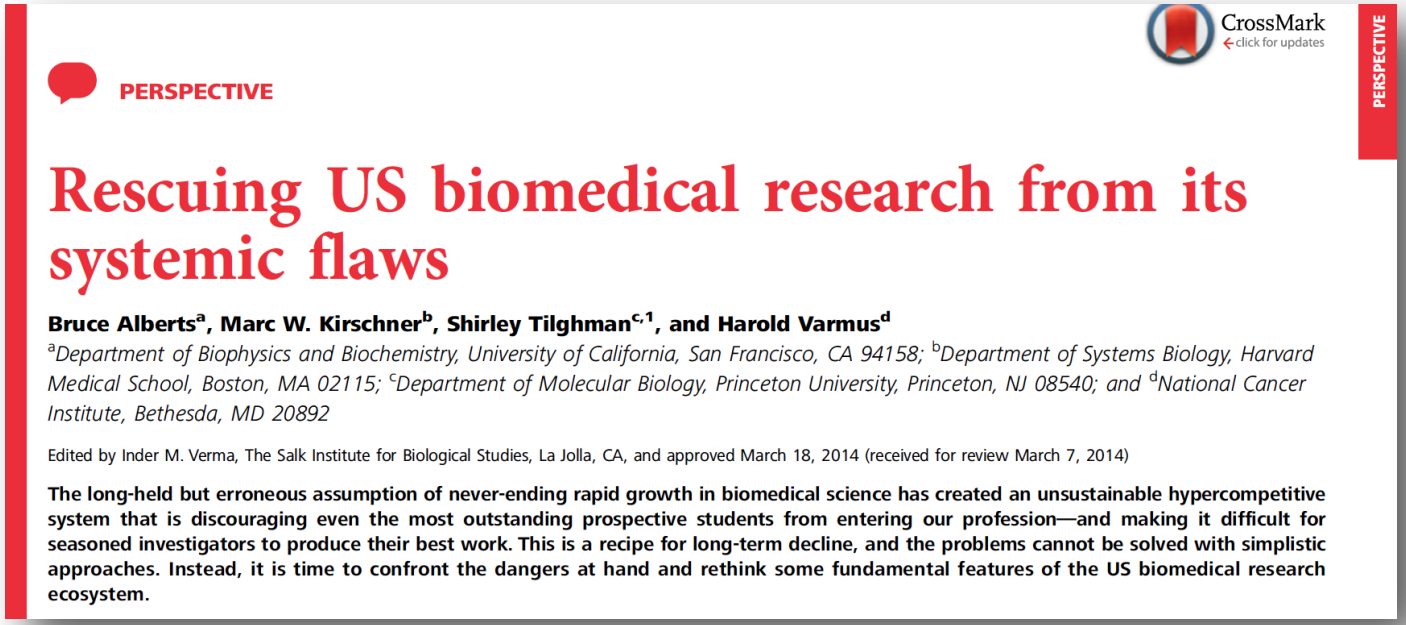
Careers of an elite cohort of U.S. basic life science postdoctoral fellows and the influence of their mentor's citation record

David G Levitt



BMC Medical Education 2010;10:80

Other Inefficiencies …



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Rescuing US biomedical research from its systemic flaws

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[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

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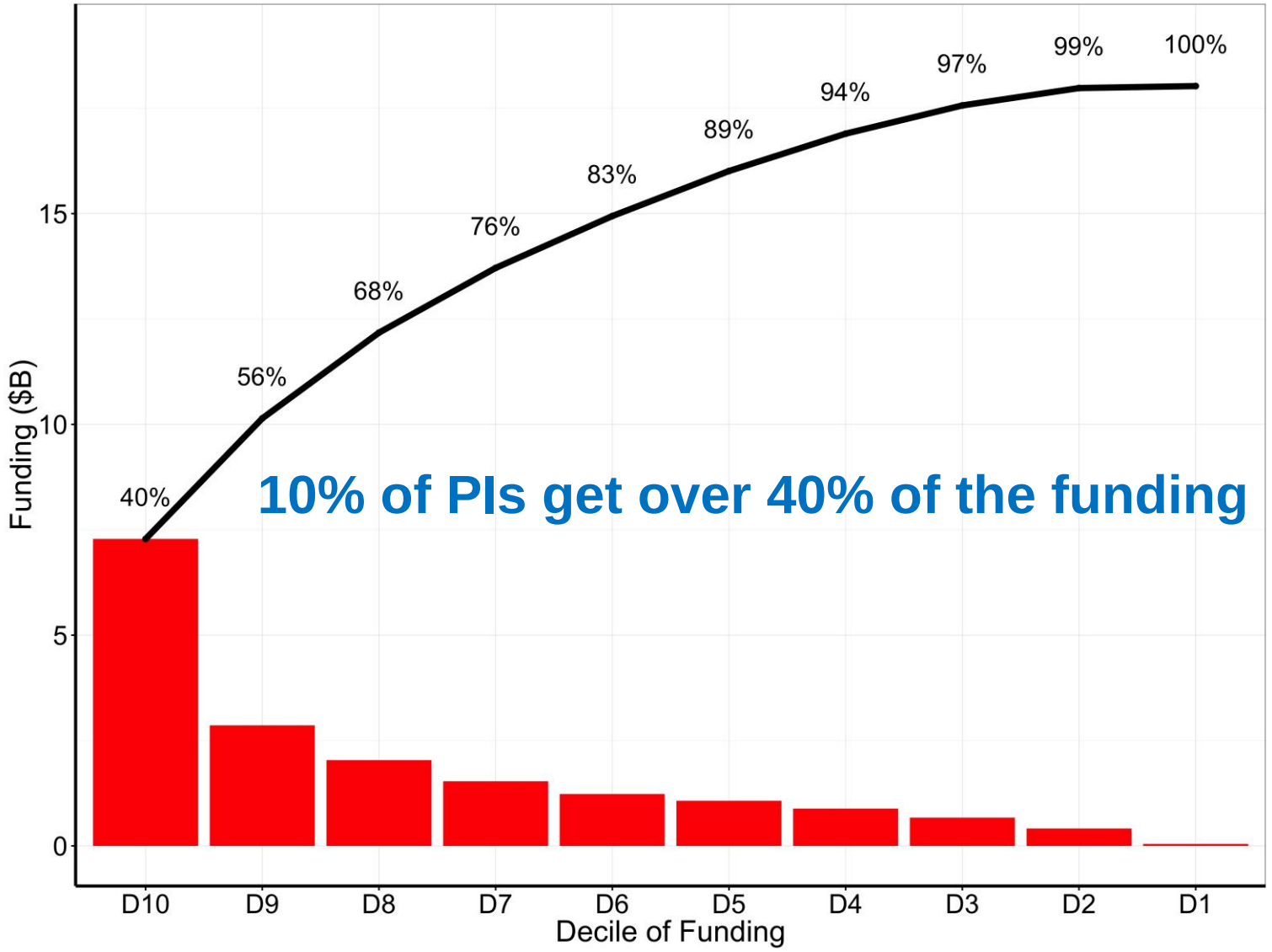
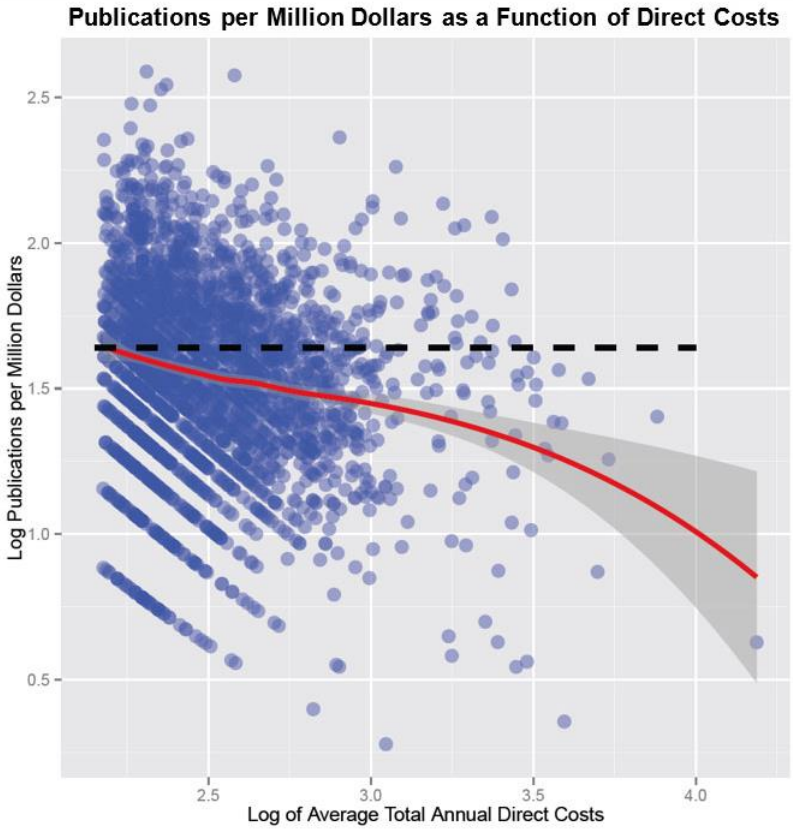
"Agencies **should be sensitive to the total numbers of dollars** granted to individual laboratories…—although **different research activities have different costs**—at some point, **returns per dollar diminish**. We applaud the recent decision by the NIH to examine grant portfolios carefully before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

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

Sensitive to Dollars: Skewed Distribution



Signs of Inefficiency: Diminishing Returns



NIMH: Mol Psychiatry. 2015 Sep;20(9):1030-6

NHLBI: Circ Res. 2015 Jul 17;117(3):239-43.

Canada: PLoS One. 2013 Jun 19;8(6):e65263.

UK: PeerJ. 2015 Jun 9;3:e989

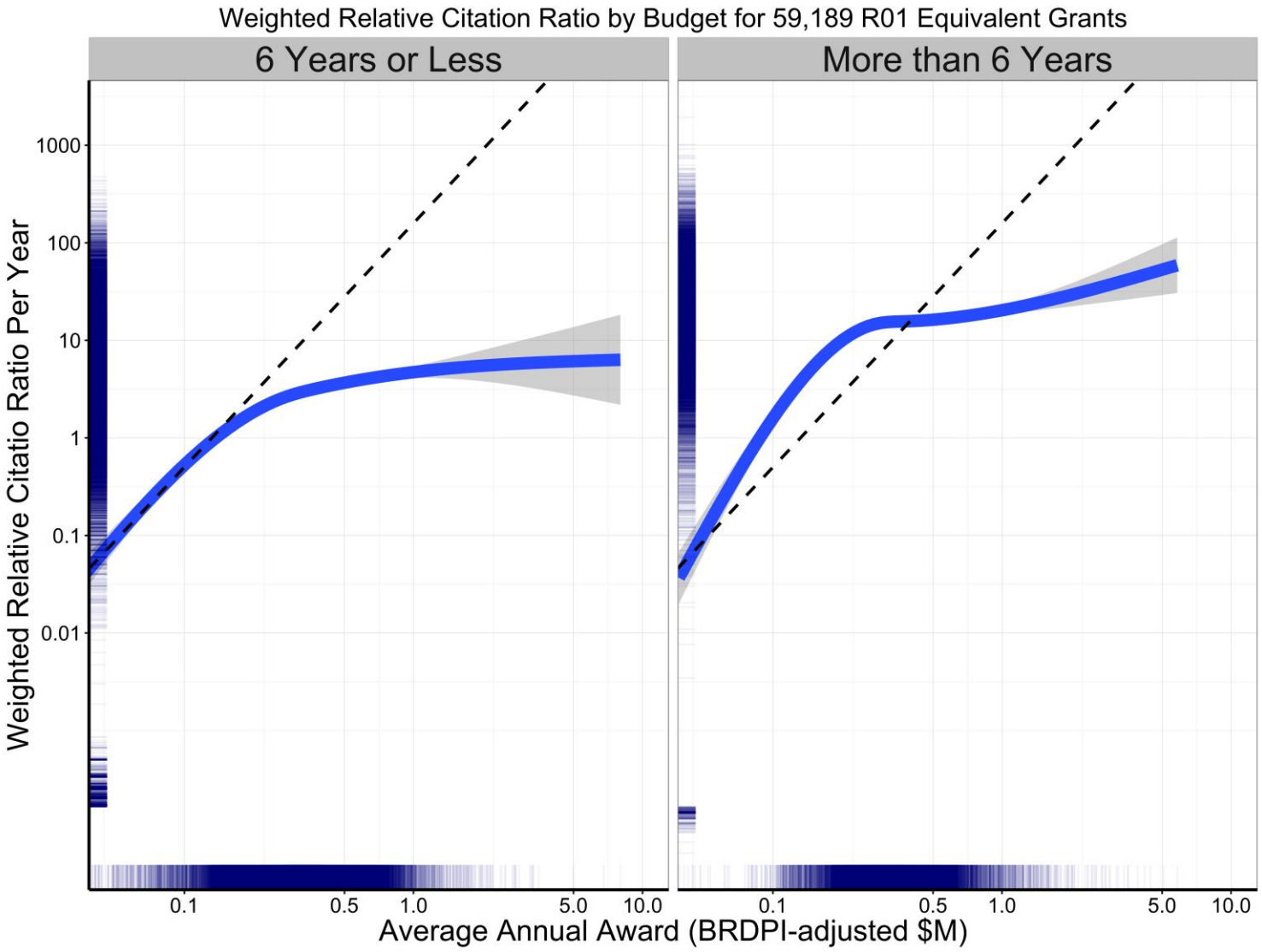
New drugs: Nat Rev Drug Disc. 2012;11:191-200

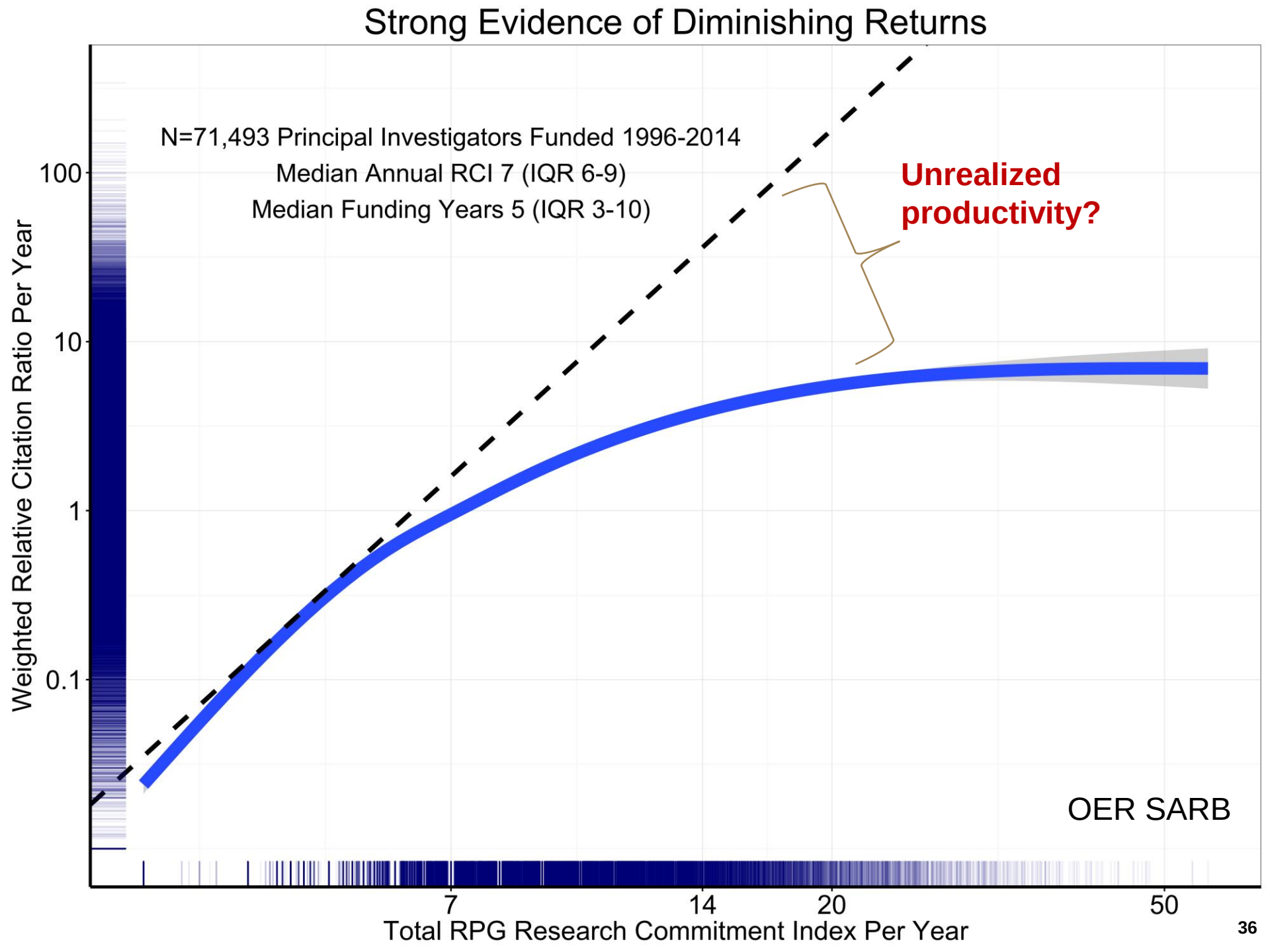
Alberts: Cell. 1985;41:337-8

Physics: Comp Sys. 2012;21:183-192

https://loop.nigms.nih.gov/wp-content/uploads/2016/07/fig4_bg.jpg

Diminishing Returns Across NIH

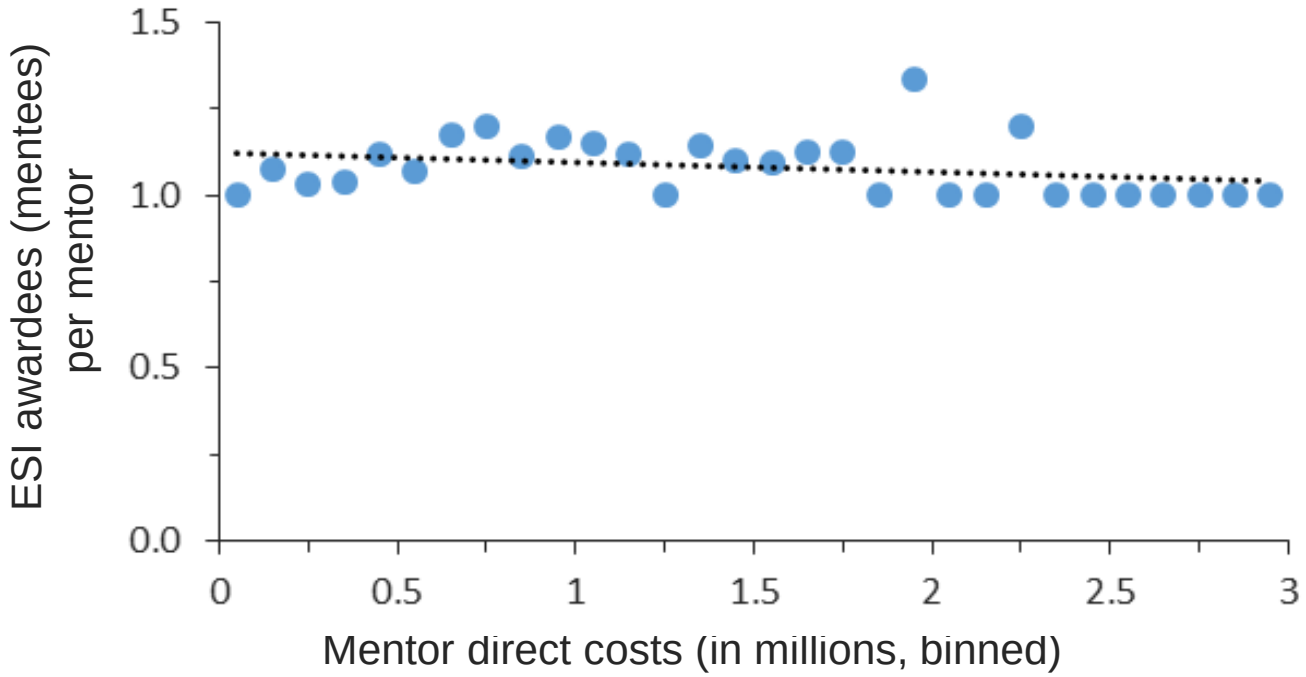



Strong Evidence of Diminishing Returns
N=71,493 Principal Investigators Funded 1996-2014
Median Annual RCI 7 (IQR 6-9)
Median Funding Years 5 (IQR 3-10)
Unrealized productivity?
Weighted Relative Citation Ratio Per Year
100
10
1
0.1
7
14
20
50
Total RPG Research Commitment Index Per Year
OER SARB

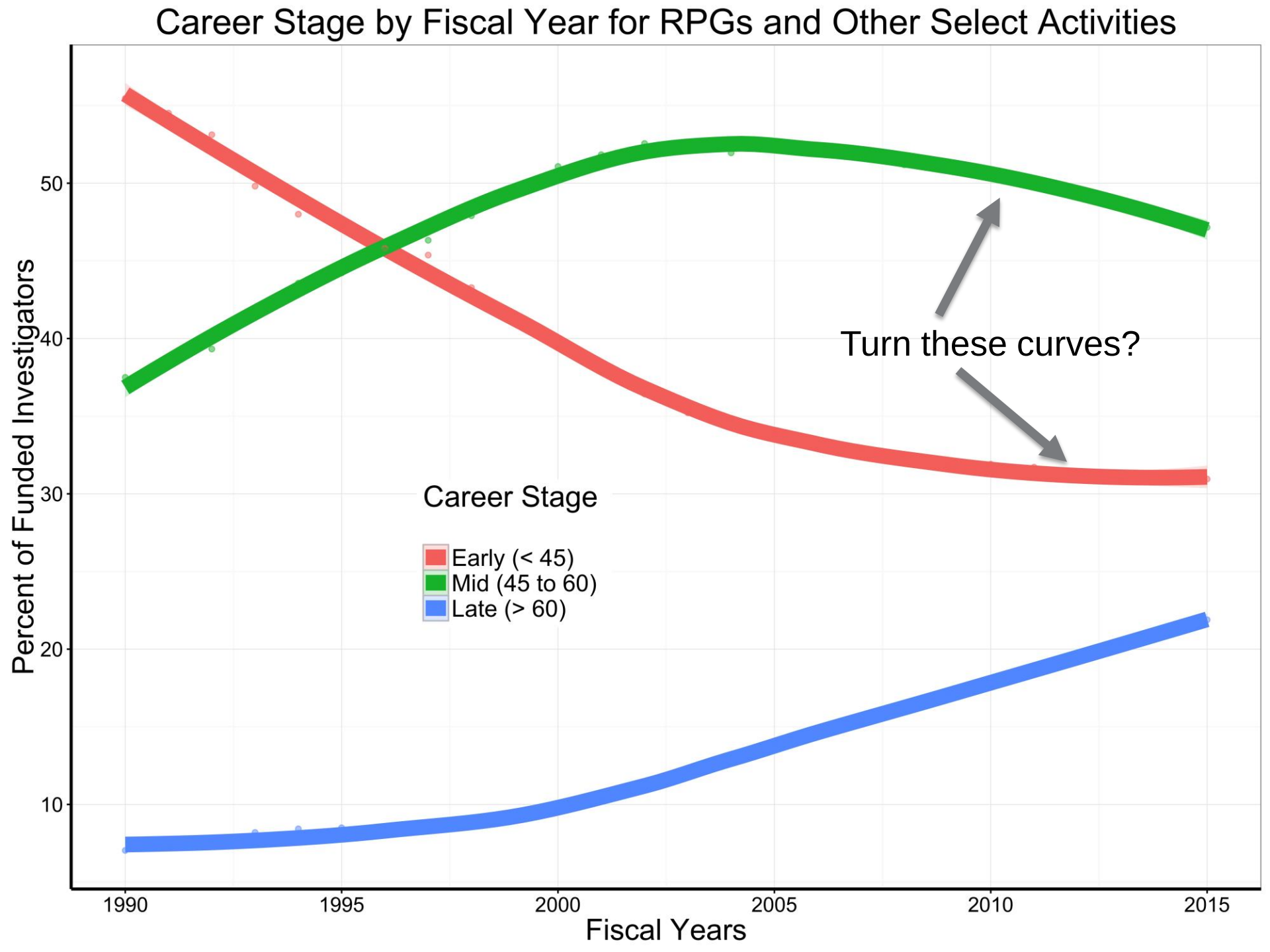
Funding Not Correlated with Mentorship

No relationship between funding level of mentors and the number of ESI awardees that they train

ESI RPG awardees per mentor versus
the FY16 direct costs of their RPG-funded mentors



Thanks to George Santangelo and OPA


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

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."

http://www.sciencemag.org/news/2016/12/nih-discusses-curbing-lab-size-fund-more-midcareer-scientists

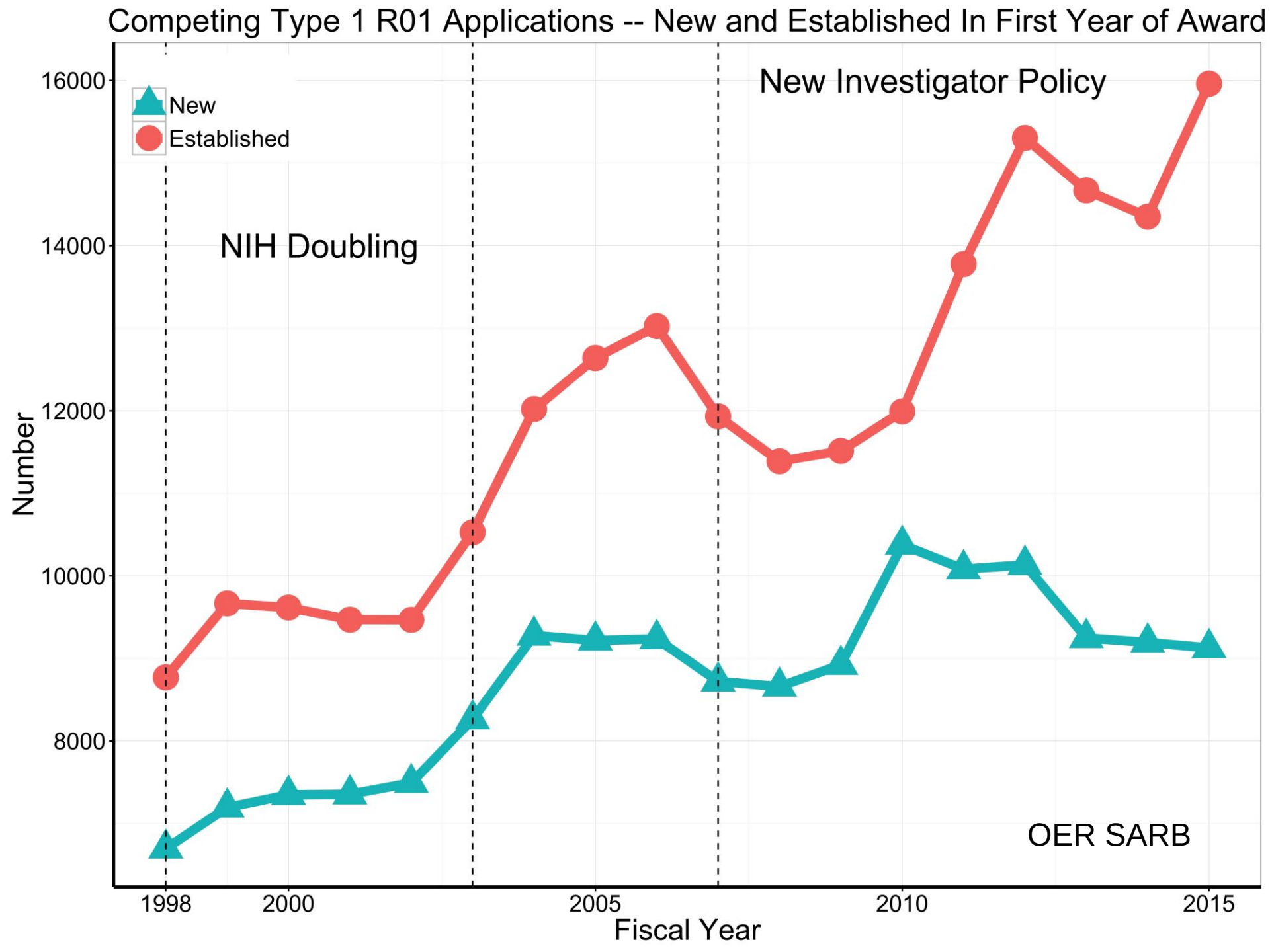
Policy Levers

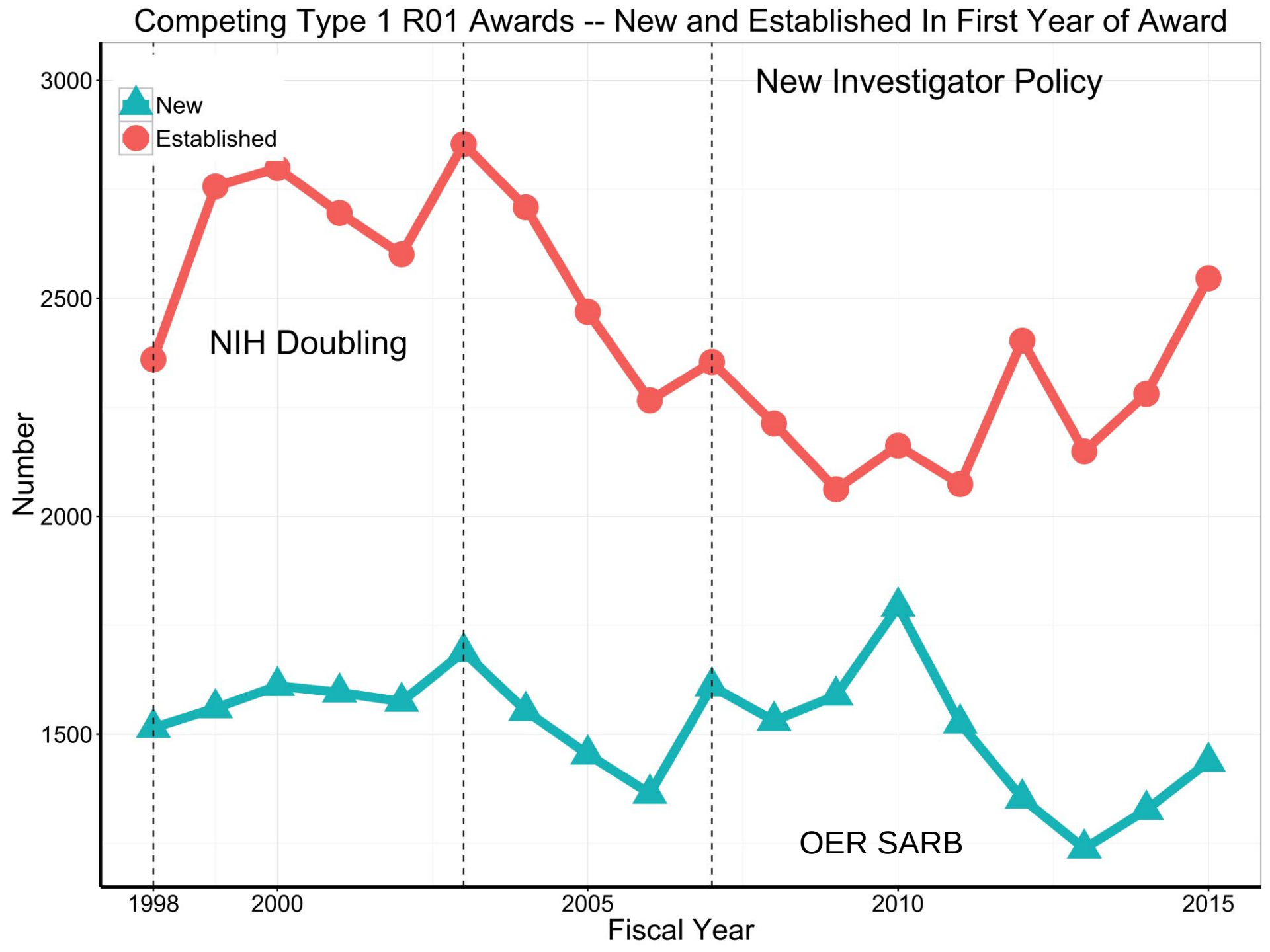
- Enhanced ESI advantage
- Focused select pay for mid-career
- Measures of grant support as tool
- Systems-approach to enhancing diversity
- R35 for younger PI's (NIGMS, NHLBI)

Closing Thoughts

- Unstable system with hyper-competition
- Hurting early- & mid-career faculty most
- Inefficient with diminishing returns
- Policy levers to fund more investigators
  - Especially early- and **mid-career**
  - Systems-based approach, focus on attrition

Appendix Material


Competing Type 1 R01 Applications -- New and Established In First Year of Award
New
Established
NIH Doubling
New Investigator Policy
OER SARB
Number
16000
14000
12000
10000
8000
1998
2000
2005
2010
2015
Fiscal Year

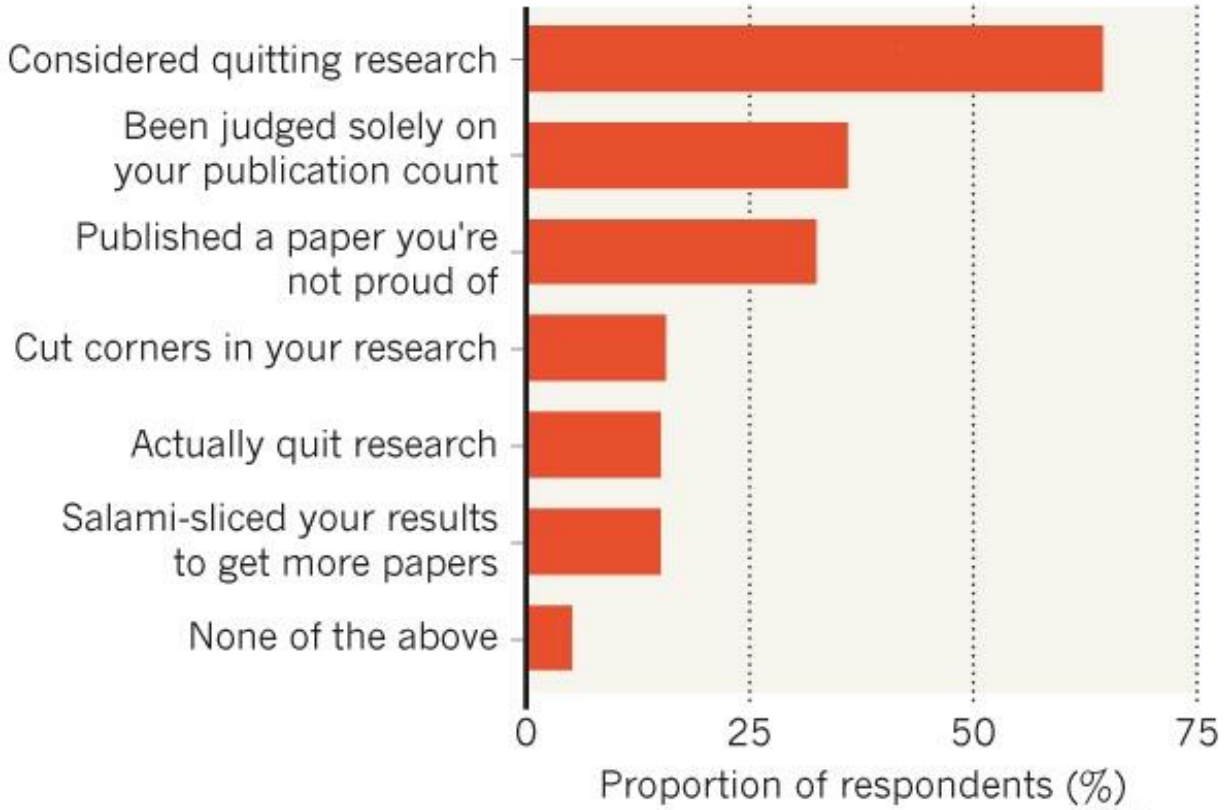

Competing Type 1 R01 Awards -- New and Established In First Year of Award
New
Established
New Investigator Policy
NIH Doubling
OER SARB
Number
3000
2500
2000
1500
1998
2000
2005
2010
2015
Fiscal Year

The Mood Outside Is Grim

SHOULD I QUIT?

Almost two-thirds of *Nature*'s readers say they have considered quitting research; 15% have actually quit.

Poll question:
Have the challenges of research ever meant that you have ... (8,820 responses)



Numbers of Researchers: A Different Metric

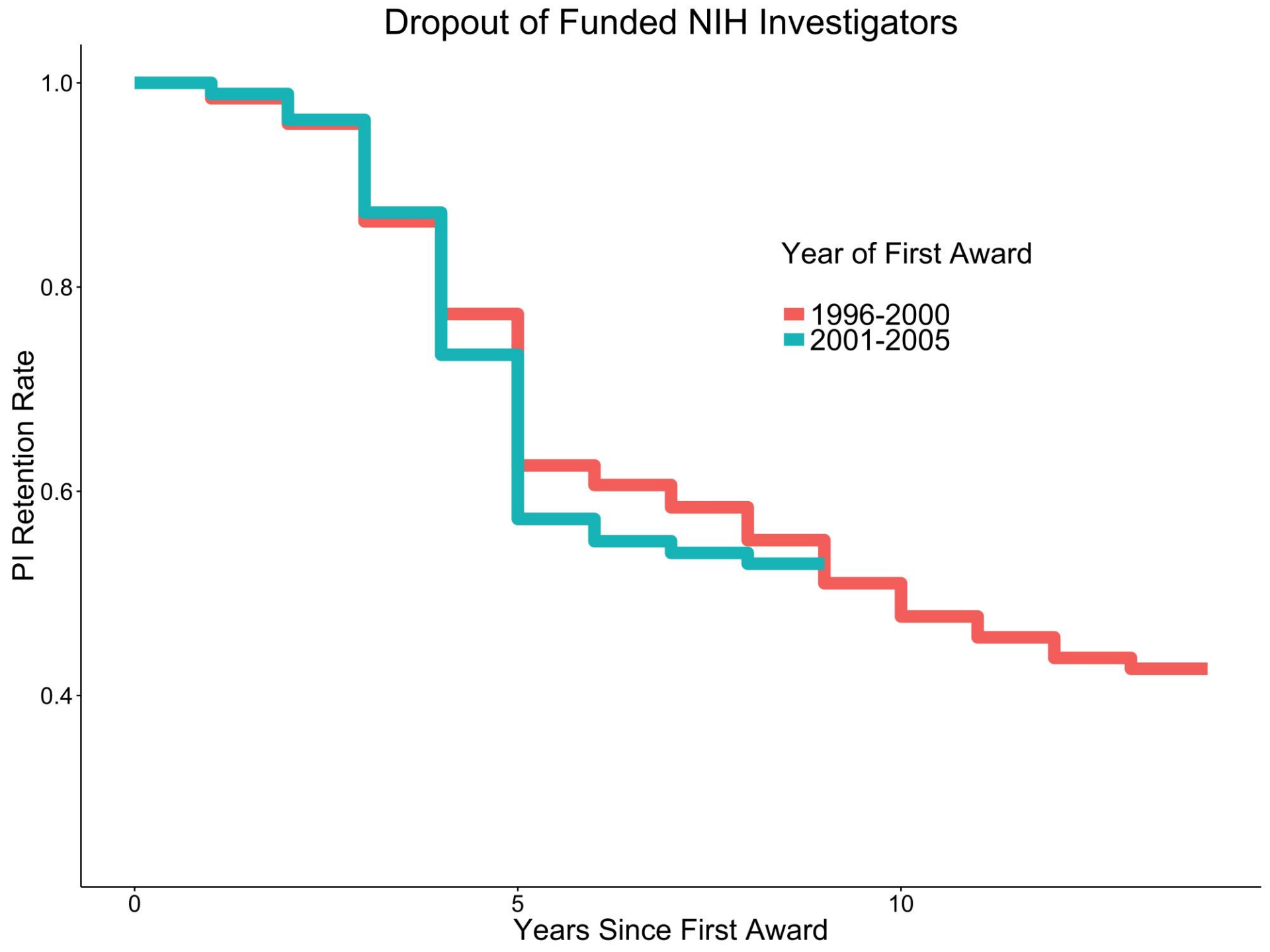
Maximizing the return on taxpayers' investments in fundamental biomedical research

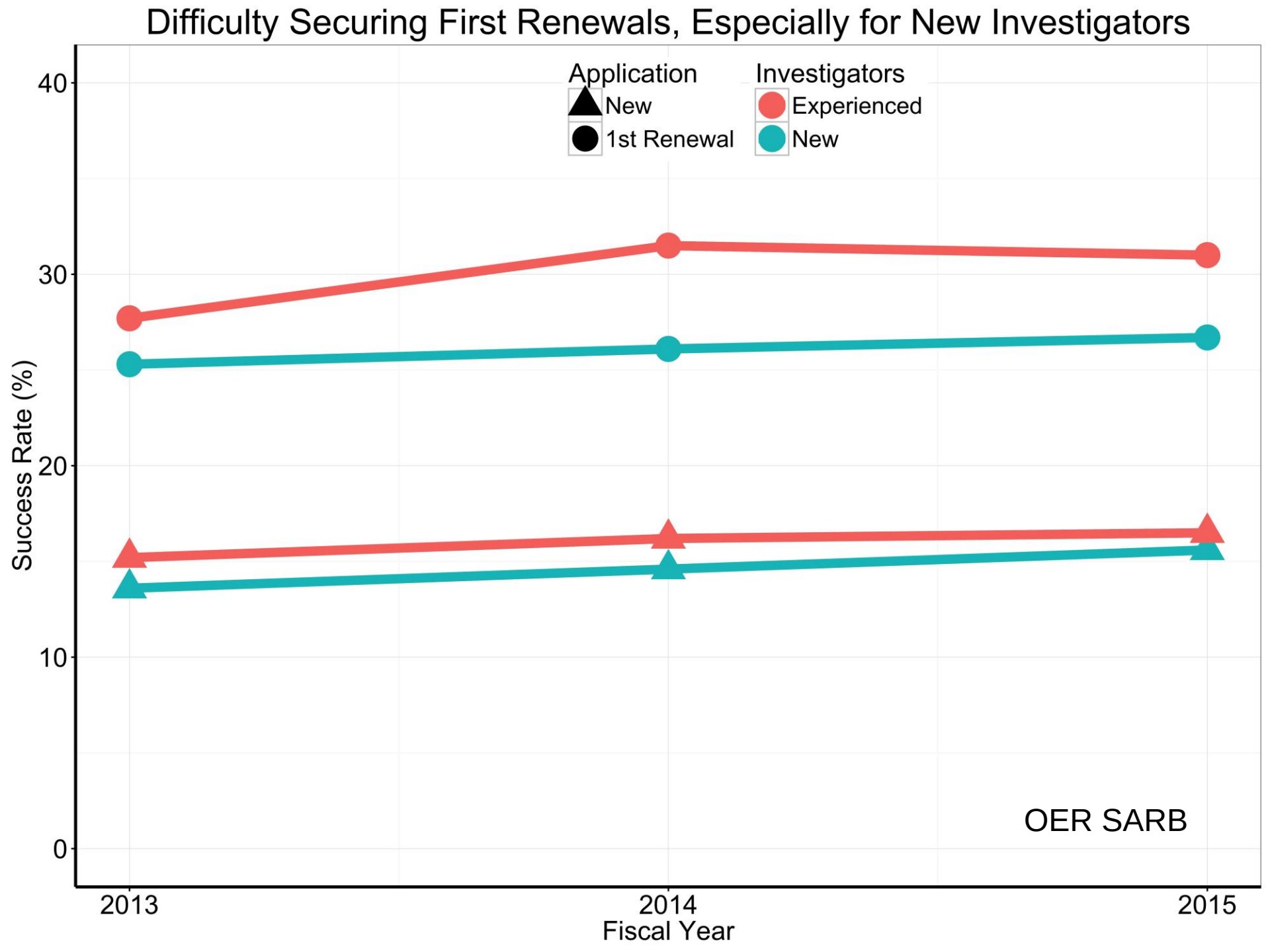
Jon R. Lorsch
National Institute of General Medical Sciences, National Institutes of Health, Bethesda, MD 20892

Changing our funding metric

"A question that at first glance may seem trivial but is, I believe, a significant one is whether our key metric for how… we invest in … research should be the number of grants we award or ***the number of investigators we support***."

Lorsch JR. Mol Biol Cell 2015;26:1578-82


Dropout of Funded NIH Investigators
PI Retention Rate
1.0
0.8
0.6
0.4
0
5
10
Years Since First Award
Year of First Award
1996-2000
2001-2005


Difficulty Securing First Renewals, Especially for New Investigators
Application
New
1st Renewal
Investigators
Experienced
New
40
30
20
10
0
Success Rate (%)
2013
2014
2015
Fiscal Year
OER SARB

Tools to Measure Input and Output

- Input
  - **Dollars, effort & grant count – problematic**
  - New tool: “Research Commitment Index”
- Output
  - Relative Citation Ratio
  - Others: mentorship, patents, guidelines
  - “Cure Networks”

Input: What About Number of Grants?

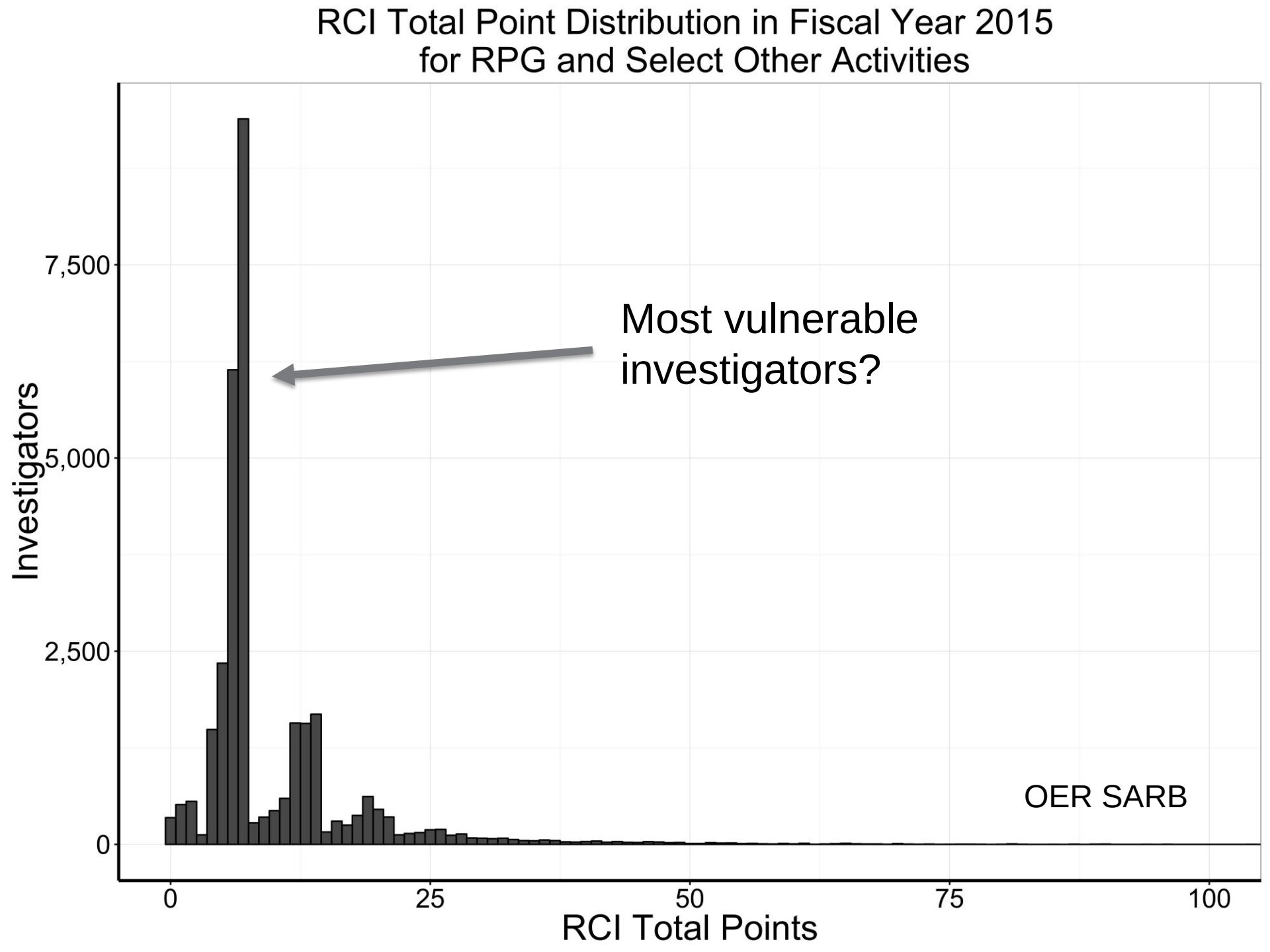
- Couldn't we simply count grants?
- Problems:
  - R01 ≠ R03 ≠ R21
  - R01 ≠ P01
  - R01 ≠ U10
  - Etc…

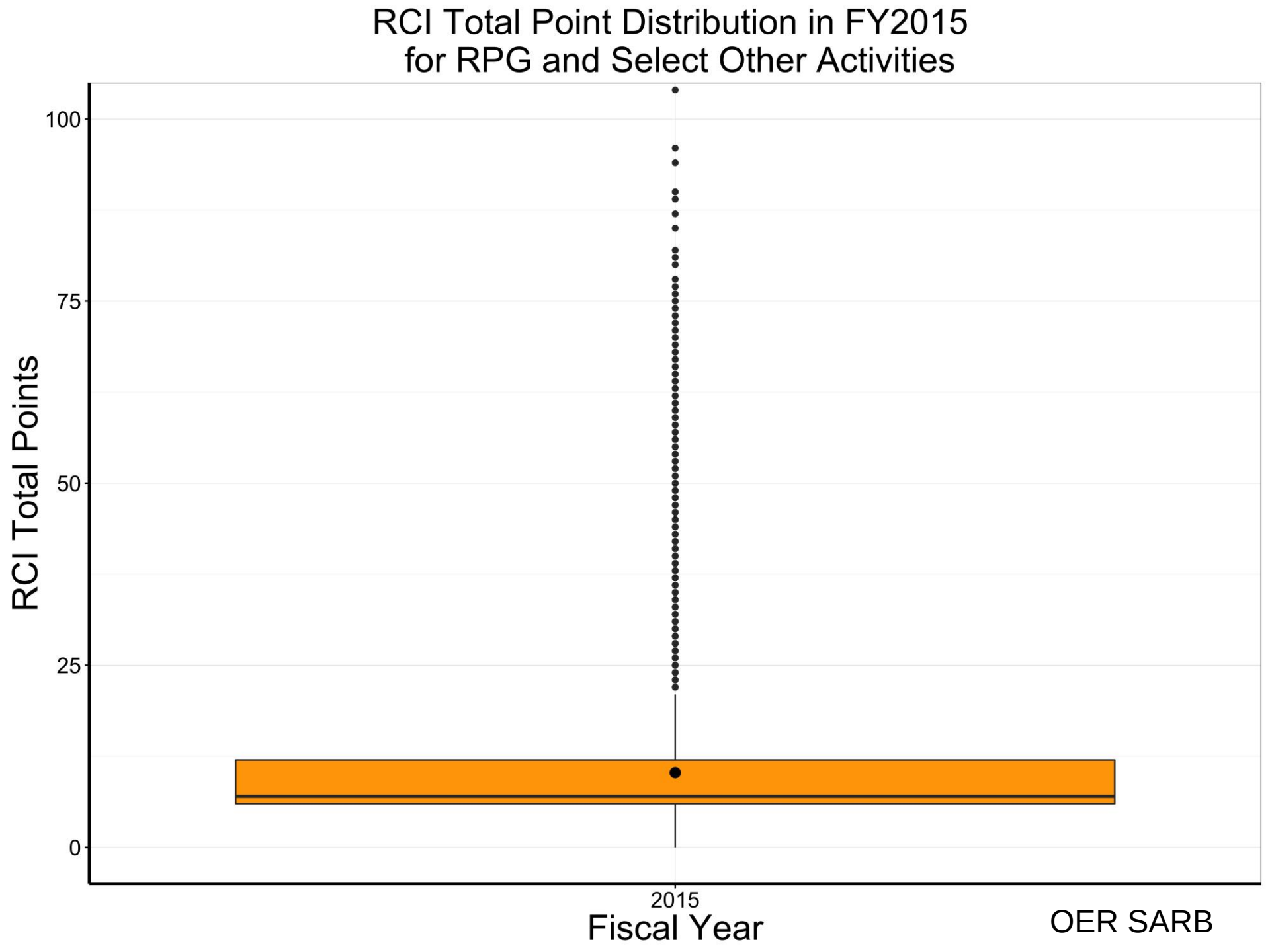
Tools to Measure Input and Output

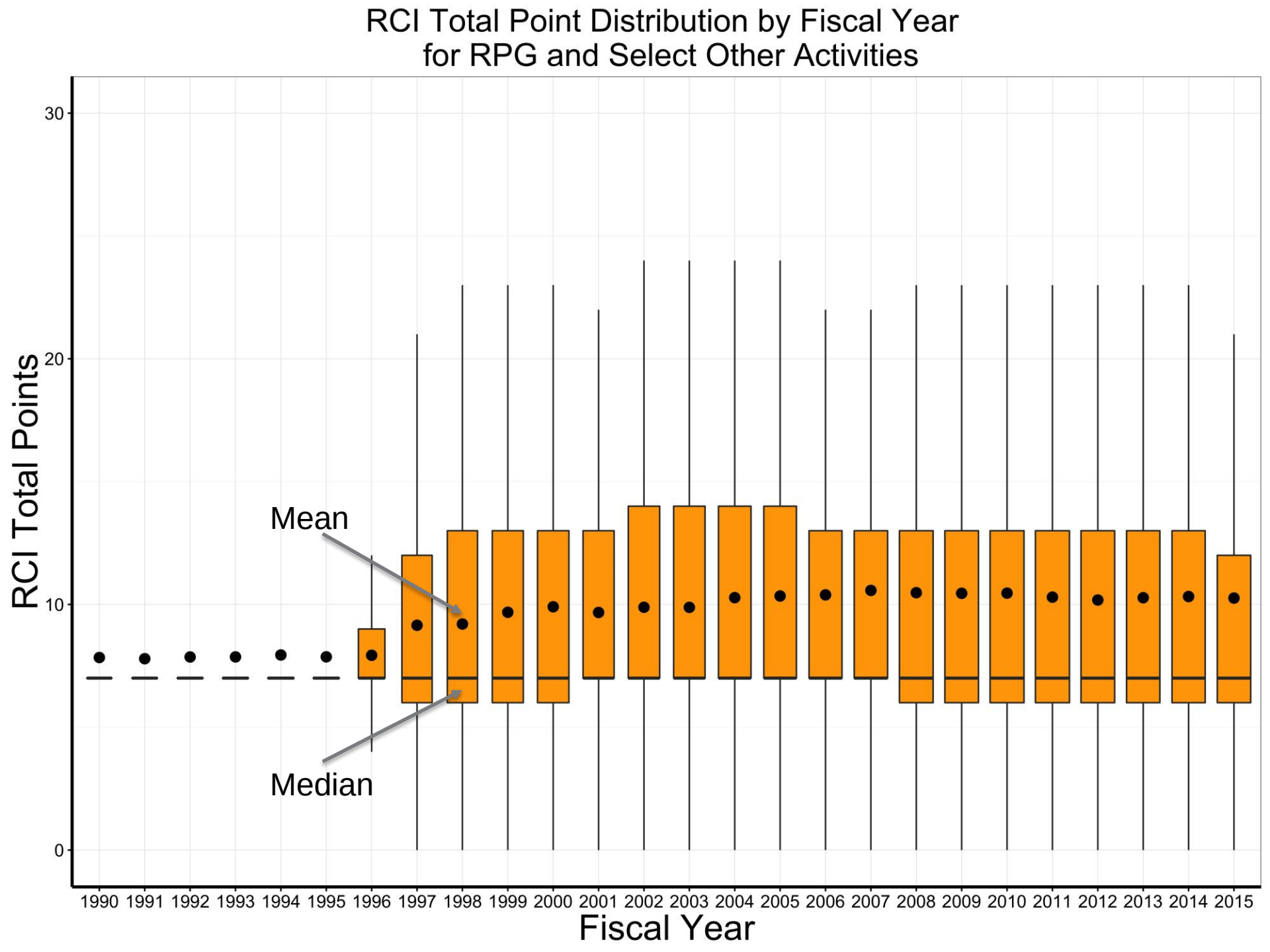
- Input
  - Dollars, effort & grant count – problematic
  - **New tool: "Research Commitment Index"**
- Output
  - Relative Citation Ratio
  - Others: mentorship, patents, guidelines
  - "Cure Networks"

Research Commitment Index (RCI)

- Measure of PI's committed bandwidth
- Not simply measure of dollars
- Benchmarked to R01 (7 points)
  - R03, R21 less
  - P50, U54 (PI) more
- Effectively, a modified grant count


RCI Total Point Distribution in Fiscal Year 2015
for RPG and Select Other Activities
Most vulnerable
investigators?
OER SARB
Investigators
7,500
5,000
2,500
0
0
25
50
75
100
RCI Total Points

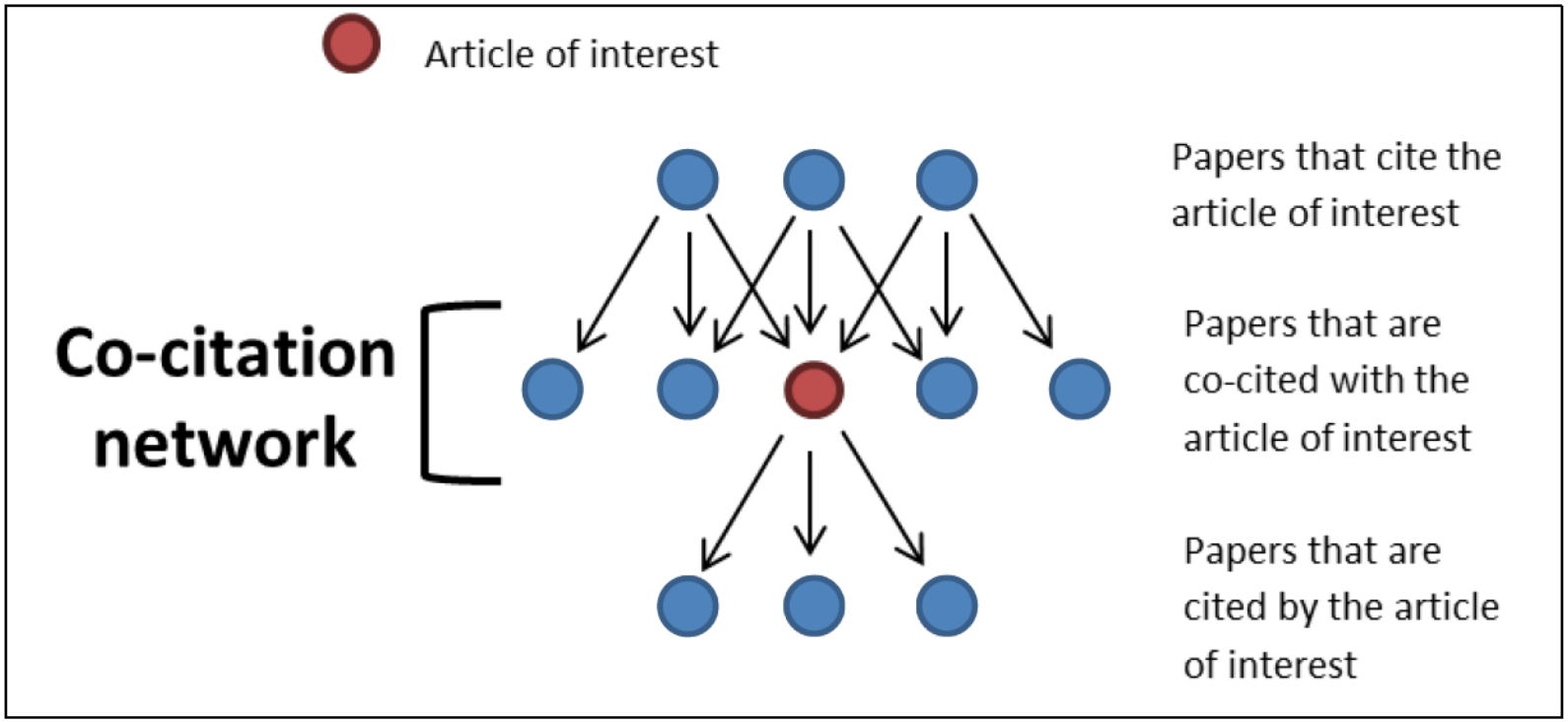

RCI Total Point Distribution in FY2015
for RPG and Select Other Activities
RCI Total Points
100
75
50
25
0
2015
Fiscal Year
OER SARB


RCI Total Point Distribution by Fiscal Year
for RPG and Select Other Activities
RCI Total Points
30
20
10
0
Mean
Median
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Fiscal Year

Tools to Measure Input and Output

- Input
  - Dollars, effort & grant count – problematic
  - New tool: “Research Commitment Index”
- Output
  - **Relative Citation Ratio**
  - Others: mentorship, patents, guidelines
  - “Cure Networks”

Relative Citation Ratio

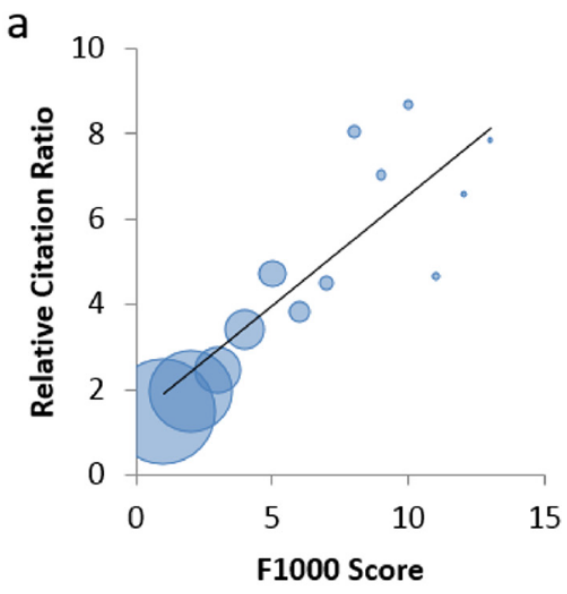


0 = never cited
1 = average
2 = twice the average
>20 = exceptionally highly cited

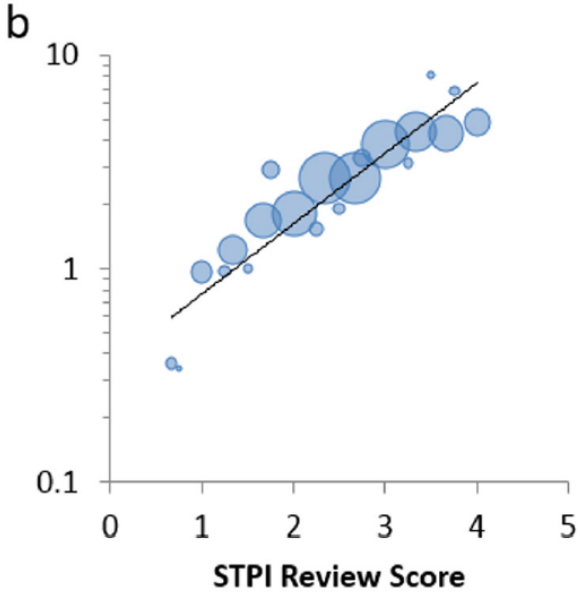
NIH Office of Portfolio Analysis
PLoS Biology (September 6, 2016)

How Do We Know Whether It Means Anything?

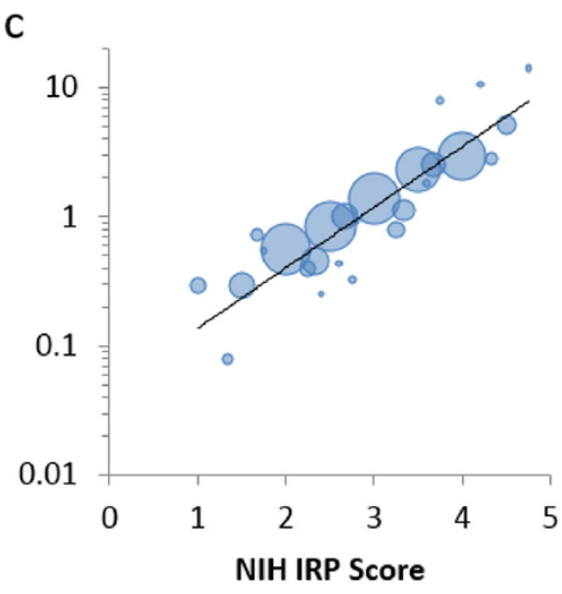
2193 R01 papers



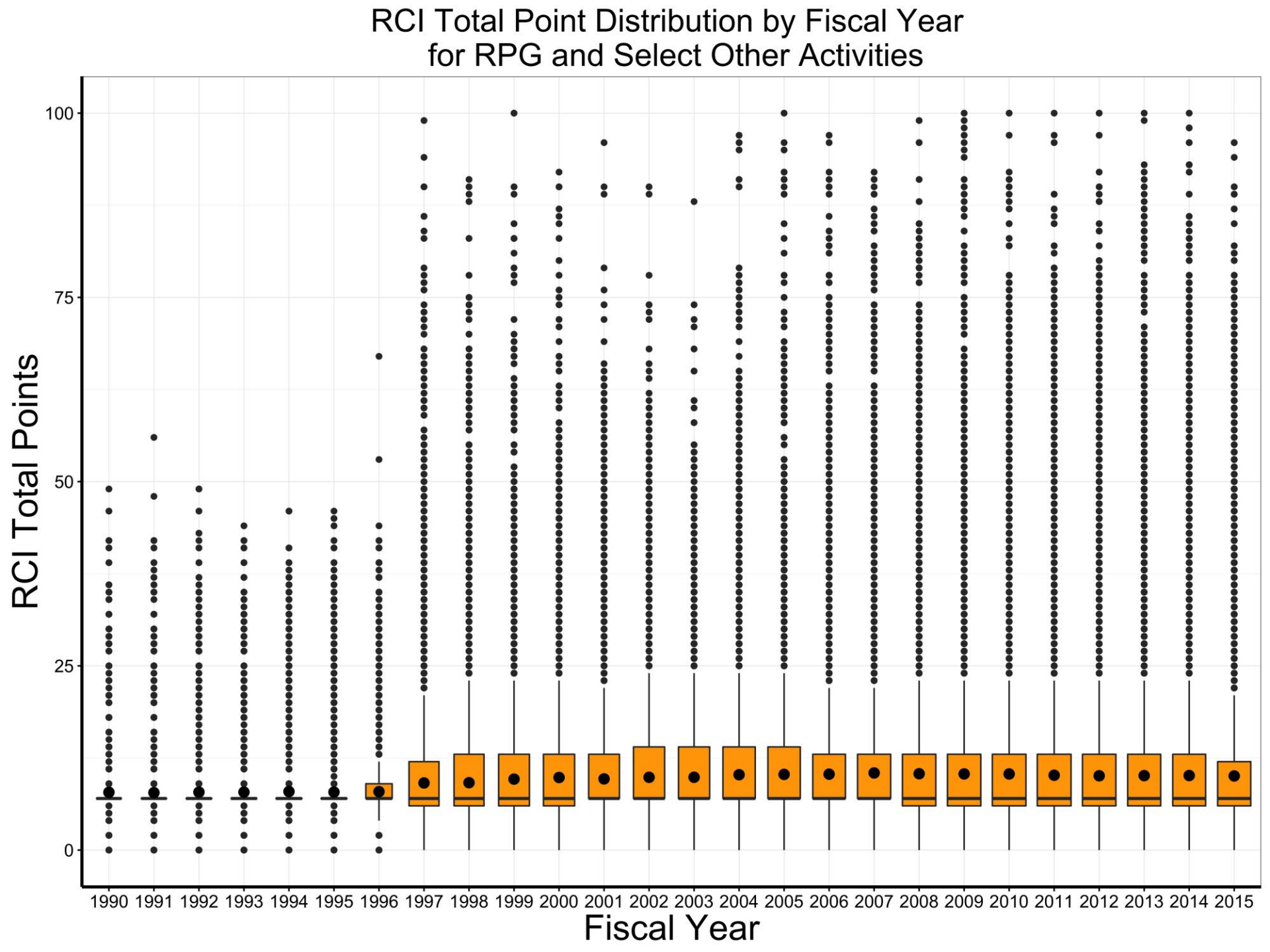
430 HHMI/NIH papers

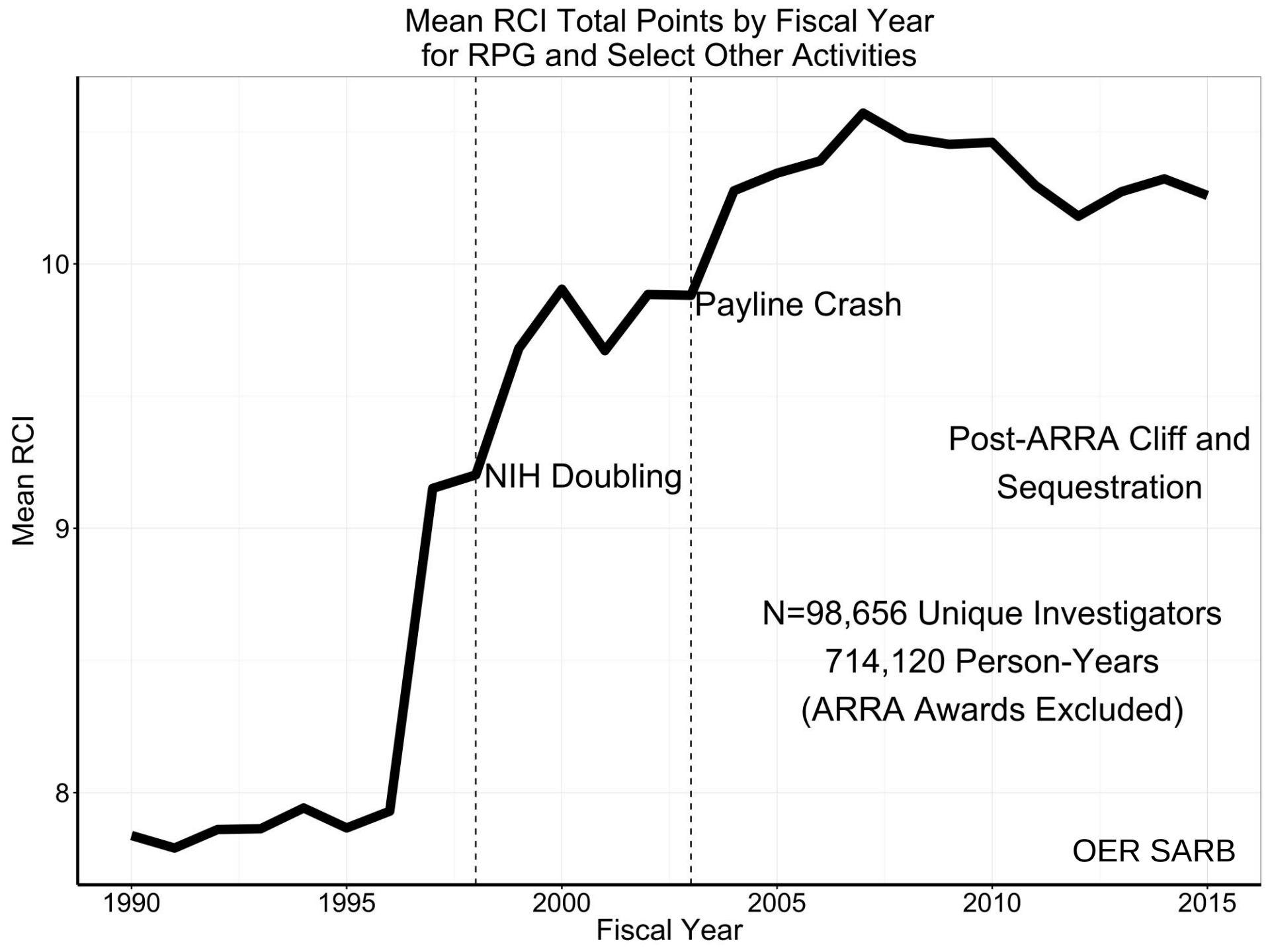


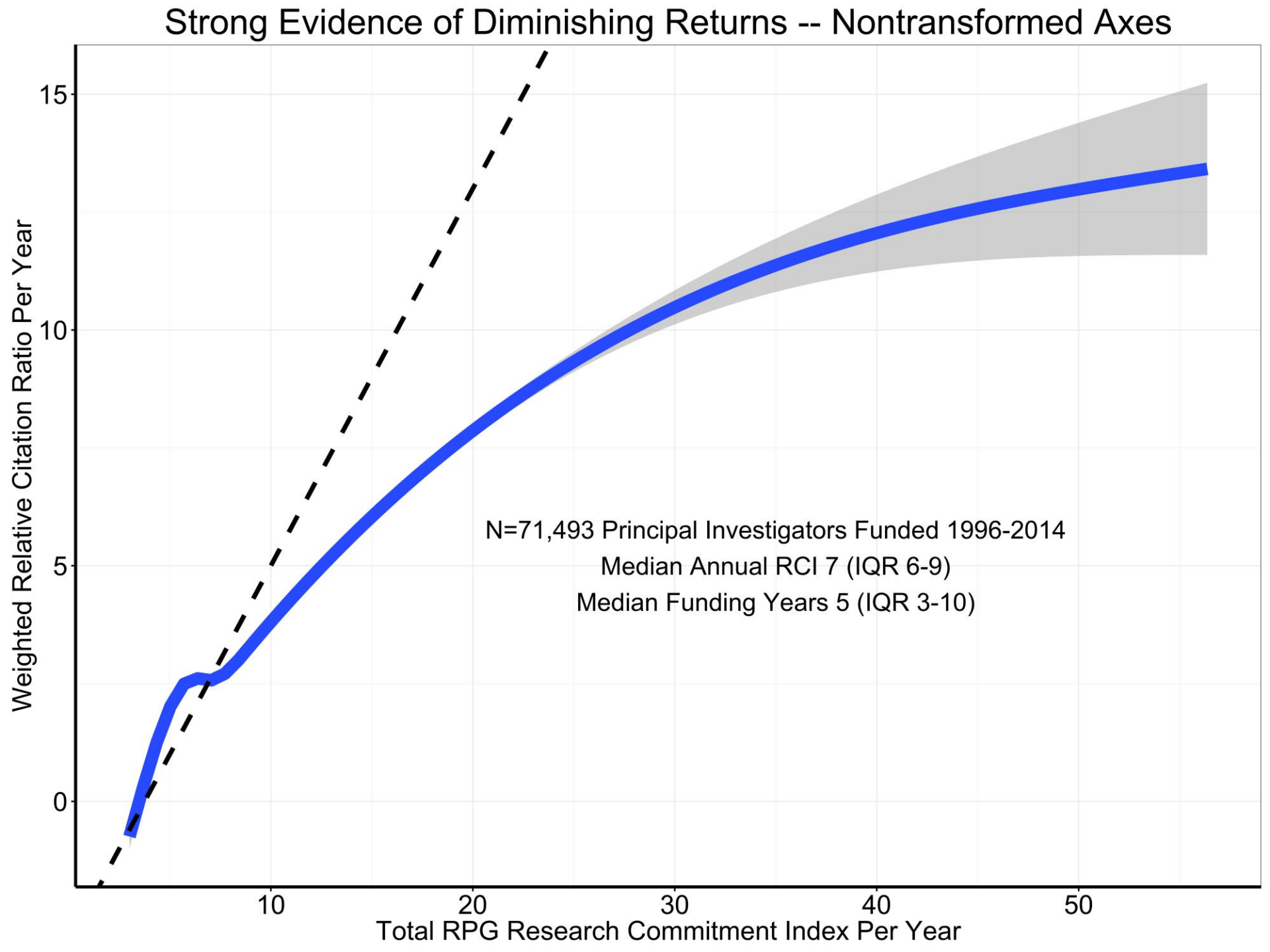
290 R01 papers



NIH Office of Portfolio Analysis
PLoS Biology (September 6, 2016)


RCI Total Point Distribution by Fiscal Year
for RPG and Select Other Activities
RCI Total Points
100
75
50
25
0
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Fiscal Year


Mean RCI Total Points by Fiscal Year
for RPG and Select Other Activities
Mean RCI
10
9
8
NIH Doubling
Payline Crash
Post-ARRA Cliff and
Sequestration
N=98,656 Unique Investigators
714,120 Person-Years
(ARRA Awards Excluded)
OER SARB
1990
1995
2000
2005
2010
2015
Fiscal Year


Strong Evidence of Diminishing Returns -- Nontransformed Axes
Weighted Relative Citation Ratio Per Year
15
10
5
0
10
20
30
40
50
Total RPG Research Commitment Index Per Year
N=71,493 Principal Investigators Funded 1996-2014
Median Annual RCI 7 (IQR 6-9)
Median Funding Years 5 (IQR 3-10)

Funding and Mentorship: OPA Analyses

Early Stage Investigator (ESI) data

- Definitions
  - ESI applicant: PI submitting at least one competing RPG ESI application in FY2015-FY2016
  - ESI awardee: PI submitting at least one RPG ESI application that was funded in FY2015-FY2016
- All publications in each ESI biosketch were computationally extracted and matched to a PubMed ID
- For each successfully matched PubMed ID, disambiguation analysis and manual curation was used to confirm the link between each ESI name and author name

Linking ESI mentees to mentor PIs

- For each confirmed ESI PubMed ID, matches between the last author and an FY2016 RPG PI were identified
- A PI was considered a mentor of an ESI if both scientists were co-authors on at least two papers that had the mentor as last author; as above, disambiguation analysis and manual curation were used to confirm matches
- If an ESI had multiple applications, the corresponding ESI-mentor links were de-duplicated

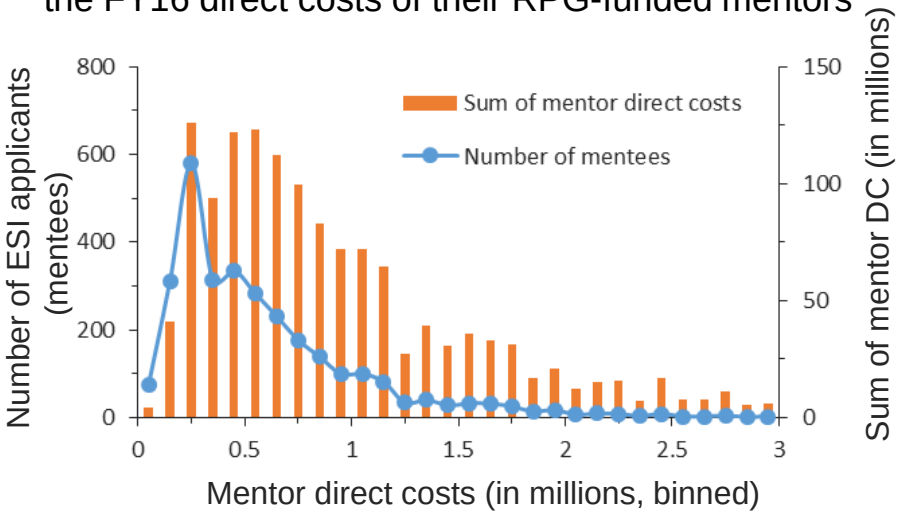
Determining mentor funding

- A mentor's total dollar amount is the sum of FY2016 direct costs for all RPGs linked to the mentor's PI ID
- For projects with subprojects, dollar amounts are apportioned to each subproject PI
- For multi-PI grants, dollar amounts are split evenly between PIs

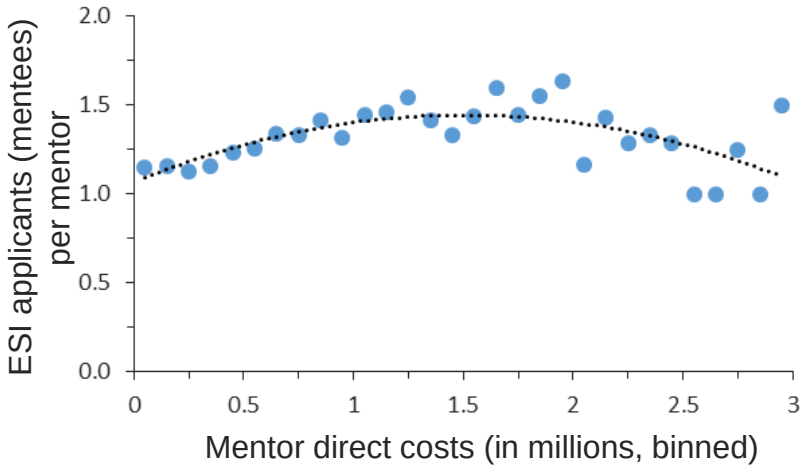
Thanks to George Santangelo and OPA

No linear relationship between funding level of mentors and the number of ESI applicants that they train

Number of ESI RPG applicants versus
the FY16 direct costs of their RPG-funded mentors



ESI RPG applicants <u>per mentor</u> versus
the FY16 direct costs of their RPG-funded mentors



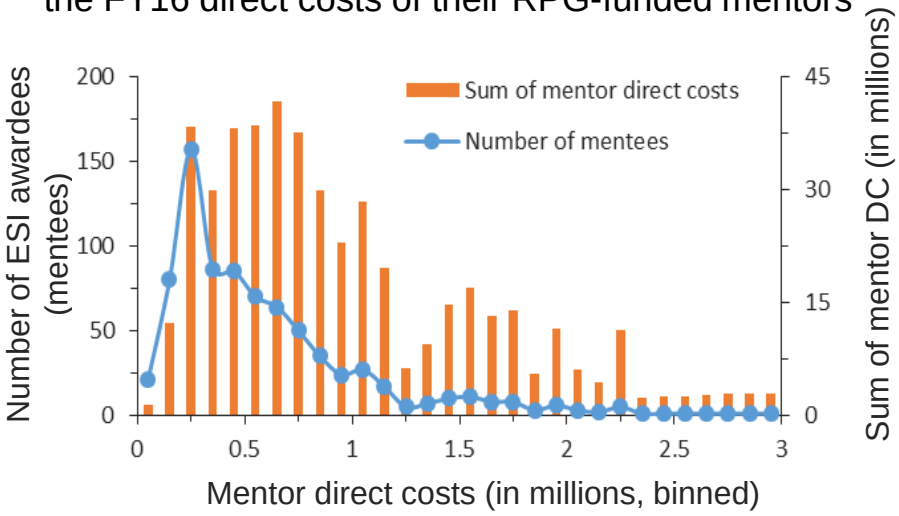
NIH National Institutes of Health
Office of Portfolio Analysis

NIH National Institutes of Health
Office of Extramural Research

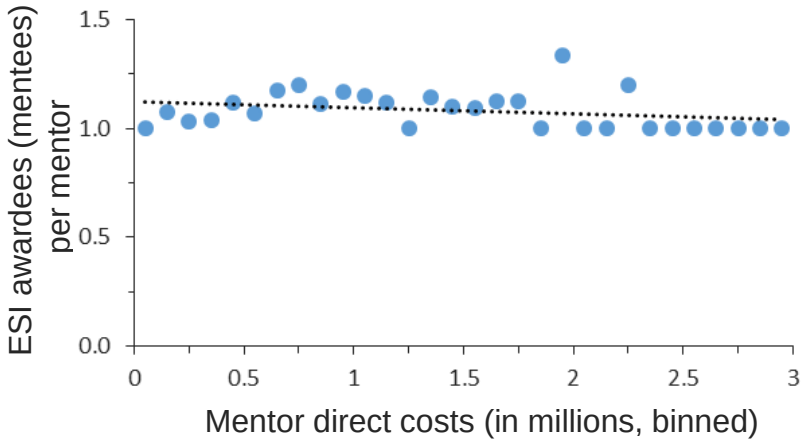
Thanks to George Santangelo and OPA

No relationship between funding level of mentors and the number of ESI awardees that they train

Number of ESI RPG awardees versus
the FY16 direct costs of their RPG-funded mentors



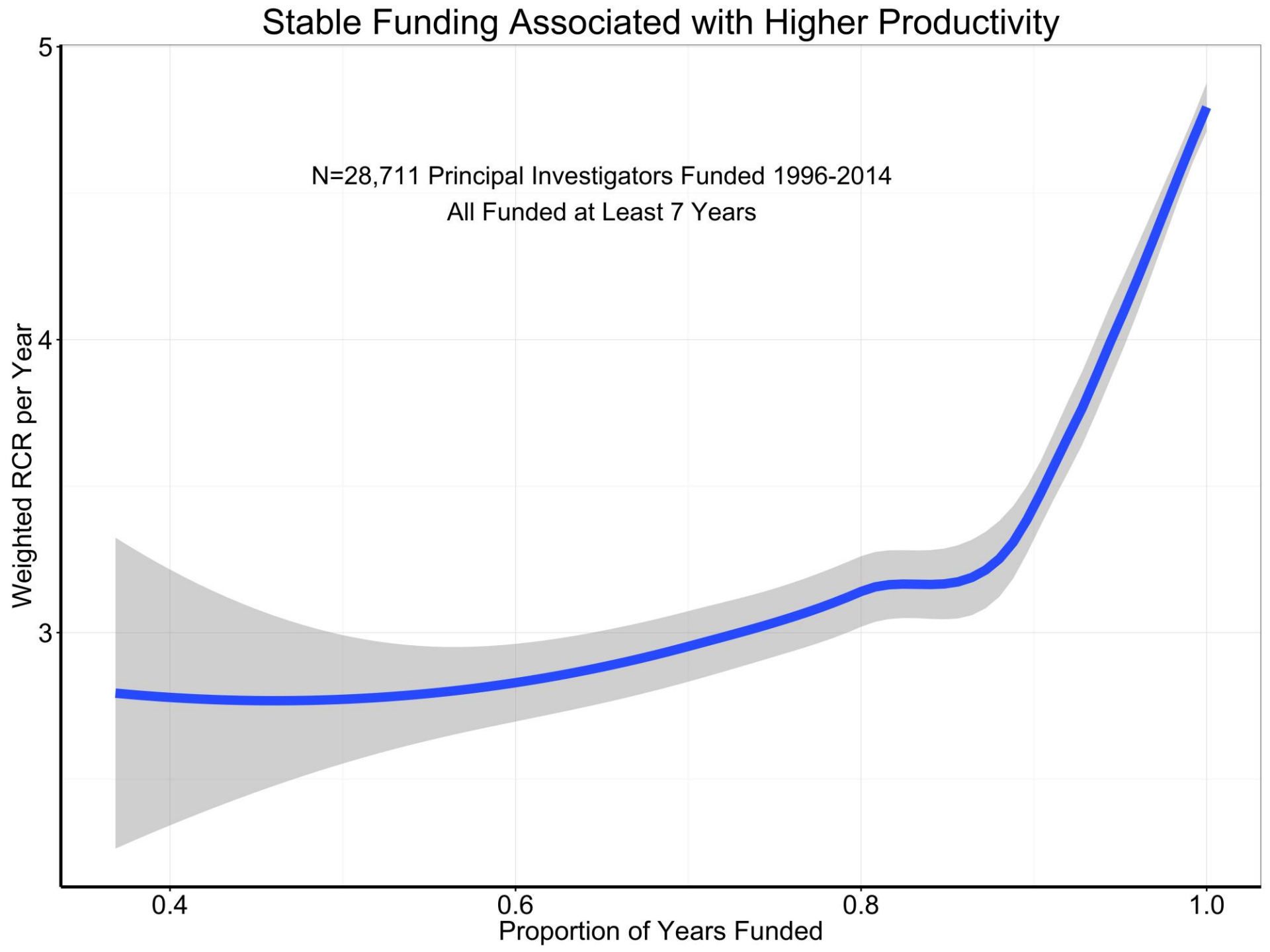
ESI RPG awardees <u>per mentor</u> versus
the FY16 direct costs of their RPG-funded mentors



NIH National Institutes of Health
Office of Portfolio Analysis

NIH National Institutes of Health
Office of Extramural Research

Thanks to George Santangelo and OPA


Stable Funding Associated with Higher Productivity
N=28,711 Principal Investigators Funded 1996-2014
All Funded at Least 7 Years
Weighted RCR per Year
5
4
3
0.4
0.6
0.8
1.0
Proportion of Years Funded

YOUNG SCIENTISTS
A *Nature* special issue
nature.com/youngscientists

NEWS FEATURE

YOUNG, TALENTED AND FED-UP

BY KENDALL POWELL

Scientists starting labs say that they are under historically high pressure to publish, secure funding and

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.

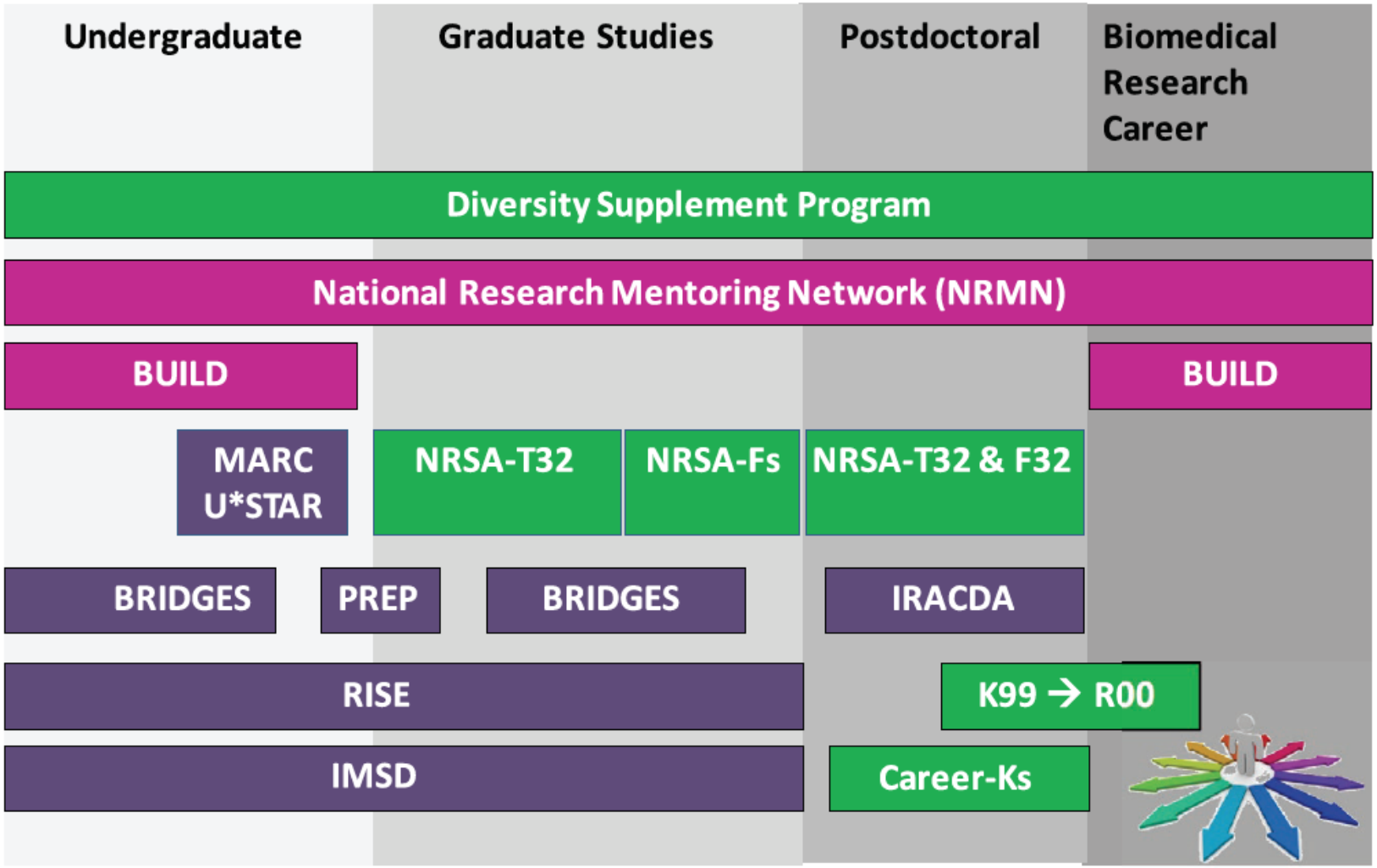
Usually, Tingley thought of himself as a "pretty stoic guy" — and on paper, his career

Young scientists and senior scientists alike feel an acute pressure to publish and are weighed down by a growing bureaucratic burden, with little administrative support. They are largely judged on their record of publishing and of winning grants — but without clear targets, they find themselves endlessly churning out paper after paper. The crucial question is whether this is harming science and scientists. Bruce Alberts, a prominent biochemist at the University of California, San Francisco, and former president of the US National Academy of Sciences, says that

The RCI Point Schedule

Activity Code	Single PI point assignment	Multiple PI point assignment
P50, P41, U54, UM1, UM2*	11	10
Subprojects under multi-component awards	6	6
R01, R33, R35, R37, R56, RC4, RF1, RL1, P01, P42, RM1, UC4, UF1, UH3, U01, U19, DP1, DP2, DP3, DP4	7	6
R00, R21, R34, R55, RC1, RC2, RL2, RL9, UG3, UH2, U34, DP5	5	4
R03, R24, P30, UC7	4	3
R25, T32, T35, T15	2	1

NIH Biomedical Research Training Programs



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