IT UNIVERSITY OF COPENHAGEN

Fondazione ISI
ISI Foundation

Scientific careers: interdisciplinarity, gender, and the chaperone effect

Roberta Sinatra

@robysinatra

Performance

Success

Performance is about you

Success is about us

Why is this important?

Simkin and Roychowdhury, Journal of Mathematical Sociology, 32(2), pp.129-141.(2006)

Salganik, Dodds, Watts, Science, 311, 5762:854-6 (2006)

Watts, Crown Business (2011)

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Nitrogen
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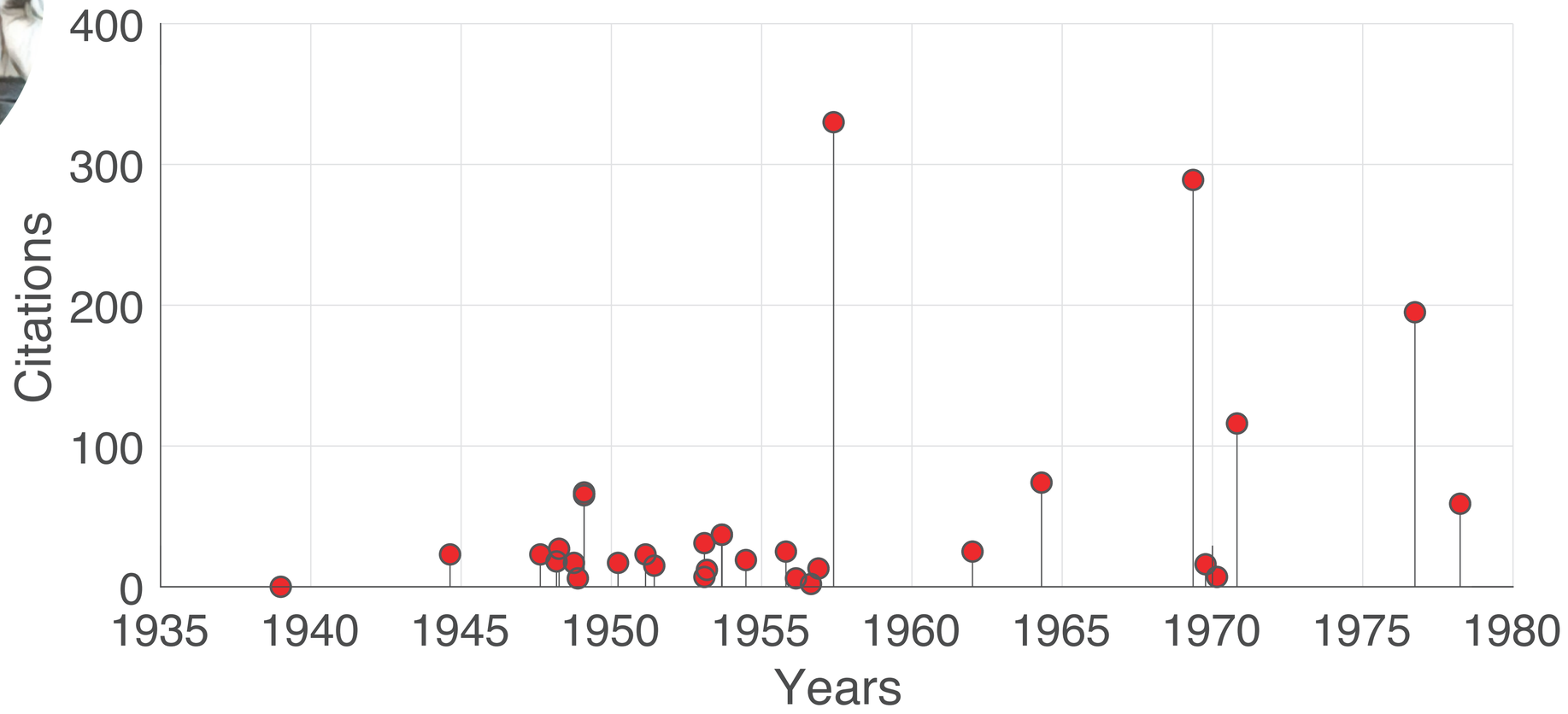
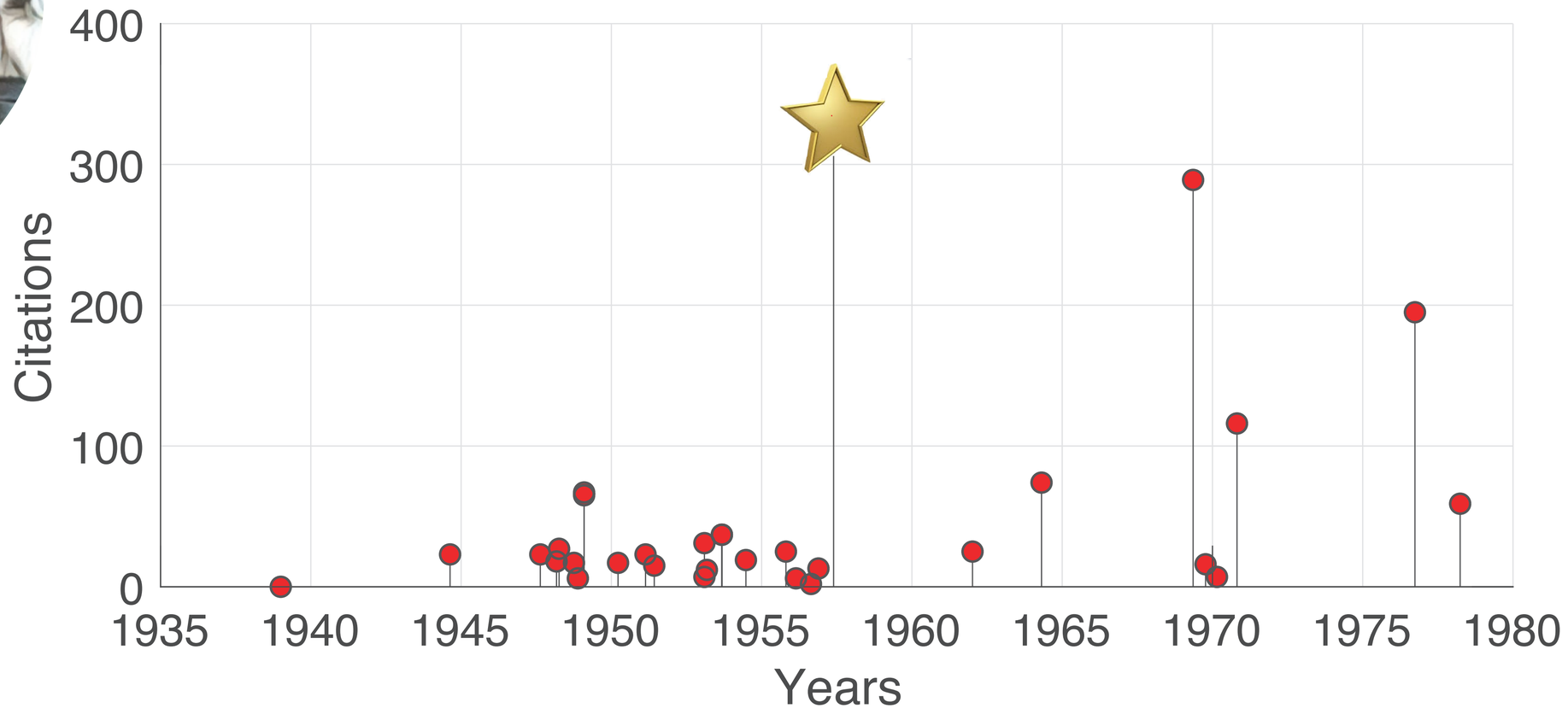
How does success evolve in scientific careers?

Career of Richard Feynman (Nobel in Physics, 1965)



Sinatra, Wang, Deville, Song, Barabási, Science, 354, 6312, aaf5239 (2016)

Career of Richard Feynman (Nobel in Physics, 1965)



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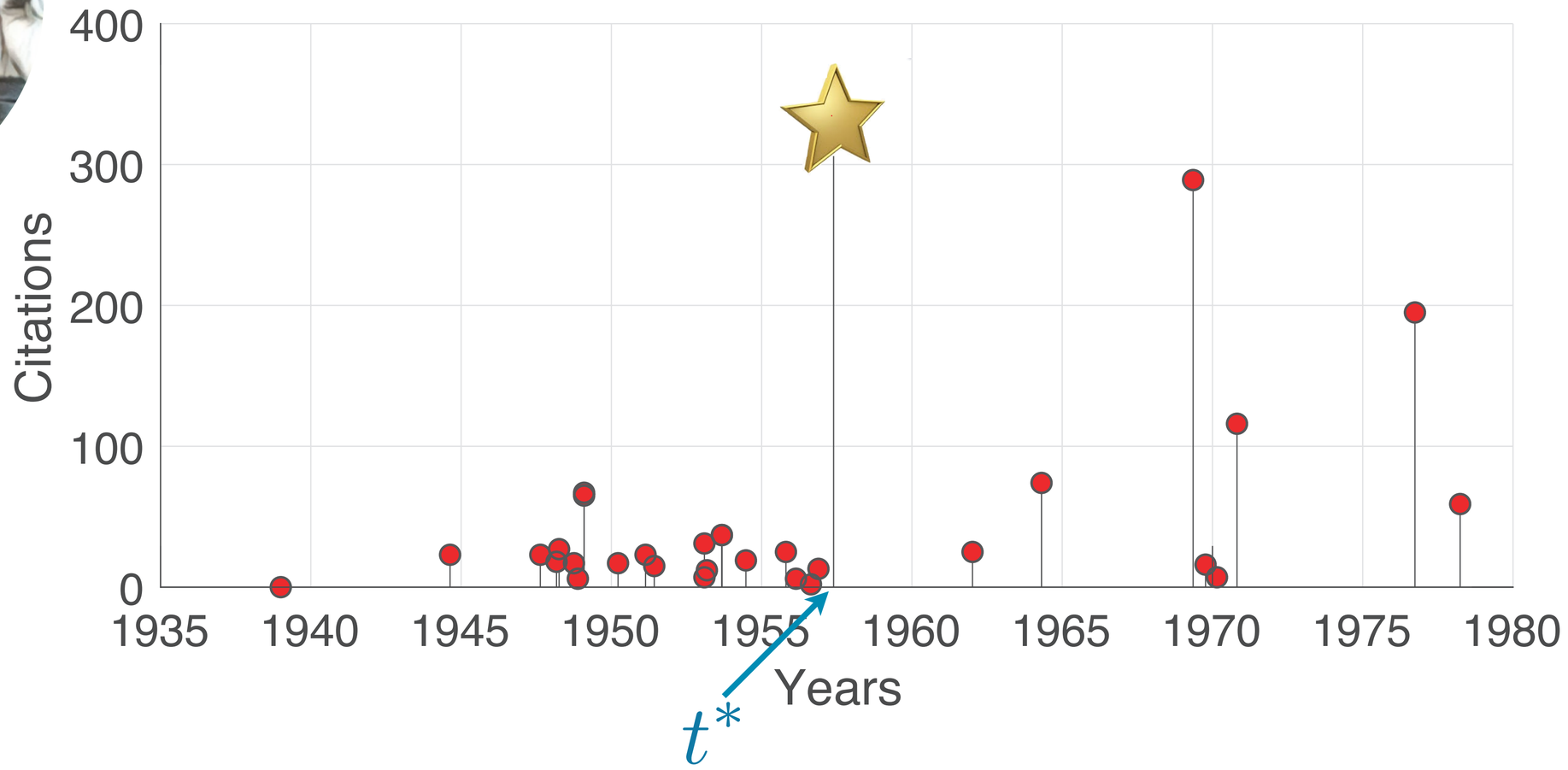

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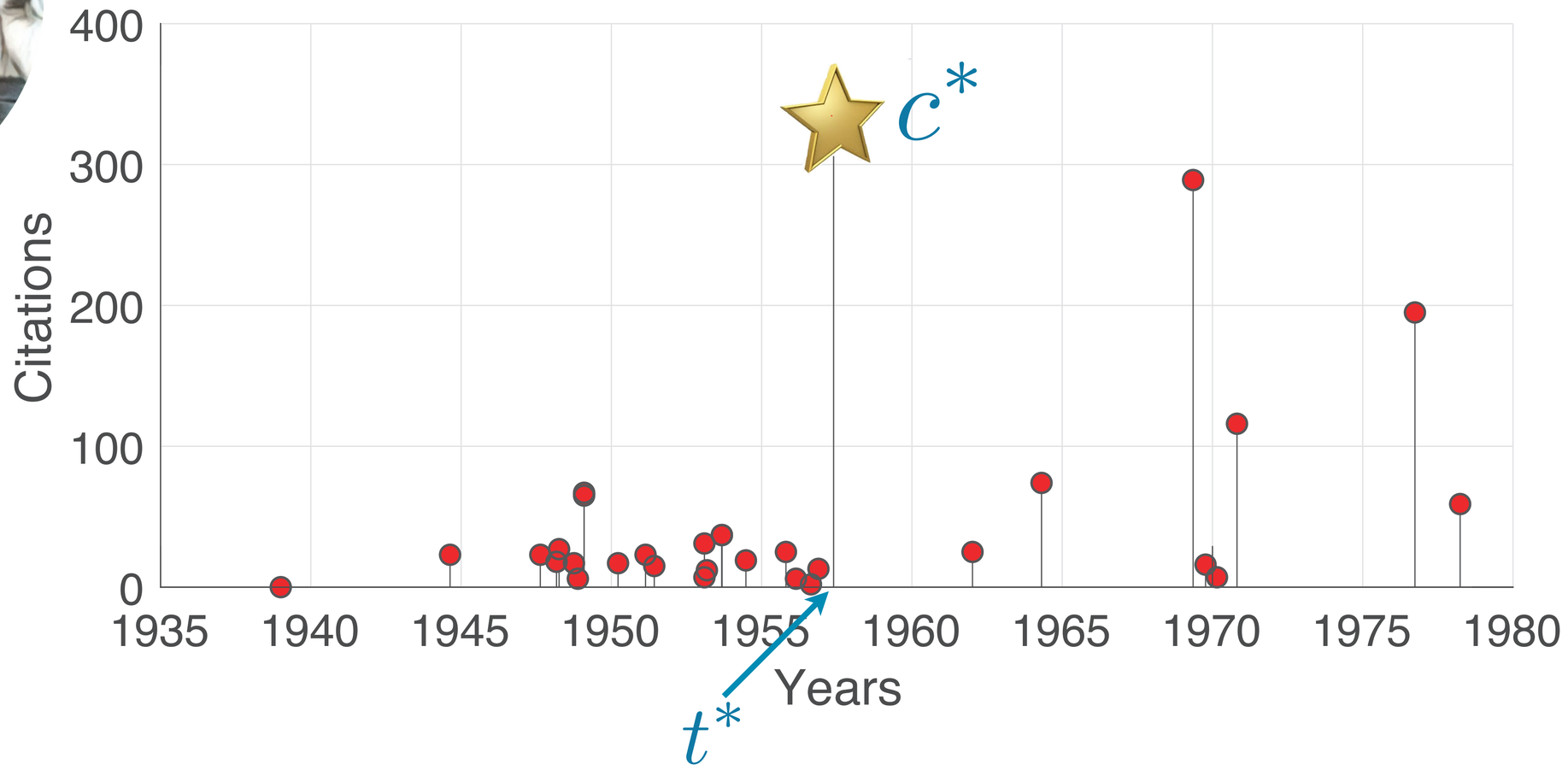
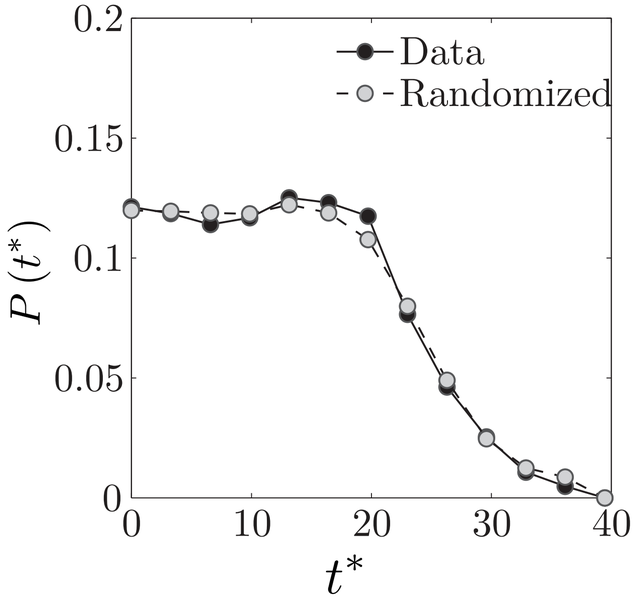


Sinatra, Wang, Deville, Song, Barabási, Science, 354, 6312, aaf5239 (2016)

Two findings: Random Impact Rule and Q-model



$$c_{j,\alpha} = p_\alpha Q_j$$

impact of j's paper = luck * researcher Q

Sinatra, Wang, Deville, Song, Barabási, Science, 354, 6312, aaf5239 (2016)

Video and interactive visualization are online

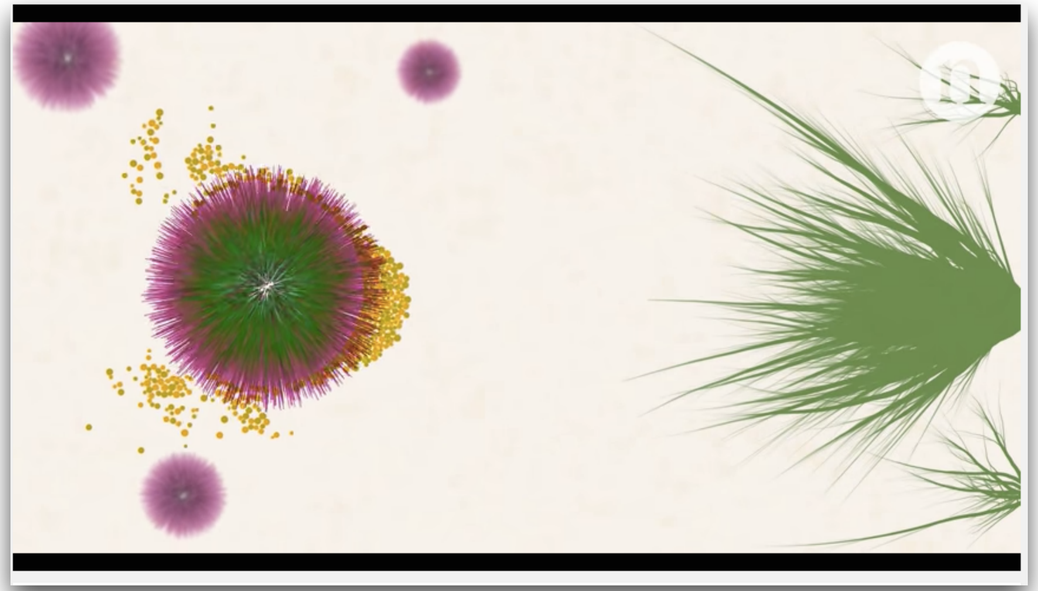
RESEARCH ARTICLE

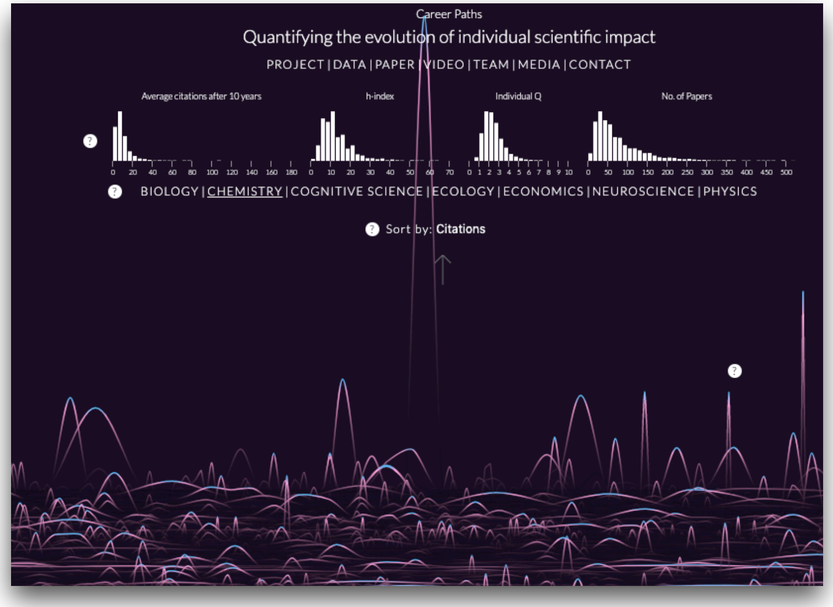
SCIENCE COMMUNITY

Quantifying the evolution of individual scientific impact

Roberta Sinatra,[1,2] Dashun Wang,[3,4] Pierre Deville,[1,5] Chaoming Song,[6] Albert-László Barabási[1,7,8,9]*

Despite the frequent use of numerous quantitative indicators to gauge the professional impact of a scientist, little is known about how scientific impact emerges and evolves in time. Here, we quantify the changes in impact and productivity throughout a career in science, finding that impact, as measured by influential publications, is distributed randomly within a scientist's sequence of publications. This random-impact rule allows us to formulate a stochastic model that uncouples the effects of productivity, individual ability, and luck and unveils the existence of universal patterns governing the emergence of scientific success. The model assigns a unique individual parameter Q to each scientist, which is stable during a career, and it accurately predicts the evolution of a scientist's impact, from the h-index to cumulative citations, and independent recognitions, such as prizes.





Nature video:
Is a scientific career predictable?

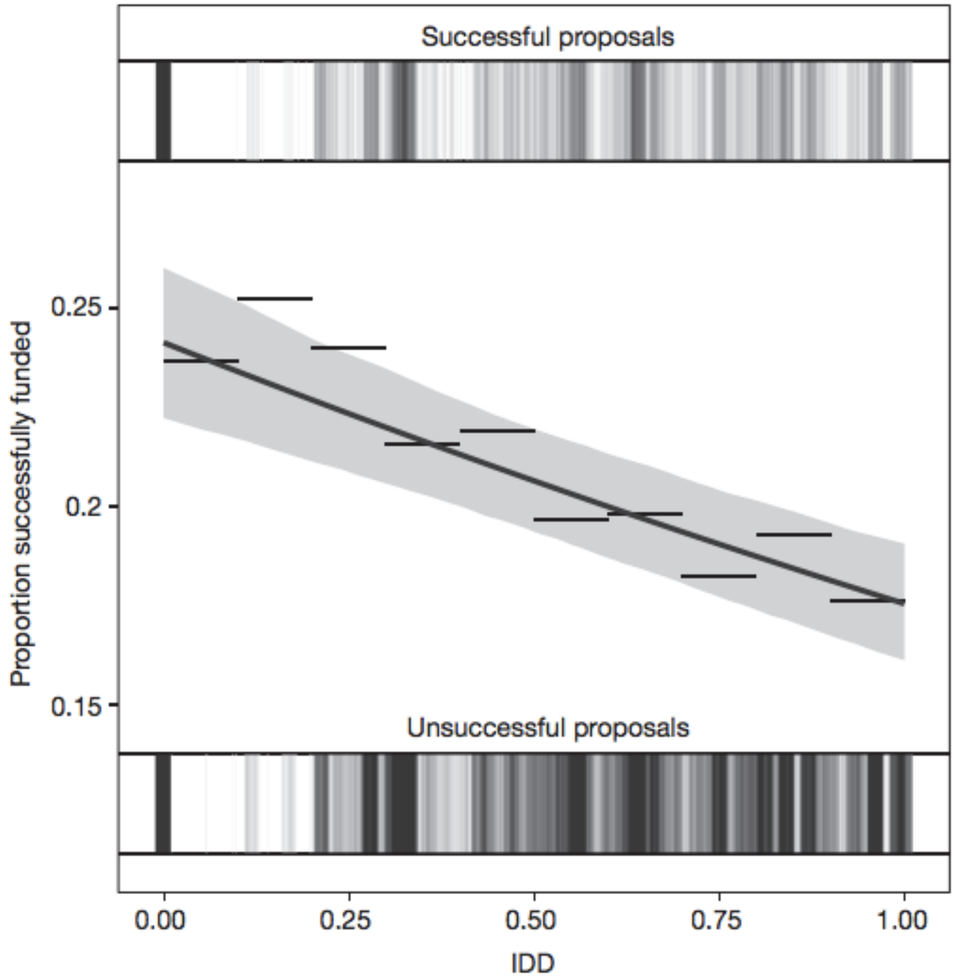
http://sciencepaths.kimalbrecht.com/

Sinatra, Wang, Deville, Song, Barabási, Science, 354, 6312, aaf5239 (2016)

Do performance and success in science differ?

1. Interdisciplinarity

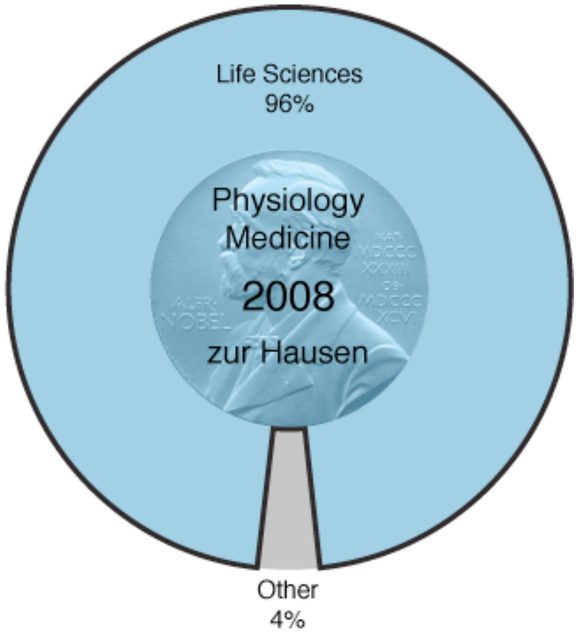
Interdisciplinary research is important but discriminated



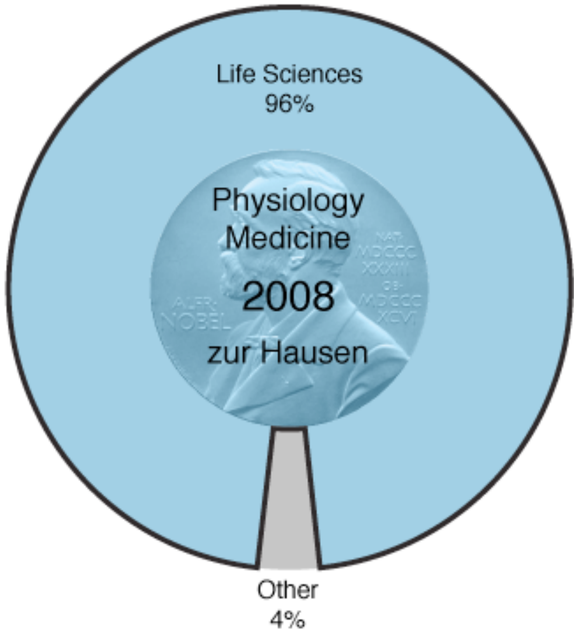
Bromham et al., Nature 534, 684-687 (2016)

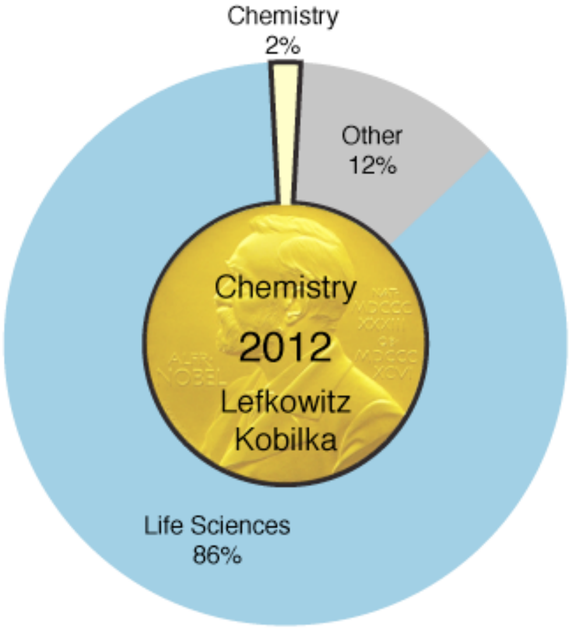
Interdisciplinary research is important but discriminated

What about awards?

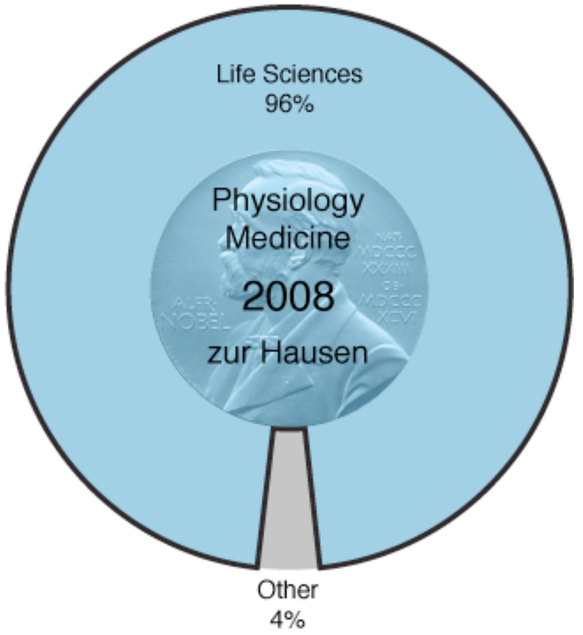


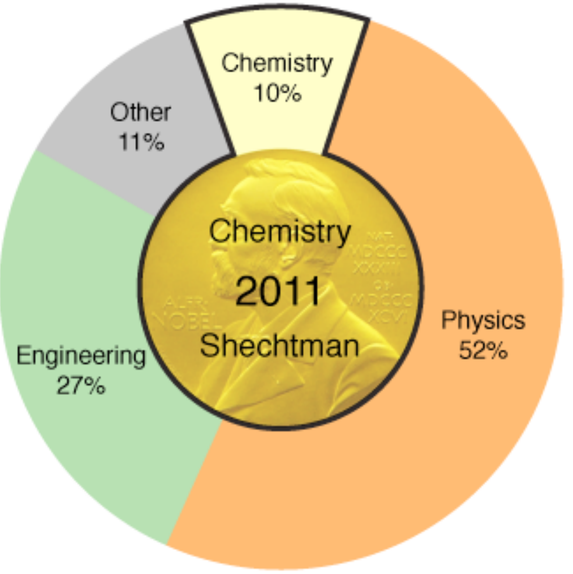
Szell, Ma, Sinatra, Nature Physics 14 1075-1078 (2018)

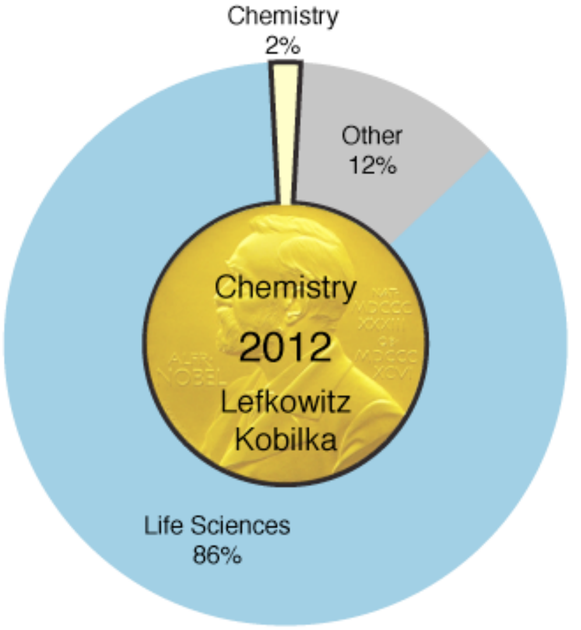




Szell, Ma, Sinatra, Nature Physics 14 1075-1078 (2018)

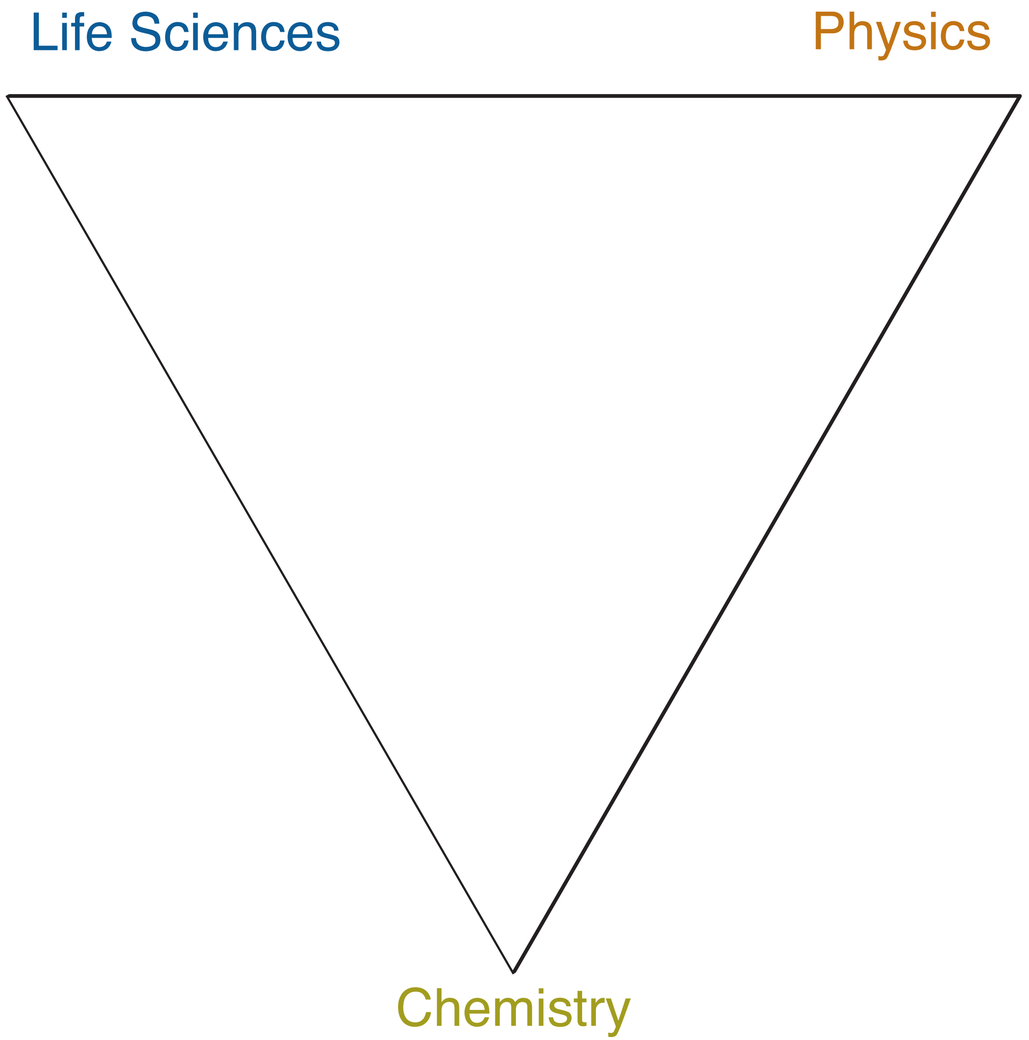






Szell, Ma, Sinatra, Nature Physics 14 1075-1078 (2018)

Visualizing interdisciplinary impact



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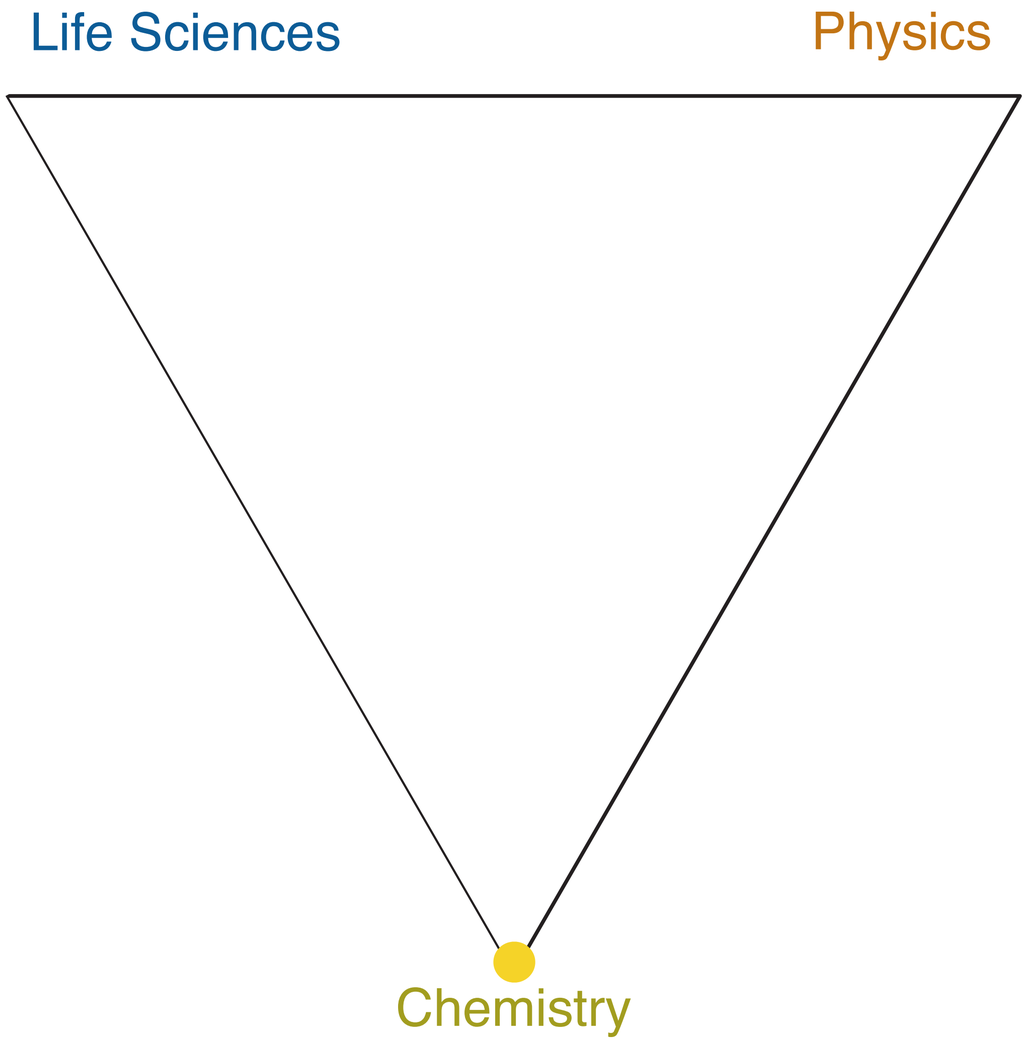

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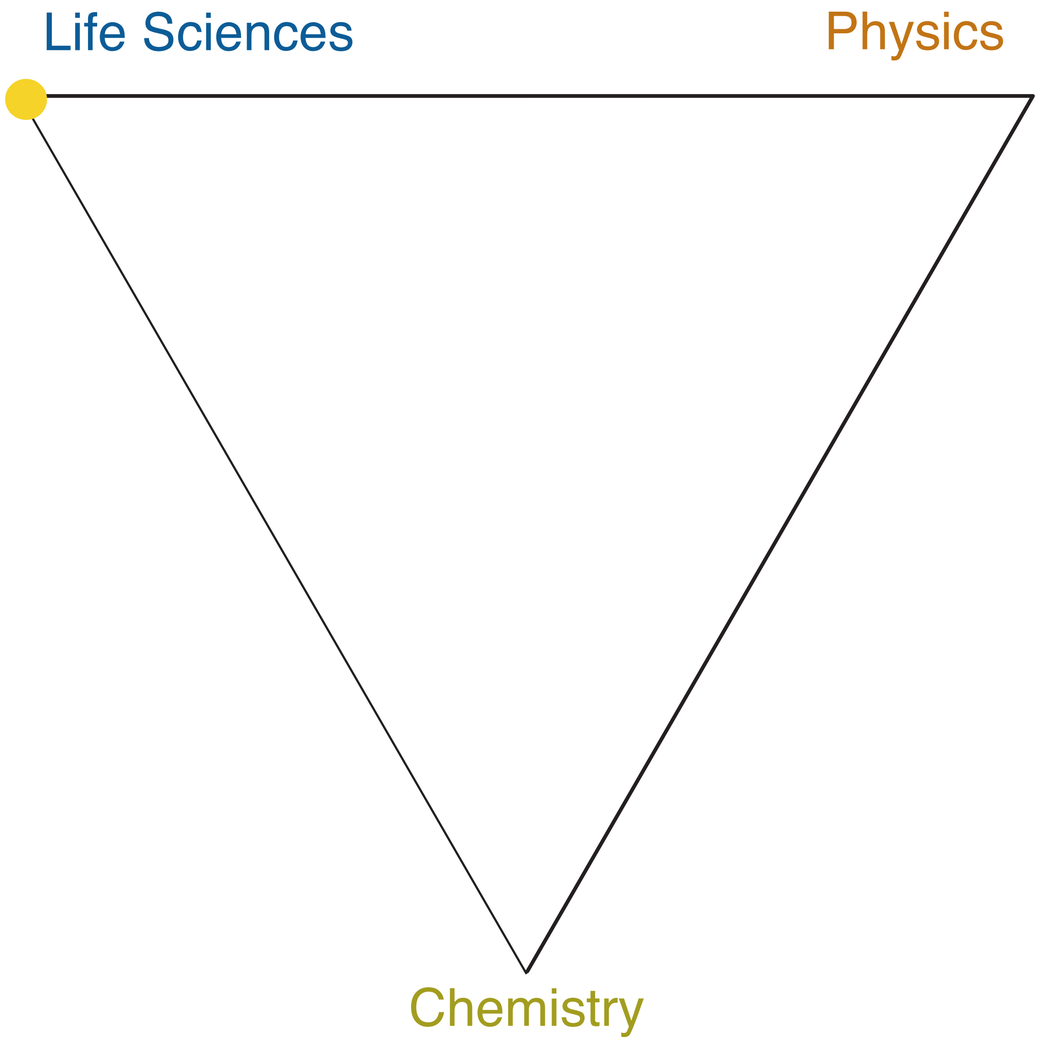
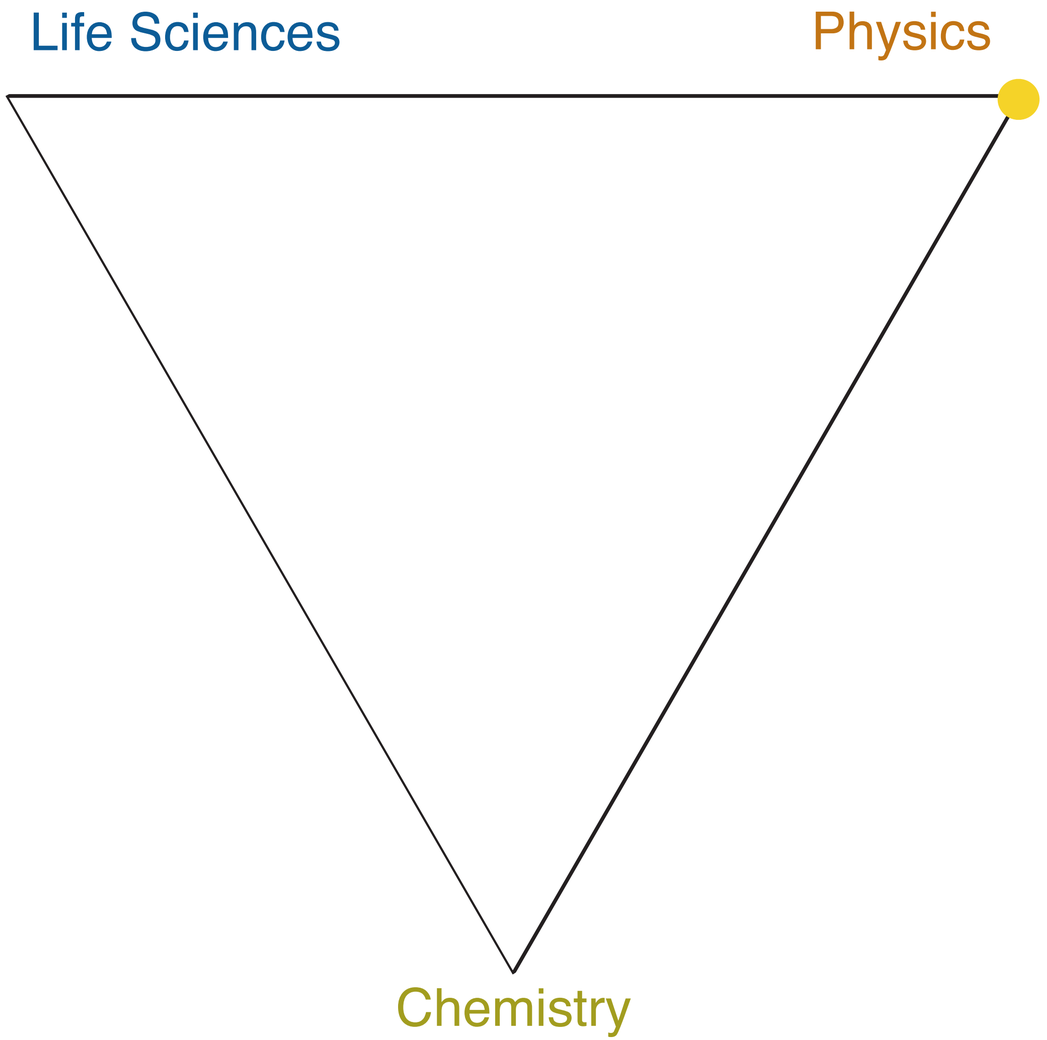


Visualizing interdisciplinary impact



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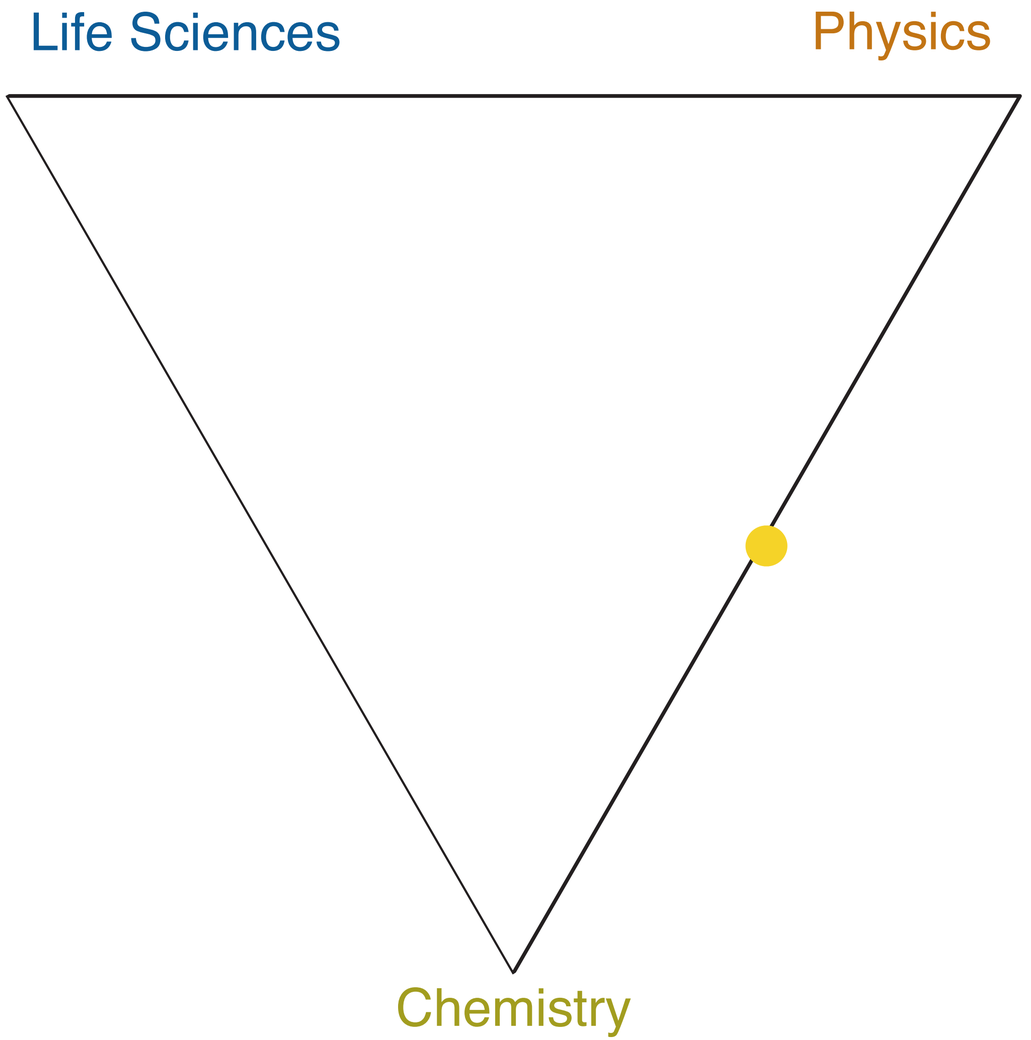

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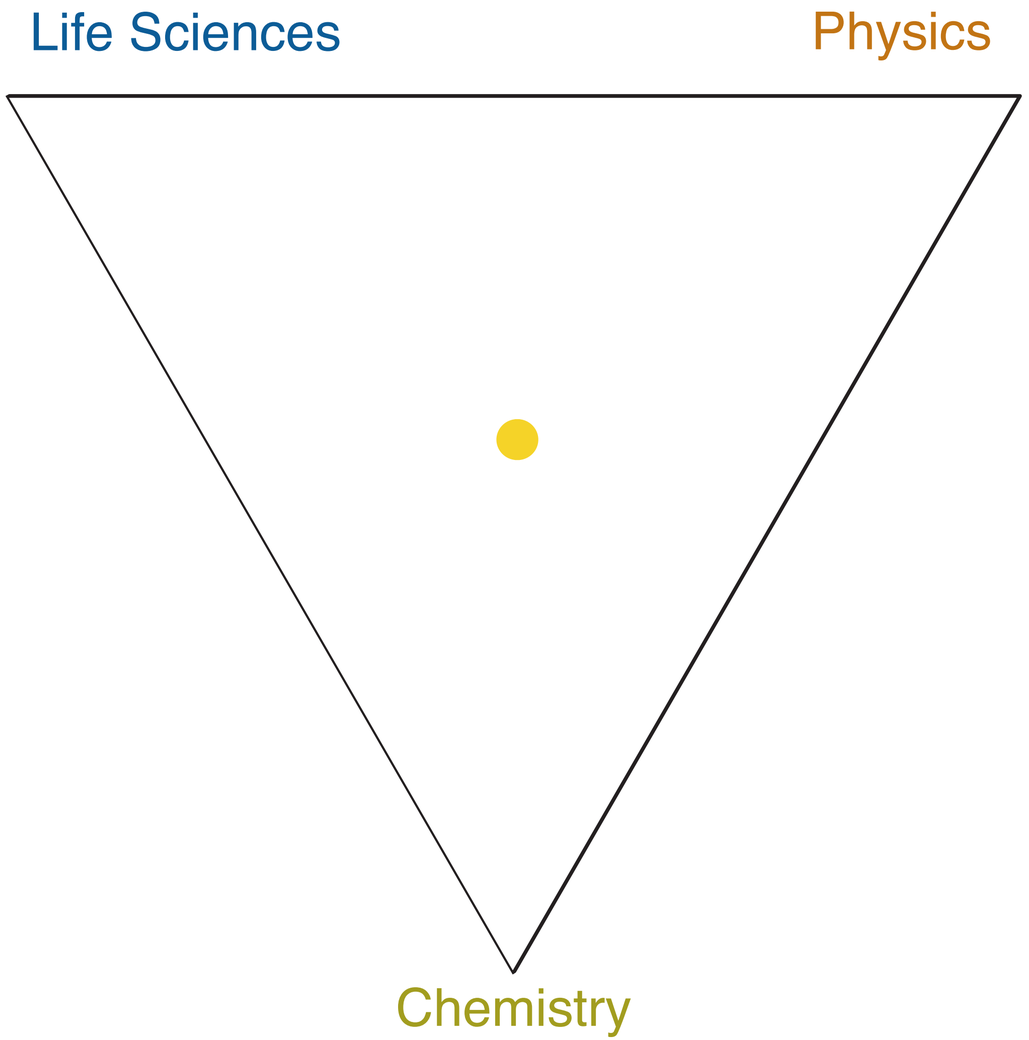

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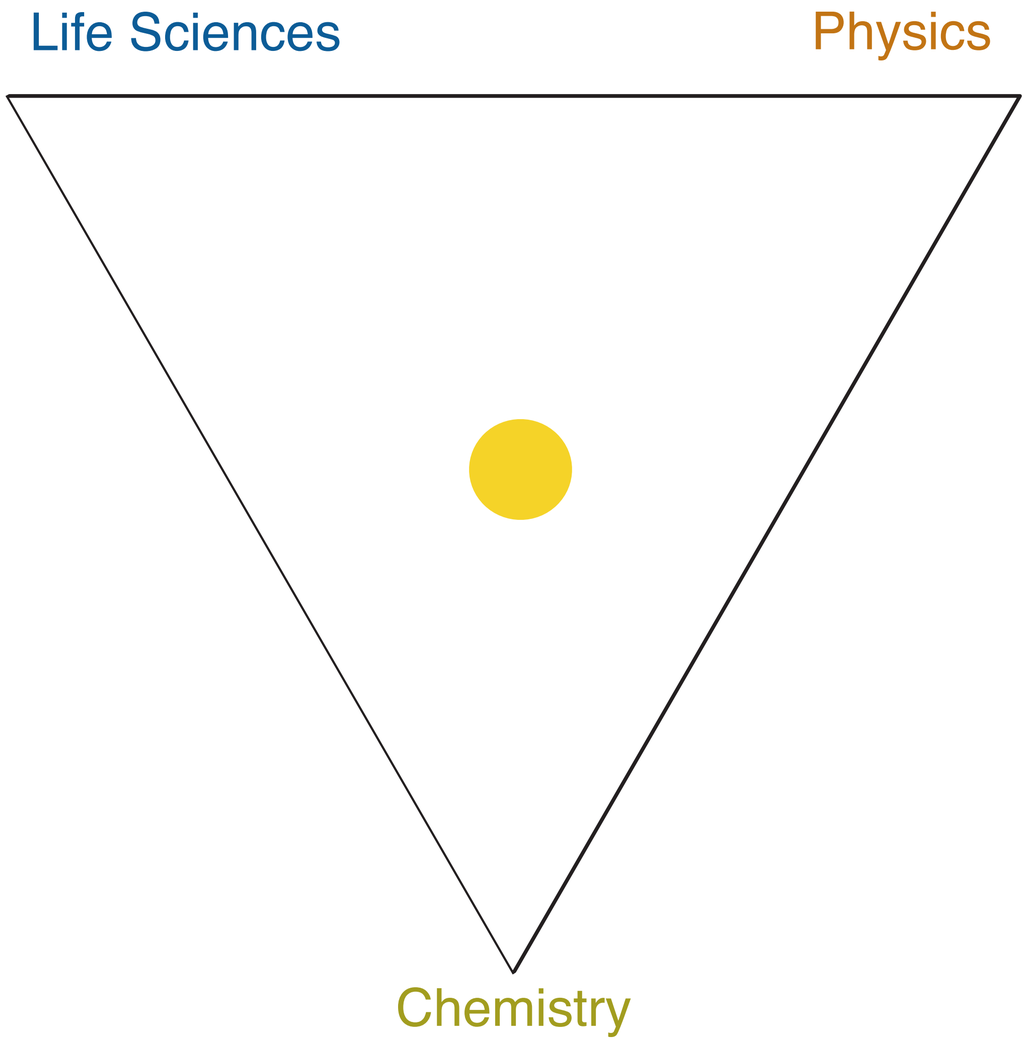
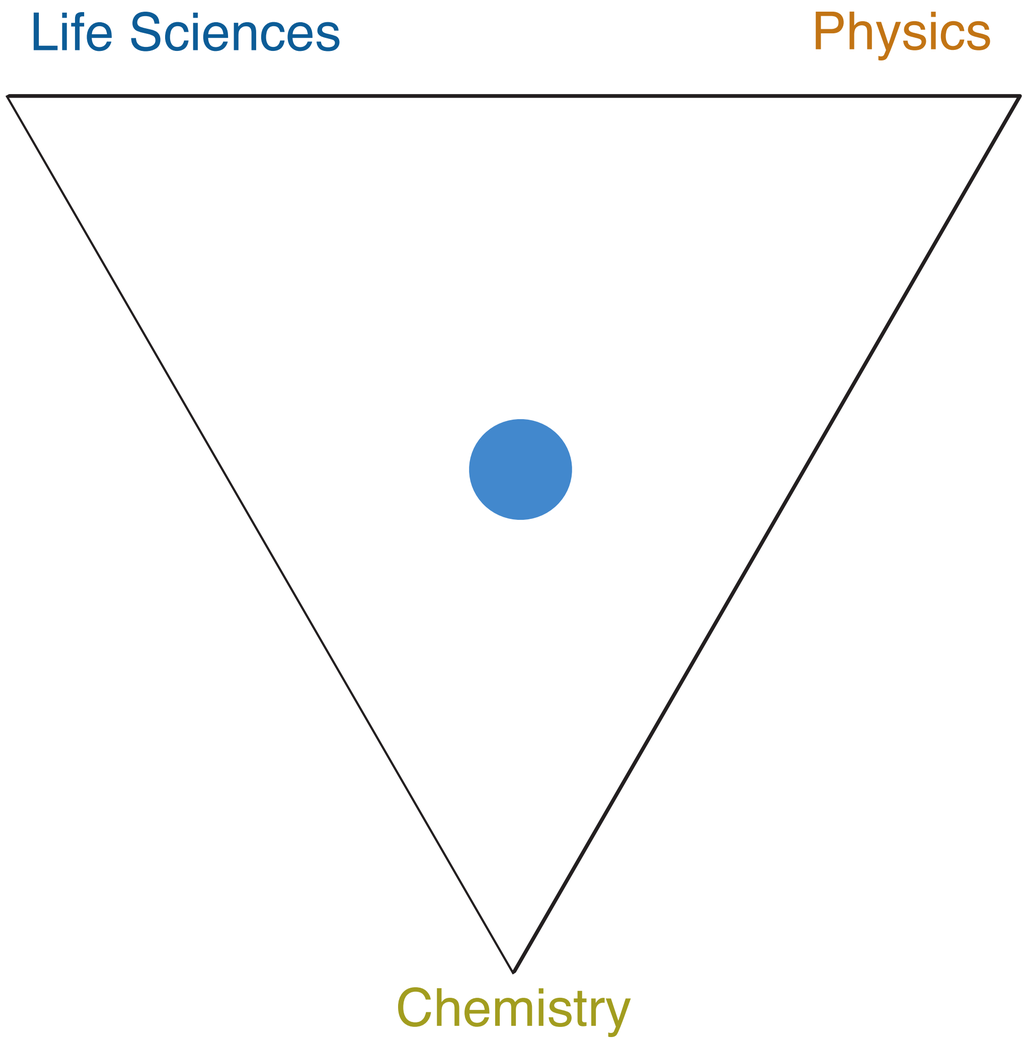
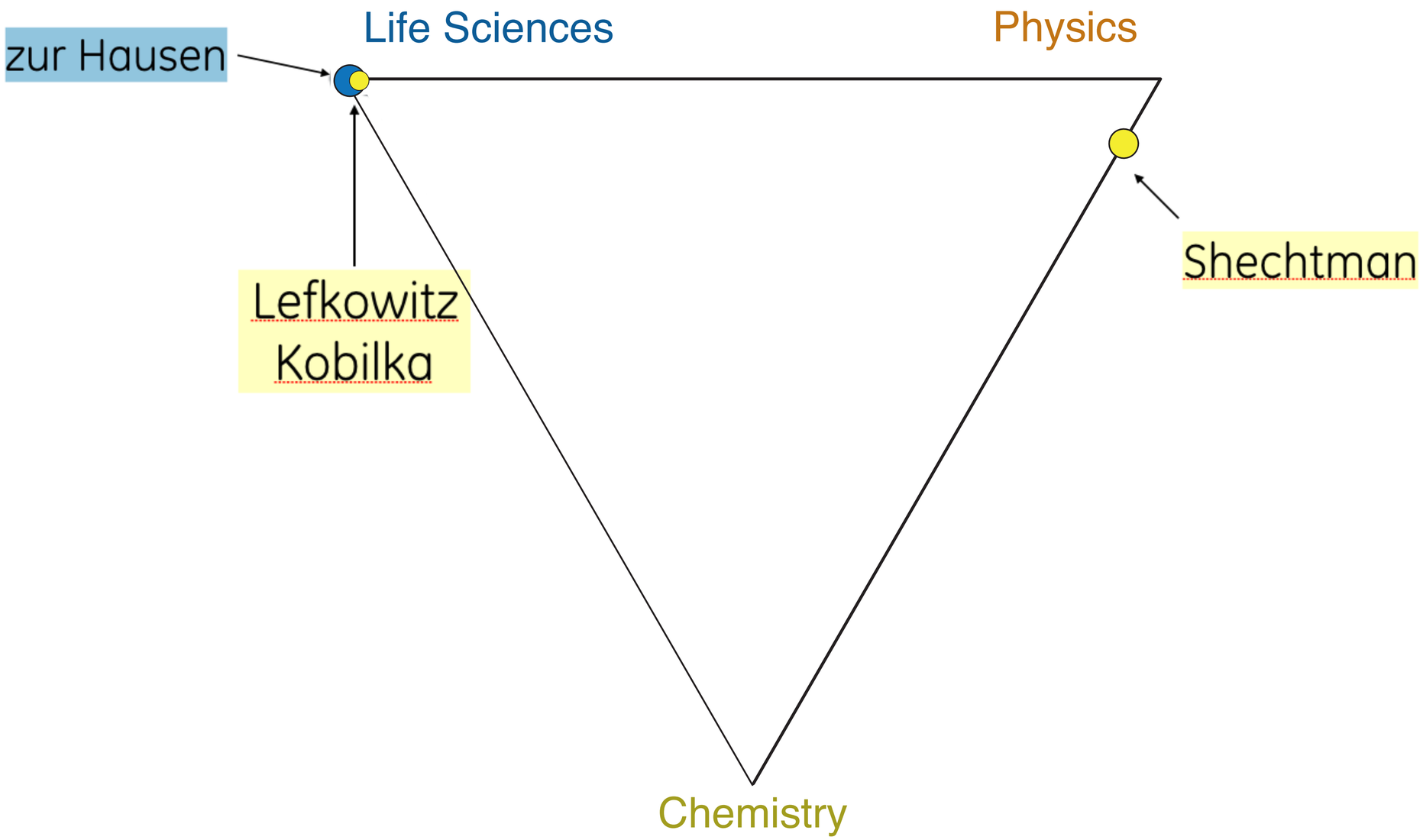


Visualizing interdisciplinary impact

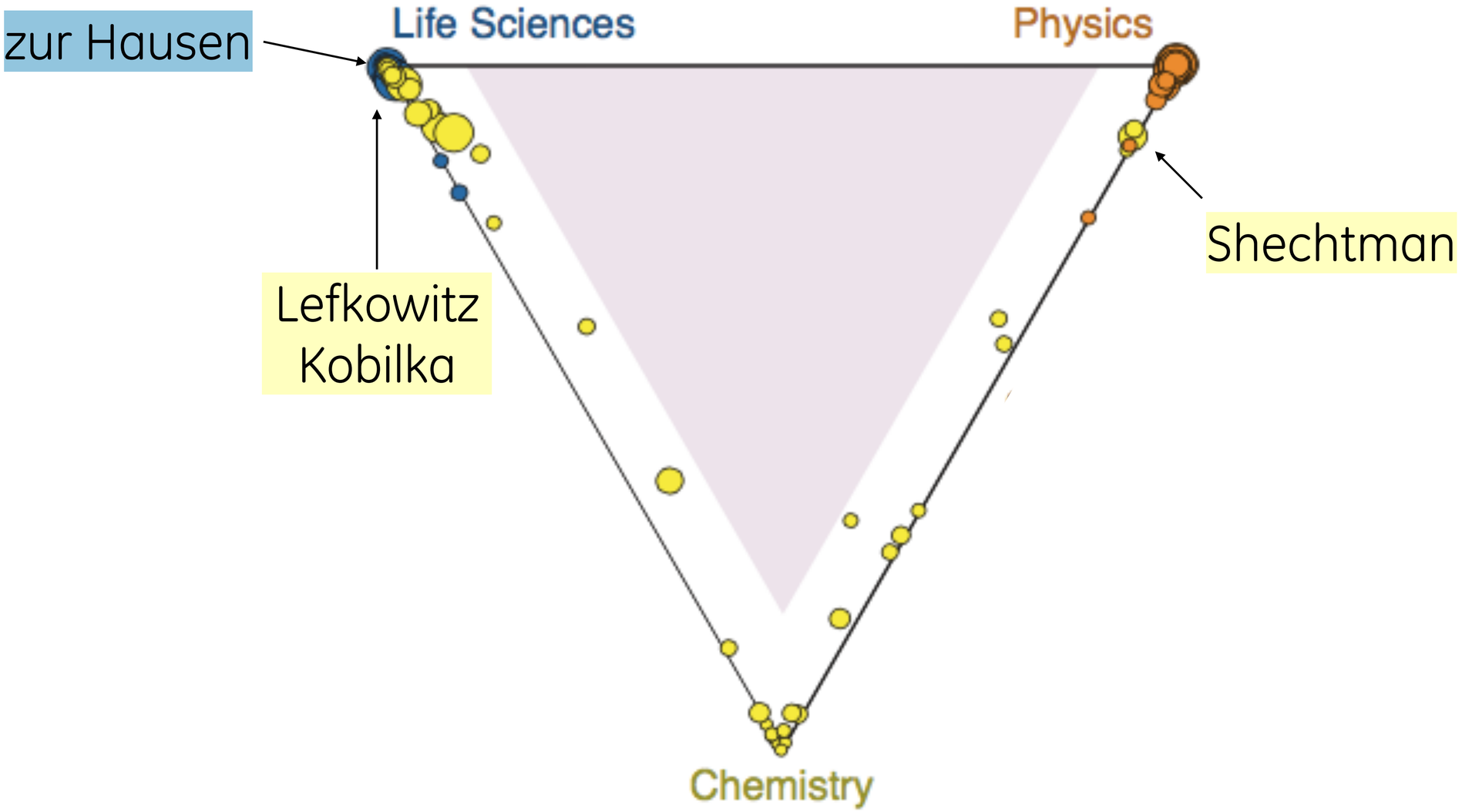


Visualizing the interdisciplinary impact of Nobel prizes



Szell, Ma, Sinatra, Nature Physics 14 1075-1078 (2018)

Visualizing the interdisciplinary impact of Nobel prizes



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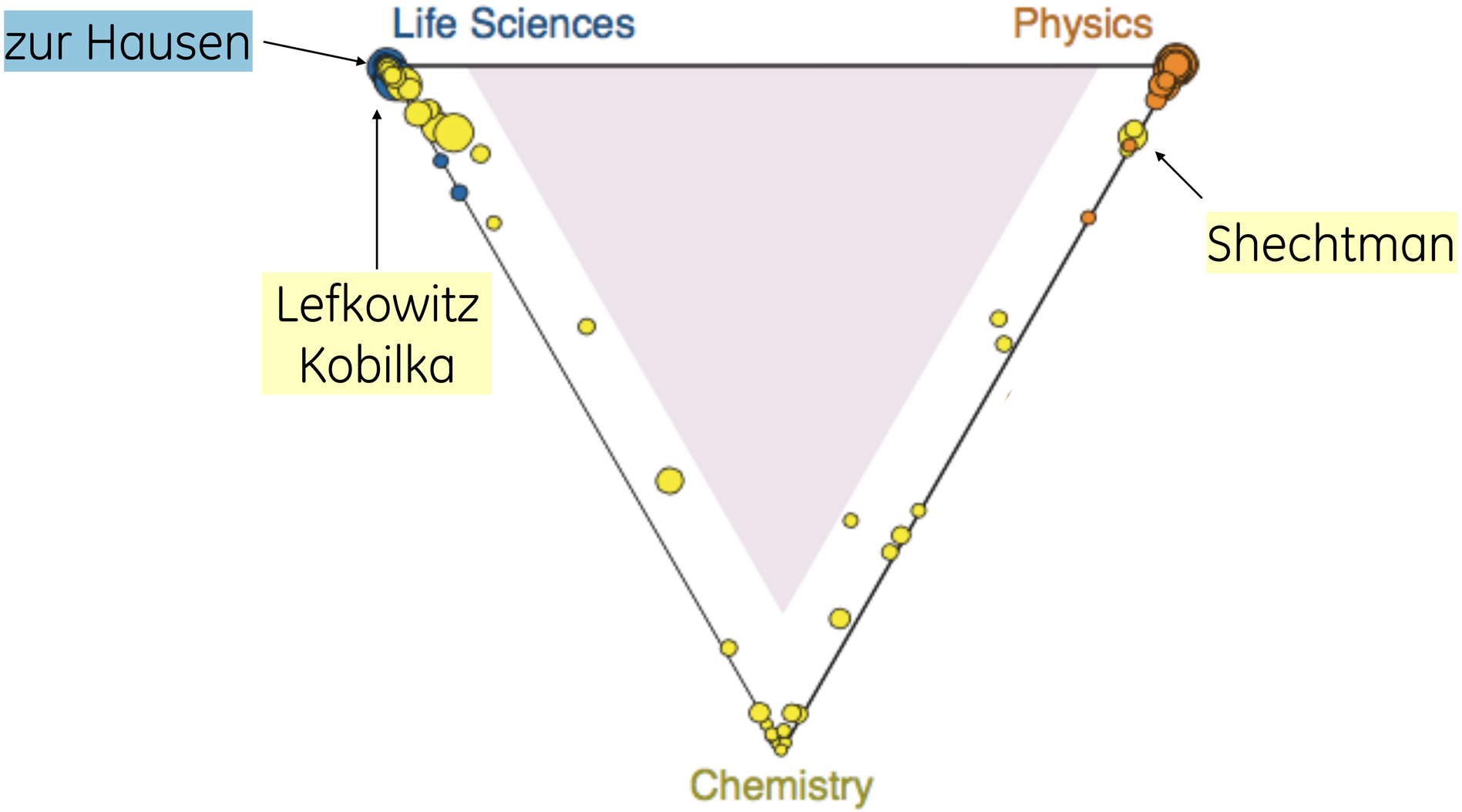
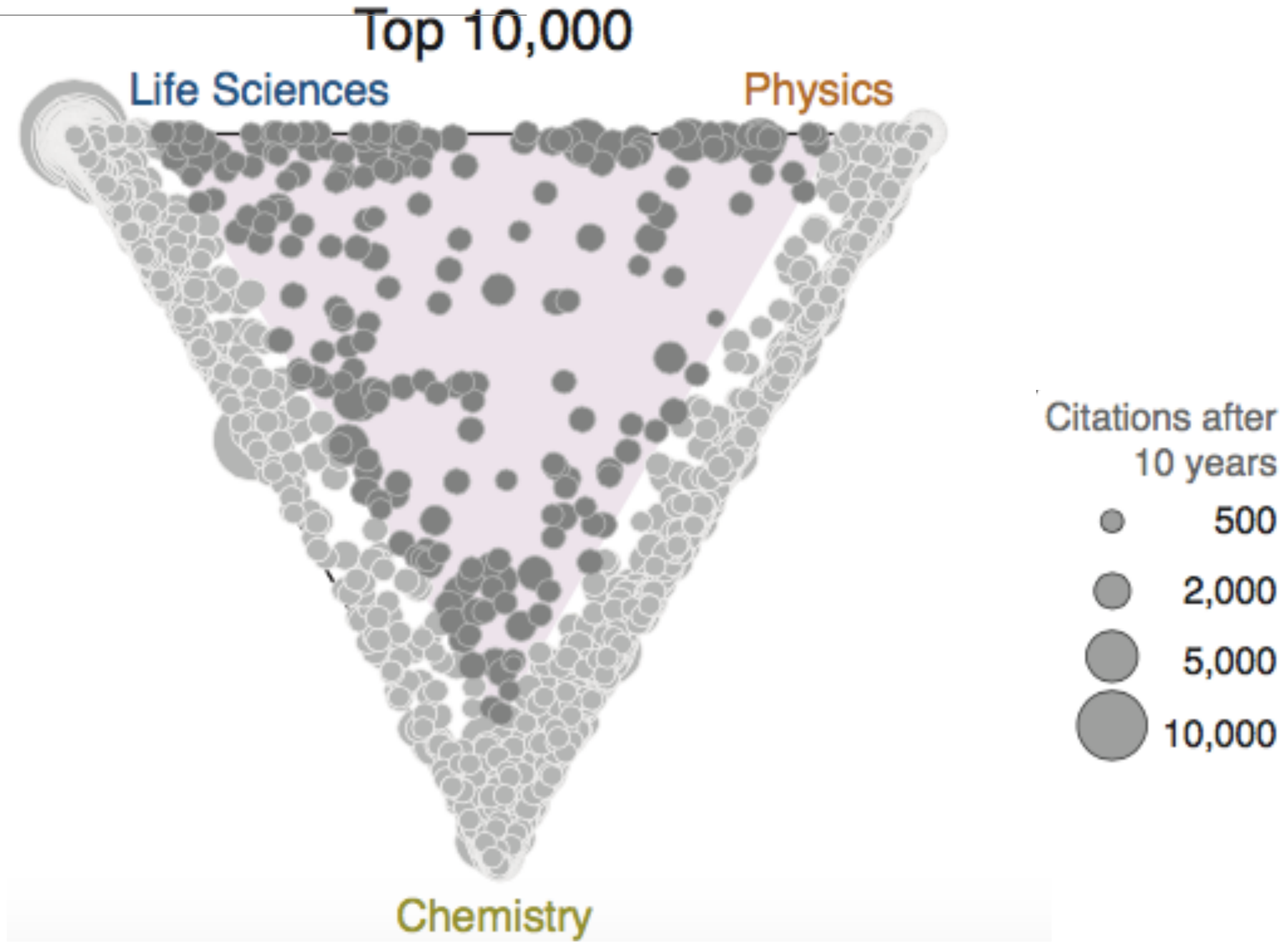
Visualizing the interdisciplinary impact of Nobel prizes



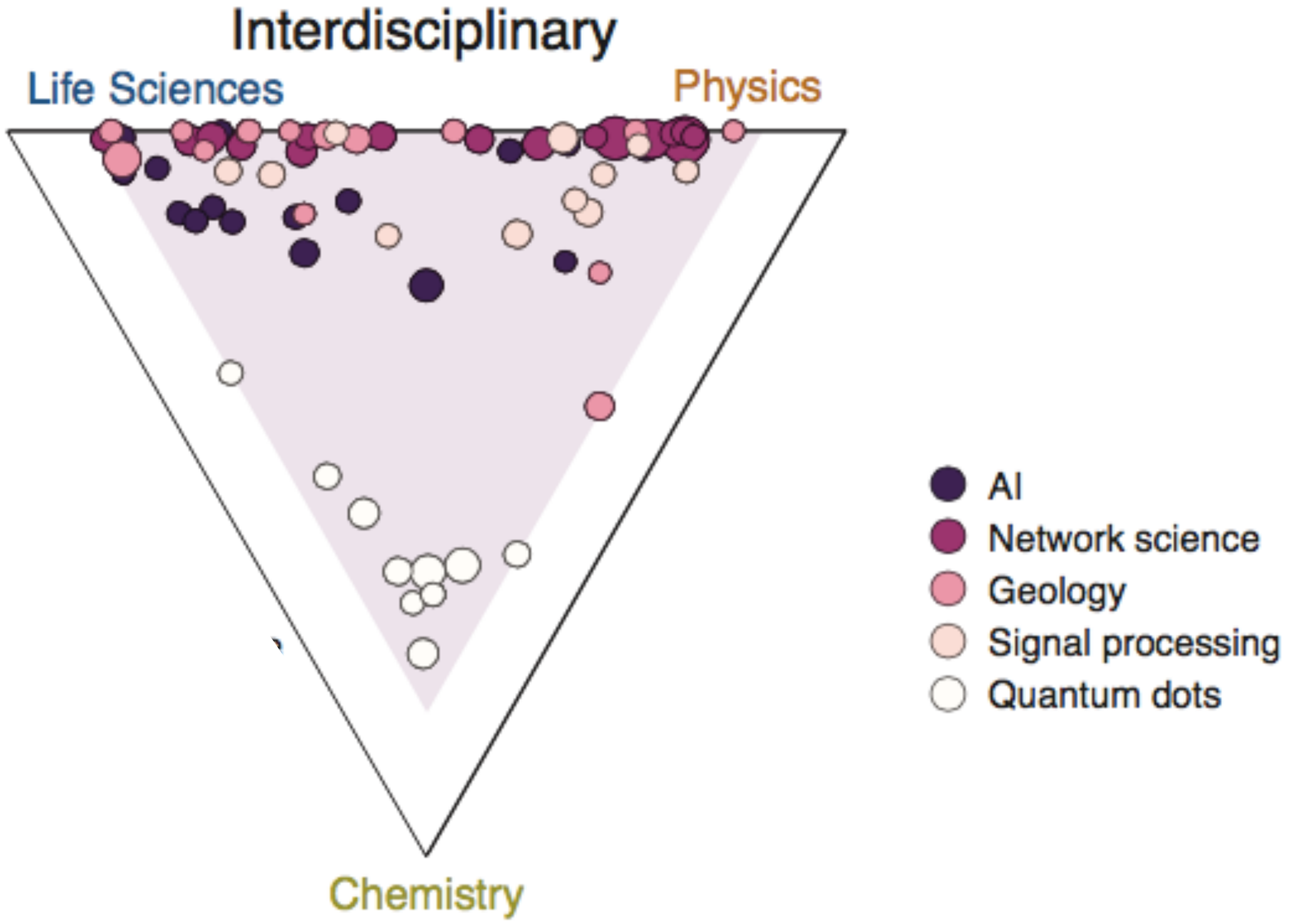
Szell, Ma, Sinatra, Nature Physics 14 1075-1078 (2018)

Visualizing the interdisciplinary impact of high impact papers



Szell, Ma, Sinatra, Nature Physics 14 1075-1078 (2018)

High interdisciplinary papers



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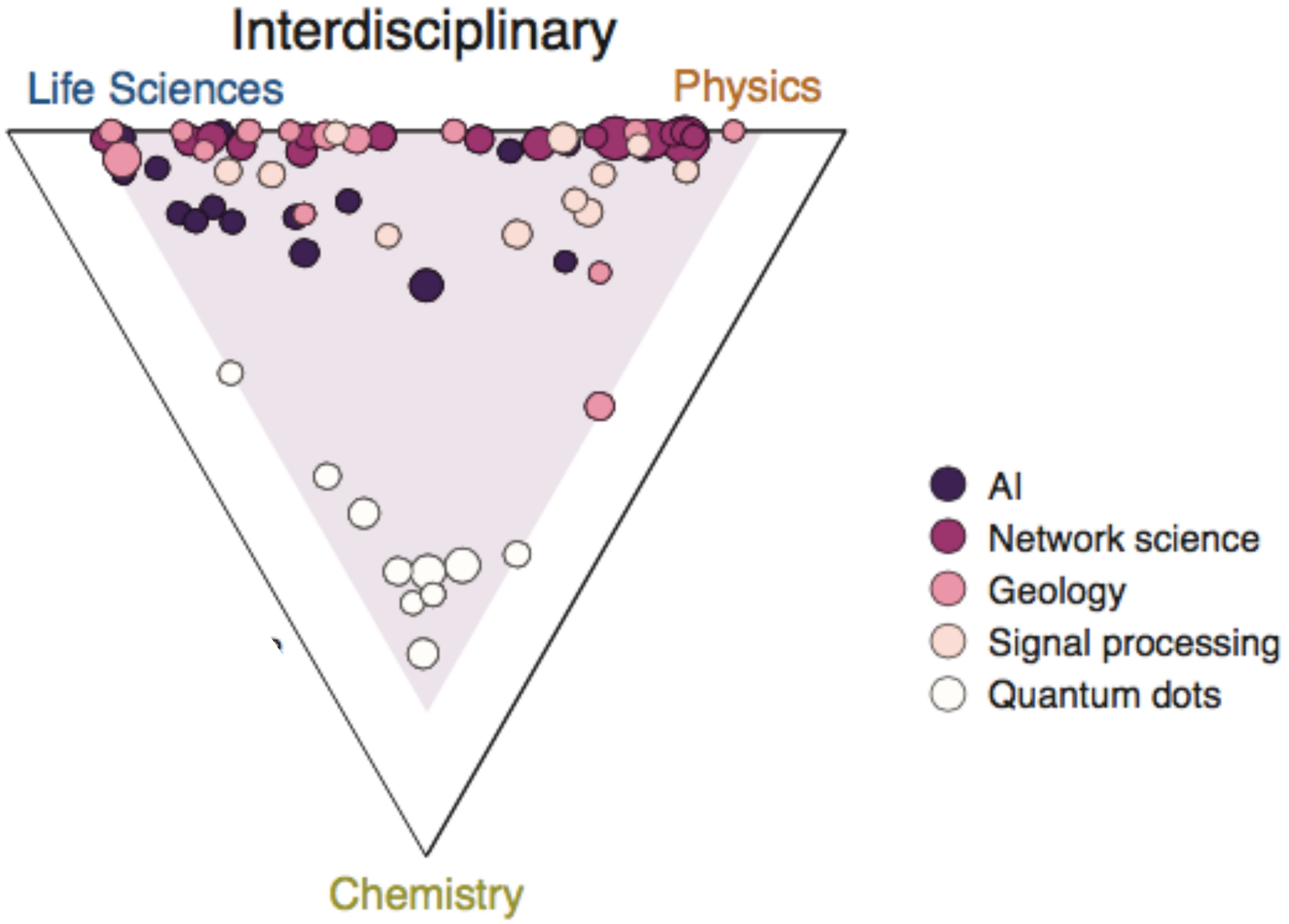
High interdisciplinary papers



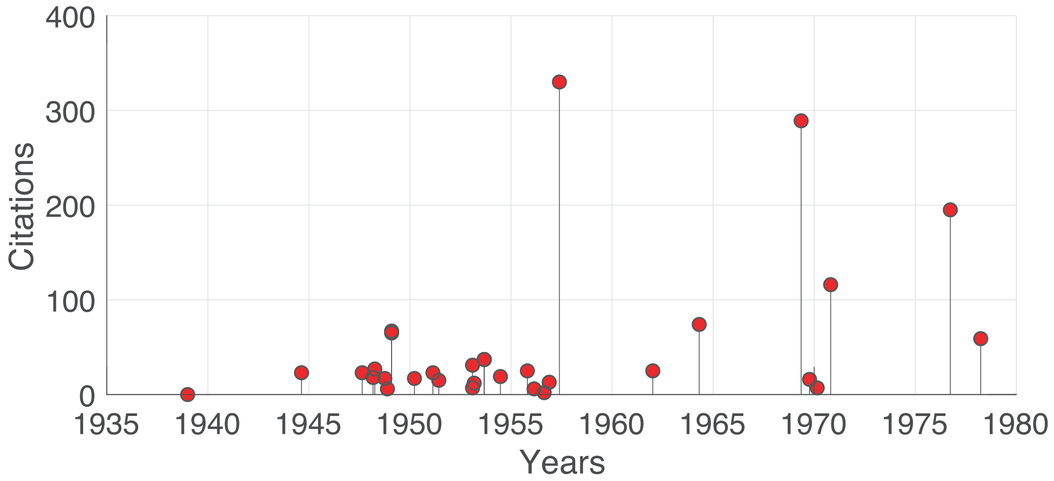
Szell, Ma, Sinatra, Nature Physics 14 1075-1078 (2018)

2. Gender

How does productivity differ between female and male scientists?

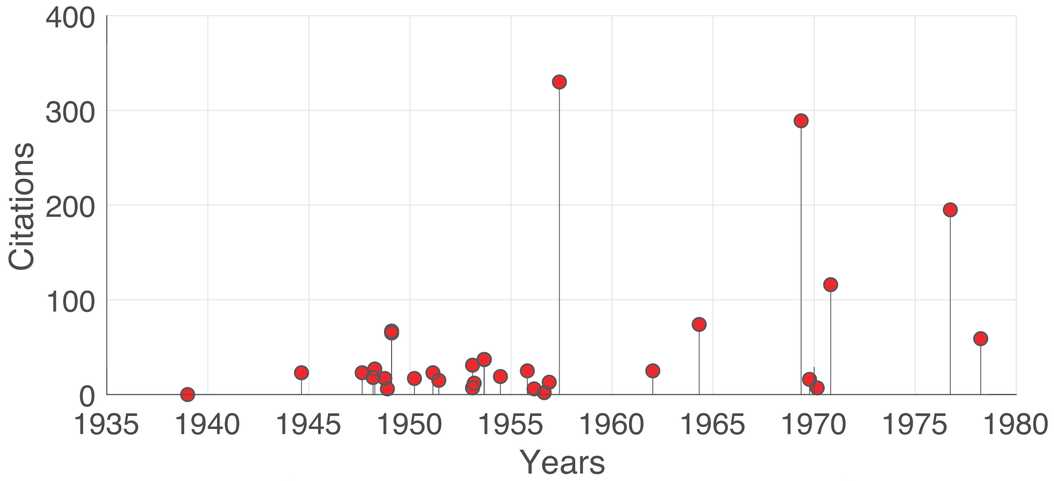
How does impact differ between female and male scientists?

Scientific careers and gender



Huang, Gates, Sinatra, Barabasi, PNAS 117:9 (2020)

Scientific careers and gender



Jennifer
Alice
Marta
Roberta
...

John
Bob
Christian
Matthew
...

Huang, Gates, Sinatra, Barabasi, PNAS 117:9 (2020)

Data sets after processing

WEB OF SCIENCE

~1,5M careers
1,1M male, 400k female

dblp
computer science bibliography

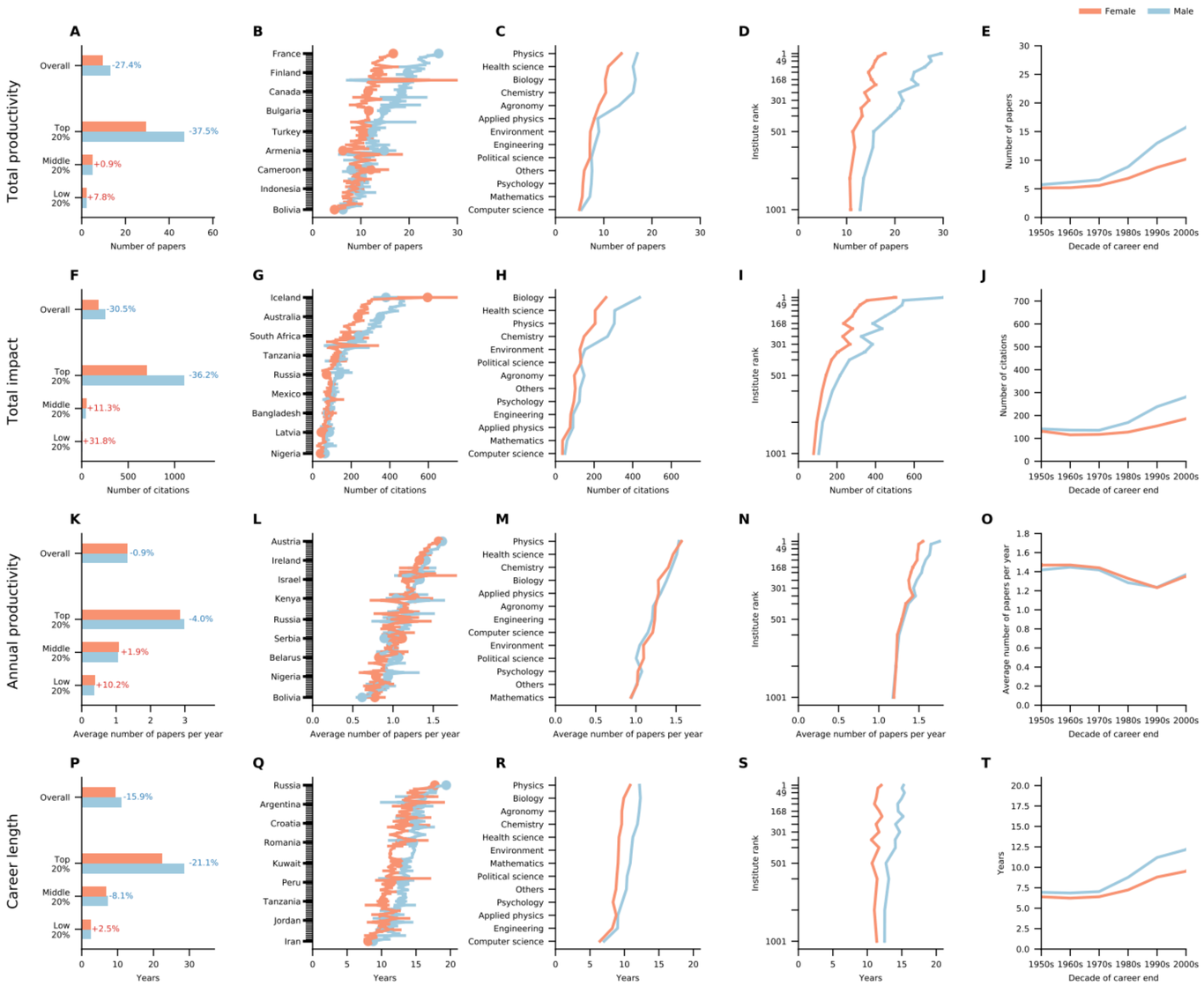
~370k careers
300k male, 70k female

Microsoft Academic Search Beta

~8.4M careers
5.8M male, 2.6M female

Huang, Gates, Sinatra, Barabasi, PNAS 117:9 (2020)

We found differences for everything!



Huang, Gates, Sinatra, Barabasi, PNAS 117:9 (2020)

We found differences for everything!

F

M

~70% of scientific workforce

Huang, Gates, Sinatra, Barabasi, PNAS 117:9 (2020)

We found differences for everything!

F

M

~70% of scientific workforce

30% more citations

Huang, Gates, Sinatra, Barabasi, PNAS 117:9 (2020)

We found differences for everything!

F

M

~70% of scientific workforce

30% more citations

10% more career productivity (1950)

35% more career productivity (2000)

Huang, Gates, Sinatra, Barabasi, PNAS 117:9 (2020)

We found differences for everything!

F

M

~70% of scientific workforce

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10% more career productivity (1950)

35% more career productivity (2000)

Same annual productivity

Huang, Gates, Sinatra, Barabasi, PNAS 117:9 (2020)

We found differences for everything!

F

M

~70% of scientific workforce

30% more citations

10% more career productivity (1950)

35% more career productivity (2000)

Same annual productivity

Shorter career length

Huang, Gates, Sinatra, Barabasi, PNAS 117:9 (2020)

Scientific careers and gender

Confounding factors!

Huang, Gates, Sinatra, Barabasi, PNAS 117:9 (2020)

We use a matched sample approach to simulate controlled experiments

25,033 female authors

Maria
American physicist with a career of 10 years,
mostly working at an institute ranked 200th ~ 250th

Angela
Italian mathematician with a career of 15 years,
mostly working at a top-20 institute

Christiana
German psychologist with a career of 30 years,
mostly working at an institute ranked 50th ~ 90th
...

25,033 male authors

Mario
American physicist with a career of 10 years,
mostly working at an institute ranked 200th ~ 250th

Angelo
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Christopher
German psychologist with a career of 30 years,
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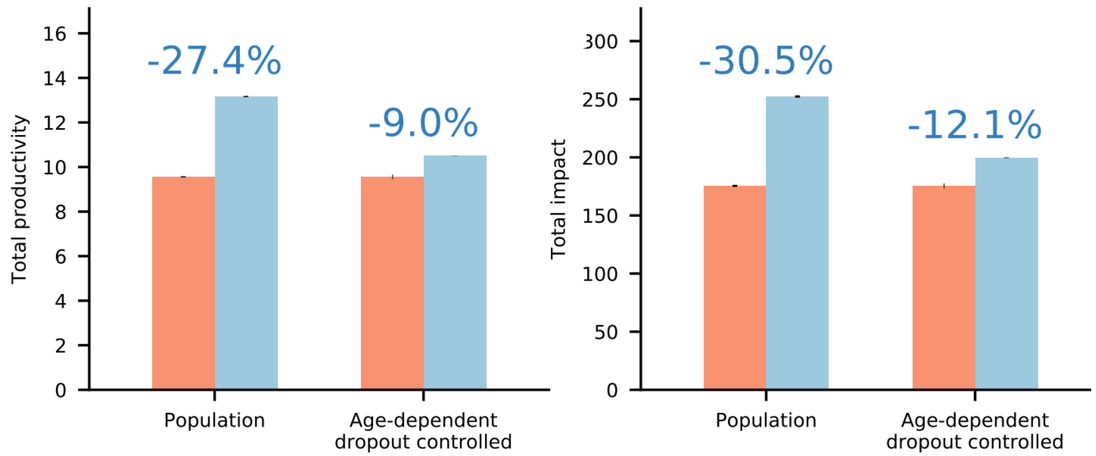
...

Huang, Gates, Sinatra, Barabasi, PNAS 117:9 (2020)

Gender affects dropout rate, productivity and impact



Huang, Gates, Sinatra, Barabasi, PNAS 117:9 (2020)

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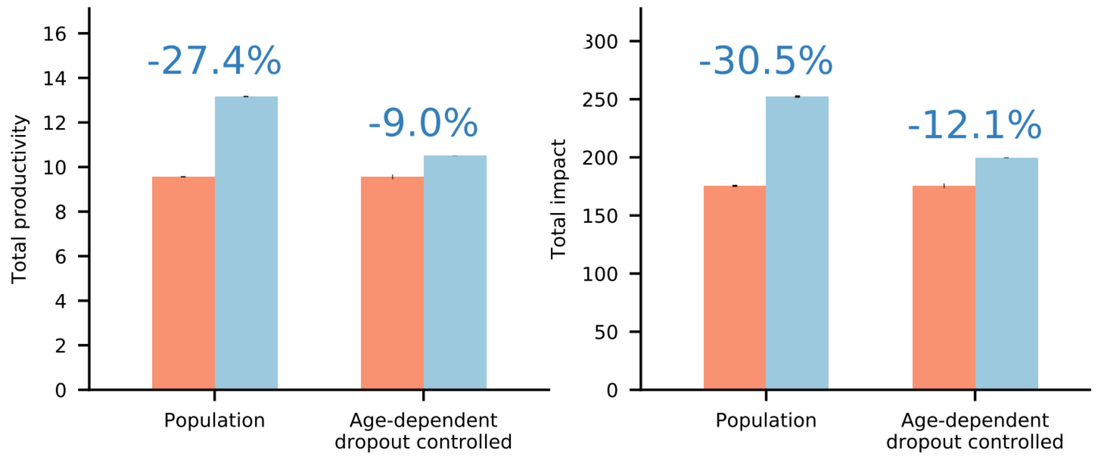
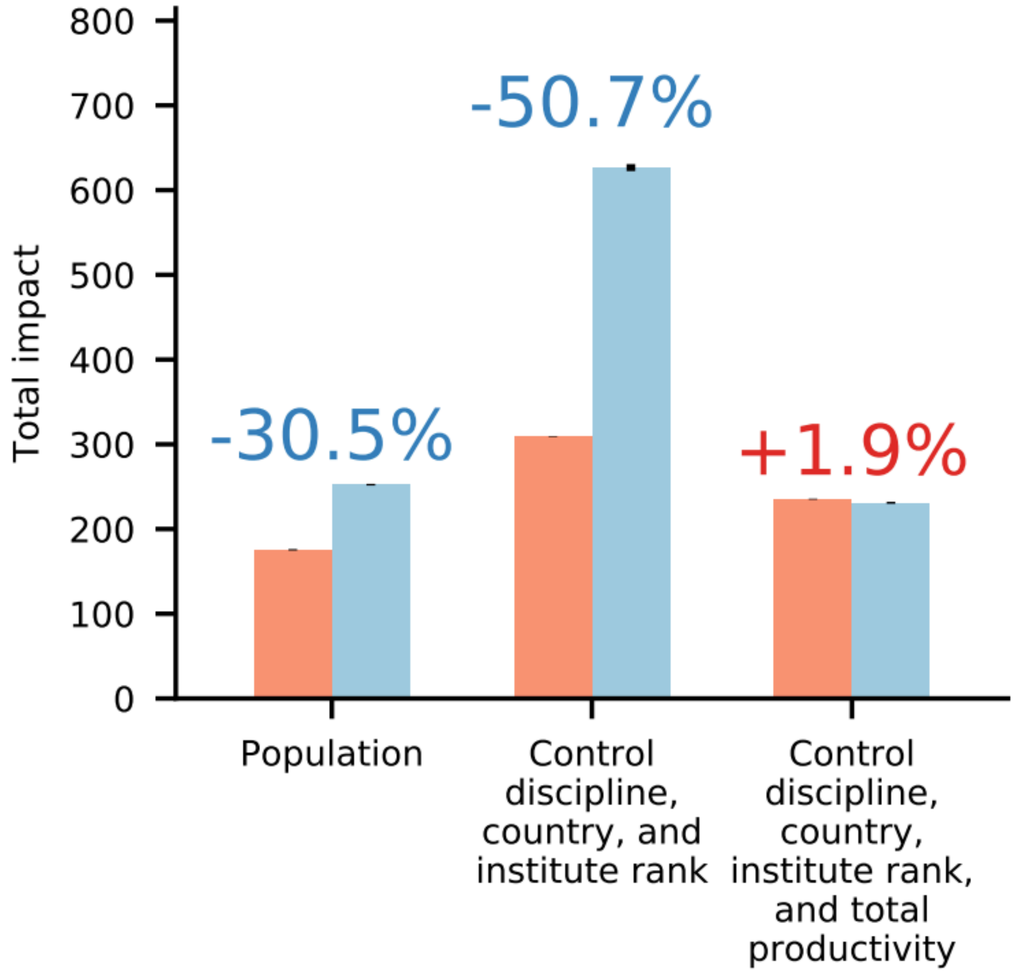




Huang, Gates, Sinatra, Barabasi, PNAS 117:9 (2020)

How does productivity differ between female and male scientists?

How does impact differ between female and male scientists?

How does productivity differ between female and male scientists?

Only by 9% if we take into account dropout rate

How does impact differ between female and male scientists?

How does productivity differ between female and male scientists?

Only by 9% if we take into account dropout rate

How does impact differ between female and male scientists?

Almost no difference if we take into account confounding factors

3. The role of chaperones in scientific publishing

Do you need to publish in *Nature* in order to publish in *Nature*?

We classify principal investigators based on their publication history in the journal

Time

Sekara, Deville, Ahnert, Barabasi, Sinatra and Lehmann, PNAS 115, 12603 - 12607 (2018)

We classify principal investigators based on their publication history in the journal

Time

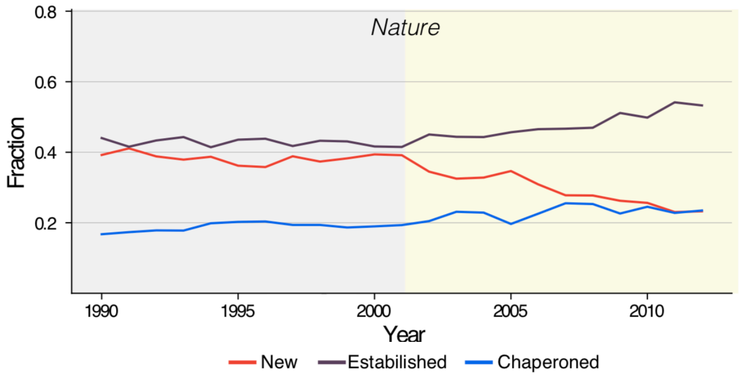
Sekara, Deville, Ahnert, Barabasi, Sinatra and Lehmann, PNAS 115, 12603 - 12607 (2018)

We classify principal investigators based on their publication history in the journal

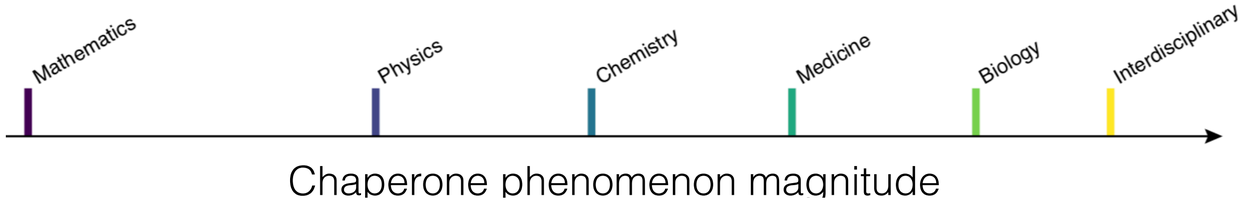
Sekara, Deville, Ahnert, Barabasi, Sinatra and Lehmann, PNAS 115, 12603 - 12607 (2018)

We have 3 main findings:

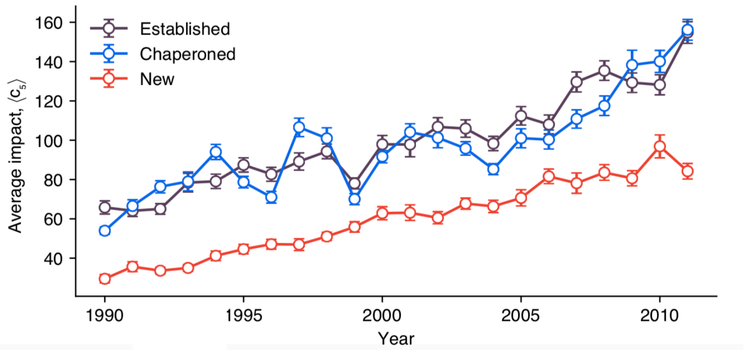
Proportion of new PIs is declining



Fields display the chaperone phenomenon with different magnitudes



Chaperoned PIs' papers have higher impact than new PIs' papers



Sekara, Deville, Ahnert, Barabasi, Sinatra and Lehmann, PNAS 115, 12603 - 12607 (2018)

Performance

Success

SUCCESS
92
93
94
95
96
97
98
99
100
101

Team Science

Kim Albrecht

Federico Battiston

László Barabási

Aaron Clauset

Pierre Deville

Magda Fontana

Alex Gates

Junming Huang

Martina Iori

Dan Larremore

Sune Lehmann

Lu Liu

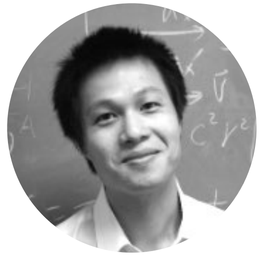
Yifang Ma

Mauro Martino

Federico Musciotto

Giancarlo Ruffo

Vedran Sekara



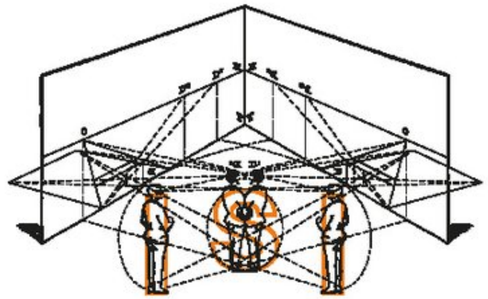
Chaoming Song

Michael Szell

Marcella Tambuscio

Dashun Wang

IT UNIVERSITY OF COPENHAGEN



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Thank you

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