



**Leonardo da Vinci**  
500 y



**Isaac Newton**  
300 y



**Albert Einstein**  
100 y



**Human Genome Project**  
10 y

**Lingfei Wu**

# Isaiah Berlin



The Hedgehog  
and the Fox



Trait



## Is research style a personal trait or an evolving strategy?

nature communications

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### Increasing trend of scientists to switch between topics

[An Zeng](#), [Zhesi Shen](#), [Jianlin Zhou](#), [Ying Fan](#), [Zengru Di](#), [Yougui Wang](#) , [H. Eugene Stanley](#) & [Shlomo Havlin](#)

Administrative Science Quarterly



Restricted access

Research article

First published online July 30, 2018

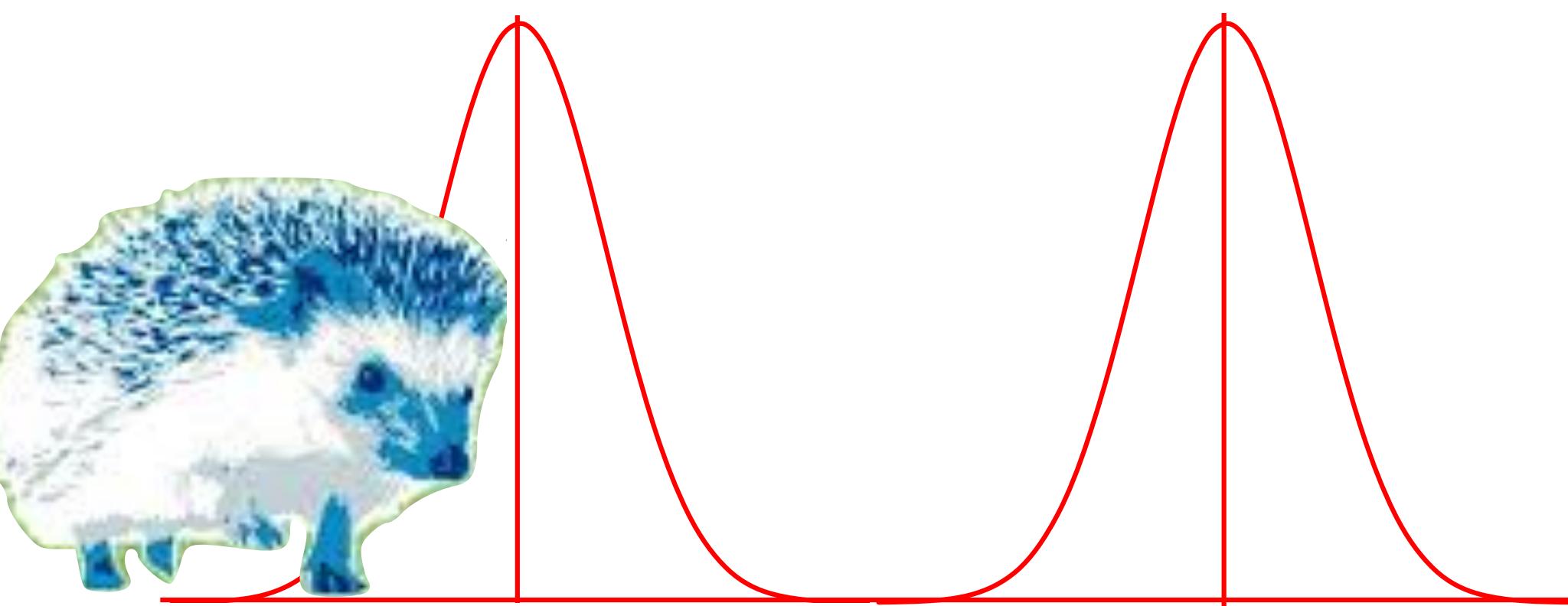
Creativity at the Knowledge Frontier: The Impact of Specialization in Fast- and Slow-paced Domains

[Florenta Teodoridis](#) , [Michaël Bikard](#), and [Keyvan Vakili](#) [View all authors and affiliations](#)

[Volume 64, Issue 4](#) | <https://doi.org/10.1177/0001839218793384>

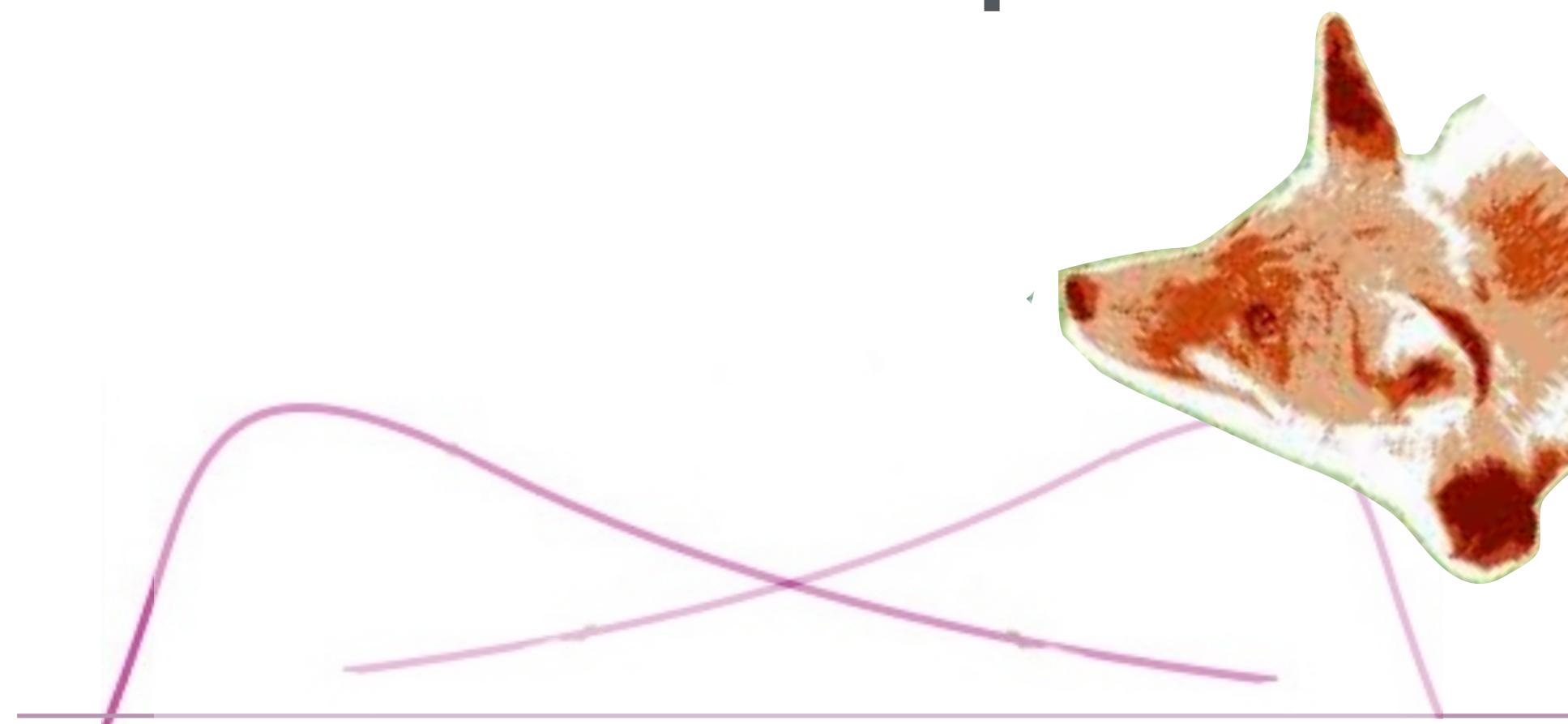
## Strategy

# Hiring foxes or hedgehogs in your interdisciplinary center?



**Economics**

**Computer Science**



**Economics**

**Computer Science**



# Edmund Rolls

Specialization (S) score = 0.71

71%



8%

4%

3%

neuroscience

cognitive psychology

pattern recognition

computer vision

# Herbert Simon

S-score = 0.12

12%

12%

11%

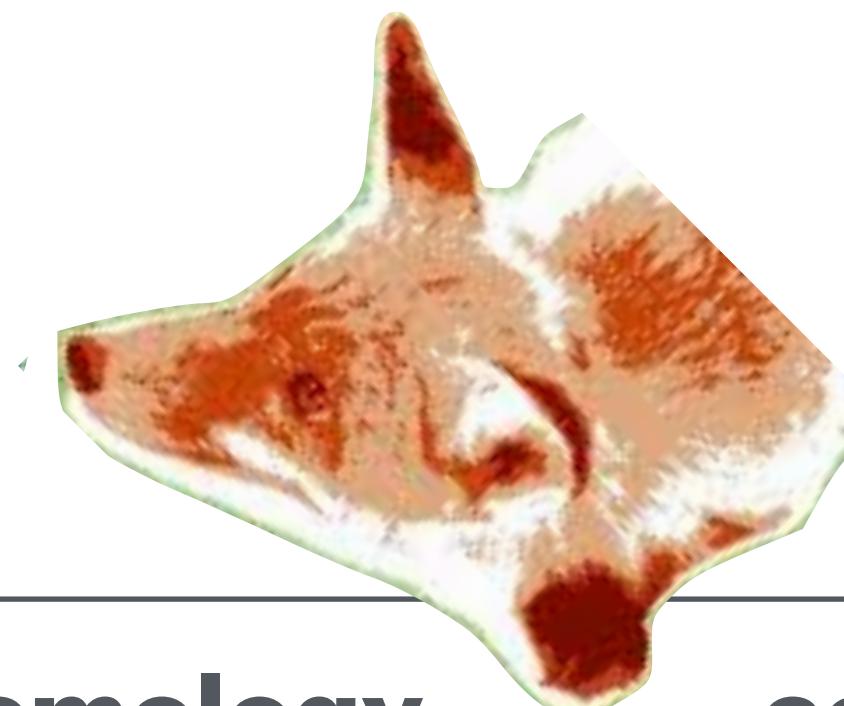
10%

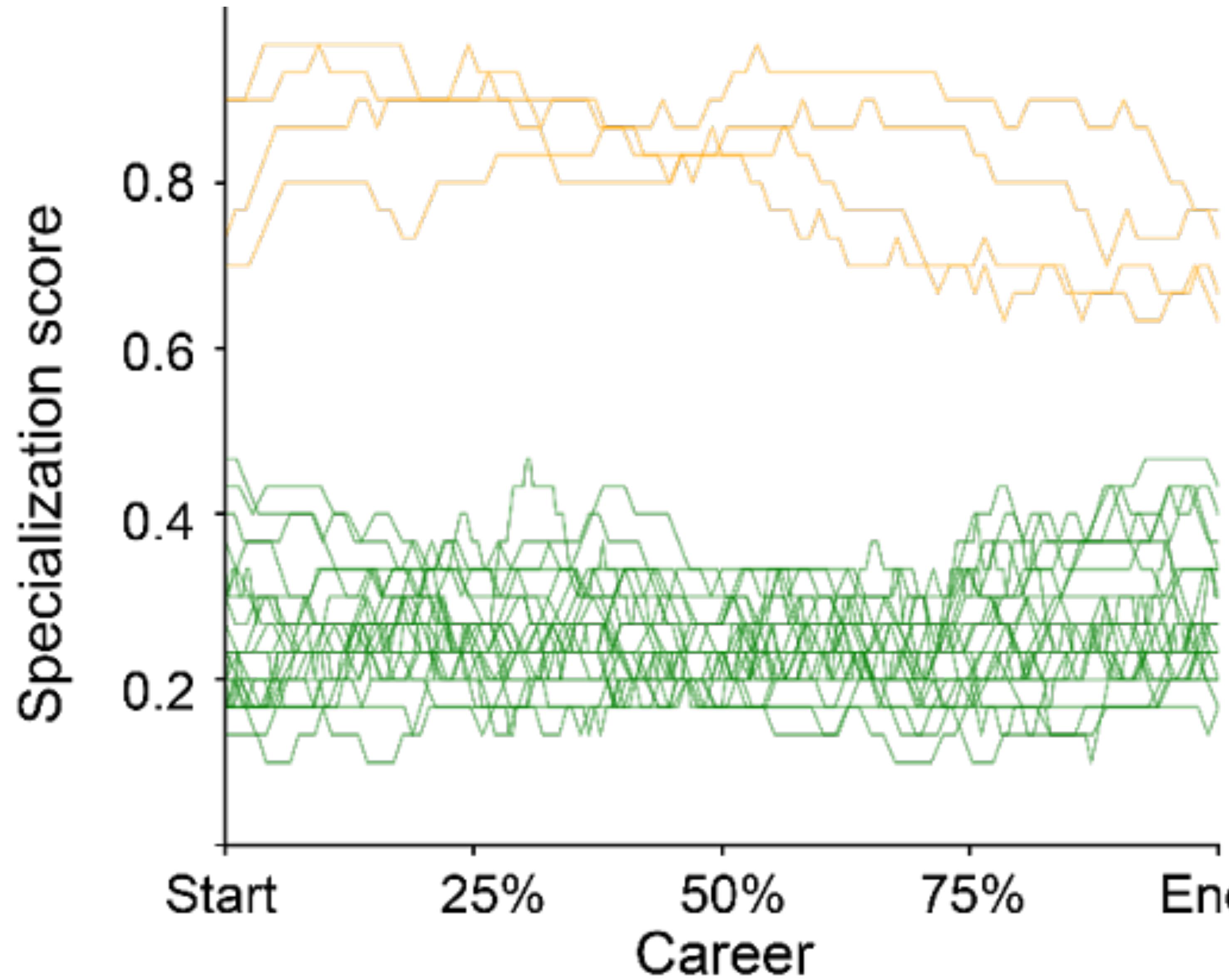
cognitive psychology

mathematical economics

epistemology

cognitive science

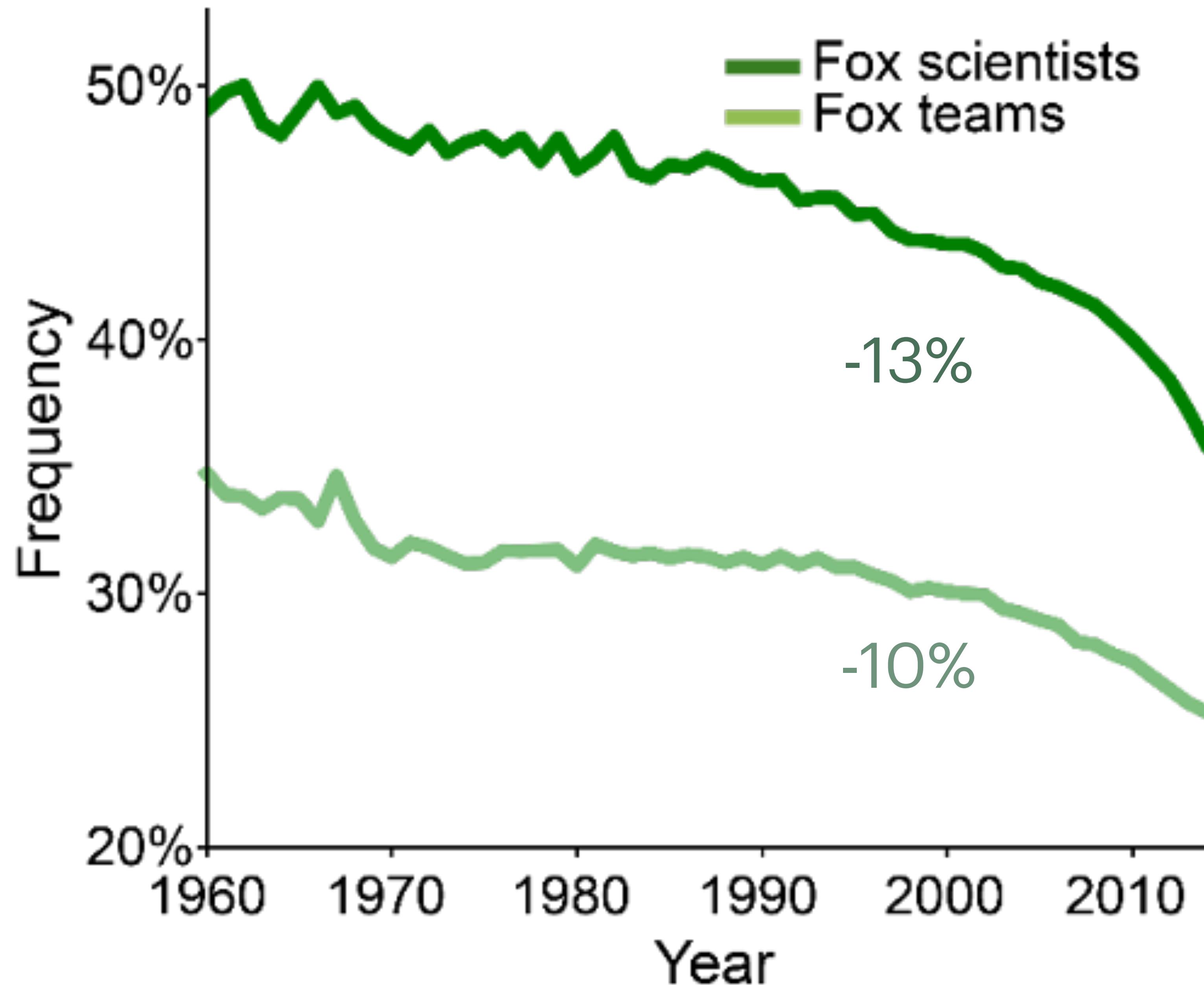




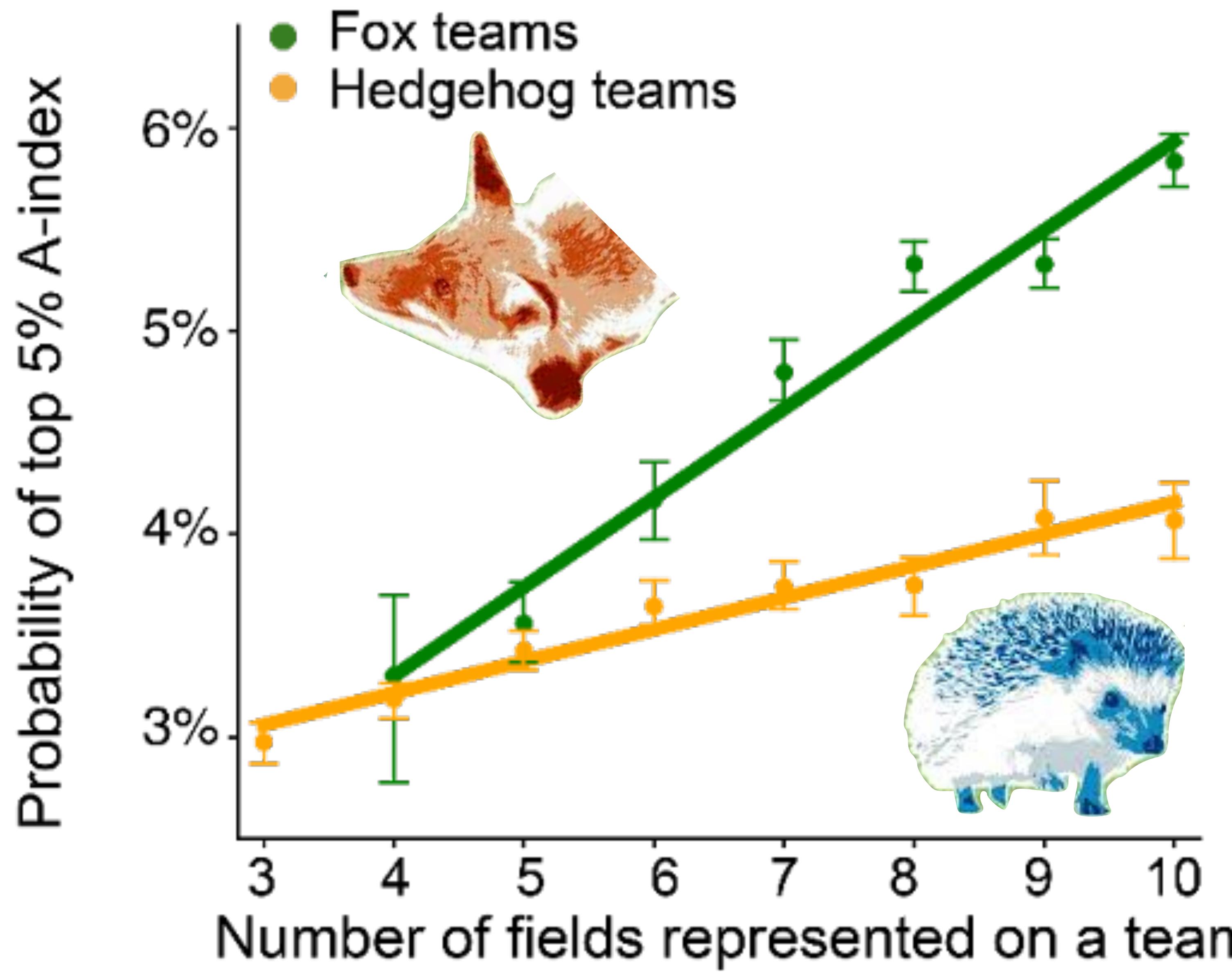
Research style is  
more a personal  
trait than an  
evolving strategy

**APS data, 24,304 scientists,  
84% unchanged**

**MAG data, 454,737 scientists,  
77% unchanged**



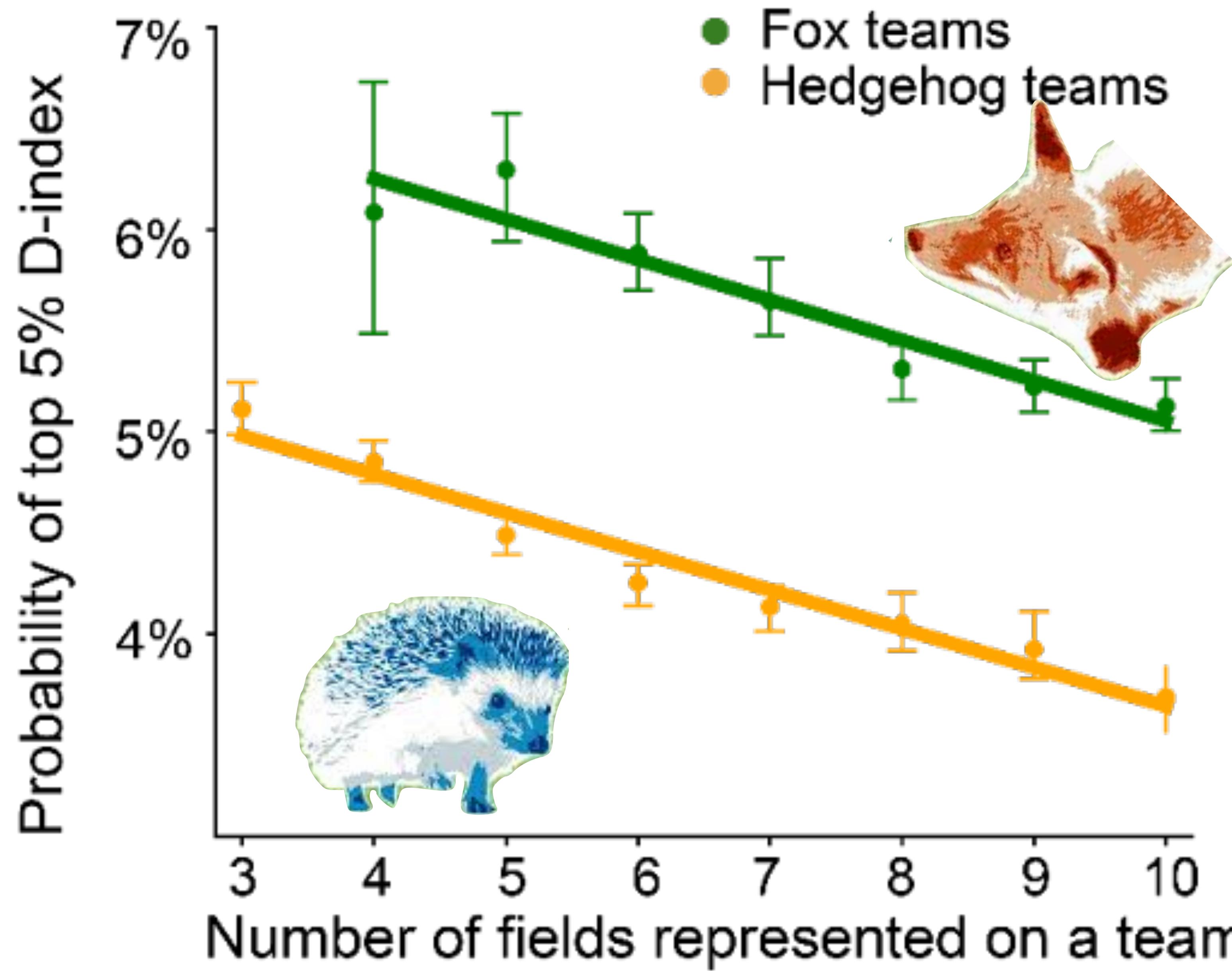
Death of  
Renaissance  
Scientists?  
Fox-like scientists  
are declining



**Atypicality index (Uzzi et al., 2013) measures (surprising) idea complementary**

**e.g., GPS, microwave TV**

Comparing the effect of research styles while accounting for knowledge diversity



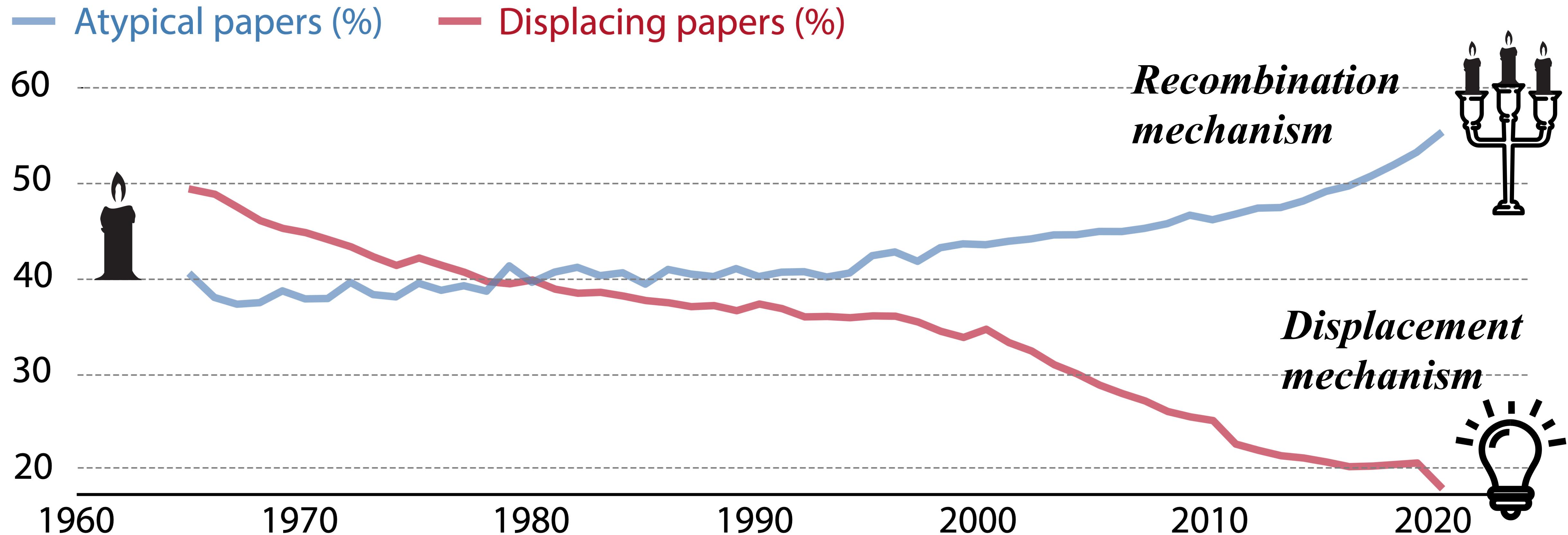
**Disruption index (Wu et al., 2019) measures idea substitution**

**e.g., light bulb vs candle**

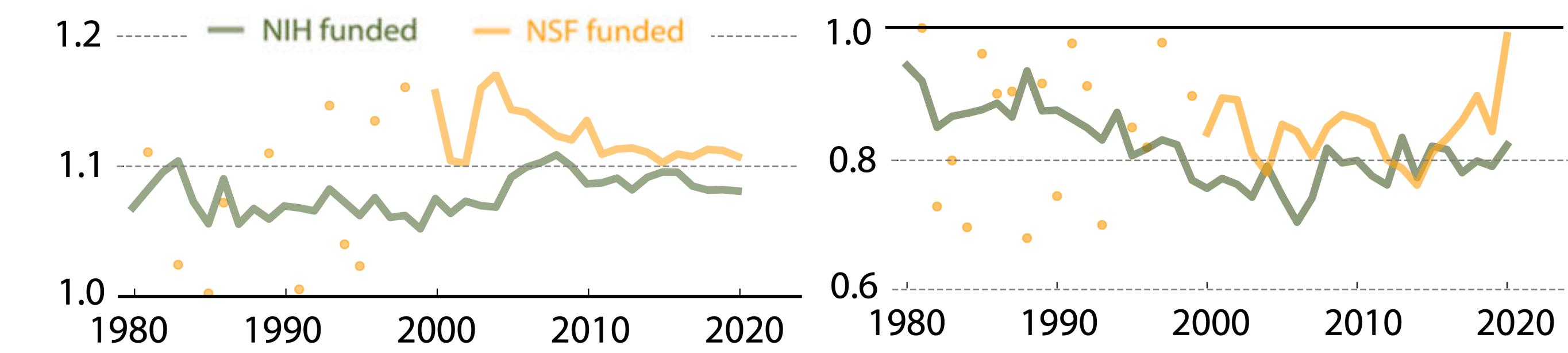
knowledge diversity becomes a burden, e.g., microwave TV

# Ideas are getting harder to displace in science

Li et al., Displacing science, 2023



*The principle of functional equivalence:* ideas or technologies of the same function substitute for one another, while those with different functions may complement each other.



# Isaiah Berlin

The Hedgehog  
and the Fox

With a foreword by  
Michael Ignatieff



## Death of Renaissance Scientists

1. Research style is more a personal trait (~80%) than an evolving strategy (~20%);
2. Fox-like scientists declined by 13% (49% to 36%) over the past six decades;
3. Fox teams consistently outperform hedgehog teams in scientific innovation.



**Zak Risha**  
*Pitt*



**Yiling Lin**  
*Pitt*



**Erin Leahey**  
*U of Arizona*

# How can science and technology advance?

*Measure innovation (metrics) and study its cognitive, organizational, and social foundations (mechanisms). Teams are the testbed for all three.*

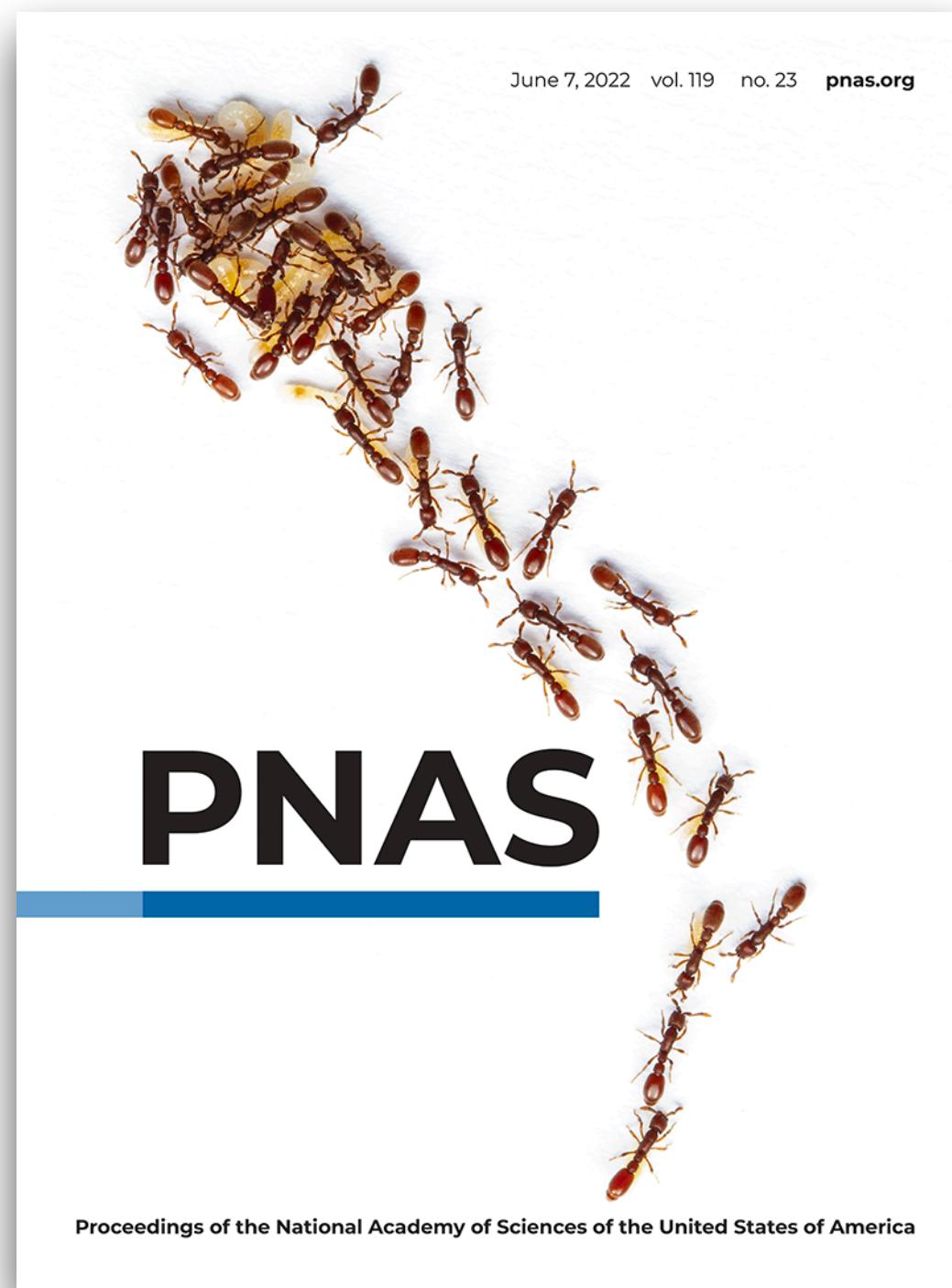
2019 size

# *Small teams disrupt*



# 2022 shape

## *Flat teams innovate*



# 2023 location Onsite teams conceive



# How scientists innovate in teams?



1. *Author rank;*
2. *Author contribution disclosure;*
3. *Author Latex Macro*

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# **“Team Science & Innovation”**

## **NSF CAREER 2023-2028**

