



Open Science Impact Pathways —

Introduction to Open Science Impact Indicator Handbook

Vincent Traag



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Path

Open Science
Handbook



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PathOS

Open Science Indicator
Handbook



Introduction

Open Science

Academic Impact

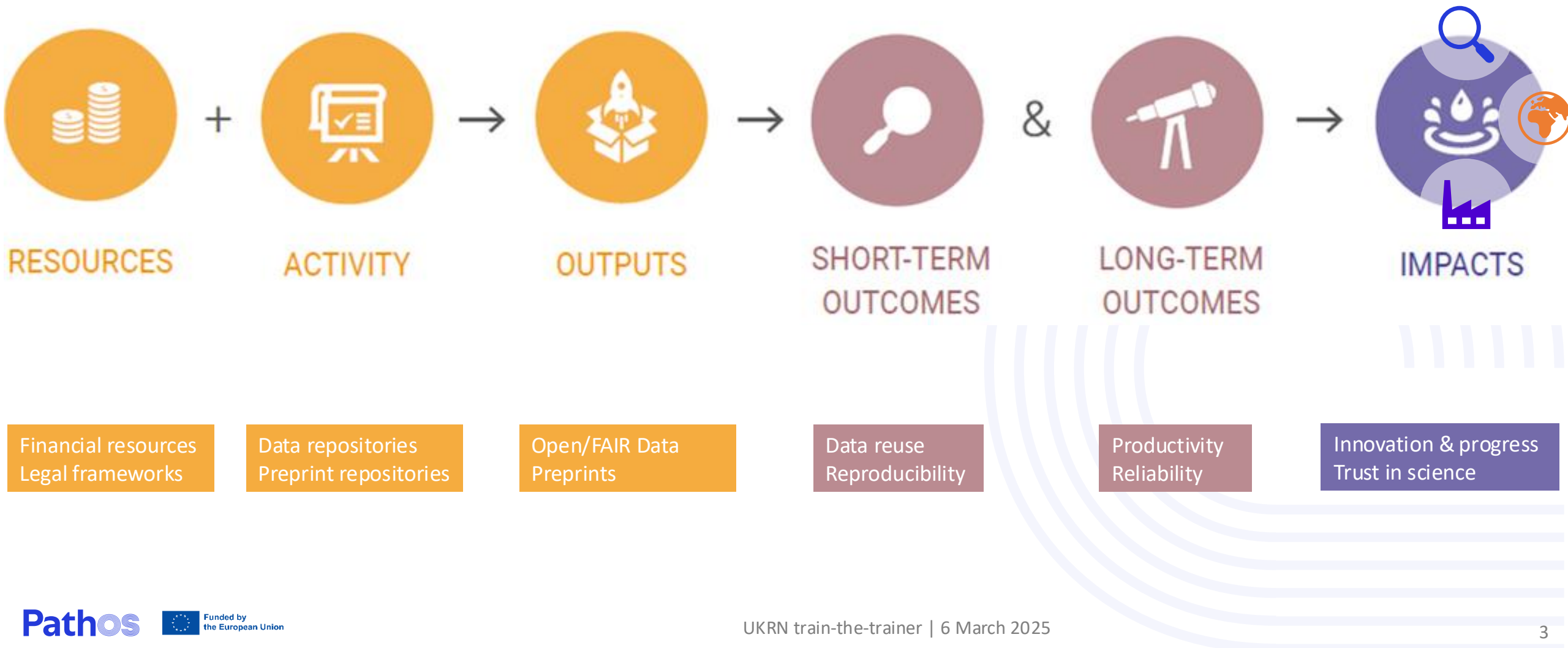
Societal Impact

Economic Impact

Reproducibility



Open Science Impact Pathways



Overview sections

Introduction to causality

Open Science

Impact

- Academic impact
- Societal impact
- Economic impact

Reproducibility

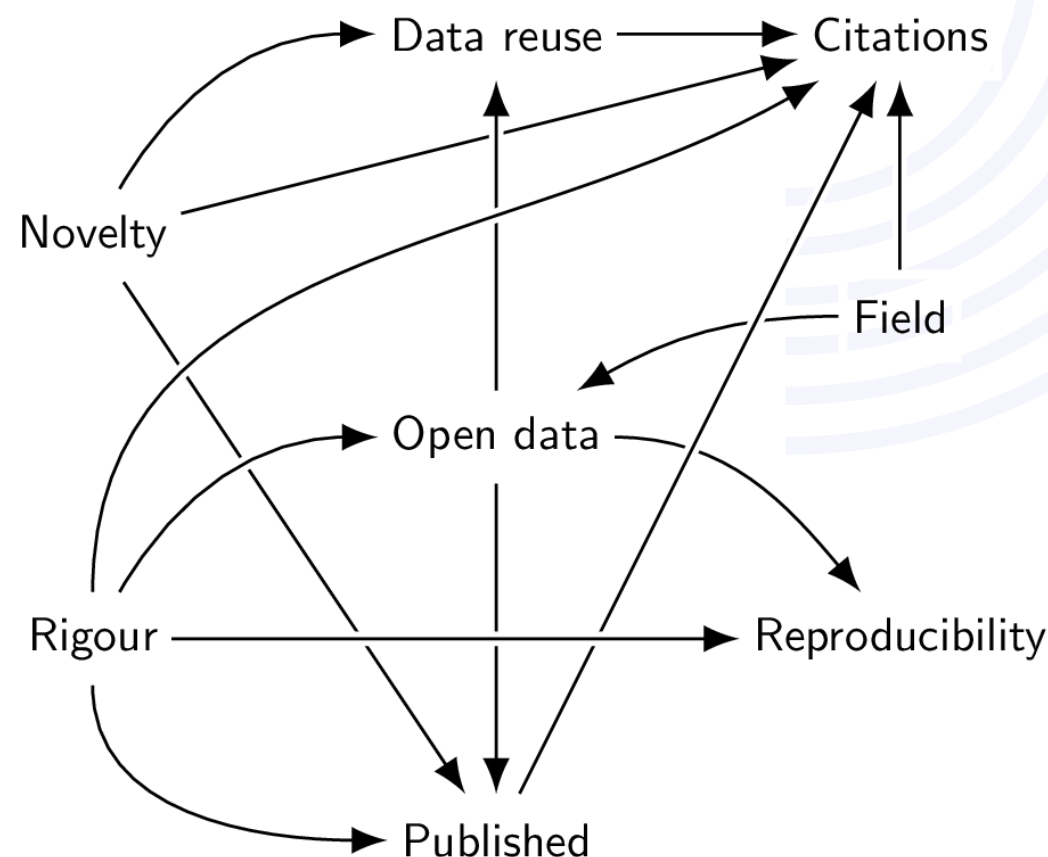
Introduction to causality

Structural causal models

- Focus on structure, not specifics

General approach

1. Construct causal diagram based on theory and earlier literature.
2. Use causal diagram to decide "control" variables.
3. Based on causal diagram, draw causal conclusion or clarify limitations.



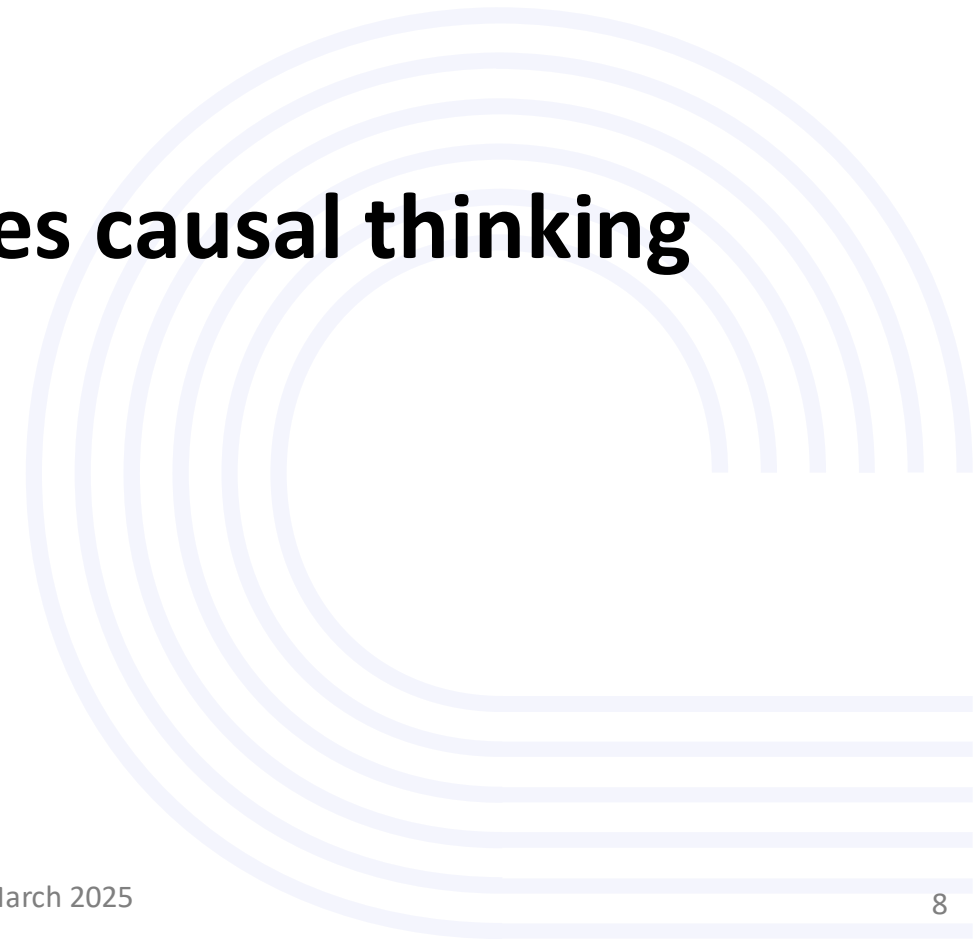
Impact of Open Science \neq Effect of Openness on impact

Impact indicators

- Combinatorial number of possibilities
- No indicators for causal effect on impact

	Citation impact	Collaboration	Reproducibility	Public engagement	...
Open access					
Open data					
Open code					
Open review					
Citizen science					
...					

Interpretation of indicators requires causal thinking

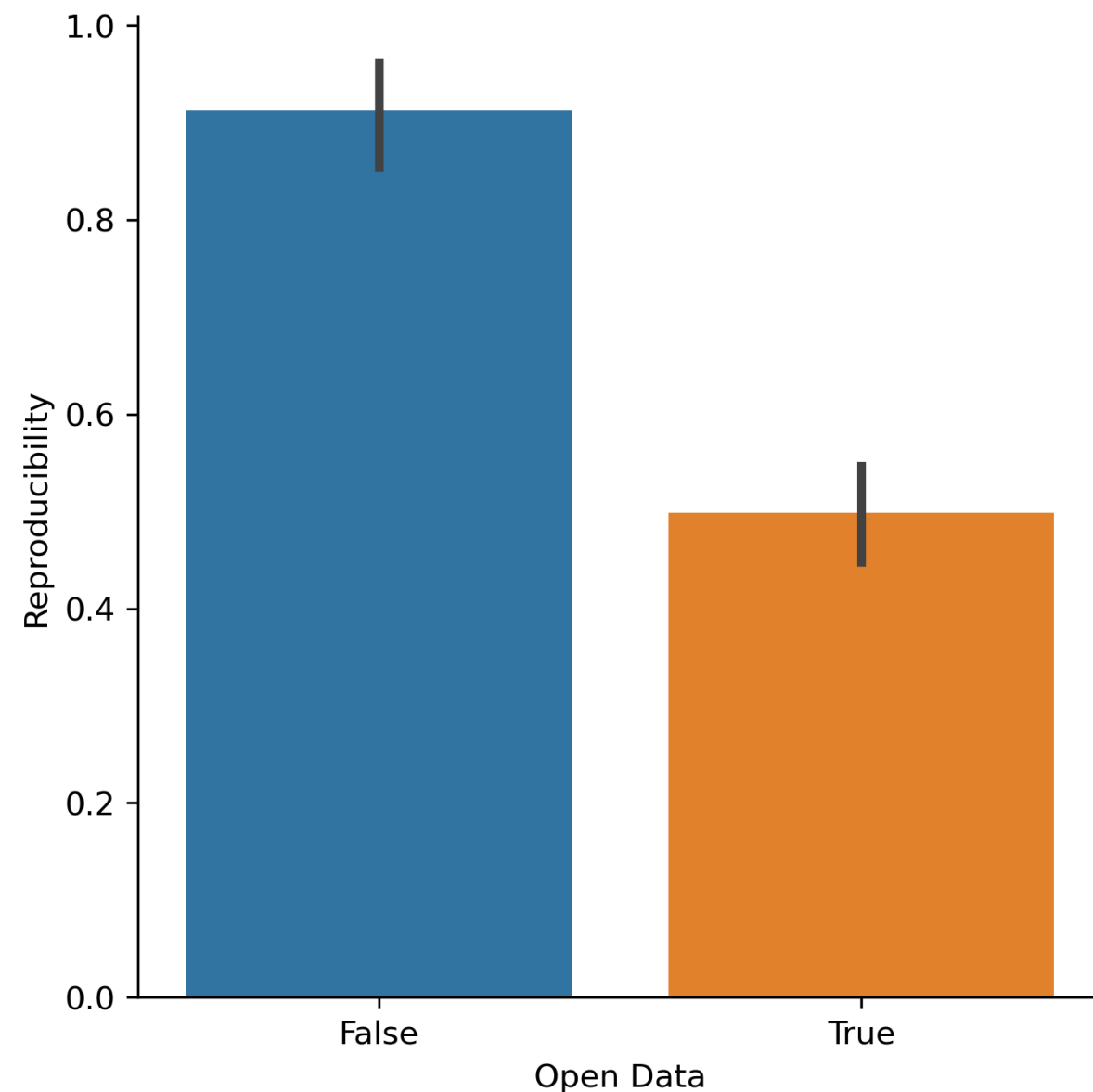




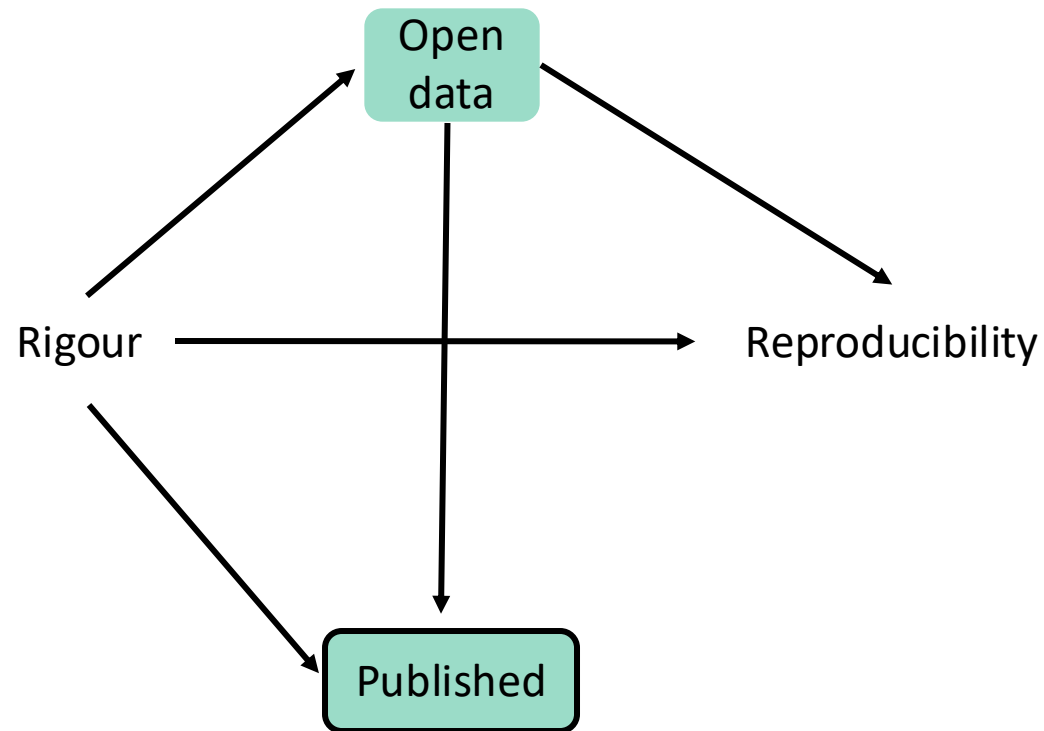
Illustrative simulation

- Clear causal effect of open data on reproducibility.
 - Assume this effect comes from experimental study.
- Introduce open data mandate in journal peer review.
 - Indicator for reproducibility of publications.
 - May be relevant, but not necessarily directly of interest.
 - Surprisingly, indicator goes down after mandate.
- Separate indicators for publications with and without open data?
 - Suggests open data actually *decreases* reproducibility.

?

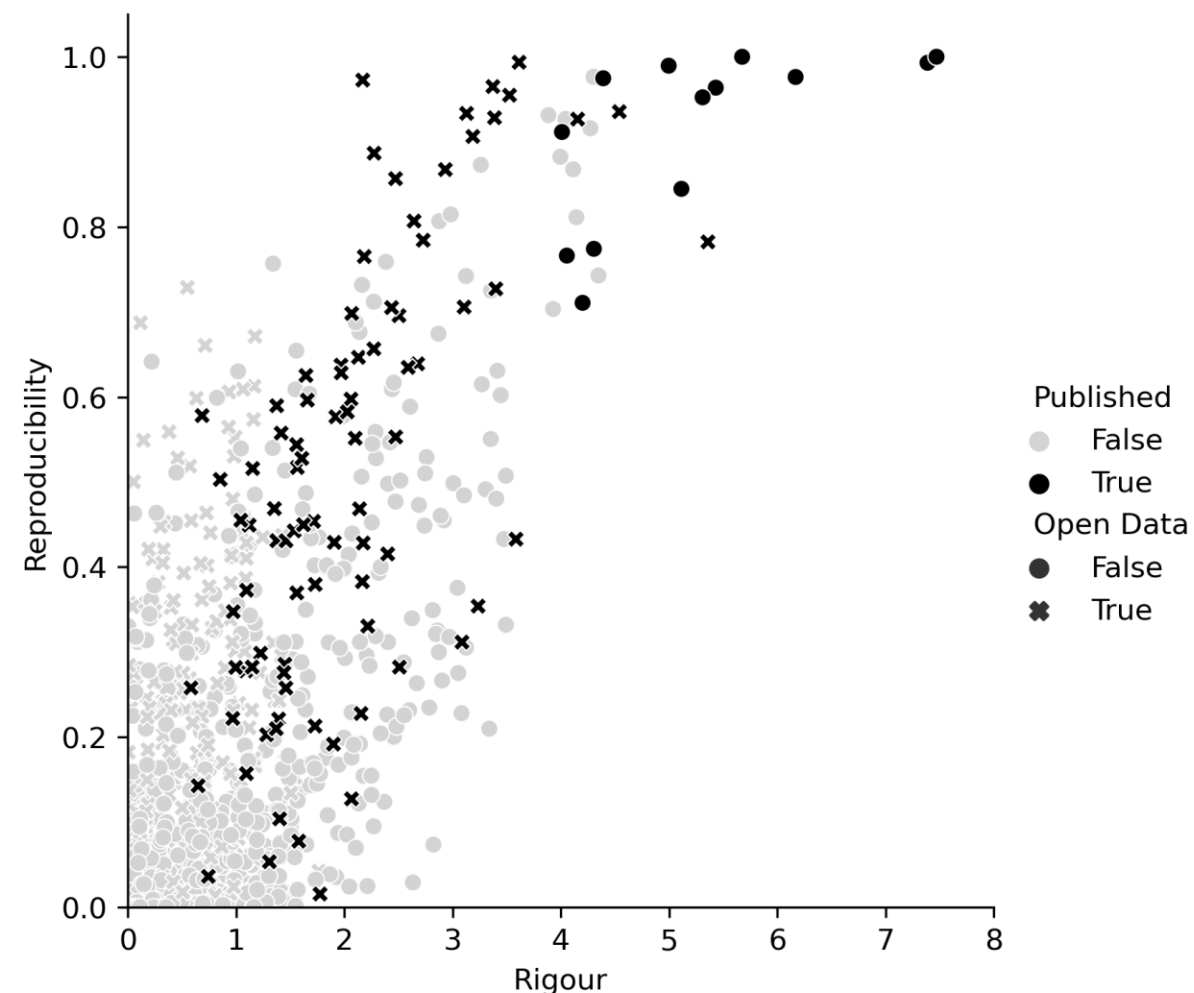


Paradox resolved



Open data and publishing

- Peer review considers rigour and open data.
- Less rigorous research with open data more likely to be published.
- Open data makes research reproducible, but rigour more.



Overview Open Science

Resources & activities

- Policies & mandates
 - National policies, funding policies, transformative agreements
- Infrastructure
 - Open metadata, repositories
- Skills & training
 - Support & training programmes
- Rewards & incentives
 - Open Science in Research Assessment (see also [GraspOS](#))

Practices

- Peer review
- Pre-registration
- Replication
- Citizen Science

Outputs

- Publication
 - OA & APCs, preprint (repositories), Transformative agreements
- Data
 - Data repositories, data sharing
- Software
 - Code sharing



Overview Academic Impact

Publishing

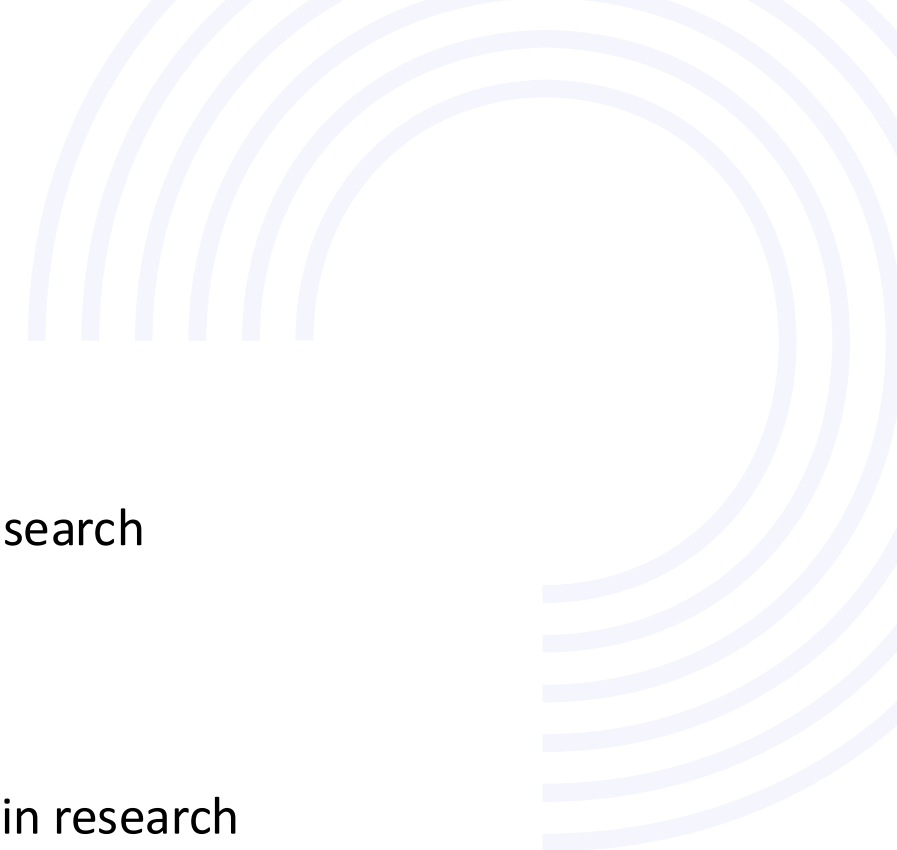
- Readership
- Citation
- Collaboration
- Diversity
- Interdisciplinarity / novelty
- Quality

Data

- Use of data in research

Software

- Use of software in research



Overview Societal Impact

Uptake

- Societal issues
- (Social) media
- Policy
- Education
- Patient groups
- Medical practice
- Legal sector

Broader

- Scientific literacy

Not covered

- Welfare, well-being
- Inequality
- Sustainability
- Climate change
- Energy
- ...



Overview Economic Impact

Innovation

- Innovation output
- Science-industry collaboration
- Socially relevant products and processes

Costs & benefits

- Labour market impacts
- Economic growth
- Cost savings



Overview Reproducibility

Reuse & citation

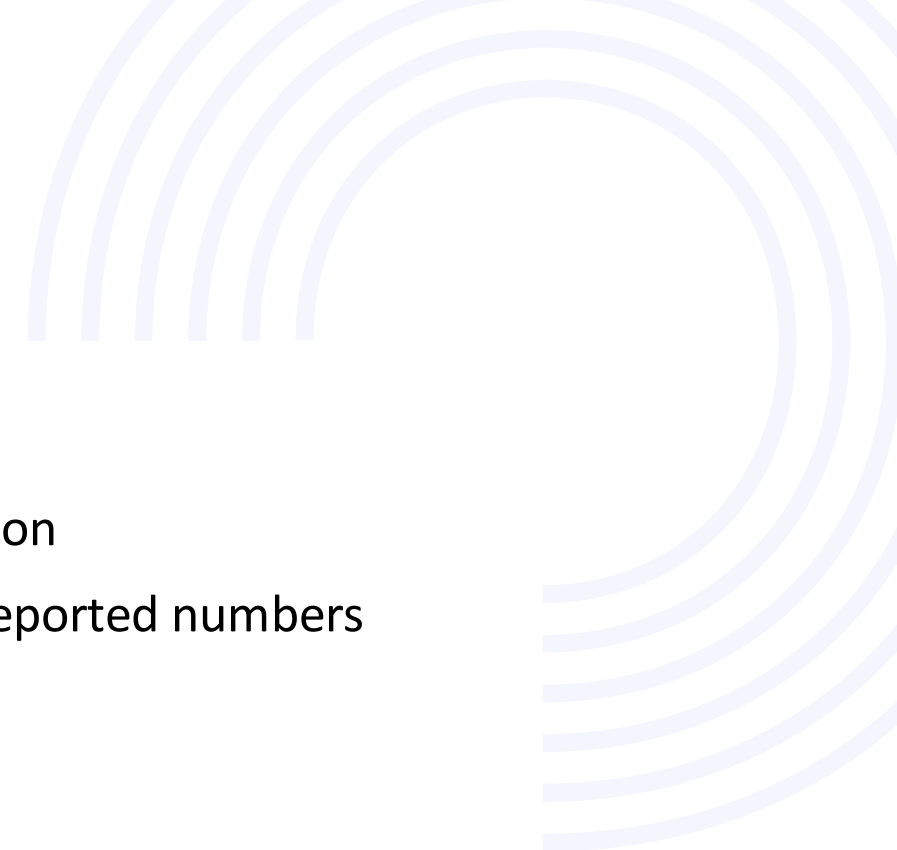
- Reuse of data & code
- Citation of data & code
- Polarity of publications
- Inclusion in reviews

Consistency

- Level of replication
- Consistency in reported numbers

Practice

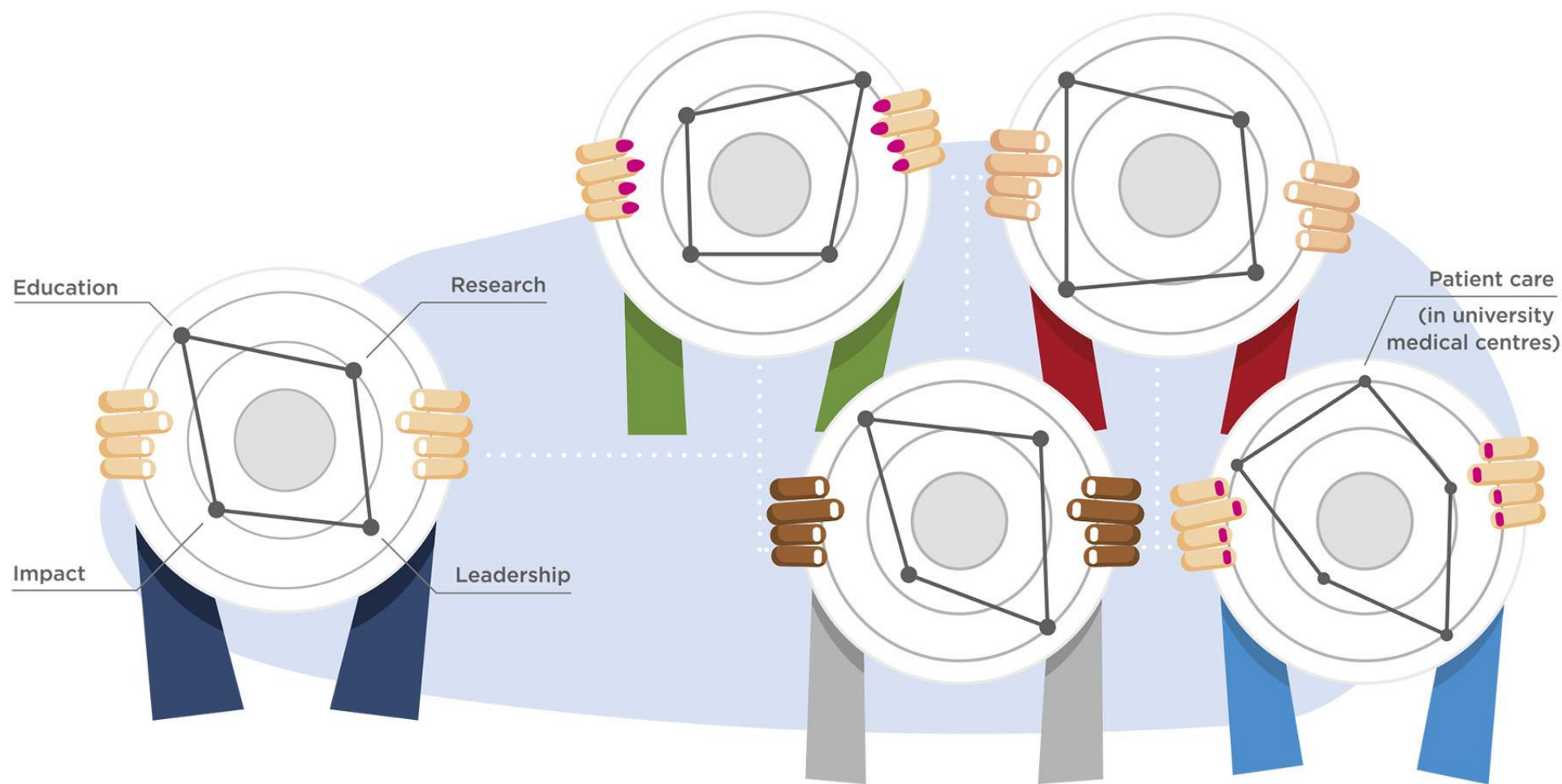
- Preregistration (already covered under Open Science)



Pathos

Recognition & Reward of Open Science

Diversifying and vitalising career paths





Academics

- Teaching
- Research
- Data collection
- Data management
- Ethical concerns
- Coding
- Reviewing



Industry

- Sales department
- Quality assurance department
- Testing vs production
- Joint reporting

Individual or institutional



ARTICLE

<https://doi.org/10.1038/s41467-021-22086-3> OPEN

Universal resilience patterns in labor markets

Esteban Moro ^{1,2,3,4,8}✉, Morgan R. Frank^{2,4,5,6,8}, Alex Pentland^{2,3,4}, Alex Rutherford ⁷, Manuel Cebrian⁷ & Iyad Rahwan ⁷✉

Individual product





Now decides next:
Insights from the leading edge of generative AI adoption

Deloitte's State of Generative AI in the Enterprise
Quarter one report

January 2024

Institutional product

Chickens

Researchers

Individual reward vs c
ollective benefit

Reward & Recognition of Open Science

- Reward at institutional level.
- Reward individual contribution to institution.
- Do not "monitor" OS practice; "monitor" how outcomes and impacts align with objectives.

Conclusion

- Focus not only on Open Science, but also on its outcomes & impact.
- Align assessment of impact to align with goals and missions.
- Consider causality when interpreting indicators.
- Open Science Impact Indicator Handbook provides indicator recipes:
 - Open Science
 - Academic, Societal & Economic Impact
 - Reproducibility
- Consider how to approach Reward & Recognition of Open Science

<https://handbook.pathos-project.eu>

Thank you

— Vincent Traag

— v.a.traag@cwts.leidenuniv.nl

— Mastodon: @vtraag@social.cwts.nl

www.pathos-project.eu



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