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Analyzing Interdisciplinary Research along Multiple Dimensions of Research Impact

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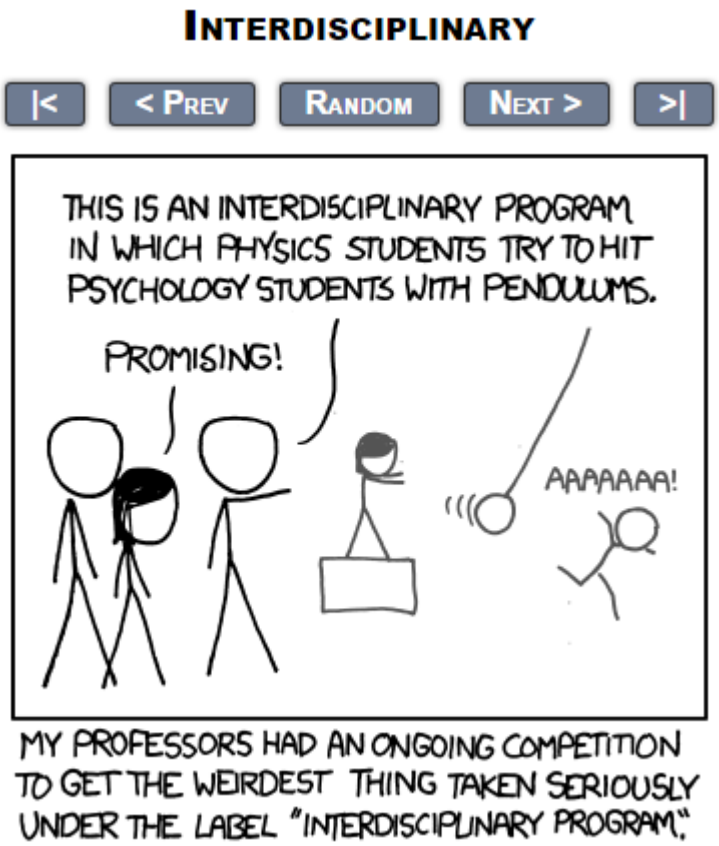
Empowering Knowledge

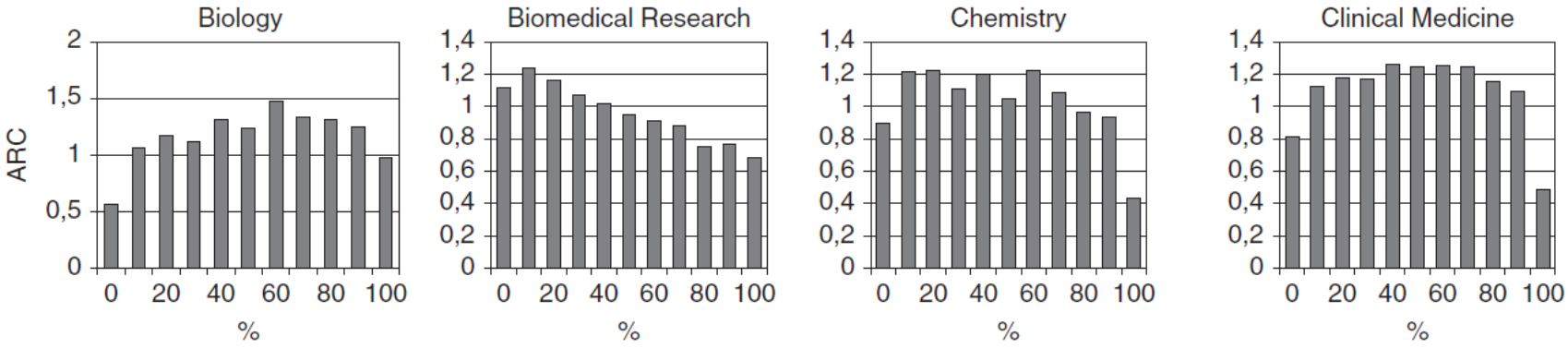
Interdisciplinary research – saving the world?

Interdisciplinary research – not always taken seriously

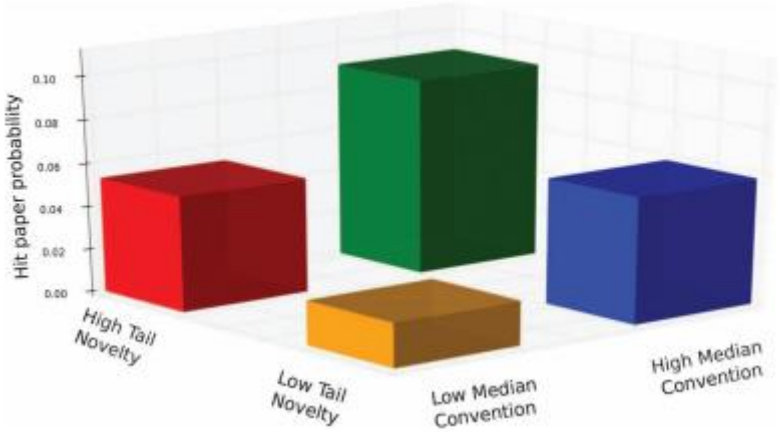


Source: https://xkcd.com/755/

An inverse U-shaped relationship between interdisciplinarity and citation impact



Source: Larivière, V., & Gingras, Y. (2010). On the relationship between interdisciplinarity and scientific impact. Journal of the American Society for Information Science and Technology, 61(1), 126–131. doi:10.1002/asi.21226



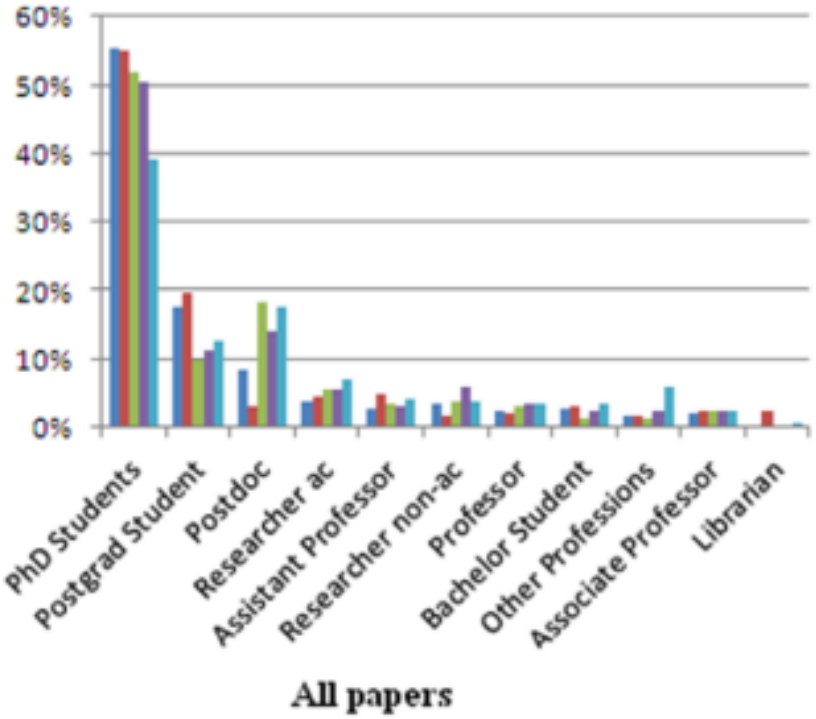
- Source: Uzzi, B., Mukherjee, S., Stringer, M., & Jones, B. (2013). Atypical combinations and scientific impact. *Science (New York, N.Y.)*, *342*(6157), 468–72. doi:10.1126/science.1240474

The Categorical Imperative versus Differentiating from the Pack

- **Follow the rules = Easy to understand and evaluate**
- **Deviate from the rules = Distinguish yourself**
  - Zuckerman (1999): Stock analyst reviews of firms that don't neatly fit an industry category
  - Zuckerman et al. (2003): Career longevity of actors who are typecast versus those who play roles in multiple genres
  - Hsu (2006): Movie critic reviews of multi-genre films

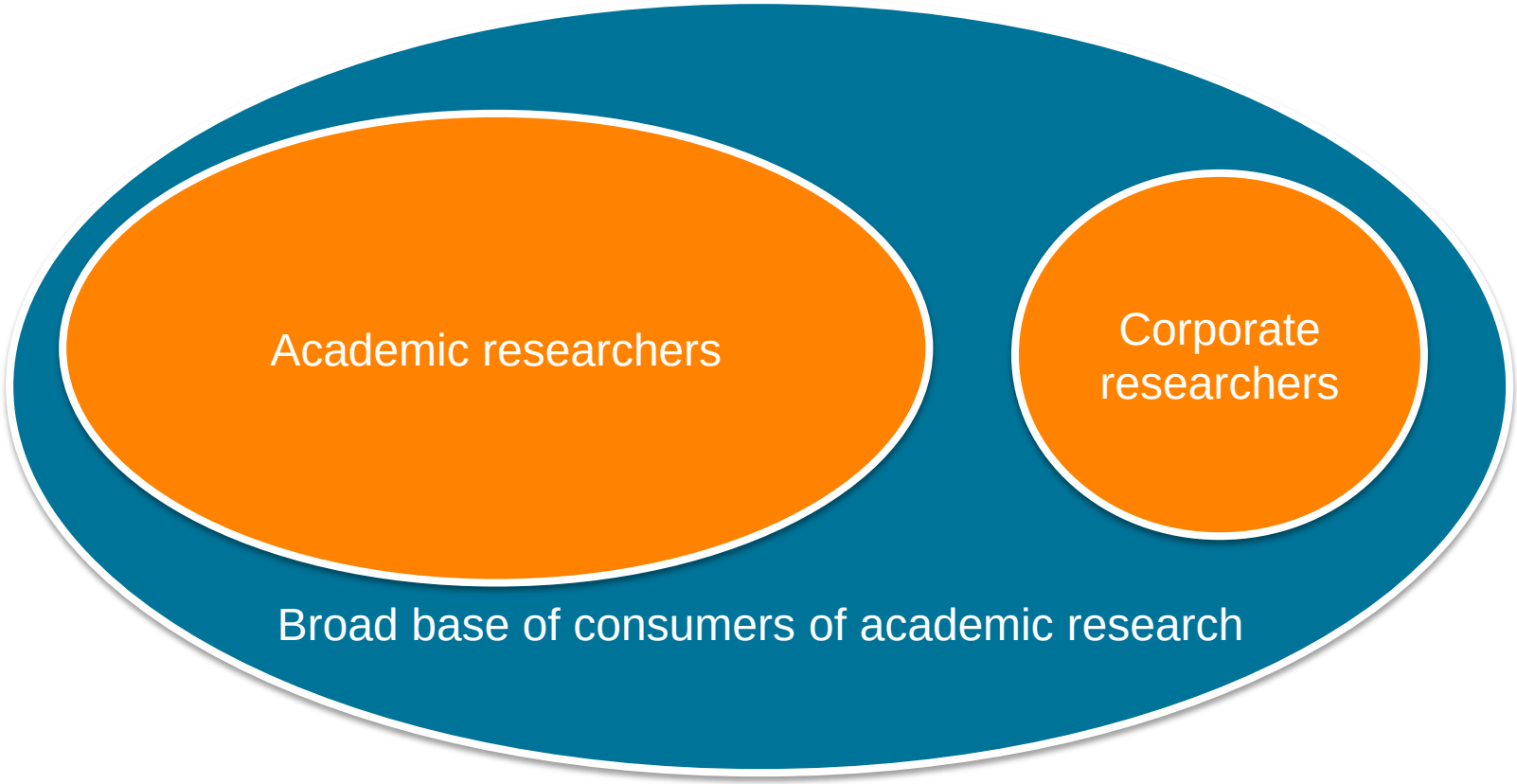
- **But, some audiences reward/penalize ambiguity differently:**
  - Pontikes (2012): software firms being evaluated by consumers versus VC firms
    - Consumers reward software firms that belong to one, clear category
    - VC firms reward software firms that span multiple, ambiguous categories

Multiple audiences evaluating academic research?



Source: Mohammadi, E., Thelwall, M., Haustein, S., & Larivière, V. (2015). Who reads research articles? An altmetrics analysis of Mendeley user categories. Journal of the Association for Information Science and Technology, 66(9), 1832–1846. doi:10.1002/asi.23286

Using different metrics to analyze evaluations of interdisciplinary research by different audiences



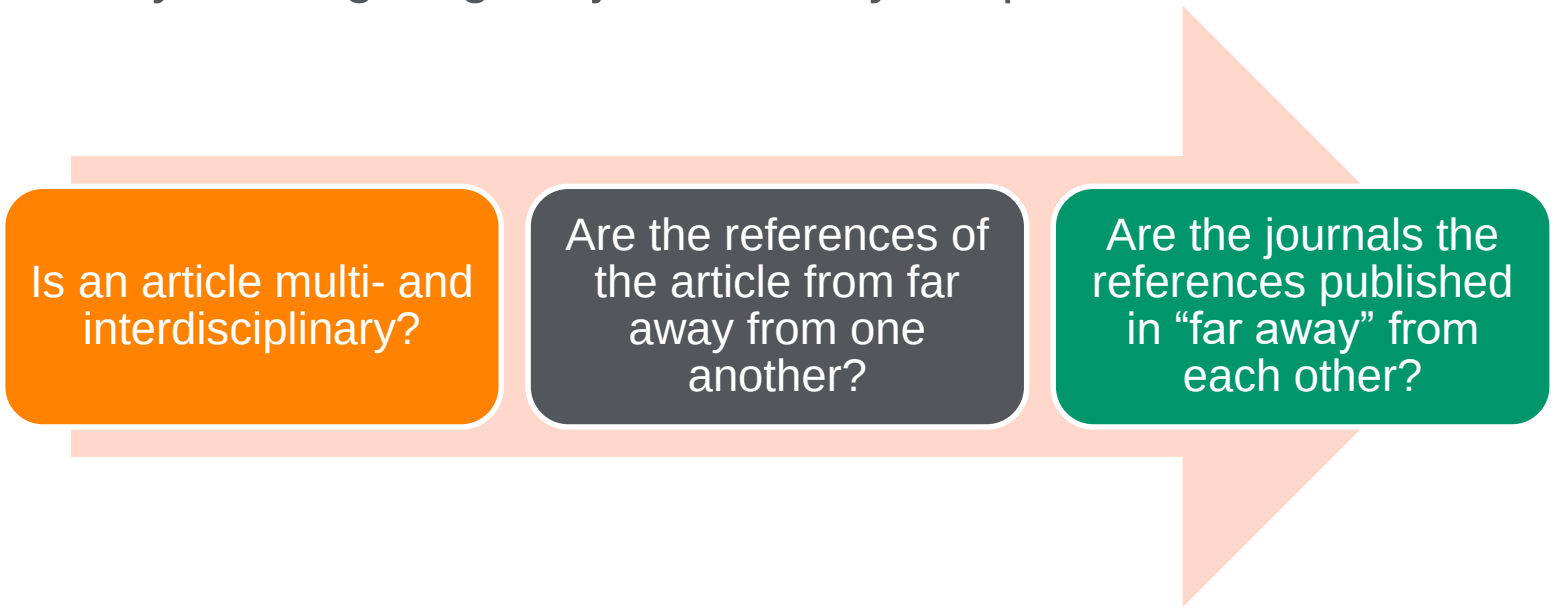
Using different metrics to analyze evaluations of interdisciplinary research by different audiences

- Academic Researchers:
  - Field-Weighted Citation Impact (Scopus)
- Broader base of consumers of academic research:
  - Field-weighted Download Impact (usage data from ScienceDirect)
- Corporate consumers of academic research:
  - Citations to academic publications in patents
  - World patent citation share relative to world publication share
  - Linked patent-publication data from Scopus and LexisNexis Patents

Methodology

- If an article **references** articles that are relatively ‘far’ from each other, that is an indication of interdisciplinarity. If an article references articles that are relatively ‘close’ to each other, this is an indication of single discipline.

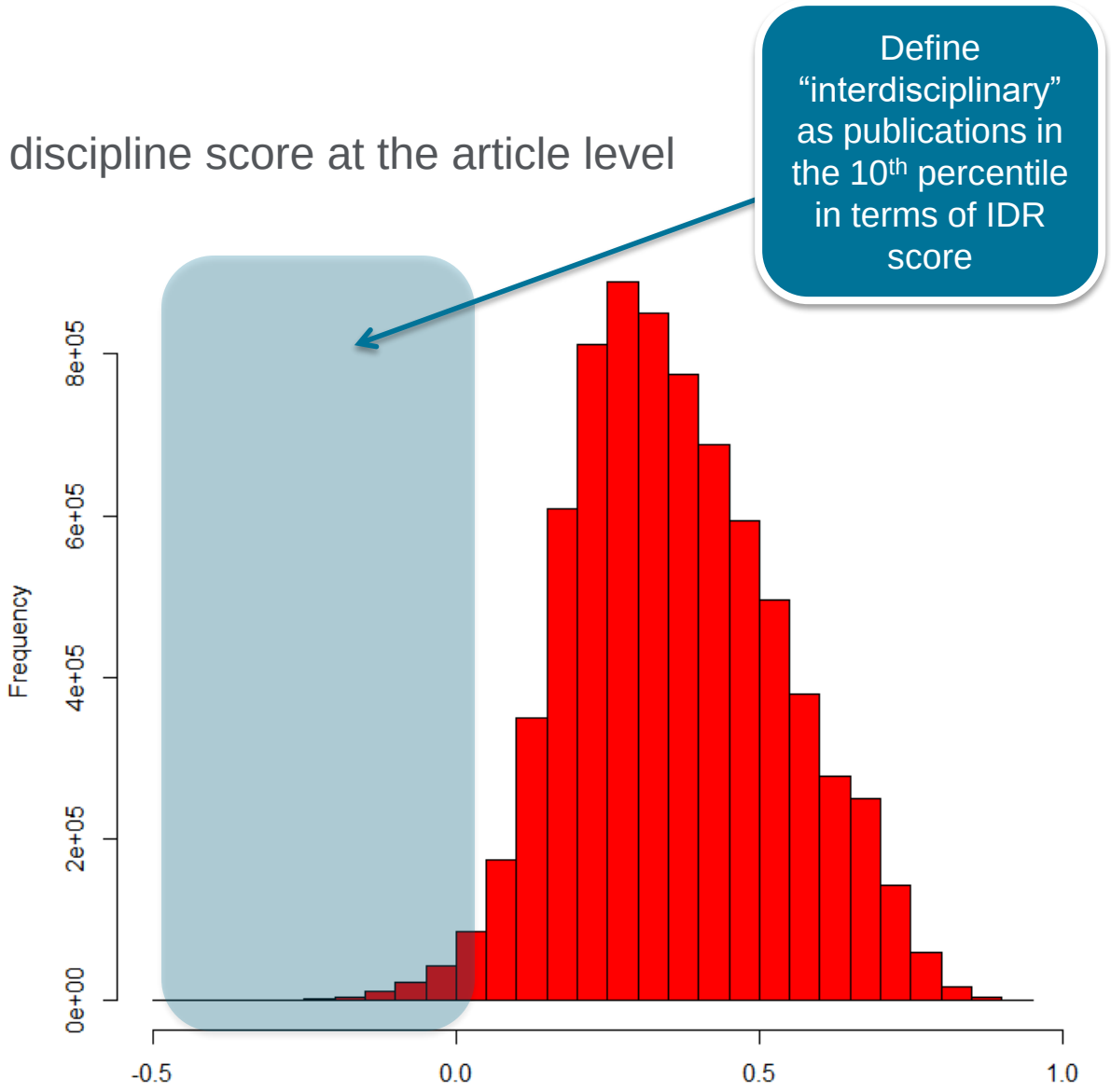
- We define whether references are “far” away or “close” to each other by investigating the journals they are published in



Methodology

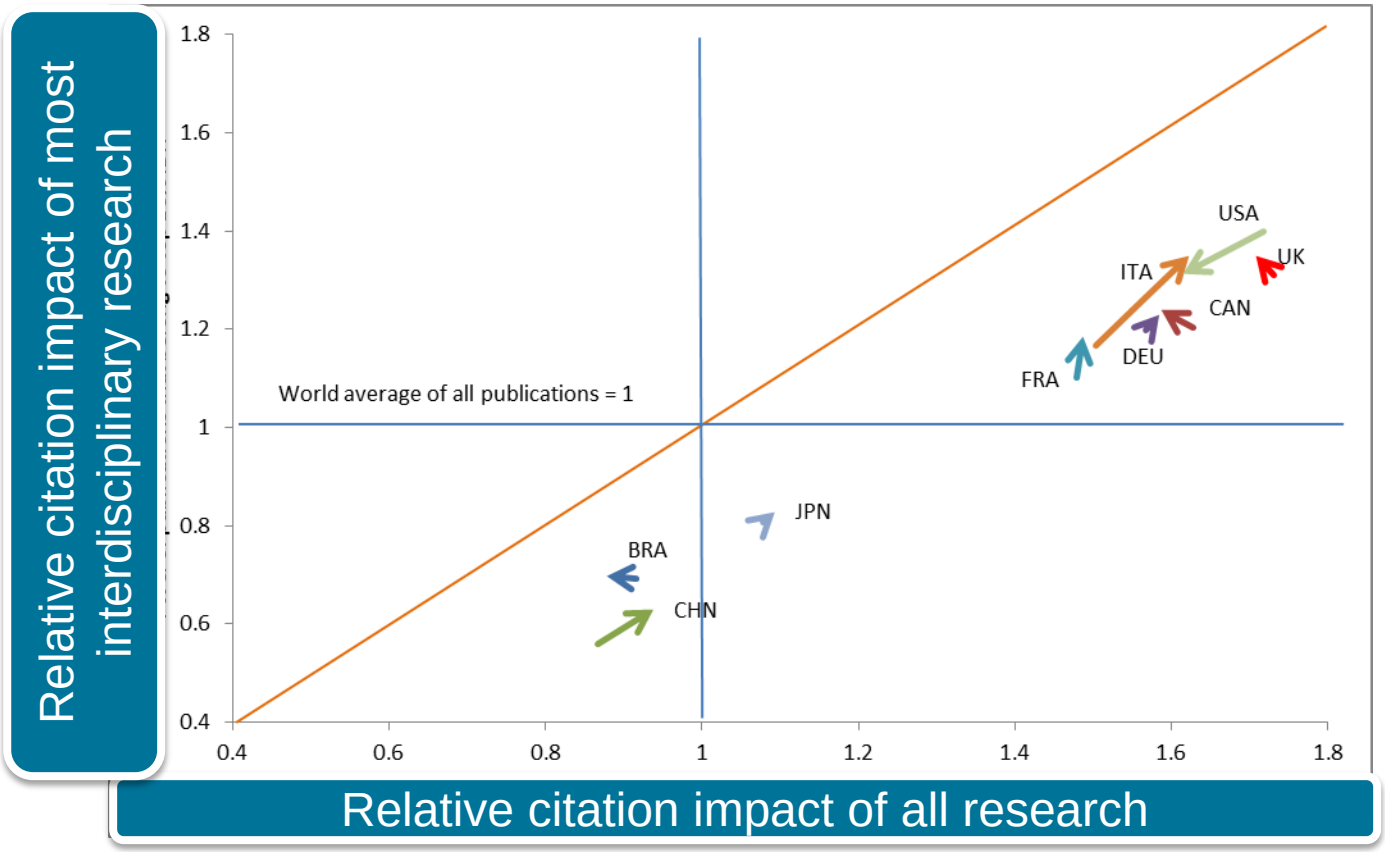
- Distribution of the single discipline score at the article level

Coverage: Out of the 9.7 million publications with references we obtain a SDS for 7.5 million of them. This results into a total coverage of 77%. There are in total 11.2 million publications in Scopus from 2009-2013.



Consistent with past studies, highly interdisciplinary research is correlated with lower relative citation impact

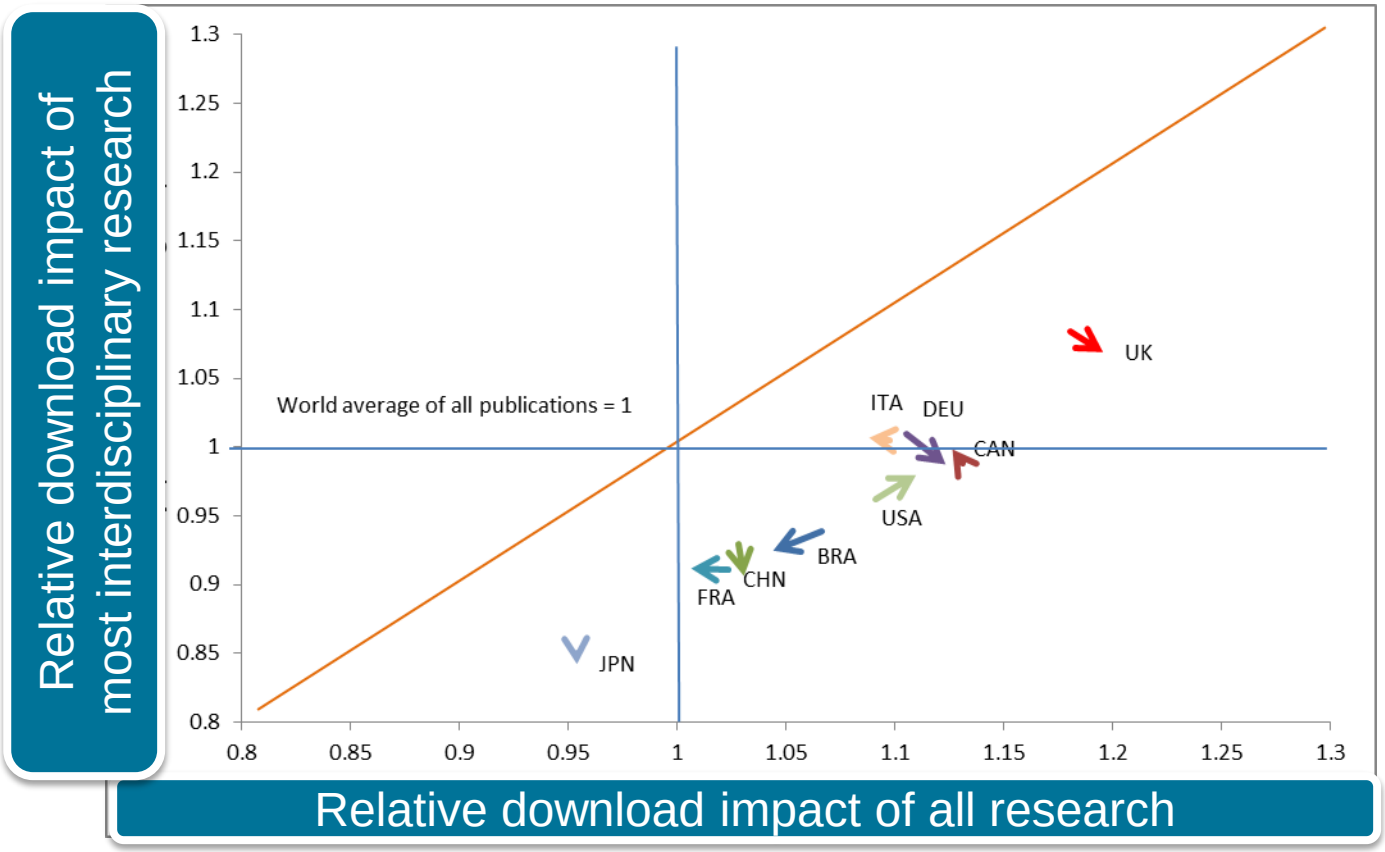
Results hold when comparing research across countries



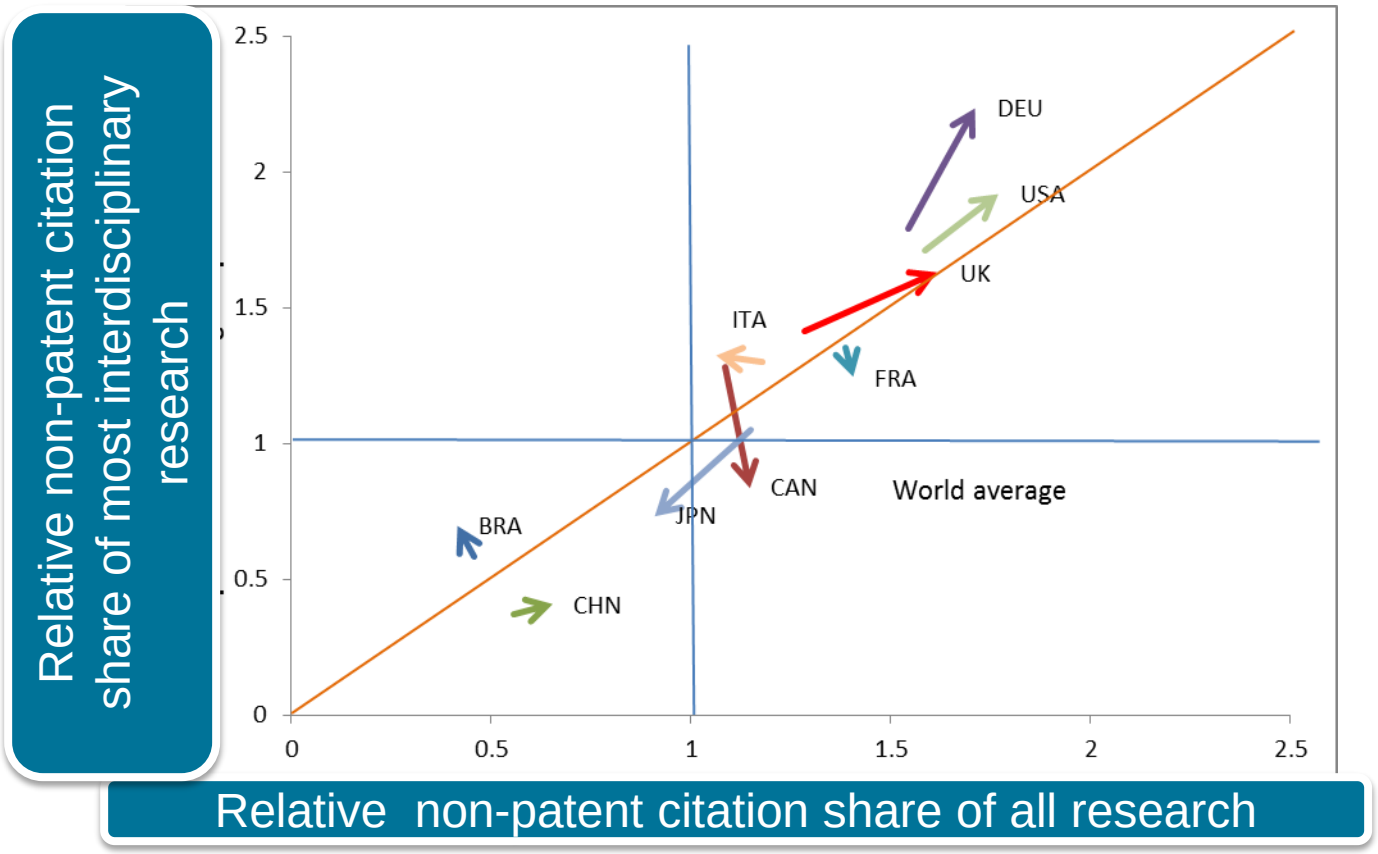
Source: Pan, L., & Katrenko, S. (2015). *A Review of the UK's Interdisciplinary Research using a Citation-based Approach: Report to the UK HE Funding Bodies and MRC by Elsevier*. Retrieved from http://www.hefce.ac.uk/pubs/rereports/Year/2015/interdisc/Title,104883,en.html

Ceteris paribus, highly interdisciplinary research is also downloaded less frequently

Results hold when comparing research across countries



Within some countries, highly interdisciplinary research does get cited more often in patent than otherwise expected



Next Steps

- Identify better proxies for alternative audiences – Mendeley, social media, blogs and news mentions, etc.
- Control for team size, relative seniority of researchers?
- Different types of collaboration as moderating variables for impact of interdisciplinary research (e.g., international collaboration, mixed-gender teams, etc.)
- Longer time period of analysis to identify trends in changes in returns to interdisciplinarity?
- Within-researcher models?

Methodology Appendix

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Empowering Knowledge

Methodology

- Step 1: mapping journals
  - How often do journals co-occur in articles' references?

Example

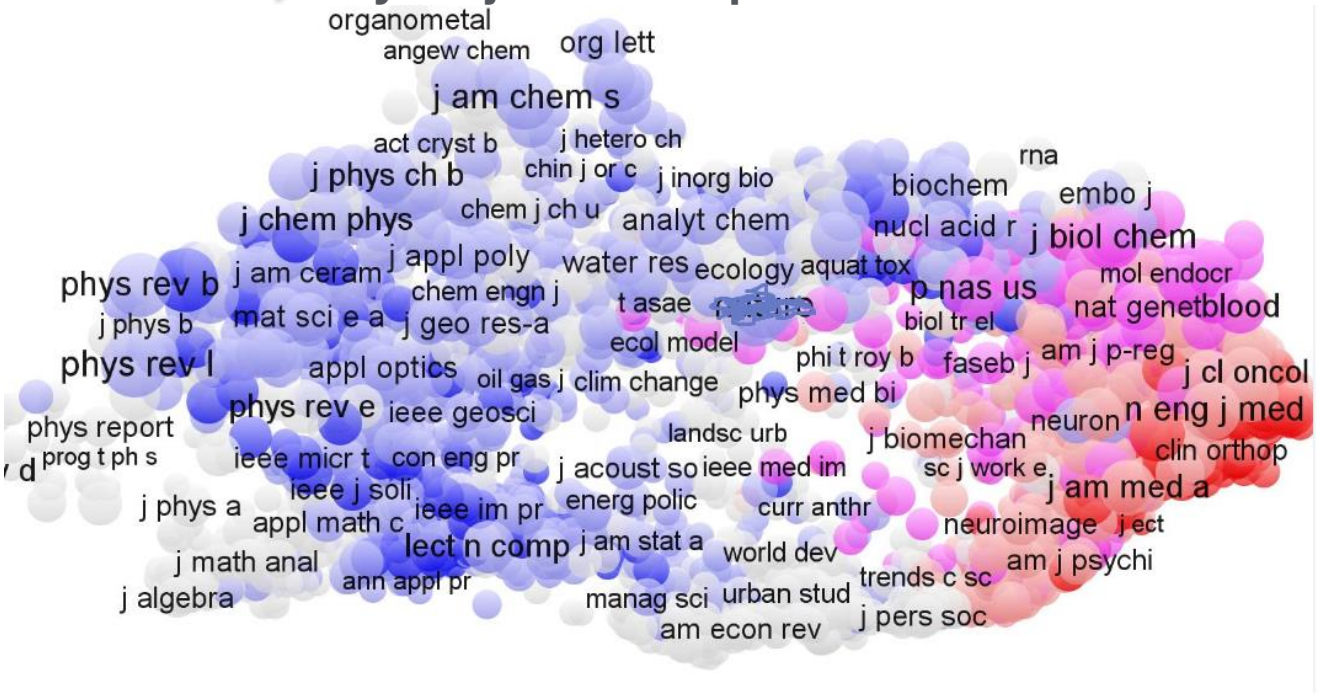
Journals	Articles	References
Journal A	A1	A2, B1
	A2	B2, B3
Journal B	B1	A1, A2
	B2	B1, B3
	B3	A1, B1
Journal C	C1	C2, C4,
	C2	C1, C4,
	C3	C1, C2, C4,
	C4	A1, C1, C2
	C5	C1, C2

Co-occurrence matrix

	Journal A	Journal B	Journal C
Journal A	1	2	1
Journal B	2	2	0
Journal C	1	0	5

Methodology

- Step 1: mapping journals
  - Year-by-year journal maps: Better capture the dynamics of the research landscape
  - 5-year journal map: More stable map with larger occurrence numbers
  - Spearman correlation coefficient of the two lists of journal pairs is equal to 0.9 → **5-year journal map is used**



Methodology

- Step 1: mapping journals
  - Examples of “close” journals: journals from the same sub-discipline

Journal 1	Journal 2
Review of Contemporary Philosophy	Contemporary Readings in Law and Social Justice
International Endodontic Journal	Journal of Endodontics
Advanced Studies in Contemporary Mathematics (Kyungshang)	Proceedings of the Jangjeon Mathematical Society
Clinical Oral Implants Research	International Journal of Oral and Maxillofacial Implants
Nuclear Physics A	Physical Review C - Nuclear Physics
International Journal of Leprosy and Other Mycobacterial Diseases	Leprosy Review
Journal of Glaciology	Annals of Glaciology
Energy Education Science and Technology Part B: Social and Educational Studies	Energy Education Science and Technology Part A: Energy Science and Research
Sport Psychologist	Journal of Applied Sport Psychology
International Journal of Primatology	American Journal of Primatology

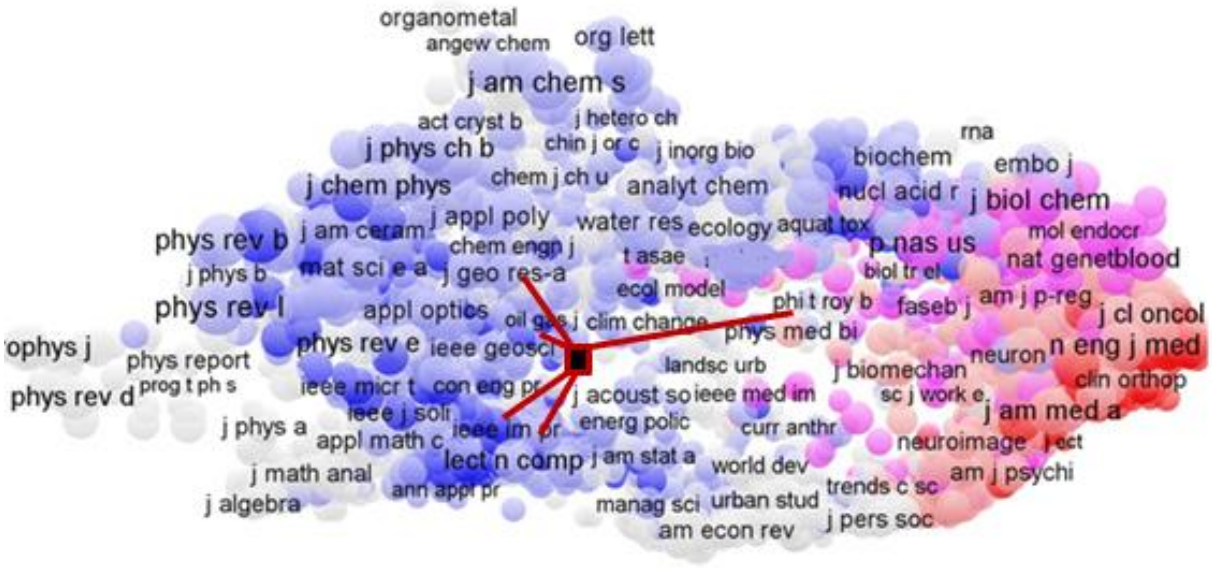
Methodology

- Step 1: mapping journals
  - Examples of “far” journals: most common case is Physics plus Medicine

Journal 1	Journal 2
Archives of Internal Medicine	Journal of Applied Physics
New England Journal of Medicine	Physical Review D - Particles, Fields, Gravitation and Cosmology
Lancet, The	Physical Review A - Atomic, Molecular, and Optical Physics
JAMA - Journal of the American Medical Association	Physical Review D - Particles, Fields, Gravitation and Cosmology
Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics	JAMA - Journal of the American Medical Association
Lancet, The	Physical Review D - Particles, Fields, Gravitation and Cosmology
American Journal of Public Health	Journal of Applied Physics
Physical Review A - Atomic, Molecular, and Optical Physics	JAMA - Journal of the American Medical Association
Applied Physics Letters	Journal of the American Geriatrics Society
New England Journal of Medicine	IEEE Transactions on Communications

Methodology

- Step 2: Calculate the single disciplinary score (SDS) for each article
  - How “close” or “far” are the journals the references of the article published in?



Methodology

- Step 2: Calculate the single disciplinary score (SDS) for each article
  - Example
    - Journal similarity scores

	Journal A	Journal B	Journal C
Journal A	-0.20	0.14	-0.30
Journal B	0.14	0.14	-1
Journal C	-0.30	-1	1

    - Article's single disciplinary score is a weighted average of journal similarity scores