h-index: Assessing a researcher's impact

2015 Scholar's Cooperative Brown Bag Series

Katherine Akers

Biomedical Reaserch & Data Specialist

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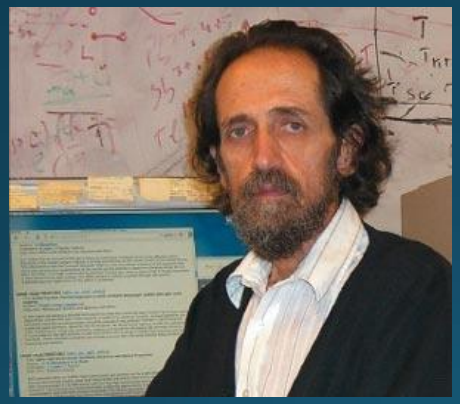
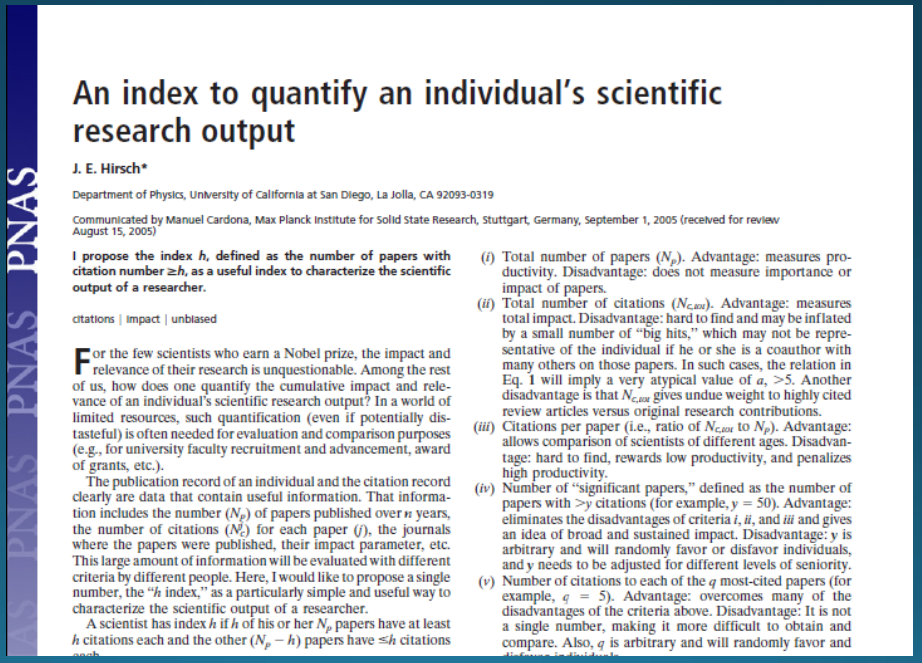
What is the *h*-index?

A combined measure of researcher productivity (# of publications) and impact (# of citations)

Created in 2005 by physicist Jorge E. Hirsch (UCSD)





PNAS PNAS PNAS

An index to quantify an individual's scientific research output

J. E. Hirsch*

Department of Physics, University of California at San Diego, La Jolla, CA 92093-0319

Communicated by Manuel Cardona, Max Planck Institute for Solid State Research, Stuttgart, Germany, September 1, 2005 (received for review August 15, 2005)

I propose the index *h*, defined as the number of papers with citation number ≥*h*, as a useful index to characterize the scientific output of a researcher.

citations | impact | unbiased

For the few scientists who earn a Nobel prize, the impact and relevance of their research is unquestionable. Among the rest of us, how does one quantify the cumulative impact and relevance of an individual's scientific research output? In a world of limited resources, such quantification (even if potentially distasteful) is often needed for evaluation and comparison purposes (e.g., for university faculty recruitment and advancement, award of grants, etc.).

The publication record of an individual and the citation record clearly are data that contain useful information. That information includes the number (N_p) of papers published over n years, the number of citations (N_c) for each paper (j), the journals where the papers were published, their impact parameter, etc. This large amount of information will be evaluated with different criteria by different people. Here, I would like to propose a single number, the "h index," as a particularly simple and useful way to characterize the scientific output of a researcher.

A scientist has index h if h of his or her N_p papers have at least h citations each and the other ($N_p - h$) papers have ≤h citations

(*i*) Total number of papers (N_p). Advantage: measures productivity. Disadvantage: does not measure importance or impact of papers.

(*ii*) Total number of citations ($N_{c,tot}$). Advantage: measures total impact. Disadvantage: hard to find and may be inflated by a small number of "big hits," which may not be representative of the individual if he or she is a coauthor with many others on those papers. In such cases, the relation in Eq. 1 will imply a very atypical value of $a_1 > 5$. Another disadvantage is that $N_{c,tot}$ gives undue weight to highly cited review articles versus original research contributions.

(*iii*) Citations per paper (i.e., ratio of $N_{c,tot}$ to N_p). Advantage: allows comparison of scientists of different ages. Disadvantage: hard to find, rewards low productivity, and penalizes high productivity.

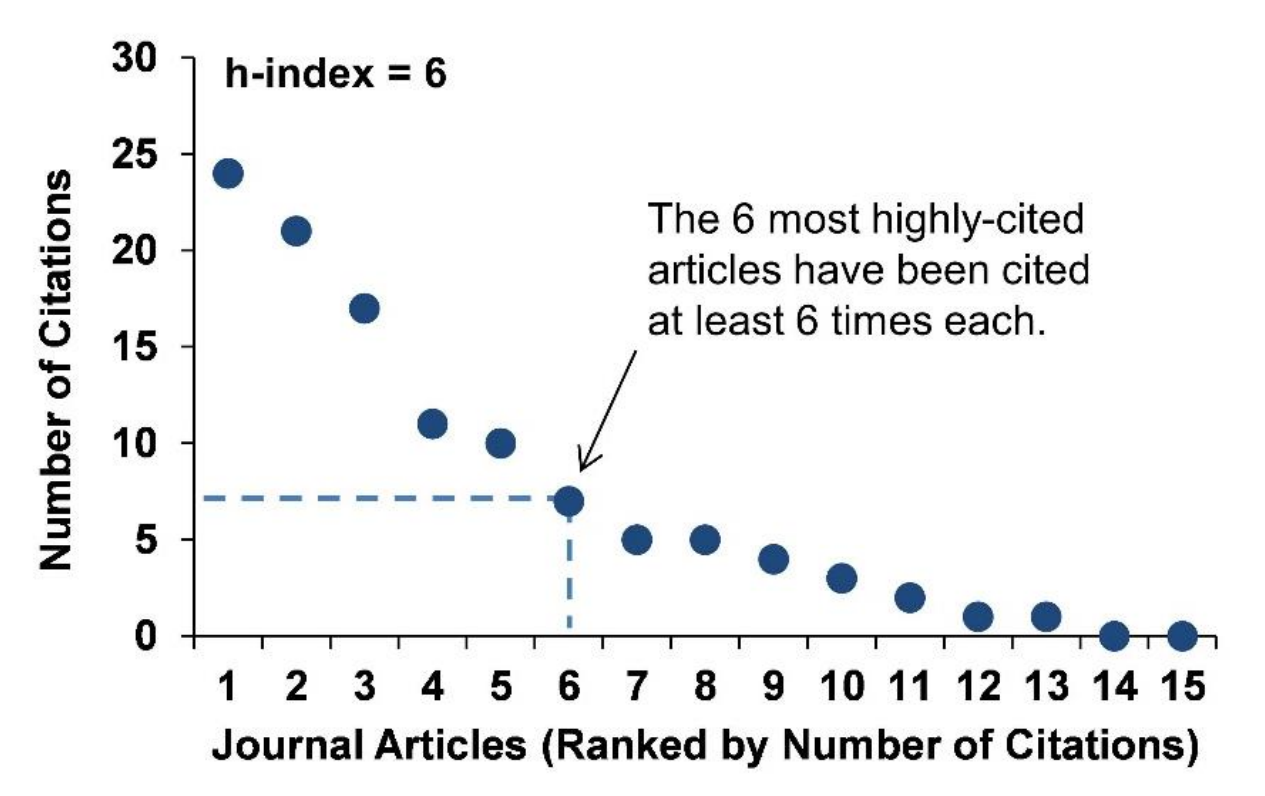
(*iv*) Number of "significant papers," defined as the number of papers with >y citations (for example, $y = 50$). Advantage: eliminates the disadvantages of criteria *i*, *ii*, and *iii* and gives an idea of broad and sustained impact. Disadvantage: y is arbitrary and will randomly favor or disfavor individuals, and y needs to be adjusted for different levels of seniority.

(*v*) Number of citations to each of the q most-cited papers (for example, $q = 5$). Advantage: overcomes many of the disadvantages of the criteria above. Disadvantage: It is not a single number, making it more difficult to obtain and compare. Also, q is arbitrary and will randomly favor and

JE Hirsch (2005). An index to quantify an individual's scientific research output. *PNAS* 102:16569-16572.

What is the *h*-index?

An *h*-index of *h* means that an author's *h* most highly cited articles have at least *h* citations each.



The *h*-index assesses *researchers*

ITEM	METRIC
journal article	citations (and altmetrics)
journal	impact factor
researcher	*h*-index

Advantages of *h*-index

- **Informative**: more informative than # of publications or # of citations
- **Simple**: easy to calculate and understand
- **Robust**: insensitive to "one-hit wonders" or an excess of uncited papers--rewards researchers who consistently publish influential work

Disadvantages of *h*-index

- **Simple**: ignores other aspects of research impact
- **Cannot decrease**: researchers can maintain a good *h*-index even if they cease to be productive
- **Gameable**: can be inflated by self-citation (5-25%)
- **Relative**: depends on discipline, length of research career, number of co-authors, etc.

Alternatives to *h*-index

g-index: accounts for highly cited articles

contemporary *h*-index: accounts for recency of articles

individual *h*-index: accounts for co-authors

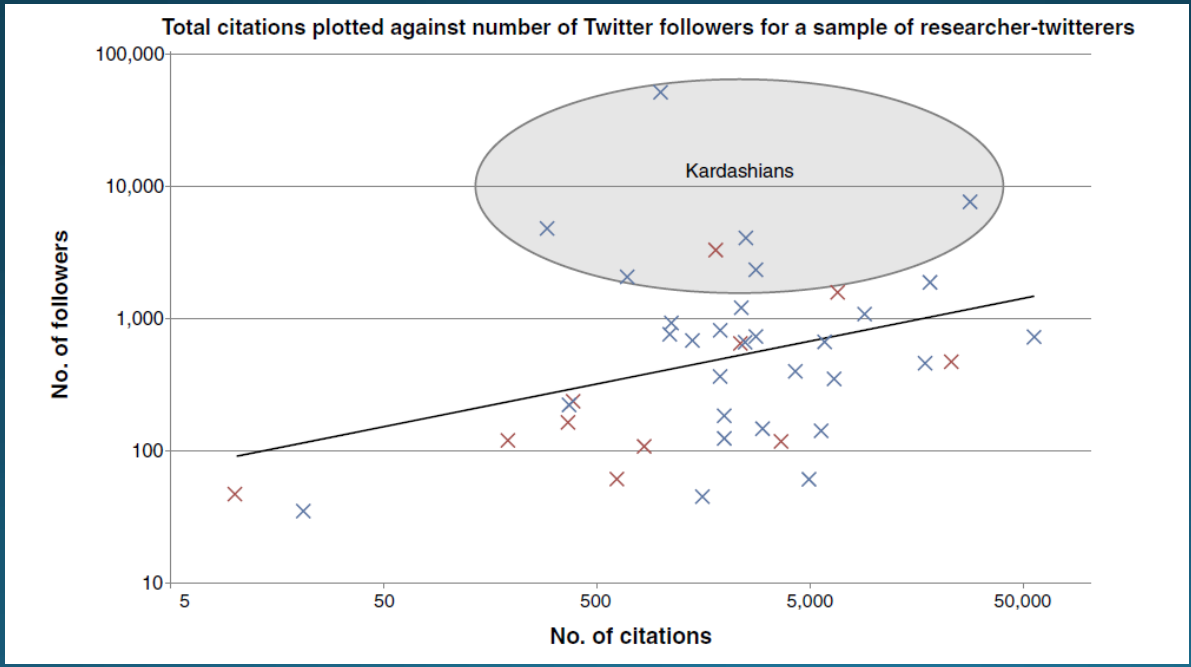
m-quotient: accounts for career length

a-index, *ar*-index, *e*-index, *c*-index, *h'*-index, *h(2)*-index, h_f-index, h_T-index, h_w-index, HCP indicator, *i10*-index, *IQp*-index, maxprod index, *p*-index, π-index, *r*-index, *s*-index, *success*-index, t-index, *w*-index

k-index

Ratio of Twitter followers ("celebrity") to citations ("scientific value")

k-index ≥ 5: overblown public profile



N Hall (2014). The Kardashian index: a measure of discrepant social media profile for scientists. *Gen Biol* 15:424.

Tools for calculating *h*-index

Web of Science

Scopus

Google Scholar

Publish or Perish software

(http://www.harzing.com/pop.htm)

h-index prediction tool

(http://klab.smpp.northwestern.edu/h-index.html)

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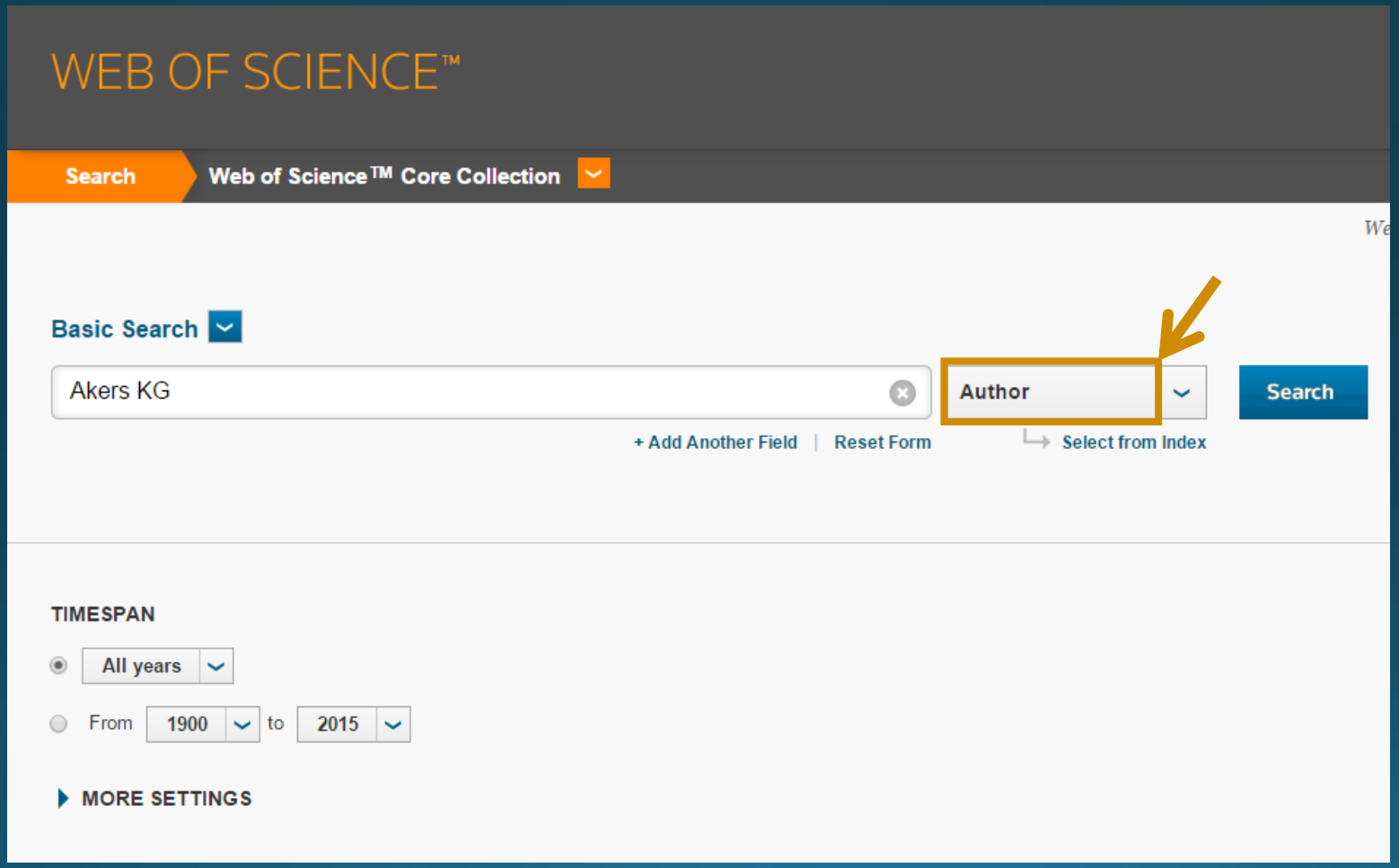

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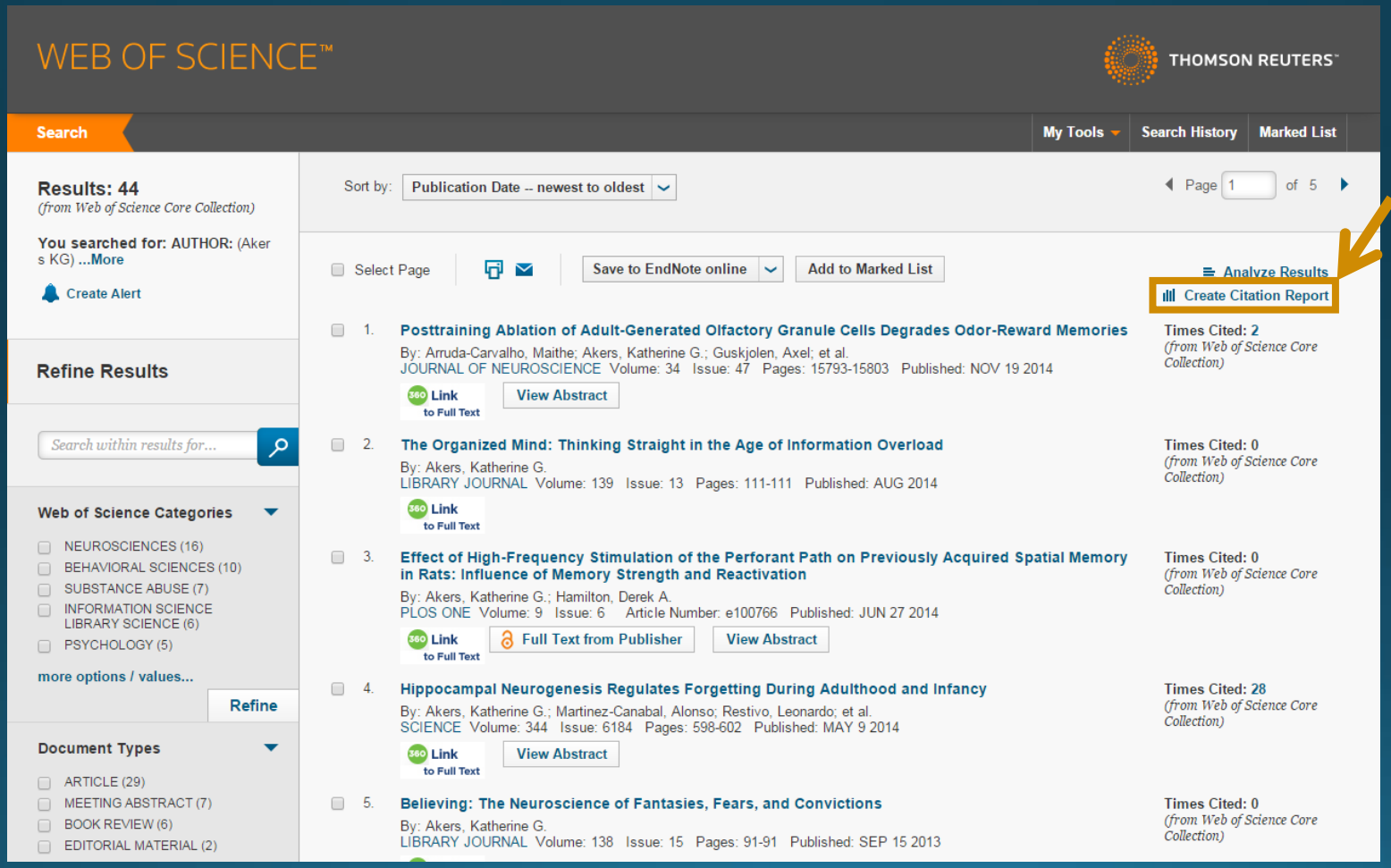

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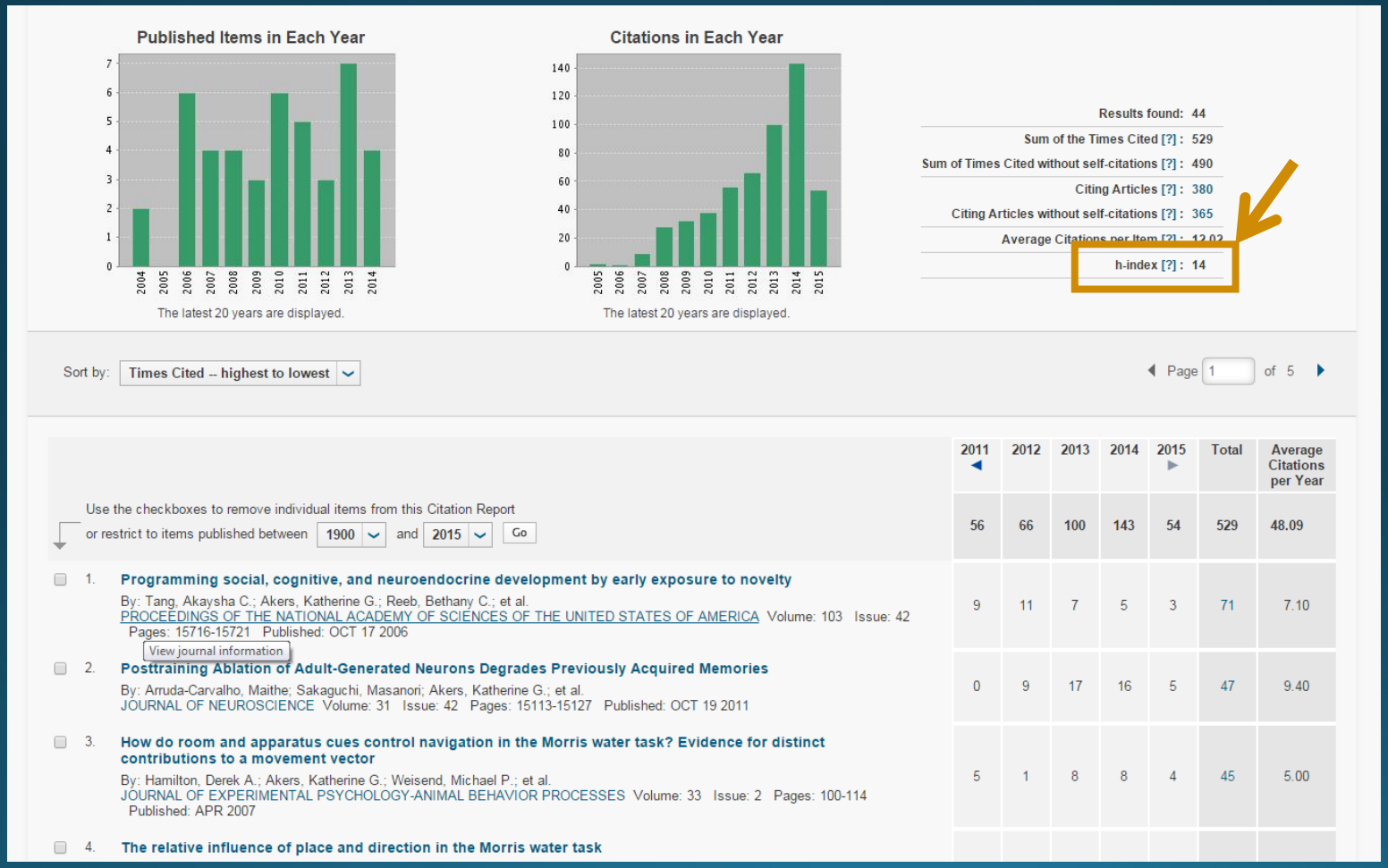

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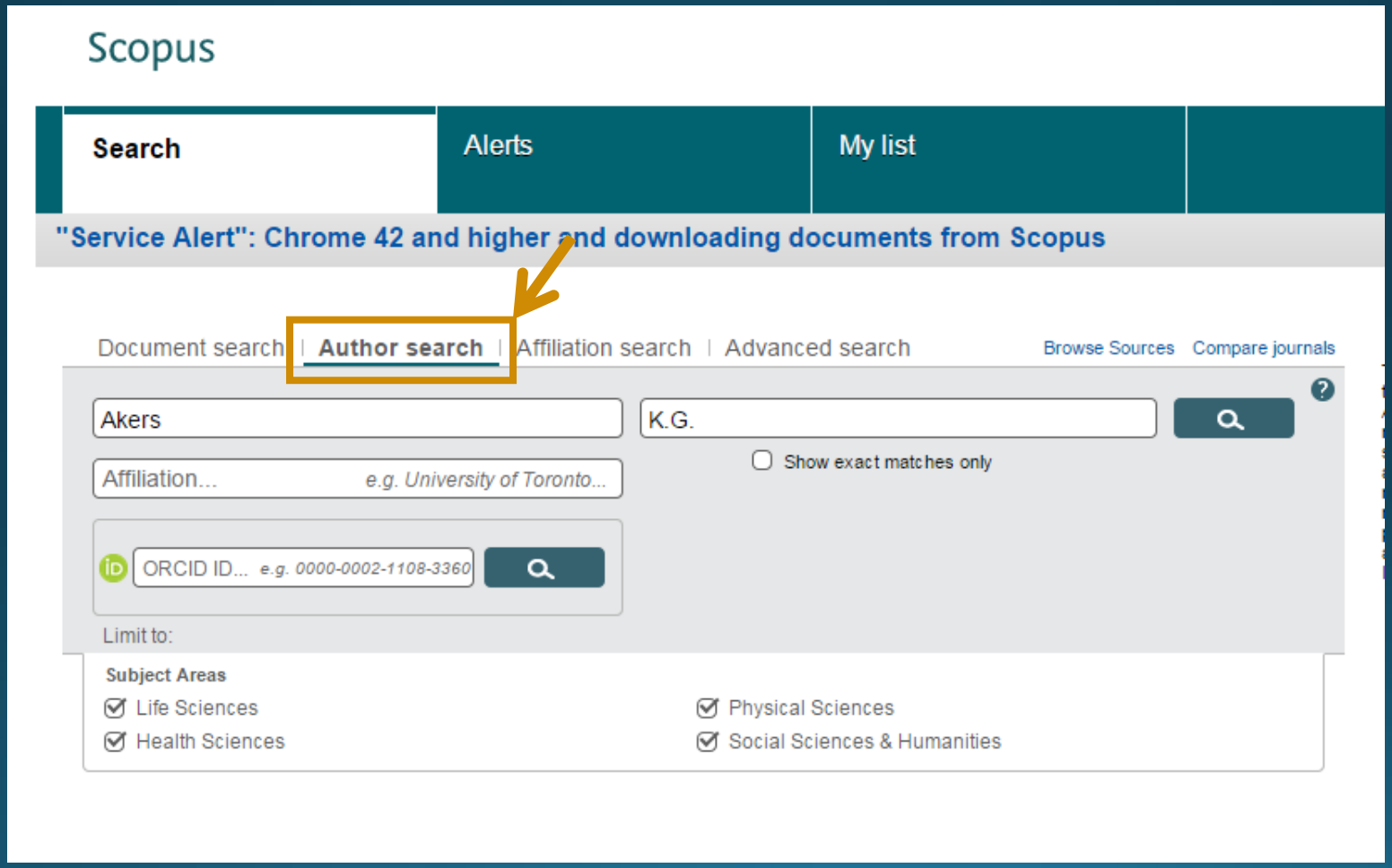
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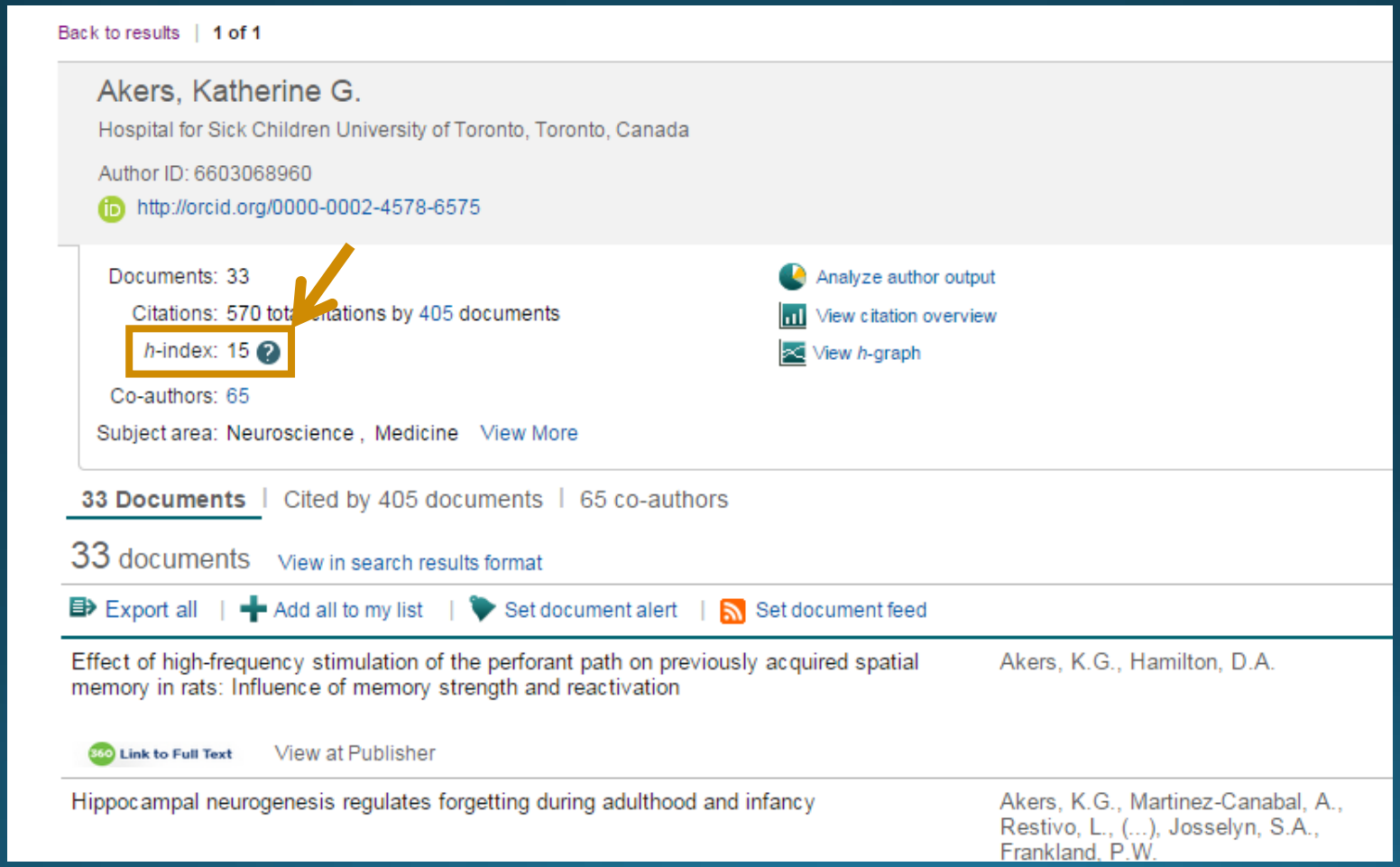
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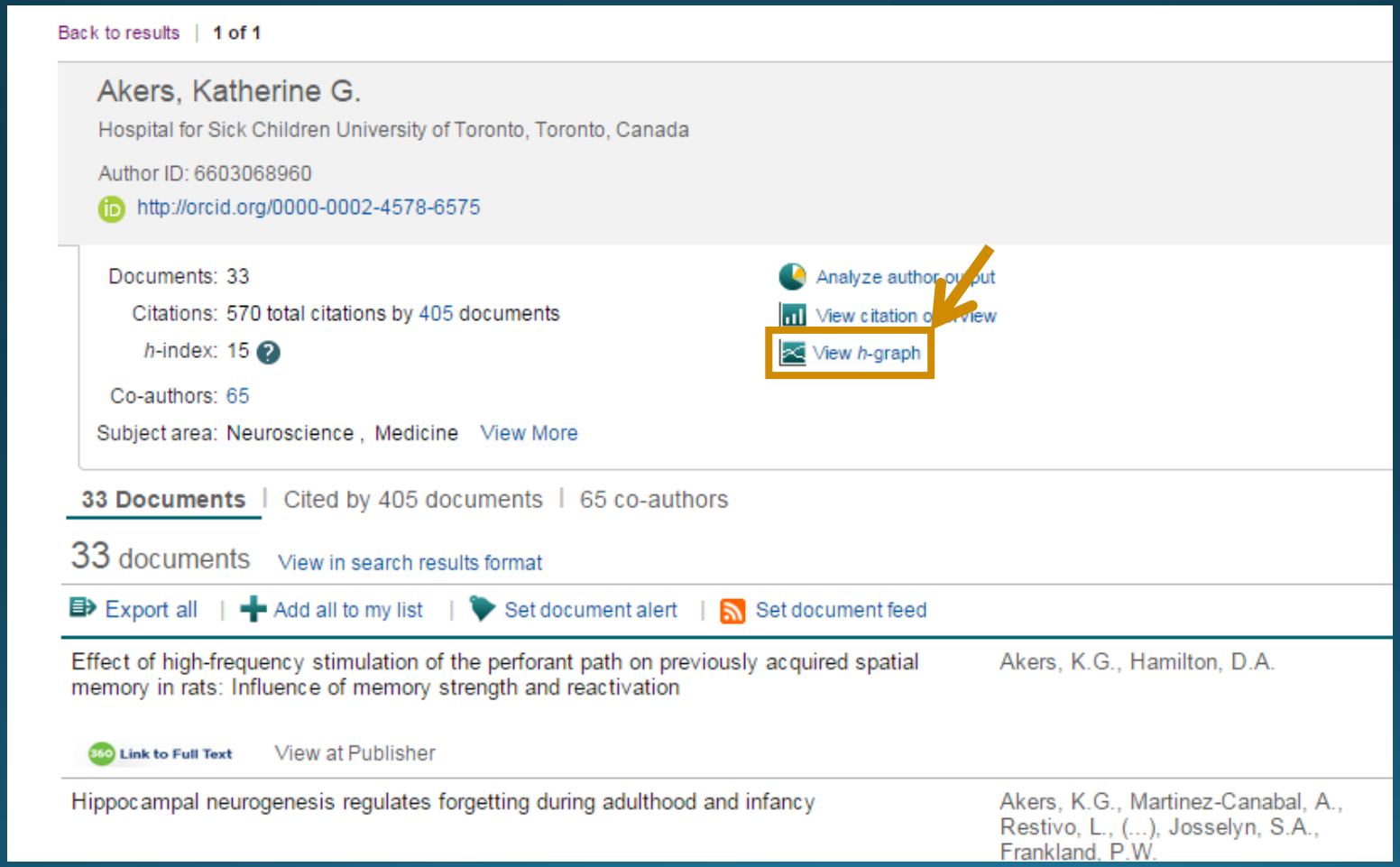
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14 15 Age-dependent effects of hippoca...
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Posttraining ablation of adult-generated neurons degrades previously acquired memories M Arruda-Carvalho, M Sakaguchi, KG Akers, SA Josselyn, PW Frankland The Journal of Neuroscience 31 (42), 15113-15127	59	2011
Hippocampal neurogenesis regulates forgetting during adulthood and infancy KG Akers, A Martinez-Canabal, L Restivo, AP Yiu, A De Cristofaro, ... Science 344 (6184), 598-602	56	2014
How do room and apparatus cues control navigation in the Morris water task? Evidence for distinct contributions to a movement vector. DA Hamilton, KG Akers, MP Weisend, RJ Sutherland Journal of Experimental Psychology: Animal Behavior Processes 33 (2), 100	56	2007
Prenatal exposure to moderate levels of ethanol alters social behavior in adult rats: relationship to structural plasticity and immediate early gene expression in frontal cortex DA Hamilton, KG Akers, JP Rice, TE Johnson, FT Candelaria-Cook, ...	47	2010

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Citations	738	669
h-index	16	15
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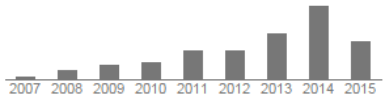

Add co-authors

- Paul Frankland
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- Tsuyoshi Miyakawa
- Koji OHIRA
- Blake Richards
- Jonathan R Epp
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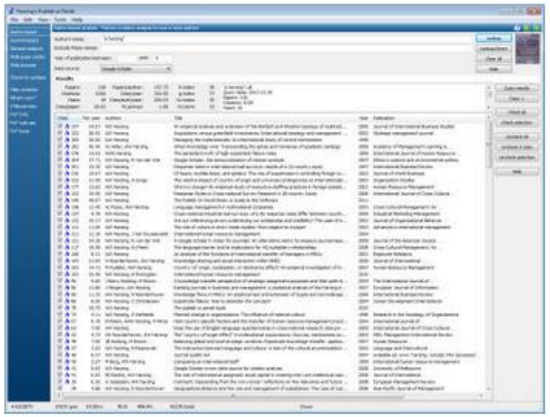

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Version: 4.15.1 (31 May 2015)

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Contents

h-index prediction

H-index prediction

Read details in Acuna, Allesina, Kording, Nature, 489, 201-202 (2012)

Save to file

H-index calculator uses BitmapExporter by Mario Klingemann

H-index: 5

articles: 12

Years since first article: 8

distinct journals: 5

articles in 'top' journals*: 1

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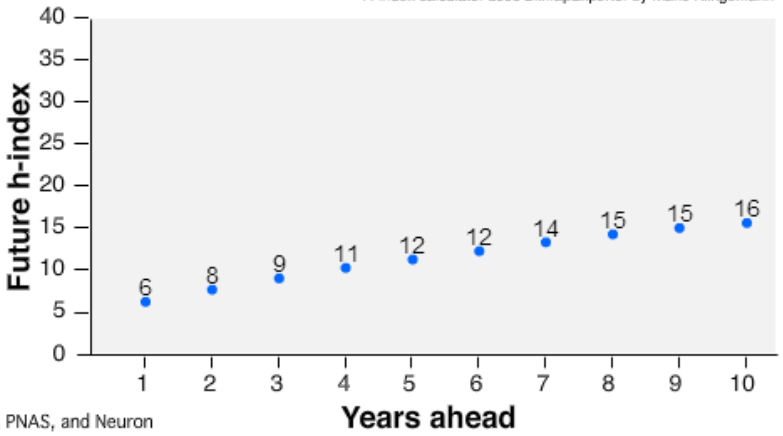

* Nature, Science, Nature Neuroscience, PNAS, and Neuron

 # distinct journals: number of different journals where you have published in.

Note: The equations and the calculator model people that are in Neurotree, have an h-index 5 or more, and are between 5 to 12 years after publishing first article.

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All media (Wired, The Scientists, The Chronicle, etc.)

Article in Nature | Editorial in Nature | Podcast (around 14 min. mark) in Nature podcast | Podcast NPR Science Friday (Spanish)

What is a good *h*-index?

For physicists:

Successful → *h*-index of 20 after 20 years of activity

Outstanding → *h*-index of 40 after 20 years of activity

Truly unique →*h*-index of 60 after 20 years of activity

h-index = 12 → tenure

h-index = 18 → full professorship

h-index = 15-20 → fellowship in American Physical Society

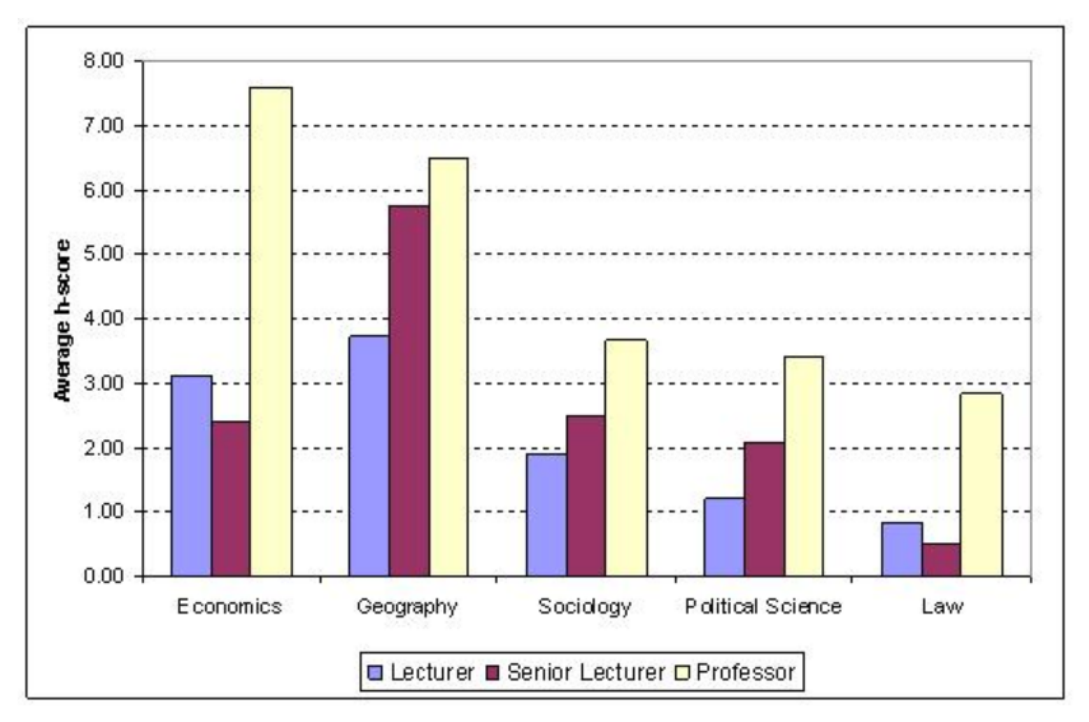
h-index ≥ 45 → membership in National Academy of Sciences

84% of physicists who won Nobel prizes had an *h*-index of at least 30

JE Hirsch (2005). An index to quantify an individual's scientific research output. *PNAS* 102:16569-16572.

What is a good *h*-index?

For social scientists:

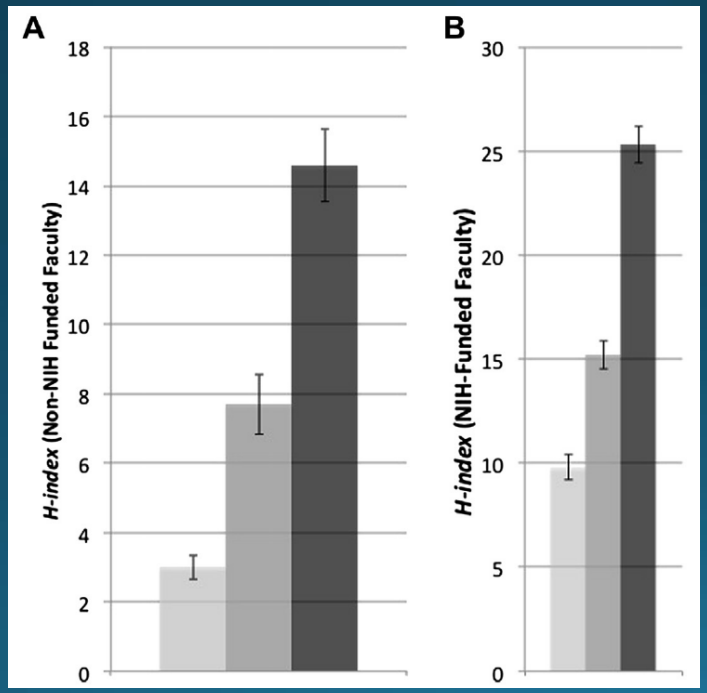


http://blogs.lse.ac.uk/impactofsocialsciences/the-handbook/chapter-3-key-measures-of-academic-influence/

Validity of *h*-index

NIH-funded researchers have higher *h*-indices than non-NIH-funded researchers.

Ophthalmologists:



PF Svider et al (2014). The association between scholarly impact and National Institutes of Health funding in ophthalmology. *Ophthalmol* 121:423-428.

Validity of *h*-index

NIH-funded researchers have higher *h*-indices than non-NIH-funded researchers.

Radiologists:

Variable	NIH Funding (*n* = 48 [23%])	No NIH Funding (*n* = 162 [77%])
h-index		
Mean ± SD	19.1 ± 12.6	10.4 ± 9.0
Median (IQR)	19.5 (9–28.5)	7.5 (4–16)

Rezek et al (2011). Is the h-index predictive of greater NIH funding success among academic radiologists? *Acad Radiol* 18:1337-1340.

Questions?

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