

The Role of Impact Metrics in Researchers' Literature Selection Processes

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Need for scalable methods of publication assessment

NEWS BLOG

Global scientific output doubles every nine years

.07_May_2014_|_16:46_BST | Posted by Richard Van Noorden | Category: Policy, Publishing

It's a common complaint among academics: today's researchers are publishing too much, too fast. But just how fast is the mass of scientific output actually growing?

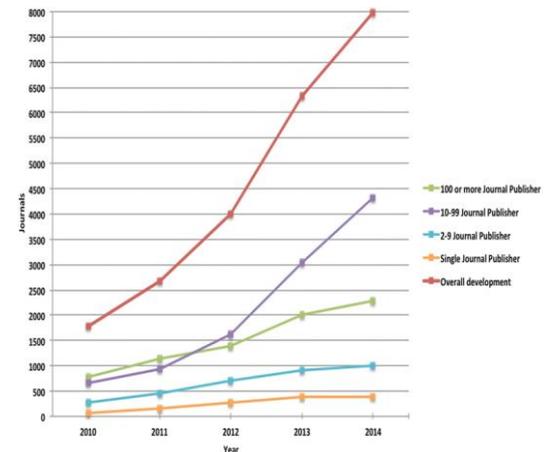
Source: <http://blogs.nature.com/news/2014/05/global-scientific-output-doubles-every-nine-years.html>

Share of preprints among Covid-19-related publications (early 2020)



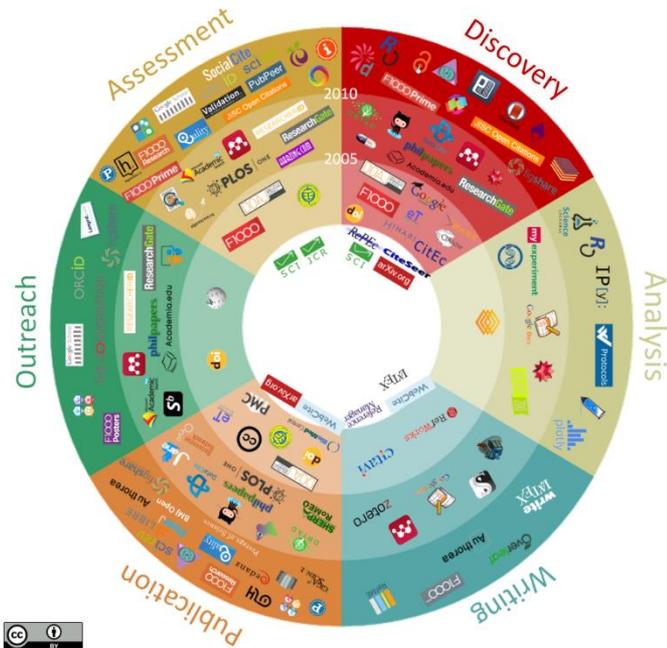
Source: Fraser, N., Brierley, L., Dey, G., Polka, J. K., Pálffy, M., & Coates, J. A. (2020). Preprinting a pandemic: the role of preprints in the COVID-19 pandemic. *bioRxiv*. <https://doi.org/10.1101/2020.05.22.111294>

Development of active predatory open access-journals (2010-2014)



Source: Shen, C., Björk, B. (2015). 'Predatory' open access: a longitudinal study of article volumes and market characteristics. *BMC Med* 13, 230. <https://doi.org/10.1186/s12916-015-0469-2>

Parallel developments in scholarly working habits



- Researchers' everyday work increasingly takes place on online platforms
- As many opportunities to track and analyze various types of usage electronically as never before
- Assessing research based on quantitative data becomes even more tempting



Source: Kramer, B., & Bosman, J. (2016). Innovations in scholarly communication—Global survey on research tool usage. *F1000Research*, 5, 692. <https://doi.org/10.12688/f1000research.8414.1>

Metrics for research evaluation ('impact metrics')

Bibliometrics:

- Traditional indicators of scientific relevance
- Include indicators that apply to
 - individual articles (e.g. citation counts)
 - journals (e.g. *Impact Factor*)
 - researchers (e.g. *h-index*)
- Usually only consider formal publications

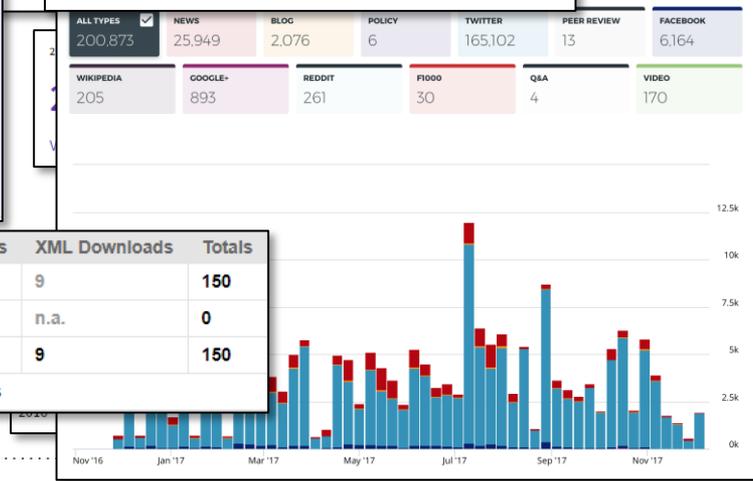
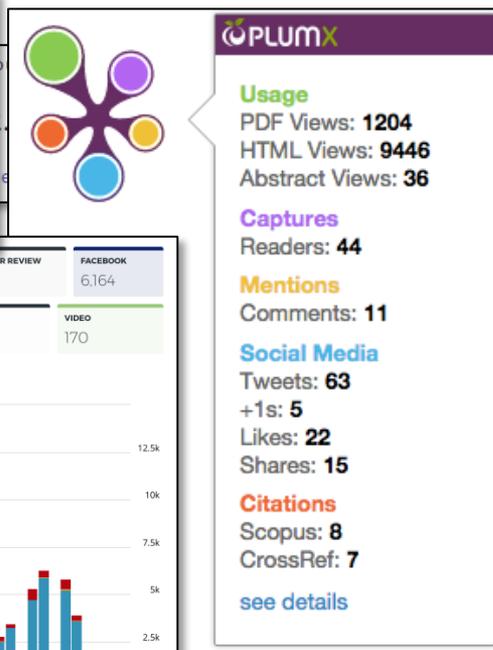
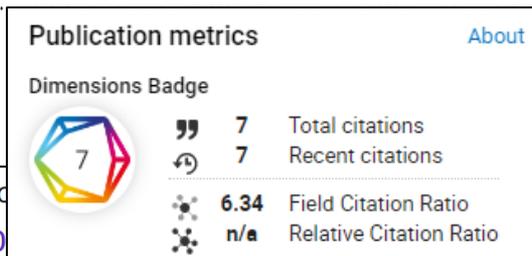
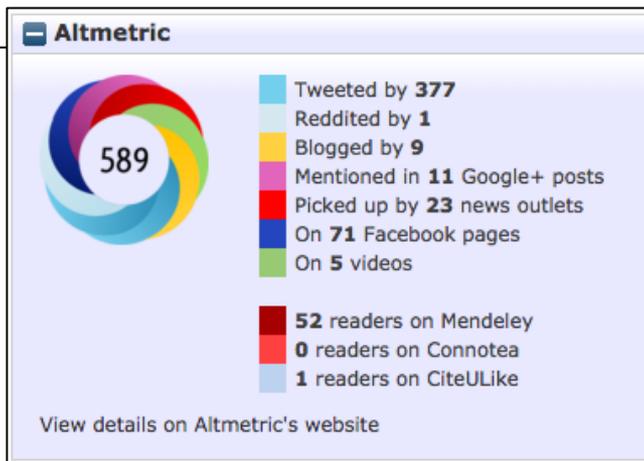
How (often) are scientific articles cited by other scientific articles?

Altmetrics and usage metrics

- (= web-based metrics):
- Highly heterogeneous, ever-changing set of indicators
 - Meant to offset some weaknesses of citations, as web-based metrics usually are
 - faster
 - applicable to more diverse outputs
 - able to reflect more types of impact
 - based on openly available data

How (often) do users interact with a scientific output online?

More types of research metrics than ever



Periodic Table of Scientometric Indicators

C	EC3	metrics																	Lnk	
Total Citations																				Links
h	P															Fav	MR	AP	RGP	WS
h-index	Number of Publications															Favorites	Monthly Readers	Academia Profiles	ResearchGate Publications	Web Site
		<ul style="list-style-type: none"> Basic Indicators Bibliometric Indicators h-index based Indicators Webmetric Indicators (1.0) Altmetric Indicators 																		
IF	AF	CS	JCS	FCS	FNCI	NJI	JCS	RgC	MASC	GSC	GSh	Lk	PM	FacL	APV	RGV	Vw			
Impact Factor	Audience Factor	Citations	Journal Citation Score	Field Citation Score	Field-normalized citation indicators	Normalized Journal Impact	Journal Citation Score	ResearchGate Citations	Microsoft Academic Search Citations	Google Scholar Citations	Google Scholar h-index	Links	Policy Mentions	Facebook Likes	Academia Profile Views	ResearchGate Views	Views			
SJR	EF	SNIP	I3	CI	MCS	MNCS	MCRS	MSNCS	MASP	GSP	Sub	BM	TwM	FacS	ADV	RGD	Dwd			
Storage-Journal Rank	Eigenfactor	Source Normalized Impact per Paper	13 Integrated Impact Indicator	Crown Indicator	Mean Citation Score	Mean Normalized Citation Score	Mean Citation Rate Subfield	Mean Source Normalized Citation Score	Microsoft Academic Search Papers	Google Scholar Papers	Subscribers	Blog Mentions	Twitter mentions	Facebook Shares	Academia Sociometric Views	ResearchGate Downloads	Downloads			
IPP	CPP	CPPex	ANCP	TNCS	RAI	RSI	RCR	RDCP	JAR	Com	PuPC	NM	WC	FacC	Afr	RGI	Ck			
Impact per Paper	Citation per paper	Citations per Paper with Citations not included	Average number of Citations per publication	Total and the Average Number of Citations	Relative Activity Index	Relative Specialization Index	Relative Citation Rate	Relative Citation Rate	Journal Academic Citation Potential	Comments	PubPages Comments	News Mentions	Wikipedia Citations	Facebook Comments	Academia Followers	ResearchGate Impact Points	Clicks			
%SC	%Pnc	PR	LogZ	IK	TI	STP	NPJ	WCH	Rev	F1Re	GoRev	MoH	ARev	Play	Afg	RGfr	FTV			
%Self-Citations	Percentage of papers not cited	PR Percentile Rank	Log ₁₀ score	Innovative Knowledge	Technological Impact	Scientific Talent Pool	Normalized position of publication journal	WorldCall list	Reviews	F1000 Reviews	Goodreads Reviews	Monographic Rating	Amazon Reviews	Number of play Videos	Academia Following	ResearchGate Followers	Full Text Views			
PT1	PT10	PT50	HCP	Q1	PWoS	NHCP	PTRJ	Exp	Q&A	F1R	GoRat	MoR	ARat	PS	OS	RGfg	AV			
Papers in Top 1	Papers in Top 10	Papers in Top 50	High Cited Papers	Papers in First Quartile	Publications in Thomson Reuters journals	Number of highly cited publications	Publications in top-ranked journals	Experts	Q&A Stack Exchange	F1000 Ratings	Goodreads Rating	Monographic Ranking	Amazon Ratings	Publons Score	Open Syllabus	ResearchGate Following	Abstract Views			
PCol	%CoA	NCol	ICol	SL	EN	Exc	Sav	ReR	F1FFa	GoRea	MoS	RcCU	RCU	BoD	AA	AAS	DIL			
Papers in Collaboration	Share of articles coauthored with another unit	National Collaboration	International Collaboration	Scientific Leadership	Elite Number	Excellence	Saves	Referred Readers	F1000 Ffa	Goodreads Readers	Monographic Star	Recommendations CRISiDs	Readers Citations	Bookmarks Delimita	Academia Application	Altmetric Altmetric Scores	Duration Visited Links			

i10	g	a	h(2)	hg	q2	r	ar	k	f	m	m-q	Ch	Th	Dh-T	n	Mh
i10-index	g-index	a-index	h(2)-index	hg-index	q2-index	r-index	ar-index	k-index	f-index	m-index	m-q-index	Cooperating Index	Trend h-index	Dynamic h-Type index	n-index	mean h-index
h5	Nh	SIs	Sih-T	Hw	Hm	Th	I10	v	e	hla	Mh	RC	CC	Ch	CSs	π
h5-index	Normalized h-index	Specific Impact Index	Geometry Independent Hirsch-Type Index	Hw-index	Hm-index	Th-index	I10-index	v-index	e-index	hla-index	Mh-index	Research Collaboration Index	Communities Collaboration Index	Ch-index	typed h-Collaboration	π-index
h5-m	2gh	Rbhm	h2-l	h2-c	h2-u	h3	p	Hbar	Mhm	w	b	Gh	SPh	hint	Hrat	πv
h5-median	2nd generation citation h-index	Risk-based h-index	h2-lower	h2-center	h2-upper	h3-index	p-index	Hbar-index	Mhm-index	w-index	b-index	Generalized h-index	Single paper h-index	h-index	h-index	πv-index

Debate on metrics use by administration

- Discussed critically in several high-profile publications, e.g.:

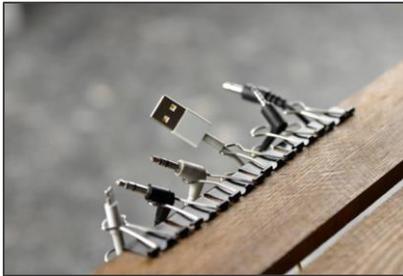


- Consensus: use of impact metrics for micro-level assessments is problematic for a number of reasons, e.g., metrics' biases towards certain disciplines, genders, and languages; substantial differences in publication and citation practices between disciplines; not every research career focuses on publications; etc.

Metrics use by individuals in everyday scenarios

Why is it of interest, how researchers perceive and use metrics?

- Researchers' metrics usage reflects a culture that determines metrics' role within the grander picture
- To develop working strategies on how to advice researchers regarding metrics use, first establishing what they already know and think is important
- And: the *usefulness* of a tool also depends on the subjective perspective of its users: do they understand the tool, do they perceive it as helpful, do they have certain concerns regarding its use?



Context of our studies on researchers' perceptions of metrics

- Part of project **metrics* (2017-2019), which had, among others, the goal to analyze how researchers perceive and use impact metrics
 - Series of focus group interviews and large-scale online surveys (article A)
 - Followed by interactive online experiment and conjoint analysis (article B)
 - Final report summarizing the whole **metrics* project openly available



Article A (Frontiers):
<https://doi.org/10.3389/frma.2018.00039>



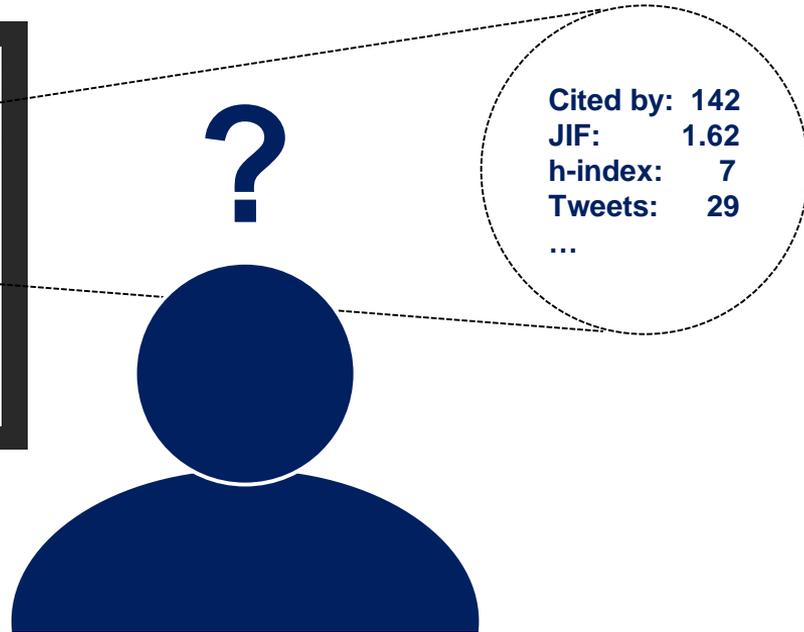
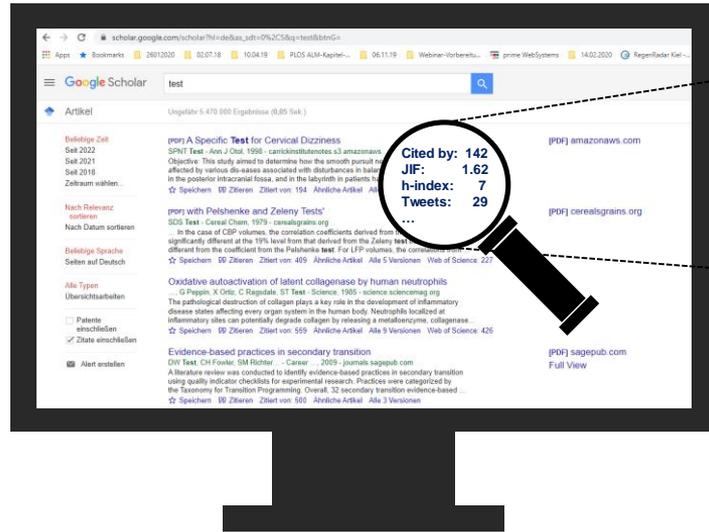
Article B (JASIST):
<https://doi.org/10.1002/asi.24445>



Final project report:
<https://doi.org/10.18452/22242.2>

Our 'everyday scenario': literature selection

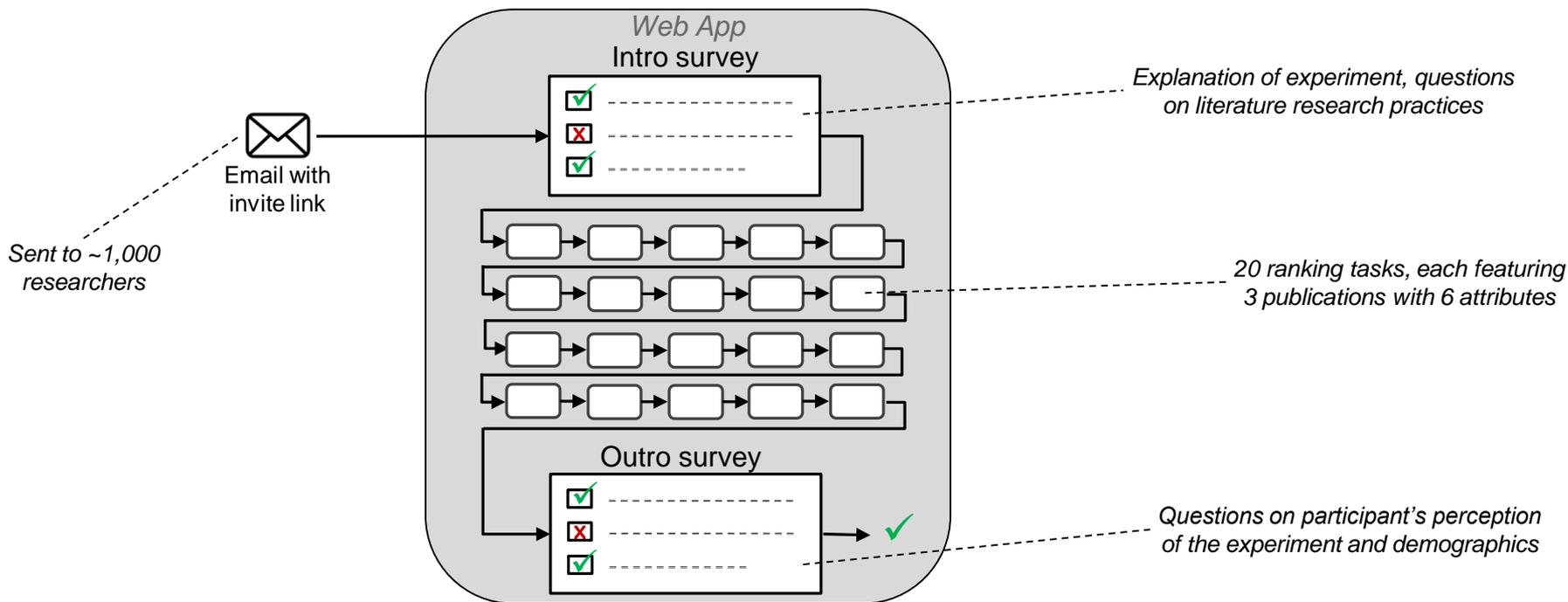
- Use case we examined: metrics use during literature selection



Past research on researchers' literature selection

- Tenopir et al. (2009): analyzed reading patterns of academic staff from US and Australia through survey – found **disciplines** and **work responsibilities** to be important characteristics determining reading behavior
- Niu and Hemminger (2012): framework of demographic, psychological, role-related, and environmental factors affecting scientists' information-seeking behavior; most important determinants are **academic position, gender, and discipline**
- Tenopir et al. (2016): survey on how do researchers determine an article's trustworthiness? by **checking soundness of its arguments and logic, checking if data used in the research are credible, reading the abstract**
- Nicholas et al. (2020): survey aimed at early career researchers found a **journal's prestige, rank and impact factor** as well as **ease of access** to be influential factors for deciding what to read

Online Experiment – Procedure



Free text question from intro survey (n = 205)

“How do you usually determine which search results to read first? Are there publication features you are looking out for?”

Journal (Prestige/Ranking/IF)	84
Citation counts	48
Title	48
Abstract	47
Authors	42
Date of publication/Recency	41
Topical relevance	40
Keywords	24
Other	19
Reference-relations	16
Publisher	11
Order of appearance in search engine	10
Availability/Access	9
Content properties	8
Publication Type	5

Online Experiment – Concept

Idea: participants imagine literature search in unfamiliar field; find three publications along with their metrics – which one would they read first?

Does their selection behavior comply with their statements from surveys?

You are doing literature research for a topic you are not yet familiar with.
Your query in the scholarly search engine of your choice reveals 3 potentially relevant publications alongside their impact metrics.
Please rank those publications in the order in which you would read them by dragging them to the area on the right.
The publication you would read first should afterwards be at the top of the list, the publication you would read last at the bottom.

Publication	Citations (e.g., on GS)	Tweets	Mendeley readers	Downloads	Journal Impact Factor	h-Index
Publication A	5	10	0	100	0	30
Publication B	250	10	0	5000	5.0	30
Publication C	5	500	500	5000	0	5

- Read first -

...

- Read last -

Online Experiment – Attributes

Publication A	
	
	Citations (e.g., on GS) 5
	Tweets 500
	Mendeley readers 500
	Downloads 5000
	Journal Impact Factor 0
	h-Index 5

- the article's *citations* (e.g., on *Google Scholar*) as an article-level bibliometric indicator;
- the publishing journal's *Journal Impact Factor* as a prominent and much-debated journal-level indicator;
- the first author's *h-index* as a widely known author-level indicator;
- the article's number of *downloads* as an article-level usage indicator;
- the article's number of mentions in *tweets* as an altmetric drawn from a social media platform targeted at a general audience;
- the article's number of *readers on Mendeley* as an altmetric drawn from a social media platform targeted at scholars.

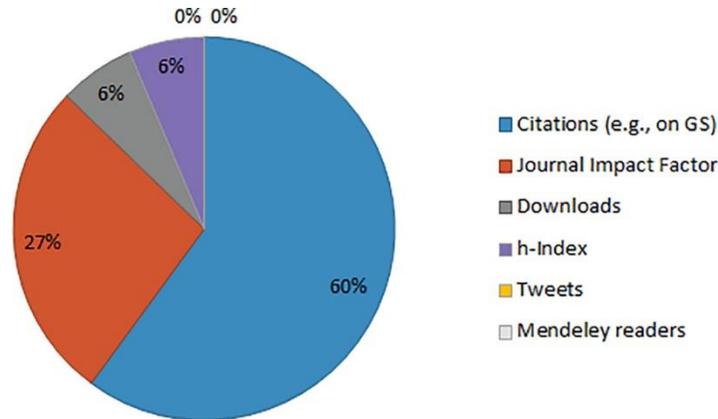
Online Experiment – Results

- Summary of logit regression model based on 7,548 choices made by 247 participants:

Variable	Estimate	SE	<i>p</i>
(intercept)	-0.419	0.016	<.001
Citations (e.g., on Google Scholar)	0.607	0.017	<.001
Journal impact factor	0.468	0.016	<.001
h-index	0.160	0.017	<.001
Downloads	0.247	0.016	<.001
Tweets	0.159	0.016	<.001
Mendeley readers	0.157	0.017	<.001

Online Experiment – Results

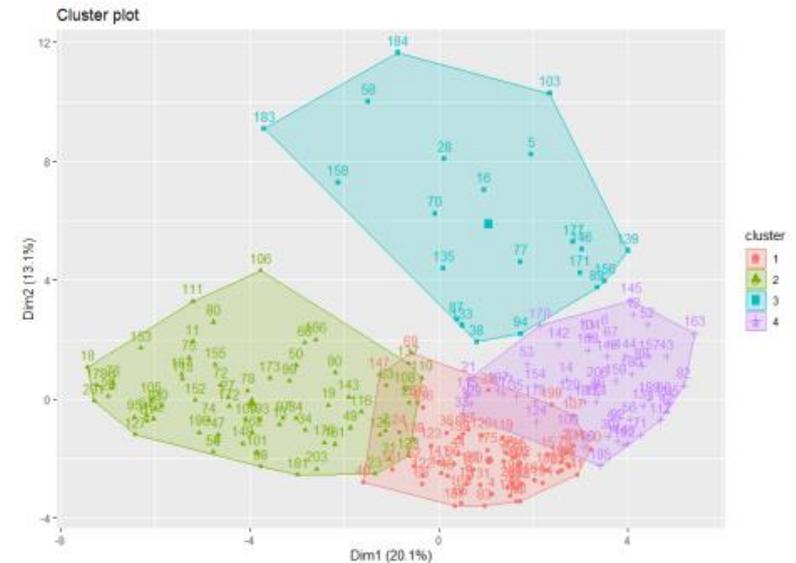
- Survey response to *“If you had to choose between the metrics that were presented to you during the previous tasks, which one do you consider most helpful as a tool for deciding which publications to read?”*:



Online Experiment – Results

k-means clustering of participants based on ranking similarities (with *k* = 4):

Variable	Estimates			
	C1	C2	C3	C4
<i>n</i>	65	67	20	53
Citations	0.853 ^{***}	0.302 ^{***}	0.332 ^{***}	0.935 ^{***}
Journal impact factor	0.486 ^{***}	0.808 ^{***}	0.146 ^{**}	0.248 ^{***}
h-index	0.227 ^{***}	0.167 ^{***}	0.086	0.171 ^{***}
Downloads	0.052	0.188 ^{***}	0.603 ^{***}	0.455 ^{***}
Tweets	0.097 ^{**}	0.171 ^{***}	0.148 ^{**}	0.286 ^{***}
Mendeley readers	0.083 ^{**}	0.274 ^{***}	0.104 [*]	0.167 ^{***}
Cluster description	"Bibliometrics-believers"	"IF-fixated"	"Usage evidence enthusiasts"	"Open-minded citation users"



Free text question after the experiment (n = 132)

“Now after having finished the experiment, would you like to add anything to your previous answer?”

Journal (Prestige/Ranking/IF)	84	+39
Citation counts	48	+61
Title	48	+1
Abstract	47	+1
Authors	42	+9
Date of publication/Recency	41	+10
Topical relevance	40	+1
Keywords	24	
Other	19	
Reference-relations	16	+3
Publisher	11	
Order of appearance in search engine	10	
Availability/Access	9	
Content properties	8	+1
Publication Type	5	

New entries – metrics:

Downloads	32
H-Index	24
Mendeley Readers	2
Tweets	4

Key findings

- Many qualitative features are important to researchers for deciding what to read, e.g., titles, abstracts, author names, recency, or topical relevance
- However: quantitative bibliometrics (esp. citations and JIF) were among the most looked out for features as well

Findings from focus group interviews and surveys

Further conclusions from interviews (n=9) and two online surveys (n=1,065; n=1,018):



<https://doi.org/10.3389/frma.2018.00039>

- Most researchers are aware of metrics and many seem to act with metrics in mind, e.g. for deciding what to read or cite and where to submit manuscripts
- Often little knowledge about how metrics are calculated and their relevant shortcomings
- Skepticism towards altmetrics sometimes is not applied to bibliometrics
- More widespread *metrics literacy*¹ (or *metric-wiseness*²) is needed

¹<https://stefaniehaustein.com/metrics-literacy/>

²<https://doi.org/10.3145/epi.2017.may.14>

Suggested resources for achieving metrics literacy

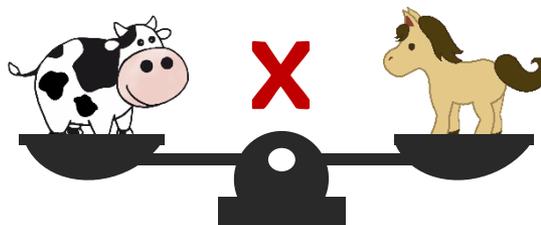
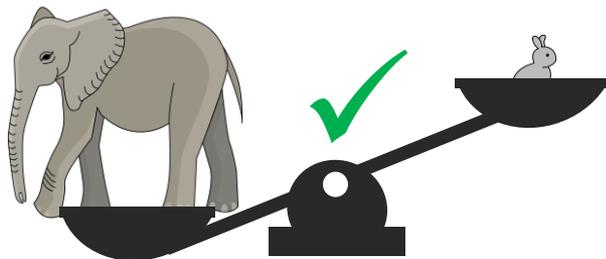
- The *Parthenos Project* can serve as a general introduction to research impact measurement:
<https://training.parthenos-project.eu/sample-page/intro-to-ri/research-impact/>
- The best practices for the use of bibliometrics condensed within the *Leiden manifesto* showcase many relevant pitfalls:
<http://www.leidenmanifesto.org/>
- The *Metrics Toolkit* provides helpful explanations of many indicators and their appropriate handling:
<https://www.metrics-toolkit.org/>
- The *IUPUI* lists more resources for further reading on responsible use of metrics:
<https://researchmetrics.iupui.edu/responsible-metrics.html>

Take away 'in a nutshell'

What should be communicated to any user of impact metrics:

- **In any type of decision-making, ideally metrics only complement but do not replace qualitative review.**

It might be helpful to think of metrics as *a scale that can distinguish an elephant from a bunny, but not a horse from a cow.*



Thank you very much for your attention!
Questions?

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