TURNING POINT US cancer researcher feels squeezed by budget cuts **p.493**

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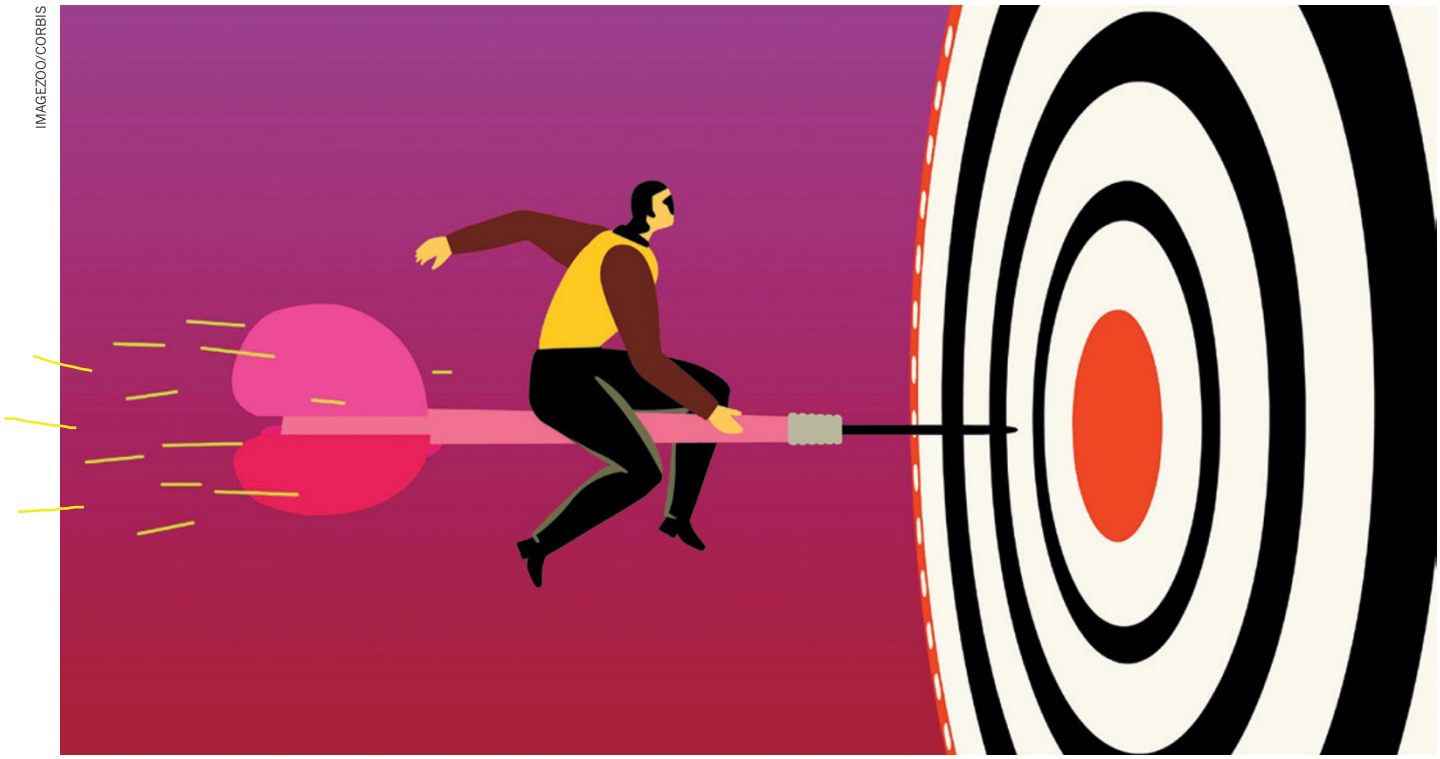

RESEARCH IMPACT

Altmetrics make their mark

Alternative measures can yield useful data on achievement — but must be used cautiously.

BY ROBERTA KWOK

Steve Pettifer and his colleagues did not heavily promote their 2008 paper on digital library tools. So it came as a surprise when, in August 2012, Pettifer got an e-mail from the Public Library of Science (PLOS), based in San Francisco, California. A PLOS representative told him that people had viewed or downloaded the article (D. Hull *et al. PLoS Comput. Biol.* **4,** e1000204; 2008) more than 53,000 times. It was the most-accessed review ever to be published in any of the seven PLOS journals. The paper had come out just as biologists' interest in digital publishing was building and the number of tools was exploding, says Pettifer, a computer scientist at the University of Manchester, UK. "It hit the right note at the right time," he says.

At one time, Pettifer would have listed the paper on his CV accompanied by the journal's impact factor and the article's number of citations — in this case, about 80. But when he came up for promotion this year, he realized that tracking citations was not going to tell the whole story about the paper's influence. Impact factor is a crude measure that applies only to the journal, not to specific articles, he says; citations take a long time to accumulate, and people may not cite a paper even if it influences their thinking. So he added the number of views to the CV entry. And he did not stop there.

Next to many of the papers listed, Pettifer added labels indicating scholarly and public engagement. The labels were generated by ImpactStory in Carrboro, North Carolina, one of several services that gauges research impact using a combination of metrics — in this case, a wide range of data sources, including the number of times a paper has been shared on social-media websites or saved using online research tools.

When Pettifer submitted his annotated CV for the first round of promotion review, his mentor expressed confusion. He took a look and said, "What the hell are these badges doing in your CV?" recalls Pettifer. "But once I explained them, he said, 'Well, give it a go.'" Pettifer submitted his CV for the second round — and got his promotion. He does not know for sure whether the metrics helped, but he plans to use them on future grant applications. "I'm definitely a convert," he says.

OUTSIDE THE BOX

'Altmetrics', a term coined in 2010 by ImpactStory co-founder Jason Priem, refers to a range of measures of research impact that go beyond citations. Several altmetrics services have ▶

emerged in the past few years (see 'Four ways to score'). They produce reports that gauge impact by taking into account not just academic citations, but also digital use and sharing of data — which can include the number of times a paper has been tweeted, 'liked' on Facebook, covered by the media or blogs, downloaded, cited on Wikipedia or bookmarked online. Some services also evaluate research products such as software, data sets and slideshows by tracking the number of people who have used or viewed the product online (see *Nature* **500,** 243–245; 2013).

Altmetrics offer researchers a way to showcase the impact of papers that have not yet gathered many citations, and to demonstrate engagement with the public. They can be accessed through journals or independent websites, and can track the impact of particular data sets or papers, or evaluate the combined influence of publications and products produced by multiple researchers in a department.

JOHN T. LATHAM

"It hit the right note at the right time."
Steve Pettifer

But these services must be used wisely. They are not meant for strict quantitative comparisons; nor do they always distinguish between positive and negative attention. And although scientists can include altmetrics in job and grant applications and annual reports, they must select relevant data and clearly explain the context to avoid provoking mistrust or confusion.

Some altmetrics services generate profiles that summarize the impact of a researcher's products. ImpactStory allows scientists to import lists of items such as papers and software from existing user profiles at websites such as Google Scholar, which automatically tracks a researcher's papers, or the online software-code repository GitHub. Scientists can also manually enter the digital object identifiers (DOIs) of their papers, or input their Open Researcher and Contributor ID (ORCID), a unique identifier that can be used to tag all of a researcher's work. ImpactStory then creates a profile showing how frequently each product has been viewed, saved, discussed, cited or recommended online.

Other services take a more article-centric approach. Altmetric in London allows users to access data on individual papers using a bookmarklet — a browser bookmark that executes JavaScript commands. (Altmetric is funded partly by Digital Science, a sister company to Nature Publishing Group.) Users install the bookmarklet in their Internet browsers; then, when they come across a paper that they are interested in, they click the bookmarklet button. A report pops up in the corner of the browser, providing altmetrics that include a score indicating how much online attention the paper has received. The score takes into account the number of people who have read or mentioned the article, as well as the relative importance of the medium and the mentioner. Newspaper coverage is weighted more heavily than tweets, and tweets by individuals more heavily than those by journals promoting their content.

Many journals display some altmetrics on their sites automatically; these might be generated in-house or provided by an external service. Every article published by PLOS, for example, includes an online metrics tab showing data such as views, downloads and social-media mentions. A feature called Article-Level Metrics Reports lets users search for PLOS papers by criteria such as author or keyword, and generates a summary metrics report for the set of results, including article usage by paper age and maps of authors' locations. Several journal publishers, including Nature Publishing Group in London and Cell Press in Cambridge, Massachusetts, display data from Altmetric on their sites, and John Wiley & Sons in Hoboken, New Jersey, began a trial with the metrics firm in May. HighWire Press, an electronic-publishing platform at Stanford University in Palo Alto, California, is collaborating with ImpactStory to add altmetrics to its journal websites.

Altmetrics enable scientists to see ripples generated by their research that might otherwise go unnoticed. Individual researchers can try to track buzz on their own, but data-aggregation and updating services make it much easier. These services also automate difficult tasks, such as finding all tweets that link to a particular paper; each article will have multiple URLs, so conducting such a search manually would be very time-consuming.

The reports can even suggest potential collaborators or journals. For example, if an informatics paper is mentioned a lot by biologists, the author might consider publishing his or her next article in a biology journal to increase exposure, says Heather Piwowar, co-founder of ImpactStory.

MEASURES OF CAUTION

Despite the benefits, researchers and evaluators must interpret altmetrics data cautiously. Data sets might not be comprehensive: not all services detect news stories that do not give URLs for the study, for example. The popularity of social-media sites changes over time, so it is unrealistic to expect a paper published in 2008 to generate as many tweets as one published in 2013. And some disciplines, such as computational biology, are more active than others on social media, so comparisons between disciplines may be unfair.

To get the most meaningful information, users should dig into the underlying data. Although a paper's Altmetric score can suggest whether it is worth clicking through to the more detailed report, "qualitative assessment is far more important than the number", says Euan Adie, founder of Altmetric.

To help users to interpret the data, most services put numbers in context. ImpactStory normalizes data by publication year and includes percentiles — it might, for example, note that a given paper has more readers on the online reference manager Mendeley than 97% of papers indexed that year. Altmetric shows results normalized by journal, which allows fairer comparison of papers in discipline-specific publications. And in May, PLOS began offering Relative Metrics, a service that lets users see how a paper compares to other PLOS articles in the same subject area, using tools such as graphs of article views.

Including altmetrics in decisions on grants, hiring and tenure requires careful consideration. Gerald Rubin, executive director of the Howard Hughes Medical Institute's Janelia Farm Research Campus in Ashburn, Virginia, is sceptical of altmetrics that do not explicitly indicate quality, such as number of tweets. He

FOUR WAYS TO SCORE
A quartet of services offers free metrics reports that go beyond citations.

	ImpactStory	Altmetric	PLOS Article-Level Metrics	Plum Analytics
Products tracked	Papers, software, data sets and more	Papers, data sets, some books	Papers published by the Public Library of Science (PLOS)	Papers, books, patents and more
What you get	Profile page, metrics badges, application programming interface (API; a means for software to access the altmetrics)	Bookmarklet, metrics badges, API	Summary reports, WordPress widget, API	Profile page (currently in testing), API
Publishers	Various, including eLife, Pensoft Publishers, PeerJ	Include Nature Publishing Group, Cell Press, BioMed Central	PLOS	Medwave (forthcoming this year)
Major funders	Alfred P. Sloan Foundation	Digital Science	PLOS, Alfred P. Sloan Foundation	Self-funded

adds that altmetrics suffer from one of the same flaws as citation counts: a mediocre paper in a popular field will receive more attention than a first-rate paper in a small field. And including altmetrics in a job application? "At this point, I don't think anyone would pay attention," says Rubin, who looks at many applications.

But some people do pay attention. Scientists are permitted to use altmetrics to demonstrate social impact in reports for the Research Excellence Framework (REF), an evaluation of UK academia that influences funding, notes Graeme Rosenberg, REF manager at the Higher Education Funding Council for England in Bristol. Plum Analytics, an altmetrics company based in Dresher, Pennsylvania, and Seattle, Washington, this year completed a pilot project with the University of Pittsburgh in Pennsylvania, in which it generated altmetrics profiles for a subset of researchers that could be aggregated by department. The next step is to roll out altmetrics profiles for the entire institution, says company co-founder Andrea Michalek. Plum is also currently running projects with about ten other institutions.

Rubin is better disposed towards altmetrics that suggest a positive value judgement, such as the number of requests to use software. In that vein, Adie suggests that rather than simply reporting numbers, researchers should use altmetrics to find success stories that they can mention in their CVs or on their websites. The data might reveal that a non-governmental organization or a government department took notice of a paper, for example. Altmetric plans soon to start flagging up citations by agencies such as the World Health Organization and the Intergovernmental Panel on Climate Change, both based in Geneva, Switzerland.

Context such as percentile ranks or explanations of data sources can help evaluators to interpret altmetrics. In Pettifer's CV, he included a legend for his ImpactStory labels, listing some of the data sources, such as Mendeley, Twitter and Wikipedia. Piwowar suggests that researchers who worry that evaluators will view altmetrics negatively could start by including the data in annual performance reviews, which are lower-risk than grant or job applications.

Some think that altmetrics will soon become a normal part of a CV. It used to be that researchers who wanted to demonstrate the importance of a recently published article could only say, "Look, I really believe this is great research," notes Mike Thelwall, an information scientist at the University of Wolverhampton, UK. Now, he adds, "you can back up your words with a little evidence". ■

Roberta Kwok *is a freelance science writer in Seattle, Washington.*

TURNING POINT
Jason Weber

Breast-cancer researcher Jason Weber of Washington University in St. Louis, Missouri, is struggling to maintain funding. As a mid-career researcher, he is part of the demographic in greatest jeopardy in the wake of US research-funding cuts (see Nature ***498****, 527–538; 2013). In May, he wrote an opinion piece about his plight in the* St. Louis Post-Dispatch*, which caught the attention of a US Senator.*

How did you end up studying breast cancer?
As a postdoc at St. Jude Children's Research Hospital in Memphis, Tennessee, I worked at the cutting edge of cell-cycle regulation, and my team discovered a key tumour suppressor. In 2001, I was hired to work in the then-new molecular-oncology division at Washington University in St. Louis, where researchers were mixing genomics with cancer biology and making the translational jump to the clinic. Breast cancer was an area where we could make a big impact clinically.

Did it take you long to get your footing in that competitive field?
It took a couple of years. The big break came in 2002, when I was named a Pew Scholar. The Pew Charitable Trusts, headquartered in Washington DC, provide generous funding and convene scholars to collaborate and exchange ideas at an annual meeting. So I was interacting with a diverse group of Pew scholars, which helped me and my lab members to think outside the box and explore new techniques. We started going in many different directions — which led to an influx of money between 2007 and 2008.

In what ways does your lab's situation now differ from what it was five years ago?
Back then, we had more than US$1.1 million in project funding from various sources: Susan G. Komen for the Cure, the American Cancer Society, two R01 grants from the US National Institutes of Health (NIH), and a Department of Defense Era of Hope grant. I had 17 people in the lab. But my NIH funding recently ran out and did not get renewed. I currently have a $100,000 grant from a children's foundation, and four people in the lab.

How has the US government's budget sequestration directly affected your lab?
The sequester adds to the burden in terms of what gets funded in the grant-review process. Essentially, an R01 grant application to the US National Cancer Institute has to be in the top 6–8% to get funded. Yet there is little difference between a grant scoring in the top 5% and one in the top 15% — it becomes arbitrary. My greatest fear is that by trimming the fat, we're starting to hit muscle. Labs with 10 to 15 people who are doing solid work are getting the squeeze now.

Why did you write your opinion piece on the impact of funding cuts?
I just got fed up. None of my non-science friends had any idea how bad the cuts were. I wrote it after I laid off one of my best young scientists, and two of my PhD students switched career paths after they graduated because of concerns about funding. I didn't write a 'woe is me' piece; I wrote a 'the public needs to better understand how these cuts actually affect the economy' piece. It led to conversations with Senator Dick Durbin (Democrat, Illinois). His staff called me to discuss the impacts of the sequester and the economic downturn on science funding. I got the sense that he is on our side at a time when it is difficult to find a congressional representative who is carrying the banner of scientific research in this country.

What is your outlook like now?
Bleak. It is frustrating to be stuck in front of the computer writing grants, instead of in the lab doing and guiding experiments. I have seven grant applications out right now, and I am writing three more.

What is most frustrating to you?
Every politician says that to have a great economy, we need a well-educated workforce. Yet although the government has the ability to maintain the highest level of that educated workforce, it chooses to slash science funding through the sequester. It makes no sense to train people with PhDs and then not fund them. Scientists need to speak up. ■

BY VIRGINIA GEWIN