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EDITORIAL

Are all paper citations equal?

A couple of years ago my colleague (and former PhD student) Jan Anne Annema told me that he checked why people cited our paper on experiences with the use of Cost–Benefit Analysis (CBA) in the Netherlands (Annema, Koopmans, & Van Wee, 2007). Several citations only used the paper to underpin the claim that in the Netherlands CBAs were carried out for large transport infrastructure projects. Such references did not relate at all to the core of the paper on the experiences with the actual use of CBA in the Netherlands. Nevertheless, citations play an important role in several scientific output metrics.

Over the last decade, there has been a lively debate on measuring scientific output via metrics (see, for example, Salimi (2017) for an overview of literature and a proposal for a method to integrate metrics). One of the debates has been over the pros and cons of publishing in journals (see, for example, the editorial of Ken Button in *Transport Reviews*, published in 2015 – Button, 2015). Discussions are manifold, ranging from manipulating impact factors (Chorus & Waltman, 2016), to the importance of journal papers relative to other output. See Hicks, Wouters, Waltman, De Rijcke, and Rafols (2015) for a discussion on metrics and how to improve the use of metrics.

One of the basic rationales for metrics has been that they provide the means to measure the research performance of academics. What does, for example, an H-index tell us, or the impact factor of journals in which academics publish? How important is the number of publications academics have published so far, in absolute terms, as well as relative to the "quality" of those publications? And how to measure this quality? In these debates citations often play an important role, because citations are generally assumed to be an indicator for impact of a paper.

But what do citations really tell us? Why do people cite papers? Inspired by the remark of Jan Anne Annema I decided to do such a check myself. I selected two papers with a clear message. The first is "Peak car: The first signs of a shift towards ICT-based activities replacing travel? A discussion paper" (Van Wee, 2015). The paper hypothesises "that the recent trend amongst young people to be less car-oriented than previous generations could be assign of a transition towards more ICT-based activity patterns and accessibility" (p. 1). I consider citations to be most valuable if they would cite the paper for this message, the transition hypothesis. A little less valuable are citations to the paper because of the more general conclusion that information and communication technologies (ICT) do impact travel behaviour, followed by citations to "only" address the phenomenon of "peak car" or car ownership levels. The second paper is: "Self-selection: A key to a better understanding of location choices, travel behaviour and transport externalities" (Van Wee, 2009). This paper has two clear messages: (1) people can self-select in more ways than with respect to residential location only, and (2) "insights into self-selection processes might significantly improve our knowledge on location choices, travel behaviour and transport externalities" (p. 209). In addition, it discusses methodologies to study self-selection processes and impacts. I consider citations to one of the two messages and methodologies to be the most valuable citations, followed by citations that refer to the paper to refer to residential self-selection. Other citations are considered to be the least valuable. The middle category is about equally relevant as citations to the peak car paper if they

only address the phenomenon of "peak car". If papers cited the paper for multiple of these four and three reasons, I scored them in the "most valuable" category.

The peak car paper received 45 citations in SCOPUS (as at 16th January 2020). Two papers were included twice in SCOPUS, so I counted them only once. Of the 44 citations through my institutional account (TU Delft, the Netherlands), I could find all papers but 5. Table 1 presents the results for the remaining 39.

The self-selection paper received 107 SCOPUS citations (as at 21st January 2020). I analysed all citations from 2016 onwards (58) to make the analyses comparable to the peak car paper, at least with respect to the period of citing the papers. One paper was included twice (journal paper and conference version) and I only included it once. Three papers could not be assessed through my institutions account. Table 2 shows the results.

Table 1 shows that only about a quarter of the citations to the peak car paper address the core message of the paper. Also, a quarter cites the paper to "only" refer to the concept of peak car. Almost half of the citations address the impact of ICT on travel behaviour. One could argue that these citations are not about the core message of the paper, but they consider the paper to be more about the impact of ICT on travel behaviour. And from the perspective of the papers citing my paper, it makes complete sense to cite the paper for that reason. So, one could argue that only a quarter of the citations relate to the core message, but a more tolerant interpretation is that about two-thirds of the citations relate to the core topic (not the core message) of the paper.

Table 2 shows that 30% of the citations to the self-selection paper relate to the core message and the added value of the paper, and about 60% "only" to address the phenomenon of residential self-selection. The remaining 9% are for other reasons.

I do not want to suggest that it is not OK to cite the peak car paper to only address the phenomenon of peak car, or the self-selection paper to only address residential self-selection. But if I had never written either paper, it would have been very easy for authors to find replacement papers to refer to the phenomena of peak car or residential self-selection. Therefore, I would argue that the impact of such citations probably reflects a less relevant contribution to science than citations to the core message of the paper. To formulate this in a more general way: I argue that not all citations are equally valuable. Citations referring to the core messages or findings of a paper are more valuable than other reasons to cite a paper.

My aim is not to downplay the importance of citations. I think citations to a paper are a good indicator for the impact of a paper. But it is important to realise that not all citations address the core of a paper, and if they do not, such citations are less useful for measuring the impact of a paper.

What does this mean for the role citations should play in the evaluation of academics, for example for the promotion from assistant to associate, or from associate to full professor? Provided that the relative share of references to the core of a paper, relative to other references, would be roughly constant over a larger number of papers written by authors in the same field, citations do measure the (relative) impact of authors. Such analyses should be field specific,

Table 1. Reasons to cite the peak car paper.

	Absolute number of citations	Per cent
Core of the paper	9	23
Impact of ICT on travel behaviour	18	46
Peak car/car ownership	9	23
Other reasons	3	8
Total	39	100

Table 2. Reasons to cite the self-selection paper.

	Absolute number of citations	Per cent
Core of the paper	16	30
Residential self-selection	33	61
Other	5	9
Total	54	100

because of the huge heterogeneity of citation cultures across fields of research (Boyack, van Eck, Colavizza, & Waltman, 2018). However, if these shares would vary substantially, then citations are a less useful indicator for that purpose. To the best of my knowledge, we do not know to what extent the share of "core citations" differs between authors. It is probably a considerable task to measure this, because the person scoring citations should know the content of the paper very well, so that the relative importance of citations can be scored. If so, I would not recommend following this path. The point I want to make clear is that not all citations are equally relevant. But on the other hand, machine learning methods can be used to score the value of citations automatically, and if so, this is a challenging avenue for future research in the area of metrics used in evaluation of papers, authors, and journals. Such methods can also include research area specific normalisation addressing differences in citation cultures across areas, and correct for evolutions in citation cultures over time, including the quite recent tendency to include more references in journal papers. If such research were to show that a large majority of citations are less valuable, this would challenge the importance of citation-based metrics.

For *Transport Reviews* the position of literature review paper is particularly relevant. Sometimes people only cite these papers in ways like: "for further information we refer to [reference] who review the literature on [topic]". Of course, it is OK to do this, but the reference is not very informative. References referring to the core of the added value of a literature review papers (gaps in literature, strengths and weaknesses of methods used, conceptualizations, … , see Van Wee & Banister, 2016) are way more informative. If most references to literature review papers would be of the first type, the impact factor of journals that publish many literature review papers exaggerates the importance of the journal, in the latter case, this certainly does not imply. Such references are – in my opinion – extremely valuable.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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