*Pro*Ac: Profiling, instead of ranking, academics

1 Project summary

Today, an academic career strongly depends on the peer-reviewed publication productivity and its impact. Both are meant to be reflected in one single number: the *h-index* (Hirsch, 2005). This number supposedly ranks all scientists, in both their early and late career, from *normal* to *outstanding*, in *worse* and *better*. The number in itself is debatable (e.g., Hirsch, 2020; Yong, 2014), especially from an interdisciplinary perspective, as the number of citations significantly differ between individual disciplines without being a result of scientific greatness, but rather of the variation in the overall number of studies being published within the different disciplines (Anauati et al., 2016; Bornmann & Daniel, 2008). Yet, it is this one-dimensional ranking system that appears to be the sharp blade between being funded and rejected. As a result, it sows unnecessary competition between peers, unhealthy publishing pressure, and thereby increases the number of publications and decreases their quality: One high-quality study is graded less than two of them in low-quality. Moreover, past achievement is presently the key to jobs and funding (e.g., Hirsch, 2020): a huge setback for both young motivated academics and novel ideas.

An employer does not necessarily want the most productive person to work in her project, she wants the best-suited one for the project. A funding agency does not necessarily want to fund the most-productive person, they want to fund the person that is best-suited for making the proposed project a success. Science is not a competition between scientists, it is teamwork towards a common goal.

***ProAc* proposes therefore to develop and apply a novel profiling of academics that is based on not one, but multiple, insightful indices that allow to profile, rather than just rank, academics.**

The ***ProAc profile*** will be developed using both existing and novel academic indices (e.g., with the *h-index* included as part of it) and made accessible via an effective graphical representation. To circumvent the initial difficulty to gain access to individual academic data, the ***ProAc open-access toolbox*** will allow all academics to create their own profile.

A broad use of the *ProAc profile* will have a significant impact on academia as a whole, as is outlined in the following three hypotheses.

Hypothesis 1: Academic profiling will enhance research quality instead of quantity. Removing the obvious pressure to increase the *h-index* as swiftly as possible will enhance the quality of individual studies (e.g., by allowing for more creative approaches) and reduce the quantity of low-quality studies.

Hypothesis 2: Academic profiling will allow to build more effective research teams. Individual academics should, in the optimal case, complement each other in their skill set to build an effective team for a given project. A team built on the academic profiles of its individual members, rather than on the basis of the *h-index* only (e.g., Batista et al., 2006), is more likely to achieve this goal.

Hypothesis 3: Academic profiling will reduce the psychological pressure on academics. Removing the one-dimensional grading of academics against each other will significantly reduce the mental stress and, with it, misbehaviour of individuals in academia (e.g., Gálvez, 2017; Van Noorden, 2020).

DOI: 10.5281/zenodo.4899016

2 Project plan

2.1 State of the art and novelty

The *h-index* (Hirsch index; Hirsch, 2005), is a so-called author-level metric. It attempts to represent two things: one is the academic productivity, the other is the citation impact of the publications produced (Glänzel, 2006). The *h-index* is applied throughout academia also for research groups (e.g., van Raan, 2006), facilities (e.g., Kinney, 2007), and countries (e.g., Csajbók et al., 2007), and considered in job offering, proposal funding, and even medal awarding to the degree that an academic career might be impossible without achieving a 'high' *h-index* (e.g., Hirsch, 2020).

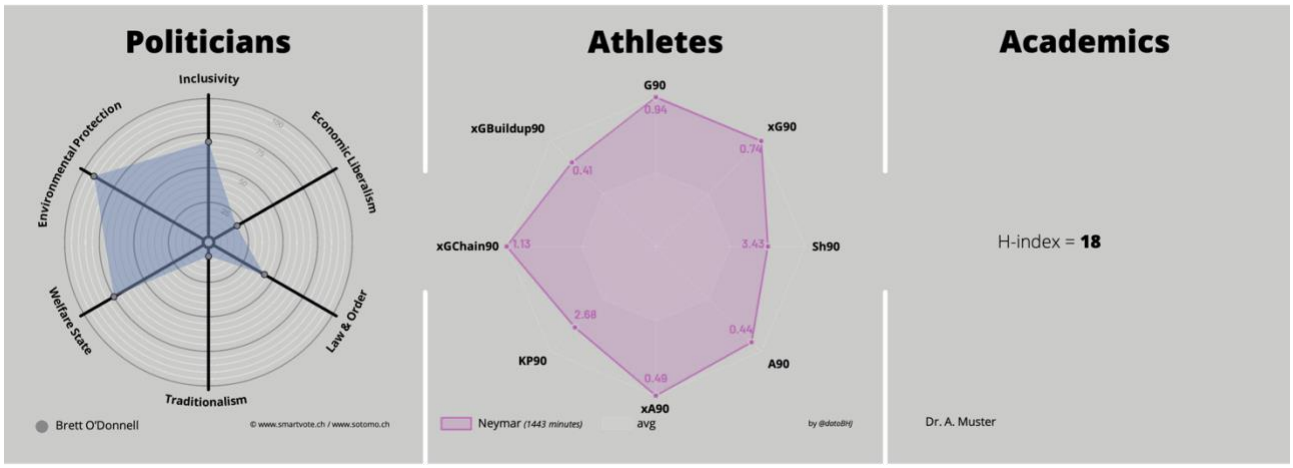

***Figure 1**: Smart profiles (e.g., **www.smartvote.ch**) are applied to a variety of professional disciplines, like politics (e.g., https://australia.smartvote.org/en/home) and sports (e.g., **https://twitter.com/DatoBHJ**) to characterise professionals and build working teams, while academia still grades individuals against each other based on their past achievements using one (imperfect) number only.*

The h-index, while certainly useful in some respects (e.g., measuring the quantity of scientist's publications), is currently facing fundamental criticism, in parts by its inventor himself (Hirsch, 2020), even for the two sole purposes (i.e., measuring productivity and impact) it aims to fulfil. Some shortcomings are listed below.

- The typical number of citations in different fields is not considered, even though the citation behaviour between fields and subdisciplines vary significantly (Anauati et al., 2016; Bornmann & Daniel, 2008).
- The author contribution to one publication is ignored, even though it can vary significantly between a single-authored contribution and a minimal contribution to a peers work (Sekercioglu, 2008).
- The discriminatory power is reduced due to the index being a natural number only that does not interpolate between h and h+1 (Ruane & Tol, 2008), which is particularly problematic for early-career researchers.
- Self-citations are not excluded, which therefore leaves the h-index vulnerable to manipulation (Bartneck & Kokkelmans, 2011; Ferrara & Romero, 2013; Gálvez, 2017).
- Coercive citations (i.e., self-interest citation suggestions of editors, but also reviewers) are not prevented but attracted (Van Noorden, 2020; Wilhite & Fong, 2012).
- The significance of the impact measure compared to simpler measures, like the total number of citations, is questionable (Yong, 2014).

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For these critical reasons and others, a multitude of adjustments to the h-index (e.g., *h(2)*, *hg*, h_l, $h_{first\ author}$, h_m, h_{mol}, h_{ms}, h_s, *hw*, *Contemporary h*, *Raw h*, *Tapered h*, *Weighted h*) and also alternative metrics (e.g., *A*, *AR*, *f*, *g*, *IQp*, *Maxprod*, *m*, *Pi*, q^2, *R*, *Specific impact*, *t*, *Wohlin*, *Wu*) have been proposed and partly applied throughout the research community (e.g., Anderson et al., 2008; Batista et al., 2006; Bornmann et al., 2011; Sidiropoulos et al., 2007). One widely known example is the *i10 index* (Connor, 2011) providing a measure for the number of publications of an academic that reached ten or more citations. Most of the many proposals (i.e., at least 37 alternatives) have been shown to be highly correlated with the original h-index and are therefore largely redundant (Bornmann et al., 2011, and references therein). Moreover, all suggested alternatives above are single-number metrics.

Indeed, until today, all these alternative suggestions are built on the assumption that they need to enable a one-dimensional ranking system, for which assigning individuals to a single number is the easiest way of achieving it. However, there is no need for just providing one single measure only to grade academics against each other. In fact, a one-dimensional grading system might even be a disadvantage (see Section 1). ***ProAc therefore proposes the novel approach to profile academics based on their various important skills and achievements rather than grading them based on one single quantity***.

Novelty and ambition

A multi-index academic profile - instead of a single-metric grade - based on, and better representing, multiple academic skills and achievements.

By collecting pre-existing measures (like the h-index) and developing new ones to effectively characterise individual academics based on a multi-measure profile, I propose a novel way to profile, instead of grading, academics.

2.2 Project description

Objectives

1. Compile and develop various single indices to contribute to an informative profile
2. Build first version of an academic profile based on the combination of multiple measures
3. Develop an effective graphical representation of the academic profile

To achieve the outlined objectives, ***ProAc*** will be carried out over the duration of one year (if fully funded) in home office or at a potential host institution that provides the necessary infrastructure and access to software and a large diverse pool of academics. The key project milestones (development; testing; representation; promotion) outlined below will provide clear guidelines and track the progress each quartal during the project (Figure 2).

A) Develop the *ProAc profile*

Existing metrics, like the *h-index* and others mentioned in Section 2.1, will be evaluated and, if suitable, added to the *ProAc profile*. Such metrics are readily available and fully described in, for example, peer-reviewed publications (see Bornmann et al., 2011, table 1). In addition, **novel metrics** will be developed that complement existing ones and extend the representative character of the *ProAc profile*.

Important academic skills and achievements that will be aimed to cover with the *ProAc profile* include, but are not limited to (some of which are already used as standalone metrics): *Current productivity* (i.e., academic productivity

 DOI: 10.5281/zenodo.4899016

during the last few years); *Past productivity* (i.e., academic productivity during the entire career); *Current impact* (i.e., impact during the last few years); *Past impact* (i.e., impact during the entire career); *Collaborations*; *Interdisciplinarity*; *Independency*; *Leading authorship*; *Co-authorship*; *Supervision*; *Public outreach*; *Teaching*.

In addition, the *ProAc profile* aims to: *be fair to early-career researchers* (e.g., by introducing a comparable early-career index for both early-career and senior researchers); *be fair across disciplines* (e.g., by comparing indices relative to peers/disciplines); *represent multi-disciplinary efforts*; *separately measure recent* (few past years) *activity only*; *consider non-publication academic efforts* (e.g., tool development and outreach activities); *normalize publication impact based on journal impact factor upon publication* (reducing pressure to publish in high-impact journals); *account for the number of supporters/collaborators on individual studies* (provides natural feedback fostering less undeserved co-authors); *provide non-competitive measures* (and reduce overall competition)

Some of these goals will be achieved more easily than others, and some of them will necessitate further digitised individual data made available. It will, however, be possible to start developing a profile that incorporates many of the above points solely by adding and combining additional measures to the presently available data. Some of the proposed measures are: *Number of self-citations by journal, by author, and by co-author*; *Median Number of co-authors per publication over all publications*; *Median citations per publication*; *Efficiency and relevance factors*: number of citations per paper per year on average (median) for publications older than a year.

♦ Milestone **A**: *Compiled suite of pre-existing and novel individual metrics*

Expected outcome: A suite of pre-existing and novel individual metrics to form the *ProAc profile*.

Risks and mitigation strategies: As with current measures, the major risk remains that the given measure misrepresent its purpose or experience unwanted side effects. However, combining multiple measures to a profile will mitigate some of these individual shortcomings as the individual importance of a measure is reduced. Necessary profile data might not be readily available to an automated web-scraping software, but providing the *ProAc open-access toolbox* (see Section 2.2 D) would circumvent that problem by allowing individual academics to create their *ProAc profile* themselves. This approach would, in fact, additionally grant access to a much wider (not automatically accessible) range of personal academic metrics and data.

B) Test and improve the *ProAc profile*

A **diverse test group of individual academics with known characteristics** will be built. I will build the test group upon peers across different scientific disciplines that are known to myself (and hence characterizable). The test group members' individual data will then be collected via an **automated web-data scraping tool** retrieving available data from resources like *Google scholar*, *Web of Science*, *Orcid*, and *Research gate*. The scraping tool will be customised for its particular purpose, but various pre-built options are openly and readily accessible (e.g., Else, 2018; Kreibich, 2017); these tools will therefore not need to be built from scratch. Such tools allow to automatically retrieve information like publication title, author list, journal, number of citations, works referencing the publication, excerpt of their content.

After building the *ProAc test group*, I will **empirically diagnose the validity of each metric** for the underlying skill or achievement and its robustness across the individuals of the test group. Personal feedback from individual group members about the representative character of both the single metrics and the complete *ProAc profile* will also be considered. Multiple iterations between testing and improving will be performed for each individual metric to achieve a first, representative version of the *ProAc profile*.

DOI: 10.5281/zenodo.4899016

Expected outcome: Multiple, well tested and robust metrics to build the first version of the *ProAc profile*.

- Milestone **B**: *A first suite of individual, well tested indices forming the ProAc profile*

Risks and mitigation strategies: The test group might be biased towards some academic disciplines, skills or achievements even though I will build it based on diversity. The *ProAc profile* would, beyond the project time frame, certainly undergo further evaluation when applied to a larger pool of academics via well-known citation databases. To allow for potential subsequent improvements, the *ProAc profile* will be versioned. The automated scraping tool might not supply all test data needed to build the *ProAc profile*, in which case the data will be retrieved by hand, which is less time-efficient, but certainly possible.

C) Represent the *ProAc profile* graphically

A **visually effective and content-expressive graphical representation** of the academic profile will be developed. I will not limit myself to, but draw inspiration from, similar graphical representations of professional profiles (e.g., ***www.smartvote.ch***; see Figure 1) that were developed to characterise politicians and other professionals outside academia. This will provide a novel but proven and convenient view on individual academics and, more specifically, their skills and achievements.

The first graphical interface will be developed in *MatLab* (due to the more time-efficient development). The final version 1.0 will eventually be provided via a fully open-access programming language (e.g., Python) and outlined in detail to be reproducible with other programming languages and software tools.

Expected outcome: An identifiable, comparable and effective graphical representation for the *ProAc profile*.

- Milestone **C**: *A graphical representation of the ProAc profile.*

Risks and mitigation strategies: Creating an effective visual representation of an academic profile from scratch might be too challenging in the assigned time period during the project. The graphical representation can, however, strongly lean on existing examples applied throughout other professions (e.g., Figure 1).

D) Promote the *ProAc profile*

To promote a wide application of the *ProAc profile*, it will be **introduced in an international, peer-reviewed publication** and promoted via effective scientific outreach (e.g., press-release, social media posts, online blog posts). Access and application to academic databases (*Google scholar*; *Web of Science*; *Research gate*; *Orcid*) will be sought.

The individually adjustable *ProAc open-access toolbox* will be developed and accompanied by a user instruction to reproduce a personalised *ProAc profile*. The first version of the toolbox will be provided as a standalone *MatLab* application, which will ensure open-accessibility and usability (without the need for a *MatLab* licence or installation; after ***https://ch.mathworks.com/help/compiler/standalone-applications.html***) and a graphically unified representation of the individually-created *ProAc profiles*. While *MatLab* provides the most time-efficient programming solution for myself (e.g., for graphics and debugging), the open-access programming language *Python* will be considered in the later stages of the project to provide a more convenient and adjustable *ProAc* toolbox to the end-users.

DOI: *10.5281/zenodo.4899016*

Expected outcome: International, peer-reviewed publication and *ProAc open-access toolbox*.

♦ Milestone **D**: *Submitted peer-reviewed publication introducing ProAc profile and open-access toolbox.*

Risks and mitigation strategies: Full access to the necessary data (or databases, like *Google scholar*) to ensure a wide application of the *ProAc profile* might not be granted during the project period. The *ProAc open-access toolbox* allows, however, to avoid this limitation by enabling individual academics to create their own individual *ProAc profiles* for the time being. Effective scientific outreach via different channels (peer-reviewed publication; scientific meeting presentations; social media posts) will increase the chance that the *ProAc profile* will be widely recognised and considered useful.

Work plan

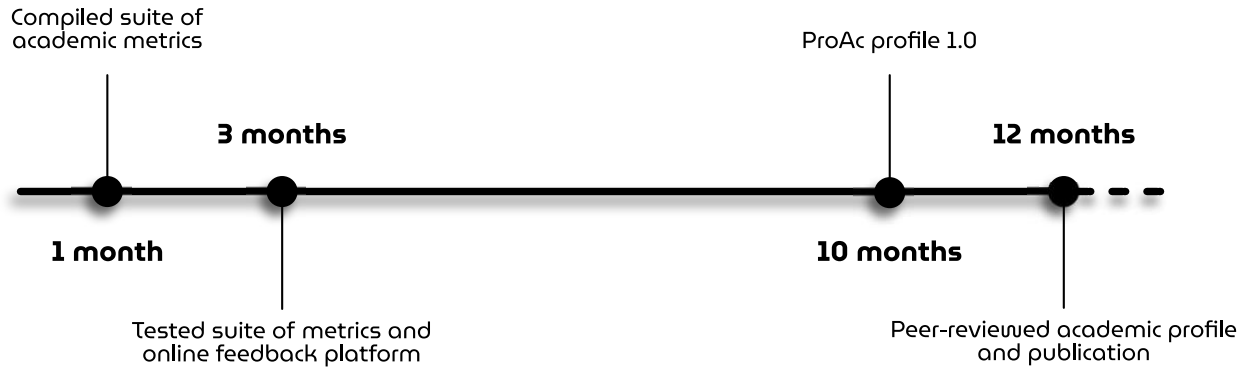

Figure 2: *The* ***ProAc*** *work plan over 12 months including the four working packages,* ***ProAc profile*** *development, testing, representation, and promotion, and their individual milestones to track progress during the project duration*.

2.3 Potential impact of the proposed research

Profiling, instead of ranking, academics will encourage collaboration instead of competition, boost quality-science instead of quantity-science, and promote novel ideas by early-career researchers through more effective distribution of research funds. It will allow research to build up on everyone's strength and encourage individual academics to improve their academic weaknesses.

The *ProAc profile* will reflect the skills and achievements of academics fairer, more thoroughly, and in a less competitive manner than the presently applied h-index. Such an improvement will foster more creative and higher-quality research, while decreasing the unhealthy mental pressure on academics.

The *ProAc project* will definitely spark discussions and possibly even some changes to a more sensible profile of academics. Additional steps might be fostered towards registering more aspects of an academic's efforts, like outreach (e.g., interviews, public talks, blog posts, artwork, etc.), toolbox development (e.g., software or hardware), organisational efforts, or teaching. This would allow to expand the academic profiling suggested here significantly.

Thank you, for contributing!

Fabio

DOI: 10.5281/zenodo.4899016

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DOI: 10.5281/zenodo.4899016