

Matthew Effects in Open Science and RRI^{*,**}

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Abstract. Success in research and innovation should primarily build and depend on merit, on clarity of thought, innovation of ideas, and integrity of processes. While the state-of-play of the current scientific system is far removed from this ideal, open science and responsible research innovation hold the promise to change this for the better. ON-MERRIT (Observing and Negating Matthew Effects in Responsible Research & Innovation Transition) investigates whether the transition to open science and responsible research innovation might actually worsen existing inequalities. To this end, the multidisciplinary team uses qualitative and computational methods to examine effects of cumulative (dis)advantages and eventually suggest a set of evidence-based recommendations for science policies, indicators and incentives. This talk introduces ON-MERRIT's rationale and aims in greater depth, as well as presenting initial results and discussing further steps.

Keywords: Open Science, Responsible Research Innovation, Matthew effect.

1 Introducing ON-MERRIT

Merit, clarity of thought, innovation of ideas and integrity of processes should be the building blocks of success in research and innovation. However, there is a vast body of literature which suggests that other factors also play a considerable role. External factors like personal characteristics, prior reputation or levels of resources continue to have a substantial impact on researchers' careers. Responsible Research and Innovation (RRI), and especially Open Science (including Open Access to publications and research data), public participation, and gender equality, hold the promise to make scientific endeavours more inclusive, participatory, understandable, accessible and re-usable for large audiences, especially beyond the ivory towers of universities and research institutions.

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It remains an open question whether this potential for the RRI agenda can be realised. Making processes open does not per se drive wide re-use or participation unless also accompanied by the capacity (in terms of knowledge, skills, technological readiness and motivation) to do so. Absorptive capacity and ability to capitalize on knowledge resources vary considerably across institutions, businesses and populations. Such differences are further intensified by other factors like geographic location, language abilities, technological skills, educational levels and access to basic equipment (e.g., Internet access). Those in possession of such capacities benefit from an advantage, with the effect that RRI's agenda of inclusivity is put at risk by conditions of "cumulative advantage" (the so-called "Matthew effect" [1]).

ON-MERRIT is a 30-month project funded by the European Commission to investigate how and if open and responsible research practices could worsen existing inequalities.

2 Aims: Building an Equitable Scientific System

To deliver on this goal, ON-MERRIT aims at broadening our knowledge base in three key respects: (1) Through an analysis of beneficiaries and dynamics we strive to unveil how current policy interventions might actually drive new inequalities or exacerbate old ones. (2) By synthesizing this evidence, we will provide a comprehensive portfolio of information, enabling conclusions about the persistence of Matthew effects in RRI to be drawn across domains and for different stakeholder groups. (3) Based on this new evidence-base and synthesis, we will analyse gaps and blind-spots in current RRI implementation guidelines and measures (i.e., MoRRI indicators [2]) and make policy recommendations for their future enhancement, extension or revision applicable to a range of stakeholders.

These questions are directed towards examining barriers, drivers and incentives for RRI practices for all four stakeholder-groups in the "quadruple-helix" model of innovation [3]: research, industry, policy and society.

In our research, we try to balance broad investigation of the state of RRI in general with deep analysis, where research focuses in on the *gender dimension* as well as three specific scientific domains, chosen for their tangible relevance for the achievement of the UN's sustainable development goals: *Agriculture*, *Climate*, and *Health*.

3 Initial Results: Literature Reviews and Datasets

Wrapping up the first project phase, we have published several literature reviews and collected valuable data. For our research on Matthew effects in academia, we selected a representative sample of academic institutions from Europe, America (north and south) and Asia. Based on this sample, we gathered data from Microsoft Academic Graph [4], as well as data on the universities' promotion, review and tenure policies (PRT-policies). Our report "D3.1 RRI and Open Science Datasets" [5] describes the rationale for collecting this data, the indicators selected and the methodology we will use in the analysis to uncover effects of cumulative advantage within

academia. Preliminary investigations suggest that PRT-policies rarely contain any reference to open access or open data.

For our investigation of the uptake of (open) science resources in industry, we carried out a semi-systematic review of the literature. Opening up scientific resources (via open access or open data) might spur economic growth, but are economic actors actually using open science resources? Our results suggest that scientific resources are currently used only by companies in certain R&D-heavy fields and open science outputs play a somewhat peripheral role [6]. We identified two main barriers to an increased uptake: a) a perceived lack of relevance of scientific outputs for innovation in many sectors and b) a lack of information seeking skills among employees.

Complementing the analysis of academia and industry, we also reviewed the literature on how policy-makers gather relevant information and what role open science outputs might play in this domain. We found that the research literature describes researchers and policy-makers as living in different and frequently incompatible worlds [7]. Uptake of basic research (i.e. academic publications) is rather low; policy-makers rely more heavily on their networks, which don't necessarily include academics, and accessing scientific outputs is not their main concern.

4 Road Ahead

In the remaining months, we will assemble further evidence to increase our understanding of cumulative advantages in the transition to open science. We enter the hot phase of active research by conducting surveys and expert workshops on the uptake of open science resources among policymakers and industrial actors, as well as the efficacy of RRI training initiatives. We will further explore our datasets on PRT-policies and academic papers by a combination of exploratory and confirmatory research.

References

- [1] R. K. Merton, "The Matthew Effect in Science: The reward and communication systems of science are considered," *Science*, vol. 159, no. 3810, pp. 56–63, Jan. 1968, doi: 10.1126/science.159.3810.56.
- [2] MoRRI project, "The evolution of Responsible Research and Innovation in Europe: The MoRRI indicators report," D4.3, Feb. 2018. Accessed: Nov. 20, 2019. [Online]. Available: https://www.technopolis-group.com/wp-content/uploads/2018/02/D4.3_Revised_20022018_clean.pdf.
- [3] E. G. Carayannis and D. F. J. Campbell, "'Mode 3' and 'Quadruple Helix': toward a 21st century fractal innovation ecosystem," *Int. J. Technol. Manag.*, vol. 46, no. 3/4, p. 201, 2009, doi: 10.1504/IJTM.2009.023374.
- [4] A. Sinha, Z. Shen, Y. Song, H. Ma, D. Eide, and K. Wang, "An Overview of Microsoft Academic Service (MAS) and Applications," May 2015, Accessed: Aug. 11, 2020. [Online]. Available: <https://www.microsoft.com/en-us/research/publication/an-overview-of-microsoft-academic-service-mas-and-applications-2/>.

- [5] N. Pontika *et al.*, “ON-MERRIT D3.1 RRI and Open Science Datasets,” May 2020, doi: 10.5281/zenodo.3874587.
- [6] A. Fessler, T. Klebel, and T. Ross-Hellauer, “ON-MERRIT D4.1 Information Seeking Behaviour and Open Science Uptake in Industry: A Literature Review,” May 2020, doi: 10.5281/zenodo.3875018.
- [7] S. Reichmann, B. Wieser, and T. Ross-Hellauer, “ON-MERRIT D5.1 Scoping Report: Open Science Outputs in Policy-Making and Public Participation,” May 2020, doi: 10.5281/zenodo.3875055.