

Appendix: The Performative Efficacy of the Grand Challenges Discourse

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The article “The Grand Challenges Discourse: Transforming Identity Work in Science and Science Policy” focused on how the GC discourse evolved historically, how it disseminated in science policy contexts, and how it was picked up by individual scientists and scientific communities. The hypothesis put forward against this background was that the GC label has the potential to transform the identity work of scientists and policymakers. Furthermore, the assumption was made that there is a performative dimension in the GC discourse, implying that the discourse not only affects the identity work of actors in the field, but also their actual behavior. In other words, and regarding the sportification of science described in the conclusion, a not yet answered question is whether, to what degree and how exactly scientists and policymakers act according to the logic of sports and competition that comes with the GC discourse. For reasons of space, the article had to stop at the descriptive level, leaving the analysis of performative effects open for future studies. However, it is possible to at least point to some empirical observations that indicate performative effects at different levels, and that have informed the arguments presented so far. This appendix brings together three examples of how the GC discourse changes not only self-descriptions, but also actual programs, structures, and practices in three different communication contexts: (1) science policy, (2) higher education, and (3) scientific journals. As these cases have not been analyzed systematically and empirically, more research is needed to corroborate the assumption of the performative efficacy of the GC discourse.

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Appendix 1: Grand Challenges and Science Policy

In 2009, the Obama administration issued their *Strategy for American Innovation*, which proposed to “harness science and technology to address the ‘grand challenges’ of the 21st century” (White House 2009: 22). In the following years, two updated versions of this report were published (White House 2011; 2015). During that time, the strategy evolved from simple to-do lists to a new and ambitious policy tool (Hicks 2016: 31-34). Between 2013 and the end of the Obama administration in January 2017, the Office of Science and Technology Policy (OSTP) displayed on its Website both a definition and a set of “grand challenges” that were funded by diverse US government institutions, such as the National Institutes of Health (NIH), the Defense Advanced Research Projects Agency (DARPA), the National Science Foundation (NSF), the Department of Education (DOE), the National Aeronautics and Space Administration (NASA), and the US Agency for International Development (USAID). Those funding programs aimed at transforming the identity work of scientists and engineers, particularly in regard to collaborative research (“all hands on deck”). Furthermore, the Obama administration’s GC programs put high value on research fields that promised major impact on society and the economy. However, to assess the structural relevance of the GC discourse in US federal science policy, one would have to examine more systematically whether the administration actually shifted their focus away from more traditional funding schemes.

On the other side of the Atlantic, the GC discourse has become a crucial element in EU science policy. After 2000, the term “societal challenges” appeared occasionally in documents of the European Commission, but it is not until 2008 that an expert group prominently used the GC idea as the main rationale for the *European Research Area* (EC 2008). Shortly after, in the so-called *Lund Declaration* (2009: 40), a wide coalition of stakeholders and representatives from science policy, industry, and research organizations proposed that “European research must focus on the Grand Challenges of our time moving beyond current rigid thematic approaches.” In 2011, the European Commission launched its eighth framework program for research and innovation under the name *Horizon 2020*. What distinguishes this program from its predecessors is that it defines “tackling societal challenges” as a third priority alongside the traditional goals of “generating excellent science” and “fostering industrial leadership” (EC 2011: 7). From a total budget of 77 billion euros, 29.7 billion have been dedicated to this new rationale (EC 2013). Given these numbers, there is no doubt that the EU commission does influence to some degree what kind of collaborative research is possible and rewarding in the European Research Area. However, for the Commission, the GC discourse is only one strategy among others in the STI policy game. The prestigious European Research Council (ERC), which is devoted solely to “excellence,” and, ultimately, to what used to be called basic research, can be interpreted as an institution counterbalancing the performative effects of

the GC discourse. The way funding is (re-)distributed in the next framework program will be a first indicator of whether the GC discourse continues its triumphant success at the supranational level.

To summarize, several observers today perceive the GC discourse as a “consolidated trend in science policy” (De Grandis and Efstathiou 2016). As a consequence, and compared to the other two contexts presented in the next two subsections, the science policy context is exhaustively discussed in the literature (see, particularly, Kallerud et al. 2013; Kuhlmann and Rip 2014; Hicks 2016; Ulnicane 2016). This secondary literature so far mostly focuses on US federal and EU supranational science policy programs. The GC concept, however, is also used by international organizations such as the OECD (2010, 2012), as well as in various national contexts beyond the West, such as China and India (Hoareau McGrath et al. 2014). Furthermore, the GC discourse is not restricted to science policy in the narrow sense of national and supranational governance. There are different kinds of GC initiatives by non-governmental actors. A prominent example that has occasionally been mentioned in this article and that is very well documented in the secondary literature is the *Grand Challenges in Global Health* initiative (Enserink 2003; Varmus et al. 2003; Matthews and Ho 2008; Brooks et al. 2009; Verma 2009; Hicks 2016: 27–29). Other important instantiations of the GC discourse are to be found in engineering and scientific societies (NAE 2008; Royal Society 2011), which have been influential in terms of public visibility, but have not received much attention in the secondary literature (see, however, Cech 2012; Hicks 2016: 30).

Appendix 2: Grand Challenges and Higher Education

In 2007, Princeton University established a *Grand Challenges Program* that focuses on the issues of climate and energy, development, and health. A glossy pamphlet asks the reader to “imagine a world in which the brightest minds work together to solve humanity’s most pressing environmental problems, a transformative world that expands classroom learning beyond traditional academic and national boundaries” (Princeton University 2011). In 2008, University College London launched the *UCL Grand Challenges* initiative to bring together expertise “from across UCL and beyond [...] to address the world’s key problems.” Four such challenges are specified: global health, sustainable cities, intercultural interaction, and human wellbeing. Following the president of UCL, the program “has become fundamental to our mission” and enables to draw “leading researchers” and “talented students” to UCL (cited in UCL 2012: 1). In the meantime, many comparable programs have been launched at prestigious universities, particularly in the United States (e.g., University of California, LA; University of Colorado, Boulder; Georgia Tech; University of Minnesota; Indiana University), Great Britain (e.g., University of Exeter; Newcastle University), and Australia (e.g., University of Melbourne). A particularly radical approach has been proposed by Michael Crow, president of

Arizona State University, who aims to achieve a comprehensive reconceptualization of research and teaching “to seek solutions to the grand challenges associated with sustainability,” the result of which will be the “New American University” (Crow 2010: 489; see also Crow and Dabars 2015).

Another way in which the GC discourse crystallizes in academia is via scholarship programs. Against the background of the “Grand Challenges for Engineering” report (NAE 2008) and the 2013 “Global Grand Challenges Summit” in London, sponsored by the Royal Academy of Engineering (UK), the National Academy of Engineering (US) and the Chinese Academy of Engineering, eight US engineering schools cooperated to organize the joint *Vest Scholarship Program* and further summit meetings. The goal of the program is to give select international graduate students “the opportunity to pursue world-changing ideas at top U.S. universities” (NAE 2013).

These examples demonstrate that the GC discourse is not restricted to research policy, but also gains relevance in global higher education policy. If this trend continues, and particularly, if the GC discourse in the long run should actually transform the curricula in at least some of the leading research universities, then we can assume strong effects regarding the identity work of both undergraduate and graduate students. It is at the university that the identity of young people is shaped and challenged. If early career scientists are socialized in interdisciplinary contexts, dealing with the grand challenges of our societies, then their future research trajectories may be different from those embedded in traditional disciplinary venues. However, there are also critical voices analyzing the GC discourse as a “new higher education ideology” (Vostal et al. 2011: 64). This critique argues for the humanist university tradition which may help “questioning the very premises behind the grand challenges” (Vostal et al. 2011: 76).

Appendix 3: Grand Challenges and Scientific Publications

So far, the examples indicate the GC discourse’s relevance in regard to science policy and higher education. What is still open is the question whether the discourse also impacts scientific communication and research practices, and thus what Nowotny et al. (2001) call the “epistemological core of science.” Again, in absence of empirical studies dealing with this question, we can only point to specific developments that may indicate such impacts. A first clue is the changing environment for scientific publications (Lawrence 2003; Franzen 2012). As publishing is crucial for every scientist to stay in the game, the assumption lies at hand that if journals expect scientists to address grand challenges in their research, this may significantly influence problem choice and research trajectories.

One telling case involves a series of editorials in the *Academy of Management Journal* (AMJ) between 2011 and 2014 in which the editors explain to potential authors how to publish in AMJ. They begin with the criterion of “significance” and propose the selection of a research topic that “confronts

or contributes to a grand challenge” (Colquitt and George 2011: 432). The editors also address “Non-US authors” and suggest that such authors can realize a particular benefit from working on grand challenges because they help “shift an overt emphasis on country context to a more interesting theoretical question or problem-oriented framing” (George 2012: 1024). Furthermore, the editors point to the importance of pursuing bold ideas: “Not all our studies understandably will be grand, nor will they all challenge conventional wisdom, but considering the relative importance and scale of a problem will likely make a study more relevant to managers, and make it more interesting for our readers” (George 2014: 2).

Beyond such examples at the micro level of journals’ publishing strategies, it is conspicuous that several prominent new journals are no longer organized around specific research fields or disciplines; instead, they focus on challenges such as climate change (e.g., *Nature Climate Change*, issued October 2010) or energy security (e.g., *Nature Energy*, issued January 2016). Other new journals are even more ambitious: The self-stated objective of *Elementa: Science of the Anthropocene* (launched 2013) is that of accelerating scientific solutions to the challenges presented by our new era (UCP 2016). Following this invitation, eminent scientists explain to the reader which grand environmental challenges have to be solved by 2050 to avoid the possible collapse of civilization as we know it (Barnosky et al. 2016: 3). It is not likely that this kind of apocalyptic rhetoric will become common sense in scientific communication, but if we see this case in the light of the other examples, we can summarize that the GC discourse actually impacts communication strategies of journals, editors, and scientists. Even if in many cases the effect is primarily a reframing of research agendas in terms of “grand challenges,” this reframing may in the long run transform our ideas of what it means to be a scientist and how to cooperate with others in regard to the grand challenges we promised to tackle.

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