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## Is it possible to give scientific solutions to Grand Challenges? On the idea of grand challenges for life science research



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### ABSTRACT

This paper argues that challenges that are grand in scope such as “lifelong health and wellbeing”, “climate action”, or “food security” cannot be addressed through scientific research only. Indeed scientific research could inhibit addressing such challenges if scientific analysis constrains the multiple possible understandings of these challenges into already available scientific categories and concepts without translating between these and everyday concerns. This argument builds on work in philosophy of science and race to postulate a process through which non-scientific notions become part of science. My aim is to make this process available to scrutiny: what I call *founding* everyday ideas in science is both culturally and epistemologically conditioned. Founding transforms a common idea into one or more scientifically relevant ones, which can be articulated into descriptively thicker and evaluatively deflated terms and enable operationalisation and measurement. The risk of founding however is that it can invisibilise or exclude from realms of scientific scrutiny interpretations that are deemed irrelevant, uninteresting or nonsensical in the domain in question—but which may remain salient for addressing grand-in-scope challenges. The paper considers concepts of “wellbeing” in development economics versus in gerontology to illustrate this process.

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### 1. Introduction

*If the function of writing is to “express the world.” My father withheld child support, forcing my mother to live with her parents, my brother and I to be raised together in a small room. Grandfather called them niggers. I can’t afford an automobile. Far across the calm bay stood a complex of long yellow buildings, a prison. A line is the distance between.*

From Ron Silliman’s “Albany”, *ABC*, Tuumba Press: Berkeley, 1983

“Lifelong health and wellbeing”, “climate action”, or “food security” are some examples of so-called “grand challenges” which are posed for multi-sector, multi-disciplinary research including the life and health sciences. Funding schemes addressing “grand”, “societal”, or “big” challenges indeed emerged initially in the

biological and health sciences. The Bill and Melinda Gates Foundation (BMGF) Challenges for Global Health is one of the first institutional instances of research oriented around the trope of “grand challenges”, set up in 2000, and inspired in part by the United Nations Millennium Development Goals.

What was envisioned to be a 21st century of biology<sup>1</sup> came with new mandates for research and policy agendas to begin to orient themselves towards addressing grand and societal challenges ([Lund Declaration, 2009](#)): scientists are now increasingly expected to both do excellent science and to ensure that their work achieves “the

<sup>1</sup> Cf. for instance “The Century of Biology” by [Venter and Cohen \(2004\)](#) written in 1997, [Wake’s \(2008\)](#) discussion of integrative biology as integrating knowledge from social science and humanities and [Dyson Freeman \(2007\)](#) imagining the 21st century as domesticating biotechnology to the extent that we have domesticated physics-based computer technology. These, like other millennial visions, are provocative and speculative but they acknowledge that biological research and innovation raise issues that beg for philosophical, ethical and societal deliberation.

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**Table 1**  
Selected formulations of “grand challenges” as presented by research funding bodies.

Bill and Melinda Gates Foundation Grand Challenges for global health <sup>a</sup>	Research Councils UK Big Research Challenges <sup>b</sup>	EU Horizon 2020 Societal Challenges <sup>c</sup>
<ol style="list-style-type: none"> <li>1. Create effective single dose vaccines that can be used soon after birth</li> <li>2. Prepare vaccines that do not require refrigeration</li> <li>3. Develop needle-free delivery systems</li> <li>4. Devise reliable tests in model systems to evaluate live attenuated vaccines</li> <li>5. Solve how to design antigens for effective, protective immunity</li> <li>6. Learn which immunological responses provide protective immunity</li> <li>7. Develop a biological strategy to deplete or incapacitate a disease-transmitting insect population</li> <li>8. Develop a chemical strategy to deplete or incapacitate a disease-transmitting insect population</li> <li>9. Create a full range of optimal, bioavailable nutrients in a single staple plant species</li> <li>10. Discover drugs and delivery systems that minimize the likelihood of drug resistant micro-organisms</li> <li>11. Create therapies that can cure latent infection</li> <li>12. Create immunological methods that can cure chronic infections</li> <li>13. Develop technologies that permit quantitative assessment of population health status</li> <li>14. Develop technologies that allow assessment of multiple conditions and pathogens at point-of-care</li> <li>15. Discover biomarkers of health and disease</li> <li>16. Discover new ways to achieve healthy birth, growth, and development</li> </ol>	<ol style="list-style-type: none"> <li>1. Digital economy</li> <li>2. Energy</li> <li>3. Global food security</li> <li>4. Global uncertainties; security for all in a changing world</li> <li>5. Living with environmental change (LWEC)</li> <li>6. Lifelong health and wellbeing</li> </ol>	<ol style="list-style-type: none"> <li>1. Health, demographic change and wellbeing</li> <li>2. Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the Bioeconomy</li> <li>3. Secure, clean and efficient energy</li> <li>4. Smart, green and integrated transport</li> <li>5. Climate action, environment, resource efficiency and raw materials</li> <li>6. Europe in a changing world—inclusive, innovative and reflective societies</li> <li>7. Secure societies—protecting freedom and security of Europe and its citizens</li> </ol>

<sup>a</sup> <http://www.grandchallenges.org/Pages/BrowseByGoal.aspx>. Last accessed: 10.06.15.

<sup>b</sup> <http://www.rcuk.ac.uk/research/xrcprogrammes/>. Last accessed: 10.06.15.

<sup>c</sup> <http://ec.europa.eu/programmes/horizon2020/en/h2020-section/societal-challenges>. Last accessed: 10.06.15.

right” impacts (Stilgoe, Owen, & Macnaghten, 2013; von Shomberg, 2013; Owen et al., 2013; European Commission, 2011). Currently both the European Union’s 7-year funding scheme, Horizon 2020, and the Research Councils of the UK cross-council research areas have adopted challenge-based funding schemes (cf. Table 1). Correspondingly these policies are setting a trend in academic research: a *Google Scholar* search for the phrase “grand challenges” in the title of articles returns 1130 results, with half of these published since 2010 and 80% of these since 2000 (06.07.2015).

In this context of increasing orientation towards addressing societal challenges, also through scientific work, this paper offers an argument for why scientific research alone cannot provide full solutions to grand challenges. This conclusion may sound trivial. After all, current research policies consider grand challenges to be in need of multi-disciplinary and multi-sector, including non-scientific, expertise. Policy-relevant problems are understood to be “wicked”, resisting full, certain and permanent solutions, while it is fully recognised that societal values have and should have key roles in guiding policy-relevant science (cf. Kincaid, Dupre, & Wylie, 2007; Rittel & Webber, 1973). Concerted study and effort are increasingly put into developing interdisciplinary work and institutional models to reflect on socially relevant choices made during scientific and technological innovation (Crow & Dabars, 2015; van den Hoven, Doorn, Swierstra, Koops, & Romijn, 2014; Frodeman et al., 2010; Klein, 2010).

However, this paper argues that scientific research can be distracting when coming to address some of the problems referred to as “grand challenges”. I distinguish between two uses of the trope of “grand challenges”: first, to refer to challenges that are of great difficulty but that may be characterised as technical goals, and second to refer to challenges that are also grand in their scope and that involve societal stakeholders and successful uptake of innovation. I point out that some of the ideas used to express the latter could have different meaning for policy makers formulating research calls and for scientists addressing them. The paper opens up to scrutiny what I think is a process whereby some everyday concepts that are used to express broad research aims can become concepts that can guide scientific measurement and research. I

propose that challenges that are grand in their scope cannot be addressed scientifically unless key everyday ideas used to express them can get *founded* into scientific contexts. Founded concepts develop from everyday concepts that get fitted to what is deemed relevant and rigorous within a particular scientific domain and epistemic culture. However, founded concepts will (at best) only address particular aspects of a grand-in-scope challenge. In order to illustrate this thesis, I examine concepts of “wellbeing” that might help to tackle grand challenges such as global and lifelong health and wellbeing, scientifically, and point out that they can leave out of the picture relevant aspects of being well.<sup>2</sup> Articulating these gaps between everyday ideas and founded concepts is one way to evidence that extra, transdisciplinary work needs to complement scientific expertise and methods when tackling a societal challenge.

*Is it possible to give scientific solutions to ‘grand’ challenges?* In short, my answer is *No*—scientific work alone cannot solve grand challenges and it could be distracting. This answer is based on three main premises pursued in different sections of the paper. Section 2 argues that we can distinguish two uses for the trope of “grand challenges”, one to specify grand-in-difficulty challenges, and a second to specify grand-in-scope challenges. Challenges that are great in their scope cut across different domains of expertise and both expert and lay domains. These challenges are often expressed using thick everyday concepts: for example, ‘wellbeing’, ‘security’, ‘health’. Section 3 proposes that social and natural science can address problems expressed in everyday ideas but only by *founding* everyday ideas into scientific contexts and transfiguring these into scientific, founded concepts which may be operationalized into relevant constructs. Section 4 argues that founded concepts are not ordinary and that they vary across scientific disciplines using the example of concepts of wellbeing. Given these premises, it follows that existing scientific work alone cannot solve challenges of a

<sup>2</sup> I use the terms “concept”, “notion” and “idea” interchangeably. I use no quotes to refer to things, single quotes to refer to ‘concepts’ and double quotes to specify “words”.

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