

Emerging investigators: challenges and opportunities for research independence and innovation

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Juana Maria Delgado-Saborit, Hee-Deung Park & David M. Cwierny

Title: Emerging Investigators: Challenges and opportunities for research independence and innovation

It's truly an honor to serve as guest editors for the Environmental Science: Processes & Impacts (ES:P&I) emerging investigators (EI) issue, which is now in its third installment. Since the debut issue in ES:P&I's predecessor Journal of Environmental Monitoring in 2010, the goal for the EI issue has been to highlight the best and brightest of early career scientists in the fields of environmental science and environmental engineering. We're delighted to say that the issue has always met this mark, increasing the visibility of the research programs of tomorrow's innovators. So, while this issue is certainly an opportunity to look forward at the promising future of our field through the work of its brightest rising stars, it is also a good time to look back and briefly reflect on where past contributors are now. Today, they include research leaders at universities and national laboratories around the globe. Thus, on the occasion of the third installment, we invite you to take a moment and revisit the prior EI themed issues, which contain original research articles and critical reviews that place among the most accessed and heavily cited works in recent years for ES:P&I.

We would be remiss to not first acknowledge the sustained efforts of ES:P&I in promoting early career investigators. On behalf of the growing and vibrant community of early career investigators, we would like to commend their commitment to building the profile of scientists that are the future of our discipline. It is this next generation of research leaders that will build upon the foundations established by early pioneers of environmental science and engineering, while also confronting the daunting trials posed by the current landscape of our natural resources.

In this EI themed issue, we are proud to present the work from 19 emerging investigators – defined as those within 10 years of earning their doctorate – which represent among the most talented early career scholars currently working in the fields of environmental science and environmental engineering. This is a diverse group, representing 4 continents around the globe. Moreover, their scientific contributions, both in the forms of critical reviews and original research reports, reflect the rapidly expanding and evolving field of environmental science and engineering. In addition to cutting edge air and water quality research, there are also works devoted to the energy–water nexus and life cycle analysis, environmental nanotechnology, sensing technologies and advanced treatment approaches that may one day lead to sustainable water supplies. We hope you'll enjoy the collection of work in this EI themed issue, which we believe provides an exciting glimpse of the future.

Now, more than ever, environmental scientists and engineers are needed to address grand environmental challenges including adaptations to and approaches that mitigate climate change, and achieving water and energy sustainability to serve a burgeoning global population. The scope of these challenges transcends generations, and as such, early career scientists must now carry the torch of the research leaders that came before them. Yet, as if the stark reality and looming consequences of these challenges were not sobering enough, it is easy to conclude that we are living among the most difficult times in recent memory for early career scientists. Indeed, the obstacles and pressures to develop and establish an independent, impactful research program have never been greater. The global financial crisis has bitten all compartments of our society, and research and development is no exception. In the United States, for example, funding trends for fundamental research remain stagnant or in decline, stymied in recent years by sequestration, budget battles between wings of a polarized government, and a vocal portion of an increasingly skeptical public that (mistakenly) questions the value of fundamental

research. Meanwhile, there are a growing number of researchers in an already near-saturated field, making it as competitive as ever to win support. It also must be noted that the cost to do so called transformative research, particularly at universities with increasing tuition prices, is consistently on the rise.

This climate is not limited to the US, as around the globe new researchers today not only face the traditional challenges that confronted their mentors but also have to battle harder to obtain invaluable, albeit often times meager, funding on their path toward independence. Nevertheless, the expectations for a “successful” researcher (metrics including but not limited to publications, invited presentations, awards and other research recognition, degrees awarded to students, and granted patents) only seem to be on the rise. This conflict between resources and expectations for young scientists is adversely impacting the professional careers of many talented researchers that fail to establish their independent research groups, forcing them to choose alternative career pathways, or move elsewhere to seek advancement. In fact, this “brain drain” is heavily impacting some economies such as Greece, or Spain. Moreover, the limited resources for helping new investigators to establish independent programs is hindering the emergence of new research ideas and stifling the innovation and creativity that younger generations can bring to solve current and future societal problems.

Fortunately, more help may be on the way. For example, the European Research Council (ERC) has recognized this problem and launched the Starting and Consolidator Grants aimed at funding excellent research proposals from talented new researchers. They also acknowledge the different career stages of post-doctoral researchers and have split the call between Starting Grants¹ (2–7 years postdoctoral experience) and Consolidator Grants² (7–12 years) to enable those promising very early researchers to flourish as independent scientists. Similar initiatives are being discussed in the United States, although for other disciplines. The US National Research Council of the National Academies has published the report “Bridges to Independence. Fostering the independence of new investigators in biomedical research”.³ It advocates the establishment of a research program targeted at new researchers to prepare the next generation of research leaders. It would combine training in essential skills to succeed as an independent researcher, such as lab and project management, grant writing and mentoring; with a series of career transition research grants. These would consist of individual awards and training grants that will allow new researchers to start planning, executing and managing their own research ideas in the laboratory of an identified senior academic, who would act as a mentor. Clearly, this model would work well in most disciplines, including environmental science and engineering, so long as there is commitment from the necessary parties to turn the vision into reality.

Creation of new initiatives and continued investment in existing programs (e.g., the US National Science Foundation's early career award and ERC Starting Grants) that target early career scientists are the best bet to curbing this “brain drain” and restoring innovation. Increased and sustained support will ensure that young, promising research talent is successfully harnessed into independent research careers rather than wasted via losses to other sectors or disciplines. Our society needs the talent, innovation and creative ideas that new researchers can bring. Let's prioritize those opportunities that enable new researchers to leave their mark on society, as the researchers in this and previous EI issues are well on their way to doing already.

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