

composition and amino-acid sequence of the virus's proteins (Mueller *et al.*, 2010).

They exploit the redundancy of the genetic code; 64 codons code for just 20 amino acids. As most amino acids are coded for by several codons, it is possible to introduce single-nucleotide changes without altering which proteins are expressed, thereby retaining all antigens that might generate an adaptive immune response. Crucially, however, this alters the expression of some genes, which reduces the ability of the virus to replicate. As Wimmer pointed out, the effect of each nucleotide change on virus activity is very small, but the cumulative impact of hundreds of such changes causes strong attenuation. "We call this 'death by a thousand cuts'," he said.

Moreover, subsequent natural mutations will probably change only one or two of these nucleotide substitutions back to the original, so the chance that the virus will regain its former virulence is very small. The greatest advantage of this approach, however, is speed. "Clearly, such recoded genomes can only be produced by chemical synthesis," said Wimmer. "They can be designed rapidly—much faster than any other live vaccine that was isolated after long trials of selection." This, argues Wimmer, makes the approach ideal for countering emerging pandemics when time is short, especially those caused by influenza. Indeed, Wimmer has demonstrated his approach by designing an influenza vaccine (Mueller *et al.*, 2010).

Even if this synthetic approach can generate new vaccine candidates more quickly, it will still require development time and

clinical trials to assess their efficacy and safety—as is the case for other emerging techniques. New knowledge and new technologies are filtering through to vaccine development; while the disappointments of the past have provided valuable lessons.

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## Power to the scientists

New grant schemes are providing more support for young scientists at the start of their careers as independent researchers

*Howard Wolinsky*

**M**aria Pia Cosma, whose research focuses on reprogramming stem cells, could have spent her entire career at the Telethon Institute of Genetics and Medicine in Naples, Italy—a nonprofit institute focused on researching human diseases. Instead, Cosma, 40, discovered a brave new world for early-career scientists when she was awarded a €1.6 million, five-year Starting

Independent Researcher Grant from the European Research Council (ERC; Brussels, Belgium). The offers came rolling in. She was stunned as Telethon offered her a substantial pay increase; the Universities of Dundee and Oxford, the Centre for Genomic Regulation (CRG) in Barcelona, and the National University of Ireland in Galway all offered her positions; Dundee even offered her a Chair.

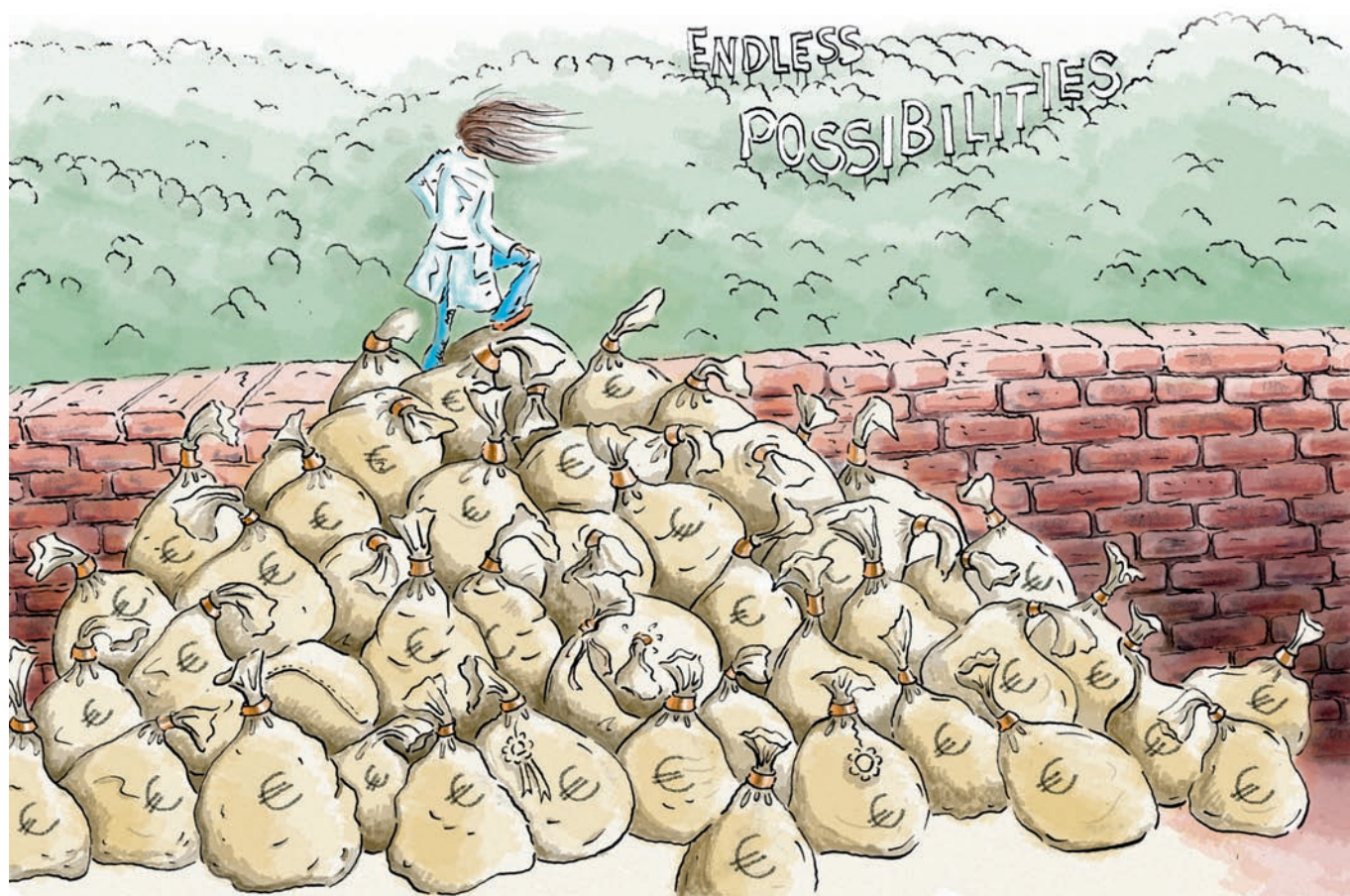
Ultimately, Cosma opted to join the CRG as a senior group leader. Announcing the appointment in March this year, the CGR noted that Cosma is one of the few women in a senior position in Spain's biomedical sector, and also proudly pointed out that: "With Cosma on board, the CRG becomes one of Spain's life science research centres to receive the most ERC grants."

ERC grants are changing the game as they offer greater freedom to young investigators, but the ERC is not alone in boosting the prospects of young scientists. Other major research funding organizations are also now recognizing the need to support researchers early in their careers.

**I**an Halliday, president of the European Science Foundation (ESF; Strasbourg, France), explained that this trend is part of broader reforms being made to the academic system in Europe, especially in Germany, France and parts of Eastern Europe. These are challenging what he referred to as the traditional "Herr Professor" system in which "the older generation was perhaps too much in control of everything". Halliday said that the ERC has brought a breath of fresh air with its strong emphasis on young investigators. "There is an empowerment of the younger people against the structures that have been in place for perhaps rather too long," he said. "It isn't just 'Let's give money to the young people', but it's part of a general shake-up of the whole system in Europe. There's an ongoing effort to change quite substantially the structure of universities and how they're governed and the rules and regulations that govern them and so on."

He commented that the research establishment in Germany, for example, has been unsure how to handle major funding for ERC grantees. "It turned out that many German universities in fact had no method for taking a lot of money being given to young people," he said. "It had never happened before so there is no structure for that happening; that a 30-year-old could end up having several million dollars."

Halliday has also noted the contrast between the UK and other countries, from his involvement over the past four years in reorganizing physics departments across eight Scottish universities. "I was struck when I sat down at a meeting which consisted entirely of [continental] Europeans. My question was: 'What are you all doing in Scotland?' And their answer to a person was the fantastic contrast with the British system: at the age



of 30 you can be your own person with your own grants, your own freedom, and your own academic intellectual freedom. In many of their countries, unless they were able to get something like a European Research Council grant, they would not have that freedom. It's part of that same kind of symptom about just how much freedom—intellectual, financial, whatever—you give to young people."

### ERC grants are changing the game, as they offer greater freedom to young investigators...

Helga Nowotny, President of the ERC, explained that her organization launched Starting Grants in 2007 to help young people gain scientific independence at a younger age. In Europe, she said, "There are still a lot of academic hierarchies, and many universities do not yet understand that you have to treat young people equally if they are good." At the same time, Nowotny said that European policy-makers are concerned about losing young researchers to the USA,

where 40,000 Europeans are now studying. She commented that although training at American laboratories is a good thing, policy-makers worry that scientists will not come back. "Part of the philosophy [with ERC Starting Grants] is to make working conditions at least as attractive as they are in the United States—in particular with regards to early scientific independence. That is one of the main attractions of the US."

Established in 2007, the ERC "aims to stimulate scientific excellence in Europe by supporting and encouraging the best creative scientists, scholars and engineers of any nationality in any field of research, to work in European host institutions." The ERC awards Advanced Grants for experienced researchers and Starting Grants for early-career investigators who are about to establish or consolidate their own research team in Europe. In the latest call, researchers were required to be between three and eight years post-PhD. Successful applicants receive up to €2 million per grant for up to five years.

So far, €621 million have been awarded to about 540 researchers in 2007 and 2009. Thirty-five per cent were in the life sciences, 45% in physical sciences/engineering, and 20% in social sciences and humanities. In the most recent round in 2009, 23% of the recipients were women and the average age was 36.

Initially, the ERC found that its Starting Grants tended to go to more established young people. To remedy this, from 2011 onwards the Council will have two schemes for young researchers. Nowotny explained that one will be for 'starters', 2–6 years post-PhD, who are just setting up their own labs; the other will be for 'consolidators' who already have research groups and are 6–12 years post-PhD.

Cosma, who started her own lab in 2003, said that the portability of the ERC Starting Grant changed her life. She had some offers before winning the Starting Grant, but "when the ERC awards were announced, I became an even stronger candidate. I was even more attractive to these universities."



The ERC is not the only funding agency supporting young scientists in their independence; others are following suit. Jack Dixon, chief scientific officer at Howard Hughes Medical Institute (HHMI; Chevy Chase, MD, USA), who directs the Institute's investigator programme, said that in late 2007 they began to move towards giving young researchers special support. "It was clear that the funding window at the National Institutes of Health was such that lots of young people were basically not getting their grants funded and they were spending an increased amount of time writing grants and re-writing grants and not spending time working in their labs and putting their labs together," he said.

**...European policy-makers are concerned about losing young researchers to the USA, where 40,000 Europeans are now studying**

Dixon added that a committee formed by the National Academy of Sciences (Washington, DC, USA), led by former HHMI President Thomas Cech, found that the average age of researchers receiving their first NIH grant was 42. "People like myself from the previous generation received our NIH grants when we were 28 or 30," he said. "Our point of view at the Hughes was if scientists were being funded at 40 rather than 30, this was taking a toll on the scientists' creativity and on our national productivity." In other words, the funding system meant that scientists were spending some of their most productive early years filling in forms and writing grants, rather than advancing research.

Discussions between Dixon, Cech, the HHMI's Medical Advisory Board and its trustees led to the 2009 launch of a programme designed to identify researchers 2–6 years after completing their postdocs. These 'Early Career Scientist' awards were limited to scientists holding an appointment as assistant professor or higher academic rank in a tenure-track faculty position at an eligible institution. The programme pays their full salaries and fringe benefits along with "a modest, but increasing amount of money for their labs. And it [gives] them an enormous amount of freedom," Dixon said. The recipients actually become HHMI employees during the term of their appointment. In March 2009, the HHMI named 50 Early Career Scientist award recipients from more than 2,000 applicants.

Dixon said the programme starts off with US \$150,000 for the lab in the first year and that HHMI will also cover other expenses, including research space and the purchase of critical equipment. "We hit a nerve in the sense that there was a major demand in the community for this kind of support," he said.

Unlike ERC grants, HHMI Early Career Scientist money is not portable. "We've taken just the opposite approach," Dixon explained. "We do not allow individuals to move within the first six years, and we think this is really the right thing to do in the sense that we are partnering with institutions. It would make no sense to make this a free-market arrangement to move to some other place because most likely your institution has made important contributions to your programme and hiring you."

Amy Wagers, 37, a tissue regeneration researcher at Harvard Medical School (Cambridge, MA, USA), said the HHMI money has helped her research network share career experiences and obtain advice from other young scientists, as well as from established HHMI scientists. Wagers, who started her own lab in 2004, said the inability to move funds elsewhere under the HHMI scheme is not a downside: "I like where I am. I'm not looking to move."

Elsewhere, the Wellcome Trust (UK) plans to launch a new funding scheme in October this year—Investigator Awards—that will focus on investigators rather than projects. Young researchers, along with more senior ones, will benefit from this philosophical change. Under the new scheme, researchers will be free to tackle research questions without having to focus on securing grants. Candace Hassall, Head of Basic Careers at the Trust, said that world-class researchers who are no more than five years from being appointed to their first academic position would be eligible for one form of the Wellcome Trust's Investigator Awards. According to the Trust's website, young researchers should "have the ability to innovate and drive advances in their field of study. They should be able to articulate a compelling long-term vision for their research and demonstrate the talent, track record and originality to achieve it."

"With the Investigator Awards we're going to be looking very closely at the quality of the candidates," Hassall said. "And on the basis of their track record, we will be less interested and less concerned by the small experimental details they plan on carrying out because

we'll be confident after we've considered their application in an interview that they'll know what needs to be done when the time comes." Researchers will be free to pursue whatever direction they find interesting within the framework of their award, she added.

The new grants will be up to about £425,000 a year for up to seven years. The new funding does not cover salaries because recipients will already have salaries from their host institutions. Instead, Hassall said the funding would support their research—team members, equipment, animals and collaborators—"basically whatever they need to carry out their research."

Like the grants from the ERC, the Wellcome Trust grants and fellowships are portable. "Obviously there is a process whereby the money has to be moved from one eligible institution to the other. We have to be assured that the research won't be harmed by the move," Hassall said.

**Giving young scientists more leeway and support to establish their own research teams is [...] mainly about making Europe more attractive to them**

Giving young scientists more leeway and support to establish their own research teams is not only about reversing the brain drain from Europe, it is mainly about making Europe more attractive. Hassall commented that the Wellcome Trust, for example, does not recognize the European 'brain drain' as being a serious issue because science is global. She added that the Trust actually encourages young researchers to move. "In our experience, what may look like brain drain at one point in an individual's career ends up being temporary. Very often we see people who move out of the UK for a period and then return later on when they're more senior," she said. "As long as they're doing great work that's having a big impact, it doesn't really matter where that's happening. We think it's important that young researchers gain experience in the best labs, no matter where they are, because that's the best way to train them to become the best scientists overall. We just need to ensure that Europe remains an attractive place for them to return to."

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