

Advancing the spark

A recent study on research creativity suggests it can be identified and encouraged. Above all, creativity occurs in small research groups within large, enabling institutions. Much can be achieved by trusting researchers with funding early in their careers.

The development of a new theory, method, tool or synthesis, or the observation of a new phenomenon can be considered a creative event. Unusually creative researchers and groups can be identified, since they are consistently nominated by their peers and funders, rewarded with prizes or both. Understanding how scientists become creative means that innovation can be fostered. At least, these are the principles of a recent survey of more than 400 nominations of highly creative research accomplishments by European and US scientists from the 1980s to 2004 in the fields of human genetics and nanoscience and nanotechnology. The survey, called CREA (<http://www.crea.server.de/>), covers five consecutive three-year periods up to 2004 and was sponsored by the European Union's (EU) New and Emerging Science and Technology program (NEST).

Five of the twenty creative events chosen for further study and interviews were from human genetics: the *in situ* localization of genes in interphase nuclei, the exploration of the mechanism of fragile X mutation, the first successful gene therapy trial, the discovery of human DNA repair syndromes and the elucidation of importin and exportin functions at the nuclear pore. Perhaps these innovations received the greatest recognition because they are useful discovery engines. The general finding can be replicated over and over in multiple specific and related instances.

CREA found that unusually creative researchers exceeded—in both citations and total publications—non-nominated contemporary researchers who had published a comparable output in the period prior to the creative event. One possible explanation for this might be that unusual creativity is more likely to happen when the right researcher encounters an unusually productive experimental system with the right tools and questions. Robert Kohler, author of *Lords of the Fly*, coined the analogy of 'a biological breeder reactor' to emphasize the parallels between the material culture of T.H. Morgan's fruit fly mutants and the research productivity the mutants enabled. Schemes that fund individuals, rather than

projects, may not help unless the individual is gifted at picking her system at the right time. And sometimes, before individuals can get creative, community resources must be created. On page 715 of this issue, Julian Dow and colleagues argue that new genomic resources extend the range of questions that can be tackled in the *Drosophila* system.

The researchers who were interviewed provide some of the most interesting comments. Funding bodies should provide "unrestricted and consistent funding", without insisting on "deliverables", reports and accountability. Scientists want responsive funding for unusual proposals. The CREA report recommends that 5% of the EU Framework funding be set aside for these. The set of institutions in which multiple creative events cluster is "not infinite". Thus, EU funding should not be derailed by the argument over centers of excellence versus equitable distribution; rather, institutions might be targeted for funding based on their current features that promote creativity and not just based on their track record.

Good organizational features promoting innovation included small research units in big institutions, non-hierarchical organization with independence for junior researchers and unplanned multidisciplinary contact within institutions. "Scientists should not be separated from teaching," but many researchers with industrial experience valued the professionalism of industrial research teams compared with students requiring training. The creative environment of the best industrial labs was, by one account, lost in the early 1990s. Acting as department head, being rewarded with a big research group or volunteering for national committee work were all identified as creativity killers.

One interviewee says we should "not lose paper journals for browsing; [they have] an effect on serendipity." With this in mind, perhaps it would now be timely to commission a complementary study: a systematic survey of scientific serendipity (4S) to see how highly creative researchers incorporate unexpected results into their work. ■