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Eleftherios P. Diamandis

Issues & Perspectives

## Perspective: Audacity is Overrated

A series of articles

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*Audacity is not the only route to scientific breakthroughs, and it's probably not the most important one.*

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([http://sciencecareers.sciencemag.org/career\\_magazine/previous\\_issues/articles/2009\\_11\\_06/credit.a0900139](http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2009_11_06/credit.a0900139)) in *Science Careers* has dealt with "audacity" as a driving force of scientific discovery. Since this interesting series was intended for young people pursuing a science career, I believe that an alternative or complementary view on the subject is warranted.

Anne Sasso, the author of the series, has interviewed a bunch of well-respected and established scientists, all of whom promoted audacity as a major vehicle for great scientific discoveries. Fair enough.

But I am not sure if the message conveyed -- be audacious if you want to make the next major breakthrough in science -- is the right one, especially for beginners. For one thing, the scientists interviewed are well established, with large laboratories and (I suspect) very good funding. It is easy for them to play the game of audacity from a secure position.

Being audacious at the beginning of your career -- as a graduate students or postdoctoral trainee -- can be a dangerous game, and very costly if you are lured by supervisors looking to build or expand their own fame by taking on risky projects to be performed by trainees. A premise in the articles, which I believe to be false, is that doing what these audacious scientists call "regular stuff" is a bad habit that promotes a false sense of security and makes you part of an undifferentiated crowd. One participant appears proud to accept only "gladiators" in his lab, people who fight for the big things -- but he admits that his students and postdocs may spend 3-5 years of their life on their projects and come up empty-handed. That is an important observation, one that scientists in training need to hear.

I'm surprised that none of these scientists noted that the point of graduate school and the postdoc is *not* to pursue a Nobel Prize. The optimal laboratory for young scientists is one that offers solid education and training in science and technique, teaches how to generate original ideas, promotes critical thinking and independence, provides opportunities to exercise creativity, and allows time to study the literature. Also important is training in professional skills, like how to write papers and grants and present their work at scientific meetings. The lab director must also provide good space, modern instrumentation, and sufficient funding so that students and postdocs are not resource-impaired.



(Comstock)

**Audacity in Science** ([http://sciencecareers.sciencemag.org/career\\_magazine/previous\\_issues/articles/2009\\_11\\_06/caredit.a0900139](http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2009_11_06/caredit.a0900139)) series index

The goal should be to produce highly skilled scientists by the end of their training, ready to take the next step of their careers. Not all of them will make the breakthroughs that seem to be the narrow focus of this series. But the skills gained during their training will allow them to pursue diverse careers. The best few will establish themselves and, if capable and lucky, make the next big breakthroughs in science.

The majority of students and postdocs I meet are ambitious. They dream of taking on big problems and making transformative discoveries. Tennis players want to play in the finals of Wimbledon, pianists want to play Carnegie Hall, and figure skaters want to land the triple Lutz-double-toe loop as soon as possible, preferably at the Olympic Games. But most, if not all, of them have to go through the painful years of preparation before they go on stage or center court. Those who are not ready may end-up with a broken neck. Their coaches will be at fault.

Another element misrepresented in the series is the implication that audacity is the only route to grand discoveries and paradigm-breaking science. Audacity is not the only route to scientific breakthroughs, and it's probably not the most important one. Most earth-shattering discoveries did not result from audaciously designed and executed experiments but are, rather, products of serendipity and careful observation, or by-products of an experiment expected to be conventional and safe. Only well-prepared and experienced scientists can see and catch the unexpected.

There are many examples of earth-shattering science that resulted from incremental and methodical work. Shinya Yamanaka, the 2009 Lasker Award Winner and a likely future Nobel Prize Winner who discovered inducible pluripotent stem cells, identified his four factors by exclusion, one at a time, out of 24 initial candidates. What a boring, anti-audacious experimental approach for such an exciting discovery!

Likewise, the 2009 Clinical Medical Research Lasker Award, **won by Brian Druker, Nicholas Lydon, and Charles Sawyers** (<http://www.laskerfoundation.org/awards/2009clinical.htm>), was conventional in its approach to identifying an inhibitor of the kinase enzyme responsible for chronic myelogenous leukemia. The compound was identified with the systematic, non-audacious process of screening thousands of compounds with a robot until one was found that worked.

I conclude that audacity is a commendable trait in some successful scientists and a driving force in some scientific discoveries. But it is not a substitute of incremental and methodical science -- which can also produce major breakthroughs. And it is not the best approach to training young scientists for the long journey of career-building, which may or may not lead to transformative work or even research careers. As senior investigators we have a responsibility to provide our students and postdocs with the best mentorship and (often conventional) training while at the same time promoting innovation, creativity, and independence. I believe that's the best way to produce the next generation of Olympians with the fewest broken necks.

It may also be useful to remind ourselves that, as **mentioned elsewhere** (<http://www.nature.com/nature/journal/v461/n7263/full/461477a.html>) (subscription required), "there is no recipe for original science; it happens anarchically and by accident, in spite of, rather than because of, scientific institutions." I would add in spite of, rather than because of, audacious scientists.

Photo (top): courtesy of E.P. Diamandis and Mount Sinai Hospital.

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