Commentary

The social science of creativity and research practice: Physical scientists, take notice

The verdict is in: The methods of science can significantly enhance the effectiveness of creative teams. Just ask employers like Google and Facebook that are applying ideas from the social sciences to improve the performance of their organizations.[1] Over the past few decades, social scientists, including psychologists, sociologists, and anthropologists, have made important strides in developing a scientific understanding of how creative individuals and creative communities operate.[2] Why not apply those insights to one of the most creative of human endeavors—the production of scientific and technological knowledge?

Sandia National Laboratories in 2013 sponsored the Art and Science of Science and Technology Forum and Roundtable,[3] which all three of us participated in and Tsao and Narayanamurti co-organized along with Greg Feist of San Jose State University. This forum and roundtable brought together distinguished practitioners of research in the physical sciences with experts in the social science of creativity and research. The meeting was a robust exchange of ideas, with much learning and teaching on both sides. The overriding sense at its conclusion, and the main message of this essay, is that it is time for physical scientists to take seriously the idea that their research practices can be improved through systematic application of the emerging social science of creativity and research and the study of the institutional cultures that nurture them.

The idea of using scientific methods to study and improve creative practice is not new, and slowly but surely it has been gaining steam. To give one example, the science policy community has taken seriously the notion that science policy itself needs to be firmly anchored in scientific ideas and analysis. The field, often described as the science of science policy, has made substantial progress, particularly through NSF's Science of Science and Innovation Policy program.[4] Another example is the rise within the life sciences of a research community devoted to the science of creative teams, seeking to understand and manage the circumstances that facilitate or hinder the effectiveness of creative, collaborative research. That movement has also gained ground,[5] particularly through the Science of Team Science program sponsored by the National Institutes of Health.

Physical sciences opportunity

Similar opportunity exists for the physical sciences. As mathematized, deep, and envied as are the physical sciences, research in them is just as much a social enterprise and practiced just as much like an art or craft as is research in other sciences. We don't know all the reasons why some research teams are highly functional, enhancing individual abilities and optimizing performance, and some are severely dysfunctional, inhibiting individual abilities and demonstrating suboptimal performance. To be sure, successful and respected research leaders, steeped in hard-earned experience, usually have a deep understanding of the practical aspects of managing research teams. However, their understanding is intuitive, without the analytical language or tool sets necessary to determine best practices, improve and replicate them, and then share them with other research groups.

Many of our most pressing planetary-scale problems, from global warming to moving the world toward a sustainable energy diet, require solutions rooted in the physical sciences. These problems, like those in the life sciences, will need the attention of interdisciplinary teams whose human complexity, subtlety, and productivity will only be optimized, not limited, by insights from outside the physical sciences.

The social sciences are not only developing analytical language and tool sets for qualitatively understanding creativity and research, they are poised to begin quantifying them through social analytics. For example, at the conclusion of the Sandia forum and roundtable, among the concepts believed ripe for exploitation was that of divergent and convergent thinking.

Divergent thinking is the generation of new, dissimilar ideas, while convergent thinking is the filtering, refining, and retention of the most useful ones. Both processes are necessary in research, but both are moderated and in some cases severely compromised by human cognitive and social biases. Divergent thinking can be compromised by idea fixation, in which an adherence to existing ideas limits the ability to recognize and embrace new ones. Convergent thinking can be hampered by groupthink, in which a desire for social consensus interferes with selecting the best ideas. Social and data analytics can, in principle, measure the degree to which research teams are engaging in divergent-thinking behaviors, such as exposure to and serious consideration of ideas beyond the team's primary focus, and convergent-thinking behaviors, such as deep rather than superficial technical debate.

We are our biggest challenge

One might expect that the physical sciences, which have repeatedly embraced revolutionary ideas that have reshaped our world, would embrace the new knowledge and tools associated with the social science of creativity and research. Why hasn't that been the case? From our own perspective as physical scientists, two likely reasons suggest themselves.

First, physical scientists have had a phenomenal record of success without help from social scientists. The physical sciences have remade the world many times over in the past centuries. Why

argue with success? Why not just leave things as they are and continue to remake the world?

Second, the problem could be a simple matter of pride. Physical scientists are accustomed to being *the* scientists. Working with social scientists may require that we become uncomfortable objects of study. Worse, many physical scientists think of the social sciences as a lesser endeavor, which implies that social scientists have little to offer.

High stakes

Despite those challenges, we believe the stakes are too high not to try to address them. As mentioned above, many of our most pressing planetary-scale problems are physical-science based. Moreover, if the physical sciences can integrate the new social sciences knowledge, tools, and insight in frequent cycles of self-examination, then the interaction will not be so much a study by an outsider but rather a process of self-reflection and improvement based on sound science. Many current standard metrics of research effectiveness—for example, the *h*-index—suffer from well documented shortcomings. That alone should provide ample reason to try something new and to engage with our social sciences colleagues to improve our research practice.

Indeed, after our experience at the Sandia forum and roundtable, George Crabtree introduced the concepts of divergent and convergent thinking into the strategic language of the US Department of Energy's Joint Center for Energy Storage Research. The center, which spans 14 institutions and 160 people, is devoted to transformational, next-generation energy-storage science and technology. Similarly, one of us (Tsao) has begun championing the use of social analytics to measure divergent and convergent thinking in research teams at Sandia.

We encourage physical scientists to explore this rich new body of scholarship and to be receptive to the broad possibilities and advantages of engaging with the social sciences.

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References

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