

Are We Prepared for Big Science?

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For a significant portion of the 20th century, science was akin to a cottage industry, where discoveries took place in individual laboratories headed by a single investigator. The image was that of lone geniuses, such as Marie Curie, Jonas Salk or B. F. Skinner, working independently in their labs.

This somewhat romanticized view of scientific discovery has given way to a significantly scaled-up enterprise. It is increasingly common for networks of researchers supported by multi-million dollar forms of technology and scientific equipment to collectively address new and far ranging questions. Numerous examples of this style of research abound in the biological and physical sciences, and include the Human Genome Project, Long-Term Ecological Research Centers, and the Earthquake Engineering Research Network.

The critical difference between a cottage industry model and one corresponding to big science is that the latter necessarily requires an interdisciplinary approach for addressing more complex issues in a more comprehensive fashion.

Much of my current knowledge about “big science” was acquired while I was the Assistant Director for Social, Behavioral and Economic Sciences at the National Science Foundation (NSF) from 1996 to 1999. Almost 25 percent of NSF’s budget is invested in large equipment (telescopes, research vessels, supercomputers), research networks and centers focusing on specific problems, such as violence, materials science, biodiversity, dimensions of global change. Regrettably, less than one percent of this infrastructure budget currently supports research in the behavioral and social sciences. I am less familiar with the data on the National Institutes of Health (NIH), but I would be surprised if the level of infrastructure support for the behavioral and social sciences is significantly greater at NIH.

Why am I raising this issue? The answer is that most psychological science researchers are unprepared, or at least lack the experience, to engage in large-scale projects that involve multiple laboratories and shared equipment. This form of research involves cooperation as well as competition, and sometimes it involves subordinating the goals of the individual research lab to the larger goals of the project. Although most researchers are likely to endorse the value of this research strategy at an abstract level, it is difficult to find behavioral and social scientists who truly understand the value of these projects and are prepared to review them in a fair and equitable fashion. At least this was my experience while at the NSF, where I found that many invited reviewers applied idiosyncratic and arbitrary criteria to the evaluation of center proposals.

One cause of this problem is that few researchers in the psychological sciences are personally familiar with centers. Most successful researchers have focused on discrete disciplinary problems that could be solved by a single laboratory. Yet, it is these very same researchers who are typically invited to review new center proposals, and often they apply the same criteria that should be applied to the evaluation of a single research project. The result is that some well-conceived and innovative center proposals in the

behavioral and social sciences receive poorer ratings than they deserve because they are reviewed without sufficient appreciation for the added value provided by the creation of a center (i.e. intellectual and physical infrastructure) for addressing some critical problem. Too often, I observed center proposals that were reviewed exclusively for the scientific merit of the proposed disciplinary research and training without considering the unique contributions of the center for promoting new and innovative interdisciplinary research.

This situation places the behavioral and social sciences at a huge disadvantage when competing for infrastructure funds from funding agencies. It is essential that researchers become better informed about the purpose and value of research centers.

I want to make it clear that I am neither arguing that the funding of research centers should be given priority over investigator-initiated research nor am I suggesting that the review criteria be compromised in any way. Instead, I'm suggesting that some research areas have evolved to a point where future progress could benefit from the collective efforts of an interdisciplinary team of researchers. We should be sure to properly acknowledge this benefit when reviewing proposals for research centers and networks.

Let me conclude with one suggestion for improving this situation. Currently, the typical method for training the next generation of researchers is the apprenticeship model, whereby graduate students work in the lab of a faculty advisor and develop conceptual and methodological expertise specific to the research questions addressed by their advisor. Although this model is fine for disciplinary research training, it does not necessarily engender an appreciation for the value of an interdisciplinary research team. According to the recent Institute of Medicine report, *Building Bridges in the Brain, Behavioral, and Clinical Sciences* [1], this is exactly the goal of interdisciplinary training. The primary goal of interdisciplinary training should be to help students develop highly specialized knowledge while simultaneously providing them with experiences working effectively with other individuals possessing complementary expertise. Students would learn the necessity of both developing as well as sharing different forms of expert knowledge.

By providing the next generation of scientists with interdisciplinary training from the start we are helping to establish a cohort of researchers who are better versed and more knowledgeable about the structure and benefits of interdisciplinary science. Although this investment in interdisciplinary training will not insure the expansion of large-scale research by psychological scientists, it strikes me as a beneficial step toward achieving this goal.

Notes

¹ Pellmar and Eisenberg, eds. (2000) *Building Bridges in the Brain, Behavioral and Clinical Sciences*, Institute of Medicine, National Academy Press, Washington, DC.