Learning from the voice of research experience

A Survival Guide for Research Scientists. , Ratna Tantra, Springer, 2019, $109.99 (paper) Buy on Amazon

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A Survival Guide for Research Scientists
Ratna Tantra
Springer, 2019.
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From the moment I saw its cover, I was suspicious about this book's title. Was *A Survival Guide for Research Scientists* another abominable student self-help book? My first reaction on opening the book and seeing its unusual format was even worse. Goodness, what is this—a compendium of PowerPoint presentations? A salad of disconnected paragraphs? A barrage of spider diagrams and bullet points?

I am often reminded of psychologist Daniel Kahneman's description of our cognitive dichotomy. We all experience initial reactions that are quick, harsh, and crude; we are also capable of later reactions that are slow, rational, and balanced. I know that unfortunately my initial reaction is wrong 60–70% of the time, so I suspended judgment and decided that my calmer thought processes should have the chance to weigh in on the book. After half an hour, I started to mentally apologize to the author. Ratna Tantra, an expert in microfluidics and nanobiosystems who has experience working in both industrial and government settings, has produced a remarkable piece of general advice for research scientists. Everything in this little book is useful.

That is not to say that I agree with her on every point, or on matters of writing style—I hate bullet points. But in 21 chapters, *A Survival Guide for Research Scientists* discusses with clarity, intelligence, and practical sense the most pressing troubles of a research career. I wish I had read it decades ago. The book's tips on navigating the laboratory, writing reports and proposals, conducting meetings and interviews, working in teams, and relating to difficult collaborators reflect the hard-won lessons of an experienced researcher.

Most chapters refer to the author's experiences, a choice that gives intimacy and freshness to the narrative. I particularly enjoyed the comments on frequent reasons why research proposals are rejected, including ineligibility for funding, weak science, inexperienced research team, lack of credibility, unclear proposal, unrealistic budget, and little added value to the existing science. That litany is familiar to me and most other research scientists. Also, the chapters on dealing with layoffs and self-employment are extremely timely.

The first part of the book deals with self-care. The author discusses topics including stress, anxiety, personal problems, and work–life balance. I initially doubted Tantra's decision to start with this matter. But after reading Chris Woolston's 2019 report in *Nature* (volume 575, page 403) about mental health in PhD students, I realized that genuine "epidemics of stress" loom on university campuses and that graduate students are particularly vulnerable. *Nature*'s international survey of 6300 doctoral students found that 71% of respondents were satisfied with their experience of research, but 36% sought help for anxiety or depression related to their PhD. In Advance HE's national survey of graduate students in the UK, 86% of the 50 000 respondents reported levels of anxiety much higher than those of the general population.

What causes such high levels of stress, anxiety, and depression among young research scientists? Long work hours, financial troubles, poor leadership and mentoring, bullying and harassment, discrimination, intellectual and technological overload, and poor job prospects all contribute to declining mental health. In my opinion, scientists' jobs have also become vastly more complex over a very short period of time. Researchers must

now deal with fiendishly difficult multidisciplinary and technological demands. They are plagued with more and more bureaucracy, suffer constant interruptions by all kinds of urgencies, and must keep ever-longer schedules that increasingly lead to less efficient work. Those stressors affect everyone in the sciences, from the group leader to the newcomer.

I recommend Tantra's book to all readers of PHYSICS TODAY. Group leaders will gain perspective on the difficulties novice researchers face and will perhaps also gain some empathy toward their junior colleagues. Graduate students will benefit from tips that could help them avoid painful learning from experience. I also hope the administrators responsible for so many aspects of research management and the well-being of young researchers will view *A Survival Guide for Research Scientists* as required reading.

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A late-19th-century Edison phonograph.

Re-creating the physical experience of sound

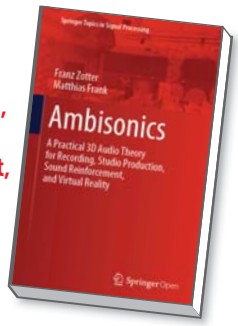
The recording and reproduction of sound has long been a source of fascination for scientists and engineers. The phonograph, invented by Thomas Edison in 1877, was arguably the first device that could both record and reproduce an acoustic signal. Although it was one of the most remarkable inventions of its time, the phonograph did not attempt to convey any spatial characteristics of the recorded sound field; it simply recorded sound and replicated the signal through a single acoustic source. The monophonic sound field the phonograph generated could not reproduce the original sound's spatial variability.

Over the next several decades, researchers made various attempts to replicate the spatial characteristics of a recorded sound field, without much practical progress. In the 1930s, however, Alan Blumlein invented stereo sound. One technique involved recording a sound field with two microphones, one with sensitivity to sound waves from all directions and one with a figure-eight directivity pattern. When the signals from the two microphones are played back over a pair of loudspeakers spaced carefully apart, a centrally located listener experiences, at least to some extent, the illusion of directional sound.

Ambisonics

A Practical 3D Audio Theory for Recording, Studio Production, Sound Reinforcement, and Virtual Reality

Franz Zotter and Matthias Frank
Springer, 2019. $59.99



The invention of ambisonics in the 1970s by Michael Gerzon, Peter Fellgett, and Peter Craven extended Blumlein's technique. As Franz Zotter and Matthias Frank explain in the opening pages of *Ambisonics: A Practical 3D Audio Theory for Recording, Studio Production, Sound Reinforcement, and Virtual Reality*, first-order ambisonics allows a recording studio to use four coincident microphones. One microphone is uniformly sensitive and three use figure-eight directivity patterns aligned to the *x*-, *y*-, and *z*-axes of a Cartesian coordinate system. Appropriate processing of those four microphone signals, along with a six-loudspeaker playback system, yields an approximate reconstruction of the directions of arrival of the recorded sound.

The book's first chapter concisely describes those microphone techniques and related approaches and provides the reader with a solid framework for understanding the basic concepts behind ambisonics. Chapter 2 covers numerous experiments that capture how well listeners perceive a change in the direction of arrival of sound as the amplitudes of the inputs to the loudspeakers are varied, or "panned" in the terminology of acoustics. Ville Pulkki's vector-base amplitude panning (VBAP) technique is the subject of