Rajeev Raizada: Statement of teaching philosophy

I strongly believe that the active, exploratory processes that make research so rewarding can also form the core of teaching. I want my students to view learning as a process of problem-solving and discovery, rather than as the ingestion of facts.

In a field as richly detailed as neuroscience, it is incredibly easy to lose sight of the "big picture." For the brain itself, the big-picture problem is how to respond to the world in order to survive. I believe that emphasising the problems that the brain must solve, by viewing it from what Marr calls the "computational level," is a good way to help students focus on this broader functional view. This provides a "why" to help to understand the "how."

One method would be to show students a particular scenario, and then bounce ideas around with them about the problems that the brain in that scenario must solve. An engaging example could be, for instance, to play a video of a tennis champion serving to try to win a tense match point. A myriad of problems and processes present themselves, from the perceptual and motor: "where is the ball? how to swing the racket? when to make contact?" to reward and motivation: "I want that prize money so bad" to planning: "where would be a good place to serve to?" to intentionality and social cognition: "where would my opponent expect me to serve to?" Each of these processes, all simultaneously taking place in the tennis player's brain, could serve as the jumping-off point for looking at whole subfields of cognitive science. I believe that after such a discussion, students will realise that they probably do use more than 10% of their brain.

I believe that it is impossible for an explanation to be too clear or too simple. This does not, I would argue, conflict with highlighting to students the deep conceptual problems that Cognitive Neuroscience often raises, because the core of many such problems can be expressed in simple terms. How is it that this lump of meat between our ears can feel and think? What does it mean to pay attention to something? How could something as introspective as attention be concretely measured? How can we test the memory of a mouse?

Some examples where I tried to use hands-on interactive methods can be found in tutorial Matlab programs that I wrote to teach fMRI analysis. (Matlab is a high-level programming language with a friendly syntax, widely used for numerical analysis and scientific graphics). In these programs, students work step-by-step through different stages of a simple fMRI analysis, with the code at each step generating graphs that illustrate the ideas. In extensive comments interspersed throughout the code, I tried to explain each step as simply and as explicitly as possible. I have presented these tutorials as a guest lecturer at MIT, and to the SPM-users group at MGH. The set of tutorials, along with sample data, are available online.[1] The webpage with these fMRI tutorials has received more than 13,000 visitors, and many other websites link to it as a useful resource: my webpage comes top in a Google search for "fMRI matlab", out of more than 200,000 results.

In a similar vein, I have made a set of interactive tutorials explaining basic statistical tests, using Python and Matlab,[2] and have made a YouTube video demonstrating the tutorials in action, which has been viewed more than 1000 times.[3]

During my Ph.D., I wrote some similar code for teaching neural networks.[4] These tutorial pro-

[1] http://raizadalab.org/fmri-matlab.html
[2] http://raizadalab.org/intro-stats.html
[3] http://www.youtube.com/watch?v=nCv_MhaeFo8
[4] http://raizadalab.org/matlab-neural-nets.html

grams have subsequently been used by lecturers at a variety of other universities, including, in the case of my fMRI tutorials, the University of Arizona,[5] and, using my neural network tutorials, the University of Regensburg.[6]

While at Dartmouth, I co-supervised a Ph.D. student (Yune-Sang Lee) on a research project building upon my previous work on categorical perception, resulting in a manuscript currently in the second round of review at the Journal of Neuroscience (**?**). This has been a very enjoyable experience, and was probably as educational for me as it was for my student. I am very much looking forward to doing more of this as I build up a lab.

Undergraduate teaching often suffers from being viewed as "the boring, easy stuff." Because Cognitive Neuroscience is permeated from top to bottom by unanswered and fundamental questions, I believe that even the most introductory class can include thought-provoking issues, and that these can work in the service of, rather than at the expense of, covering core curricular subject matter. Consider, for example, the question posed above of how it could be possible to measure attention. I remember the amazement I felt when I first learned how it is possible not only to establish with testable rigour that a monkey is attending to a particular spatial location, but moreover to measure the effects of that attention with an electrode. None of that requires concepts more complex than training, task-relevance, and reward. I have tried to incorporate these ideas into lectures that I have given to undergraduate as well as graduate classes, and am enthused by and committed to both.

Conveying understanding to someone can be incredibly satisfying. Teaching provides a set of challenges and rewards complementary to those of research, and provides a human element that sitting in front of a computer just somehow doesn't match. The brain is the most powerful learning machine in the world. I will try to give it the nourishment that it deserves.

Examples of courses that I could teach

Undergraduate level:
Introduction to neurolinguistics
Introduction to cognitive neuroscience
Statistics for research

Graduate level:
Cognitive neuroscience of language
Computational methods for cognitive neuroscience
Multivariate statistics
Neural representations and behaviour

[5] http://web.arizona.edu/~cnl/spm.htm
[6] http://fbim.fh-regensburg.de/~saj39122/vhb/Lehrbriefe/lehrbrief7/sofm.m