Rajeev Raizada: Statement of teaching philosophy

My interest in how Cognitive Neuroscience can be applied to education is tied closely to a firm commitment to teaching. 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?

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.

One way of teaching students the power of exploration and discovery would be as simple as showing them how to use PubMed. Each student could select a topic that they personally relate to and would like to find out more about, for example the neural basis of anxiety, or why coffee makes you more alert, or why music can pack such an emotional punch. I believe that it would be exciting for students to discover how a few properly formulated search terms could bring up a recent and short review article about any of those topics in just seconds, with one more click to download the article itself. When curiosity learns how to feed itself, it just grows all the hungrier.

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 receives more than 200 visitors per month.

During my Ph.D., I wrote some similar code for teaching neural networks.[2] These tutorial programs have subsequently been used by lecturers at a variety of other universities, including, in the case of my fMRI tutorials, the Max Planck Institute for Biological Cybernetics[3] and the University of Arizona,[4] and, using my neural network tutorials, the University of Stirling.[5]

While at Dartmouth, I have 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 recently submitted for publication (Lee et al., 2010). 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.

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.

References

Lee, Y. S., Granger, R. H., & Raizada, R. D. S. (2010). Different spatial scales of categorical processing in Broca's area and the supramarginal gyrus: multivoxel analysis and adaptation-fMRI compared. *Being revised for resubmission*.

[1] http://www.dartmouth.edu/~raj/fmri-matlab.html
[2] http://www.dartmouth.edu/~raj/matlab-neural-nets.html
[3] http://www.kyb.mpg.de/bu/people/unoppe/Tub_lecture2009/3GLM/math_of_convolution[1].m
[4] http://web.arizona.edu/~cnl/spm.htm
[5] http://www.cs.stir.ac.uk/courses/31YF/Handouts/Practicals/bp.m