Q & A

Jon Driver

Jon Driver trained in Experimental Psychology at Oxford in the 1980s. He then spent a formative period in the USA at Oregon (with Mike Posner among others) and in the Bay Area, before returning to the UK for a faculty post at Cambridge. He moved to London in 1997, where he has been Director of the UCL Institute of Cognitive Neuroscience since 2004. He works on multisensory perception, selective attention and spatial cognition, studying the normal and damaged brain in humans but with close reference to related animal studies. He is a Fellow of the Academy of Medical Sciences, of the British Academy, and a member of Academia Europaea.

Why did you choose to study psychology and then neuroscience? I was fascinated by human perception from late childhood, having stumbled across stereo-vision, audio-visual ventriloquism — the mislocation of sounds to their apparent visual source — and visual motion aftereffects just through simple explorations at home. These topics all still fascinate me today. But perhaps the most telling influence came in adolescence when my mother, a school librarian, brought home Richard Gregory's book *Eye and Brain*, in the hope that it might interest me enough to distract me from more adolescent pursuits. That wonderful book really did capture my attention (though it did not make me any less adolescent). It focuses on vision research, combining historical overview with presentation of many intriguing perceptual illusions in charismatic Gregory fashion, all with a relatively early emphasis on the key importance of neural processes (albeit rather poorly specified back then) for understanding of the mind.

A sadder but even more compelling example of the importance of neural function was provided by witnessing my grandmother's decline with Parkinson's disease. Around that time, in my late teens, I volunteered for occupational-therapy work with neurological patients in the local hospital, exposing me to some of the bizarre but highly selective cognitive deficits that can be caused by a localized brain injury. For instance, when I introduced myself to the very first stroke patient I ever encountered, saying "Hello I am Jon Driver", she replied "Hello I am Jon Driver", while seeming frustrated by this apparently unintended verbal echoing (classic symptoms of 'echolia' that I would later read about in neuropsychology texts at university).

In addition to language-related deficits, my basic voluntary work with neurological patients (which essentially just consisted of me turning up to provide some company, as a schoolboy, during occupational therapy sessions) exposed me to selective deficits of perception, motor control, and memory after brain damage. I also encountered cases of unilateral spatial neglect, where the patient can seem completely oblivious to one side of space despite intact primary sensory and motor functions. I would later learn to think of this syndrome as involving disruptions to multisensory integration, attention and spatial cognition; the very topics I study today.

It is said that many university students choose psychology for the wrong reasons, expecting revelatory insights into the minds of other people — how was it for you? I was thrilled rather than disappointed. I actually think psychology and biology do ultimately provide insights into the human mind, albeit hard won. I was already interested in human perception and in cognitive deficits after brain injury while still a schoolboy (see above), so choosing psychology for a university subject was straightforward for me. Unlike many enrolling psychology students, I got what I was looking for. Psychology at Oxford had (and still has) a very strong emphasis on neuroscience. I started off reading Psychology with Philosophy, but decided very quickly that, despite the intellectual gravitas of some philosophers, psychology and neuroscience were making much faster progress. So I dropped philosophy after just two terms. While some readers of my papers might justifiably claim to be able to notice that, I never looked back myself.

Psychology can suffer from a lack of self-confidence as a discipline, partly because it doesn't have a monistic core approach, partly as a putatively 'softer' science that nevertheless rubs shoulders with 'harder' sciences, such as physiology. But I think the tendency for psychologists to envy harder science has been a good thing overall, making psychology an outward-looking discipline that has been drawn to increasingly solid methods and to collaboration with other approaches. Although cognitive neuroscience was considered a relatively new field in the 1980s and 1990s, from my perspective psychology (and my own interests) had inevitably been heading towards neuroscience for a considerable time. The advent of new methods and technologies — such as single-unit recordings in freely moving animals performing cognitive tasks or functional neuroimaging of the human brain during related cognitive tasks — simply accelerated the inevitable coming together of psychology and neuroscience.

What and who were your major influences? I am eternally grateful to my undergraduate tutors for forcing me to track down and read key journal papers in their original form, rather than only via more contemporary digests. I am pleased that the ever-expanding electronic availability of journal papers now makes reading of original papers — albeit not always the older literature — come naturally to most young researchers. During my Oxford years, Colin Blakemore, Alan Cowey and Dick Passingham were impressive role-models. My two PhD supervisors, Alan Allport and Peter McLeod, gave importantly contrasting examples of scholarship versus realism, while leaving me to my own devices. Irvin Rock was a sabbatical visitor studying human perception who inspired me by his infectious enthusiasm and desire to learn, so late in his career. I was also struck by Donald Broadbent's desire (and John Duncan's matching efforts) to master not just most of the experimental literature in their fields, but absolutely *all* of it; and with the ingenuity of new experiments by some of the then-postdocs who surrounded me (including Steve Tipper and Gordon Baylis), who out of kindness became *de facto* mentors for naïve PhD students like myself. I tested my first neurological patients in Oxford with Peter Halligan and John Marshall, then flew to Munich to test the famous

'motion-blind' case reported by Zihl and colleagues. But my most vivid scientific Oxford memory was of Bob Desimone visiting from the US to present the attentional effects on monkey single-unit data that would be published in 1984 as an influential paper in *Science*. At the time, this seemed to me light-years ahead of previous work.

During my own time in the States, Mike Posner, Anne Treisman and Daniel Kahneman illustrated the dynamism of US science in my field, while Bob Rafal took time out of his hectic medical schedule to teach me some behavioural neurology, illustrating this through the real cases on his ward. Rich Ivry, who was then a junior faculty member at Berkeley, set me the perfect example of how to be collegial and selfless in support of others' scientific endeavours, while Nancy Kanwisher showed what sheer hard work and persistence can achieve.

On returning to the UK at Cambridge, Horace Barlow, Tony Dickinson, Trevor Robbins and John Duncan (among others) more than lived up to the challenge of following-on from the stellar individuals I had encountered in the US. But my growing interests in neurology and in the rapidly expanding field of human neuroimaging drew me to London, as did my wife. In London, I found a critical mass that exceeded even my positive experiences of the Bay Area and of Boston. In and around the UCL campus there is a truly remarkable concentration of neuroscientists, the largest in Europe, who collectively make this a very exciting place to work, with over 400 neuroscience PIs within 5–10 minutes of my office. The UCL Institute of Cognitive Neuroscience that I now direct was founded by Tim Shallice, Uta Frith and John O'Keefe. It is located in Queen Square right next door to the National Hospital for Neurology and Neurosurgery, and to the celebrated Wellcome Centre for Neuroimaging, founded by the likes of Dolan, Frackowiak, Friston, Chris Frith and Zeki, all remarkable characters and forces of nature. I have been very blessed by my colleagues over the years and still am. Even more inspiring are the brilliant students and postdocs that pass through our labs and those surrounding us. My first PhD student was Charles Spence, my first postdoc was Jason Mattingley. They both set a remarkable pace. Others since have lived up to this, including Patrik Vuilleumier, Emiliano Macaluso, Elloit Freeman, Toemme Noesselt and Christian Ruff among many others.

What are the best pieces of career advice you have received? "*It takes all sorts*"— a cliché, that I first heard from my mother, but one that seems to me as true of science as for many other aspects of human experience. "*Read their words carefully, but think about them for yourself even more carefully*" — obvious advice for an academic, but despite my quick exit from philosophy, I confess that in my own case it was a philosophy tutor who first really got the penny to drop for me on this one. "*If you're going to do it, do it properly*" — standard advice again, but no less true for being so. In my own case it was John Mollon, the Cambridge colour-vision expert, who illustrated this for me by his own meticulous example.

What is your favourite scientific paper? A great thing about neuroscience is that (unlike many art forms) the very best work in the field certainly still lies ahead. Moreover, although most scientists do their best work in their 30s, there are exceptions; hence even those of us whose 30s are now well behind us can still live in hope. In general, progress in biology can still be so startling and unexpected that this aspect of our work provides yet another motivation for living long, if any were needed.

What is your biggest mistake? I don't think I've made a truly major howler yet, though perhaps that lies ahead. For sure, I've missed some telling results, and sometimes have been less effective in following-up even my own work than others have. But one of the great strengths of science is that if you fail to scale a particular peak yourself, the methods and knowledge are there for someone else to do so.

Do you have any career regrets? I used to wish I had undertaken medical training, but more recently I have come to regret my lack of high-level mathematics. It has become obvious that formalisms and computational theory provide absolutely essential approaches for neuroscience, as for many other complex systems in biology. I am fortunate to be surrounded by many theoretically talented neuroscientists — such as Peter Dayan and colleagues at the Gatsby Computational Neuroscience Unit and Karl Friston and his team at the Wellcome Centre for Neuroimaging at UCL — but I very much lack their mathematical brilliance. Theoretical physics now seems a much better starting point for a career in neuroscience (as exemplified by my colleague Neil Burgess) than it used to do.

I confess to envying the Max Planck Society, so a slight regret is that there aren't more countries with such a well-funded science system. And while England has innumerable charms and UK science remains very vibrant, in my more superficial moments I occasionally regret that it is not situated on the Mediterranean and blessed with permanent sunshine.

What is the biggest challenge and opportunity facing your field? I am very impressed by the recent breakthroughs in exploiting molecular biology and optogenetics for studying neural micro-circuits in small model systems. I'm also envious of the level of precision illustrated, for example, by the recent work on dendritic processing by my UCL colleague Michael Hausser. But while the precision of the new micro-circuit methods provides many exciting new opportunities for biological studies of the brain, relating such work to studies of higher cognition in more complex animals (including, ultimately, humans) still remains very challenging. A major ambition for UCL Neuroscience is to take micro-circuit neuroscience forward, yet at the same time still relate this to other levels of neuroscience.

Another challenge is to take human neuroimaging to the next level. Cognitive fMRI studies have now become so prevalent that some people have become rather blasé about a remarkable field that would have been unimaginable just a few decades ago. I'm confident that there is still a lot more to come from this field, and from bridging between it and finer scales of analysis. In our own work we are trying to bring causal interventions into human neuroimaging — for example, see Ruff *et al*. (2006). Curr. Biol. *16*, 1479–1488.

UCL Institute of Cognitive Neuroscience, 17 Queen Square, London WC1N 3AR, UK.
E-mail: j.driver@ucl.ac.uk