At the interface

Jon Sutton interviews **Trevor Robbins CBE** (University of Cambridge)

I hear that the two 'departments' of psychology in Cambridge – Experimental Psychology and Social and Developmental Psychology – look set to merge. How has that come about?

That's an impressive piece of investigative journalism! I can confirm that this historic merger is likely to take place, pending the decision of the University's General Board. The factors leading to it have been based on teaching and research considerations, as well as a desire to simplify admissions for promising sixth formers who want to read psychology at Cambridge. In terms of teaching, we will now have a new 'Psychology and Behavioural Sciences Tripos'. This will allow students to be admitted to read psychology, including initially biological and experimental, as well as developmental and social aspects. Those students doing the Natural Science Tripos (i.e. some combination of chemistry, physics and biological courses) will also still be able to study psychology, as at present.

On the research front, the Department has wanted to have a broader as well as greater critical mass which will allow us to develop exciting new bridging areas such as social neuroscience and behavioural economics, as well as consolidate our joint strengths in developmental psychology, including our newly established Centre for Neuroscience in Education.

Your own research spans cognitive neuroscience, behavioural neuroscience and psychopharmacology, areas *The Psychologist* perhaps doesn't feature as much as it should. Does your field have its fair share of communicators, scientists who can take this very complex information and engage and inform a diverse audience?

Perhaps the publication reflects the main interests of Society members, and that is as it should be. But I have seen, for example, recent fascinating features in *The Psychologist* on how serotonin can affect moral judgement! I am sure that you would find plenty of contributors in these 'biological' fields – partly because it is the firm intention of major funding bodes such as the Medical Research Council and the Wellcome Trust that scientists should communicate their work to the public. Our own Behavioural and Clinical Neuroscience Institute certainly feeds our University Press Office with a constant stream of stories; sometimes, I'm sure, to their chagrin! But seriously, topics such as drug addiction, cognitive-enhancing drugs and the functions of the frontal lobes must surely be worthy of some kind of coverage, especially from the psychological angle?

MRC

Trevor Robbins CBE – for more information, see tinyurl.com/cnzey

Absolutely. But do you think that biology gets the recognition it deserves within psychology?

You could aptly invert that question, and so provide part of the answer, which is that it should be a symbiotic relationship. We have always striven to emphasise the vital contributions psychology makes to brain and evolutionary science. However, the unprecedented challenges and opportunities posed by the drive to understand the brain and capitalise on the human genome project surely have to be taken up by psychologists. It is often said that the greatest advances are always made at the interface of different disciplines, and I certainly take this to be the case, for example, for cognitive neuroscience. And I would also argue that 'applied biology' at the clinical/medical interface is important for understanding and ameliorating mental illness.

What's the logical end point of a more biological approach to psychology? For example, do you think that DSM could have a far more biological footing?

To answer your first general, but rather difficult question, I would argue that the goal is not a naive reductionism to render say, a construct such as working memory to a number of biochemical cascades, but rather a way potentially of helping to distinguish among different psychological accounts of the same phenomena through an analysis of mechanisms.

With respect to DSM, indeed I would hope that this useful psychiatric manual does become infused with more biological knowledge in the years to come, as we strive to define common threads running through different pathologies and whether there are in fact any completely unique descriptive markers of psychiatric disorders such as obsessive compulsive disorder or schizophrenia.

How is your current work leading to that goal?

We are especially interested in defining endophenotypes for psychiatric disorders which we think will help provide more accurate and objective criteria for diagnosis, as well as better phenotypes for genetic studies of aetiology, more homogeneous samples of patients to enable clinical trials of treatments, and possible opportunities to intervene when necessary in individuals exhibiting such endophenotypes deemed to be 'at risk' for exhibiting such disorders as Alzheimer's disease and schizophrenia.

What are these endophenotypes?

We suggest specific deficits in defined psychological processes, ideally linked to particular neural circuits. An example would be impulsivity arising from lack of cognitive control – and often to changes in grey or white matter in the frontal lobes. This tendency or trait can be detected for example, in the non-drug-using siblings of chronic stimulant drug

abusers. Many questions remain of course, not least, whether such changes are of genetic or family environment origin (or the usual interaction). Have a look at our recent article in *Trends in Cognitive Science* for a fuller account of this approach.

It seems it has always been important to you to use a variety of methods, and integrate basic research and clinical practice.

Yes, on two points. First of all you must always be on the lookout for new ways to test your theories and ideally find that magical convergence of findings which encourages you to think you are on the right track. I recall that one of my mentors once said 'All the techniques have problems…', so this is an insurance against being too dependent on any of them. Second, apart from that nagging need to do 'something useful', I have always found it useful to be inspired by clinical problems and issues that focus my research questions and help me reduce the number of research directions I could possibly pursue. I suppose I have also been especially interested in the 'pathological approach' to understanding causal mechanisms in psychological processes – perhaps sometimes depending too much on the (potentially misleading) notion that knowing how something can go wrong somehow helps you understand normal function.

You seem to be drawn to the darker side of human behaviour – addiction, risk taking, etc.

Well, psychopathology seldom plays on the bright side – well-being and happiness being among the toughest things to quantify. But I have also been interested in effective treatments of psychopathology, as well as cognitive enhancement by various means in healthy subjects – so if you like, generally trying to 'make things better'.

Where do you stand on these cognitive enhancers?

I wrote about them in the Academy of Mental Sciences report *Brain Science, Drugs and Addiction* and the recent Royal Society publication *Brainwaves*. Aspects of cognition can be enhanced, even in healthy volunteers, by pharmacological means – think caffeine, and Ritalin, as well as modafinil, for example. These effects may depend to some extent on maintaining alertness, but probably aren't simply due to effects on arousal. The effects may be individually variable, depending in part on genetic differences. There are currently a number of different mechanisms being explored by researchers to modulate learning and memory processes. Sometimes an improvement in one cognitive domain may be accompanied by impairments in another – we found this most graphically for effects of L-Dopa in Parkinson's disease. But as is always the case, research will need to determine possible long-term adverse consequences of drugs, and also how best to combine their positive effects with the appropriate psychological context or treatment in the case of patients (who stand to gain most of all from their actions).

I'm interested in the side of your work that directly links the underlying biology to changing behaviour. For example, can you tell me what is happening in the brain as a person goes from taking drugs as an action, then a habit, and finally a compulsion?

Neuronal plasticity mediated by such processes as long-term potentiation is the direct brain correlate of behavioural learning. But different types of learning, which may be going on simultaneously – thus 'over-determining' behavioural output – are probably mediated by distinct and 'parallel' anatomical systems in the striatum and its connections with the frontal lobe. Nevertheless, these parallel systems are hooked up together anatomically and can interact with one another to some extent. More specifically, Pavlovian, and goal-directed, instrumental behaviour, which depends (as Tony Dickinson has shown) on both action-outcome and stimulus-response habit learning, all seem to use different circuits. Habits come to dominate behaviour with continued training, and so the idea that Barry Everitt and I had was that addiction may reflect an extreme version of habit learning, after initial predominant involvement of Pavlovian and goal-directed processes. In neural terms, this would implicate first the ventral striatum (where drugs such as cocaine act initially) and gradually include the dorsal striatum (which mediates habitual behaviour), as well as likely a disabling of the top-down control of the frontal cortex on these structures to produce the compulsive drug-seeking element. There's quite a bit of evidence accruing on these points in humans as well as experimental animals, so we have at least stimulated some new research…

You're a Royal Society fellow, one of the 100 most cited neuroscientists, you've just received a CBE from the Queen, you've even been ranked 19th in England at chess! What's left to do, what gets you up in the morning?

I think my main motivation comes from the excitement of discussing and implementing new ideas, as well as the resultant intellectual and social interactions I have with colleagues, students and friends, all over the world. But it's the sound of our mewing Burmese cat that generally does the job!

Tweet meet

What do you think experimental psychology will look like in 20 years time? (from @LindaKKaye)

Tricky! I suspect that many of the theoretical questions concerning perception, attention, motivation and memory will remain the same, but new technologies will enable us to collect, analyse and model data in very powerful ways to reach new levels of understanding. Maybe consciousness will also start to yield its secrets. New neuroscience concepts such as the default mode network may help here… The mysterious functions of the frontal lobes will surely continue to continue to challenge us, particularly in the realm of social cognition and development. Genetics will revolutionise personality theory. I see increasing emphasis on non-clinical as well as clinical applications of the new experimental psychology – partly motivated by our need to convince Research Councils that what we are doing is useful.

What are the most important practical contributions of experimental psychology to the lives of ordinary people? (from @StevenShorrock)

Again, it's perhaps easier to look to the future. Much of what we could contribute is 'subliminal' to most people at present. Cognitive ergonomics based on firm experimental psychological principles could continue to make our lives easier in the design of machines and devices. Improved screening, e.g. for visual development as well as possible memory dysfunction, will enable healthy people to remain so. Optimising methods and techniques for memorising and learning and 'cognitive training' will preserve our ageing faculties. Research on decision-making cognition should be applied to enhance our faculties for the perception and assessment of risks that pervade all aspects of everyday life. And that should surely include running commercial corporations.

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