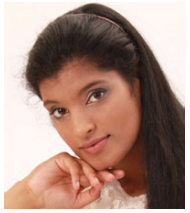
Bright Brains Newsletter

Issue No. 4
Autumn 2016



Welcome to the *second* autumn edition of our 'Bright Brains' Newsletter! We are pleased to present you with an impressive variety of thought-provoking articles that have been composed and edited by BNA students, postdocs and early-career researchers from a diverse array of neuroscientific disciplines throughout the UK.

It has now been one year since we launched our first 'Bright Brains' edition. Since then, our newsletter has undergone exciting expansions both in print and online! More importantly, Bright Brains has brought neuroscience students and early-career researchers from all over the UK more closely together, inspired them to engage in science communication, and encouraged them to share with us their impressive initiatives to increase public awareness and understanding of neuroscience. The Bright Brains Team would therefore like to thank the BNA for continuing to strengthen the voice of its young members within the BNA community.

By encouraging students both to get involved in and advertise public engagement events, Bright Brains is playing a leading role in making students aware of one critical way in which research impact can be meaningfully created. By explaining why *your* research matters and how the gained insights result in impact, by clarifying your intervention and the difference it could make, and by communicating its magnitude to non-specialists, you are creating an impact narrative that you can take ownership of as an individual researcher when writing your impact strategy.

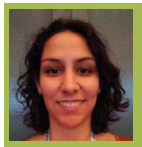
As well as public engagement, there are other means by which impact can be achieved. These include coming up with novel ways of thinking that can affect scientific practices or ideas such as creating a novel method. Initiating a debate in public policy or providing expert advice to government, charities and the private sector are other examples of impact. To give you a better understanding of the types of impact that are likely to occur in scientific research, a list of different ideas exemplifying impact is presented below for you to have a think about what kind of impact *you* can create with your research.

In addition, this special 'Bright Brains' autumn edition is packed with many more magnificent features! The 'Nuntia' section reviews two exciting neuroscience schools that took place outside of the UK over the summer. Our 'Socialia' section highlights the importance of professionally sharing our research narratives, and draws your attention to a public outreach event that aimed to inspire children to take care of their brains. Our 'Varietas' section presents you with part 2 of the brilliant 'Research heading to the East' series, and it explores the use of computer algorithms as a promising new approach in neurorehabilitation. To celebrate the one-year anniversary of Bright Brains, this edition features a special interview that provides young BNA members with valuable career insights and tips. The interview is with senior neuroscientist Philip Winn who from 1987 to 1990 was editor of the newsletter for the Brain Research Association as the BNA was known before 1997. Last but not least, we are challenging you to have a go at our BNA crossword, which has neurodevelopment as its theme.

Finally, we sincerely hope that you will have as much joy in reading our fourth 'Bright Brains' newsletter as we had in producing it. On that note, we would like to encourage you to get involved in science communication by joining our newsletter team. Please direct enquiries to jayanthinykangatharan@gmail.com.

Jayanthiny Kangatharan, 'Bright Brains' newsletter coordinator

How your research in neuroscience can create impact	
Citations in academic literature, public discussions or media	Recommendation of product for use
Development of educational resources emerging from research	Continuous and continual engagement with a group
Novel or altered technical protocols	Measures of enhanced public services
Changes to clinical standards	Third-party evidence of altered practices
Alterations in knowledge, competence or conduct of practitioners	Policy debate in the media or parliament
Enhanced patient experience	Impact on legislation or policy



Ana Bottura de Barros
PhD student in Neuroscience, University of Oxford

TENSS: Vampires and brains

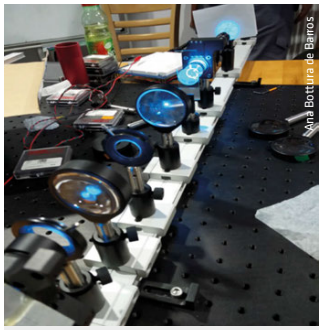
A guest house in the middle of the mountains in Romania, more precisely in Transylvania. When I told my mother I was going there for an experimental neuroscience summer course, she was suspicious: "Are you sure you will be doing the experiments and not taking part in them?" Well, I was about to find out the answer at TENSS: the Transylvanian Experimental Neuroscience Summer School.

Five years ago, a group of researchers from Cold Spring Harbor, USA, joined forces with local researchers in Cluj, Romania, to create a summer course for neuroscientists in the middle of Transylvania. The idea was to show neuroscientists that experiments can be carried out even in remote locations as long as you have the right knowledge and know where to get the right tools.

As a comprehensive summer school, TENSS combines high-quality lectures with hands-on sessions, which makes learning much more effective. Starting from basic optics, students go on to build their own microscopes to get fluorescent images or intrinsic imaging data, or even use their custom-built two-photon microscope to carry out calcium imaging. The course covers a variety of topics in neuroscience from electrophysiological recordings to behaviour; the school shows its students how to easily set up experiments even when outside the lab environment.

By the end of the course, students have learned how to use a wide spectrum of techniques and are then free to explore all of them in group projects. It is with these group projects that the real challenge lies and where students will realise that, even in the middle of the mountains in Transylvania, it is indeed possible to do real science.

Whether you are a young PhD student or are starting your own lab, I can personally recommend TENSS (**www.tenss.ro**) as an invaluable source of information and inspiration, with the Transylvanian landscape providing an additional source of stimulation.



Wide-field benchtop microscope built by students.

Stefano Vrizzi
Undergraduate student in Neuroscience, University of Leeds

Summer School on Memory and Plasticity: from theory to biochemistry

I recently had the unique opportunity to attend the summer school 'Computational Approaches to Memory and Plasticity' (CAMP) at the National Centre for Biological Sciences (NCBS), in Bengaluru, India, from 1–16 July 2016. The school was divided into four modules, with lectures ranging from abstract theory of free memory recall to detailed biochemistry of synapses.

Talks covered research on working memory capacity of the human brain and 'perfect' learners' strategy in recalling random words (1). Other examples were order specificity of dendritic integration (2, 3) and the concept of degeneracy (4), both of which highlighted the extraordinary importance of computation in neuroscience.

Each module included tutorials on a specific software or computational tool, such as Python, Neuron or Moose, which students put into practice in small group projects. Each group included students from all over the world: around half were Indian, with others coming from places as diverse as Europe, Hong Kong, Mexico and the USA. It was energising to feel part of a community committed to implementing the computer models needed for our projects. Differences in language, cultural or educational background were not obstacles, but invaluable resources.

Students replicating Dr Tsodyks' work of a simple model to simulate free memory recall.

Beyond the academic side, it was exhilarating to dine and play sports with eminent neuroscientists. The school allowed us to sample a variety of Indian foods each day and enjoy fun outdoors activities, such as building a raft from scratch to sailing on a lake.

Despite a busy schedule, this experience allowed me to taste a totally different reality. Most importantly, I enjoyed feeling surrounded by passionate researchers, teaching assistants and students wishing to collaborate, learn, explore, question, connect and integrate the complementary and conflicting aspects of how our brains can change.

1. **Katkov M, Romani S, Tsodyks M** (2014) Word length effect in free recall of randomly assembled word lists. *Front Comput Neurosci.* 8:129.
2. **Branco T, Clark BA, Häusser M** (2010) Dendritic discrimination of temporal input sequences in cortical neurons. *Science.* 329(5999):1671–1675.
3. **Bhalla US** (2014) Molecular computation in neurons: A modeling perspective. *Curr Opin Neurobiol.* 25:31–37.
4. **Rathour RK, Narayanan R** (2014) Homeostasis of functional maps in active dendrites emerges in the absence of individual channelostasis. *Proc Natl Acad Sci USA.* 111(17):E1787–96.

Sebastian Vásquez-López
PhD student in Neuroscience,
University of Oxford

Scientists do not win Nobel Prizes in Literature

...perhaps in Peace, like Linus Pauling did following his Nobel Prize in Chemistry, but not in Literature. It is not that the prose of scientists is underserving. We have simply agreed to use a style of writing whose purpose is to clearly and efficiently share information, not to strike the perfect phrase. Occasionally, we appeal to rhetoric for persuasion, using solid and well-delivered facts to defend our case, but we still give little importance to aesthetics.

Aristotle famously described three elements of rhetoric: logos, ethos and pathos*. Papers should have a lot of the first, grant proposals, the second, but scientific literature lacks much of the third. This was not always the case. Santiago Ramón y Cajal's writings are famous for their floweriness – quite literally. Words like 'spines', 'mossy', 'tuft', 'pyriform', which are now part of modern neuroscientific jargon, came from the romanticised descriptions he gave to neuronal structures that resembled forms in nature. Some have proposed that the loss of this style came about by the de-personification of the profession, where large research projects are becoming the norm and the contribution that any individual makes is small (1).

Here is an idea: let's give scientists the opportunity to share the personal narrative, the human aspect of research, the tale behind the findings. How a graduate student, after attending a talk that he almost missed, came up with the idea for an experiment. How a senior professor gave a chance to a risky idea, even when this was not in line with her research priorities. How after many weeks of failed experiments and frustration, a researcher managed to find the right experimental conditions by not giving up. How a neuroscientist made sense of some puzzling findings after talking to an astronomer friend over a few too many pints. What each of the authors were doing, what did they feel, and how they reacted after receiving their acceptance letter for their paper. In short, let them tell the story of how a research question was born and answered.

Some journals have already implemented sections like lay summaries, video abstracts, reviewer correspondence and even raw data repositories. Perhaps one day we will have another section: *The researcher's quest*. Yet, I fear this title might be a little too flowery, even by Cajal's standards.

* Logos referred to the factual, ethos to the moral or righteous, and pathos to the emotional or aesthetical.

1. **DeFelipe J, Garrido E, Markram H** (2014) The death of Cajal and the end of scientific romanticism and individualism. *Trends Neurosci.* 37(10):525–527.

Jayanthiny Kangatharan
Postdoctoral Research Assistant,
Harvard University

Introducing the wonders of the human brain: Science Lab Launch at Pakeman Primary School

During 20–24 June 2016, the Pakeman Primary School in Islington launched its new Science Lab with a series of exciting events at which children learned about volcanoes and minerals, and even got in contact with wild animals via Safari Pete to learn about the importance of conserving wildlife. On 24 June I had the privilege, as a STEM ambassador, to be invited to introduce 7–9-year-olds to the wonders of the human brain. After introducing myself, I started by asking the children what they knew about the brain. To my surprise, I saw nearly all hands up. The children were clearly very eager to share their knowledge with everyone! They knew, for example, that the brain enables us to move our bodies, and helps us to have a conscious mind.

I proceeded to tell them about the concept of plasticity and clarified its importance in forming new knowledge and modifying behaviour. I emphasised how the children themselves can influence their own brain development by challenging their mental and physical abilities on a daily basis in simple but novel ways. Needless to say, the children knew that studying is essential to ensure healthy brain development. I pointed out that spending time in nature, acquiring a second language, and learning to play an instrument, as well as adequate sleep, healthy nutrition and plenty of exercise, can all stimulate brain development.

After this interactive introduction, I showed the children slides illustrating the structure of the human brain. With the help of these slides, and a couple of brain handouts, I then moved into the practical part of my visit. Here children built models of the brain using pink Play-Doh that teachers had kindly provided. I thoroughly enjoyed answering children's questions while they happily chatted among themselves and moulded different brain structures.

At the end of the one-hour session, I was pleased to receive an overwhelmingly positive response from the children to the interactive and practical activities. I felt truly inspired to have been part of such a wonderful team that over the course of one week helped launch the new Science Lab. I felt very honoured to have represented the subject of neuroscience within that team.

All in all, I hope that I helped the children learn a little bit about their brains and how to take care of them. In future I am looking forward to seeing more primary schools opening a Science Lab, which provides children with the opportunity to learn about new ways of looking at the world in a positive, encouraging and supportive environment.

Sophie Williams
PhD student in Neuroscience,
UCL

Computer algorithms restore movement in paralysed man

Computer systems can reproduce an increasing number of tasks normally completed by the human brain. As a key step in achieving this feat, computer algorithms can now interpret patterns of brain signals in real time. These have been converted into desired physical actions for a paralysed man through stimulation of peripheral muscles.

Recently a US research team of neuroscientists helped a quadriplegic man with spinal cord damage following a diving accident, using computer algorithms in a neural bypass system (1). A microelectrode array was surgically implanted on the surface of the cortex to record multiunit activity. The patient was asked to mirror videos of hand movements while undergoing fMRI to target the hand portion of the primary motor area. Recorded neuronal activity was processed in real time by a machine-learning algorithm, and the computer-generated output stimulated patterns of electrodes around the paralysed arm to produce a desired movement. Understanding the timing and order in which electrodes had to be stimulated to achieve the chosen action required painstaking trial and error.

Using this method, the patient was able to learn six different wrist and hand movements by copying an animated virtual hand or through verbal cues. Each movement involved isolated finger movements and were representative of complex, functional everyday tasks such as pouring from a glass. Following multiple 3–4-hour training sessions, the patient's conscious intention was enough to initiate movement 70% of the time. However, there was less sensitivity for choosing and sustaining the correct movement.

This groundbreaking study may mark a new era, in which computers compensate for otherwise untreatable damage to the nervous system. However, the neural bypass system requires healthy cortex and peripheral muscles, which may not be suitable for neurological conditions such as amyotrophic lateral sclerosis. Previously, implanting olfactory ensheathing cells to the spinal cord injury site was successful at restoring movement (2). Nevertheless, revolutionary neural bypass systems show the potential for technology to integrate with biological systems that, in turn, could lead to exciting new therapeutic strategies for both physical and functional recovery in neurological patients.

1. **Bouton CE *et al.*** (2016) Restoring cortical control of functional movement in a human with quadriplegia. *Nature*. 533(7602): 247–250.
2. **Tabakow P *et al*.** (2014) Functional regeneration of supraspinal connections in a patient with transected spinal cord following transplantation of bulbar olfactory ensheathing cells with peripheral nerve bridging. *Cell Transplant*. 23(12): 1631–1655.

Joshua Au Yeung
Foundation Doctor,
Pennine Acute Trust

A trip to Kolkata: Research life in the East (Part II of III)

Clear, colourless and glistening: *liquor cerebrospinalis*, or cerebrospinal fluid (CSF), immerses our brain and spinal cord acting both as a cushion and a homeostatic buffer. Without CSF, not only would our neurons perish from electrochemical excitation, but our brains would collapse under their own weight, compromising blood flow, leading to a loss of cardiorespiratory function and coma.

Like blood plasma, CSF has a water-like consistency and composition: both contain a similar concentration of electrolytes and glucose. Litres of artificial CSF sit in various shaped beakers and flasks in the lab. Just like a chef, I concoct them using a carefully devised recipe.

The lab is a small, compact room filled to the brim with laboratory equipment, microscopes, computers and chemicals delivered from the UK. The lab sits on the top floor of a tertiary hospital: the Institute of Neuroscience, Kolkata. Work is often disrupted by after-shocks from the tragic Nepal earthquakes reverberating through the building. The alarm rings, and I sprint down 20 flights of stairs to evacuate the hospital.

Neurosurgeons look for the eruption of sparkling CSF to mark the entry into the outermost layer of the brain, the dura. I wait eagerly by the surgeon's side, with my beaker of cold artificial CSF. The patient is a 40-year-old gentleman suffering from epileptic seizures and headache from a large brain tumour, a glioma, measuring five centimetres in diameter. This is a rare sight; very few gliomas grow to that size without being detected and removed.

Once a piece of glioma is removed, it is carefully placed into the beaker, which is then locked into a secure box and oxygenated with a canister before being transported to the lab. The next step involves slicing the tumour into paper-thin slices and moving them into a pool of artificial CSF, recreating their physiological environment. Using sophisticated electrodes, neuronal activity and discharges can be measured in the tumour slices. I am interested in treating epileptic seizures deriving from tumoral glial cells.

Night falls and morning dawns. Experiments often take an arduous 24 hours to complete as glioma tissue is rare. Not only is it prudent, but also ethical not to let any go to waste. With two slices yet to be tested, the peaceful silence is suddenly broken as a plastic cylinder drops onto the ground. The artificial CSF in the flasks oscillates and shakes violently: another aftershock. I stand up, finish my coffee and, once again, prepare for my descent down the stairs.

'BRIGHT BRAINS' INTERVIEW WITH...

Phil Winn
Research Professor
of Neuroscience

1. Tell us a little bit about yourself.
Research Professor of Neuroscience; graduated BA and PhD from Hull, then worked in London at the Institute of Neurology and in Experimental Psychology at Cambridge. After that I spent most of my career in St Andrews before moving to Strathclyde in 2010.

2. One moment that changed the course of your career?
I went to the University of Hull to read Psychology in the BA programme but became better tuned to science while I was there – and I met Peter Redgrave who totally enthused me about research in behavioural neuroscience.

3. The highlight of your working career?
I've been very lucky and had a lot of good moments. The pivotal one, from which a great deal else follows, was getting tenure at St Andrews in 1984, a time when academic positions were in very short supply. I can still remember the details – where, when, who – of being told that I'd got the job.

4. One insight that has stuck with you?
I've spent a lot of my career working with brainstem systems. It dawned on me at a fairly early point in my career that these low level systems do very much more than automatic processing and can be described in terms of cognitive processes. Read my papers.

5. The major challenges that neuroscience faces in the future?
There are pragmatic, political issues around funding, obviously – but there's a very real sense in which every branch of academic life believes it should have more resources than it has. Neuroscience can make a good case because of the scale of the problems we face – early life psychiatric disorders and greater life expectancy leading to a higher incidence of neurodegenerative diseases. Some of the challenges faced I think are tractable now and will be solved – understanding why neurons die in Parkinson's and Alzheimer's is surely possible to understand, with better biomarkers to follow. But in many ways these can be thought of as problems of cell biology. In my opinion the really big issue for neuroscience is finding a coherent theoretical approach to understanding how brain tissue gives rise to coherent and robust psychological states.

6. What is the key to success in neuroscience?
Same as in everything else: moments of inspiration followed by huge amounts of perspiration. And a willingness not to follow the crowd but develop your own ideas and follow through on them.

7. Biggest challenge that you have faced in your career?
My career has involved a lot of science as well as being a dean, a vice-principal and head of an institute so challenges have come in various ways. Small challenges come in things like establishing new techniques in the lab. Bigger challenges come in trying to persuade others to accept ideas they don't like or do things they might not want to – and in having the wit to change your own positions when others present better cases. Whether this is in science or in running a faculty or university doesn't matter.

8. One important misconception?
That the brainstem is dim. My favorite little-known fact is that 80% of the neurons in brain are in the cerebellum. What goes on underneath the cortex and the immediate subcortical structures is really rather important.

9. If you weren't a neuroscientist, what would you be?
It's a bit late for this. It might seem bizarre but after I got over the usual juvenile ambitions – train driver, footballer, I don't know what – all I ever wanted to be was an academic.

10. Who has inspired you during your research journey?
Three people were critical in my early research. I worked with and was educated by, successively, Peter Redgrave, the late and sadly missed Jac Herberg and then Trevor Robbins. I also admired greatly Sue Iversen, whose work I read when I was an undergraduate and then graduate student, and whom it was a great pleasure eventually to meet. And I admire Richard Morris. I worked alongside him briefly in St Andrews – I found Richard to be a generous colleague and a scientist of terrific imagination and drive.

11. What advice would you give to future neuroscientists?
Two things. First, try to keep a bigger perspective. We work on bits and pieces of brain, because we have to – it's a very reductive approach, with hopefully lots of small insights combining to give better overall understanding. But while working on whatever it is you do – some structure, a biochemical or cognitive process, a gene family, whatever – it's important to keep a sense of where it all fits in a bigger scheme of things.

Second – and this is for academic neuroscientists – commit fully to teaching as well as research. I've loved teaching and being involved in teaching policy – I was vice-principal with responsibility for learning and teaching and still work on national committees supporting higher education in the UK and abroad. Working with undergraduate and postgraduate students is terrifically stimulating. Explaining ideas to bright, articulate students tests the sensibility of what you're saying and helps clarify problems for yourself. I suspect that the long-term impact on our students of our teaching outstrips the half-lives of our research papers by some distance.

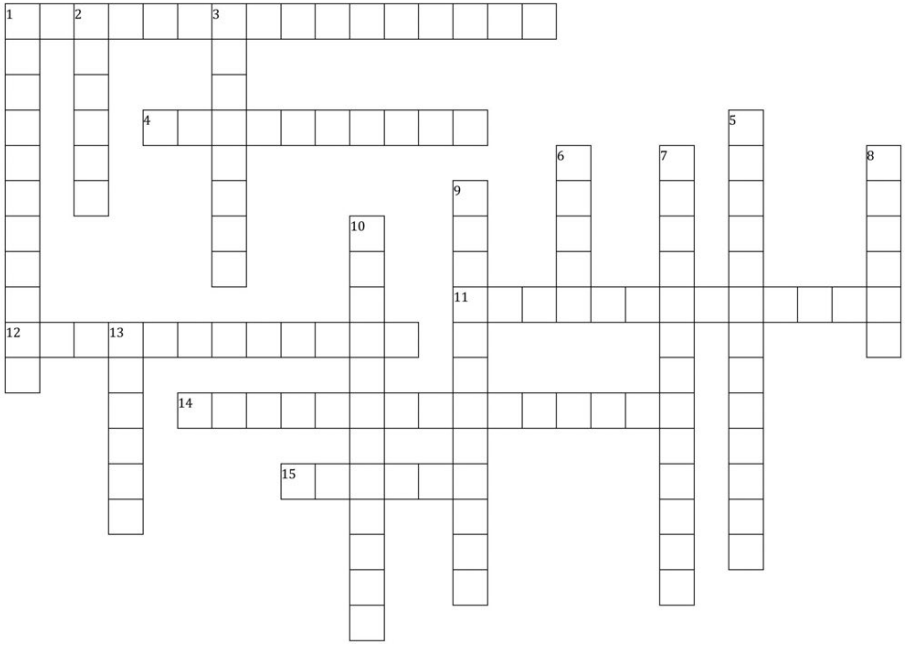
How well versed are you in neurodevelopment?

Test your knowledge by completing the BNA crossword! Answers will be revealed in the next edition. Answers to last edition's crossword are provided at the bottom of the page.

Enter this edition's competition by sending your answers to jayanthinykangatharan@gmail.com. Entries received before 1 March 2017 will be entered into a prize draw to win a unique contribution towards the 'Bright Brains' spring edition!

HORIZONTAL
1. Procedure developed by Mary Ainsworth to observe attachment patterns (7,9)
4. The germanitive epithelium that gives rise to cerebellar granule cells (7,3)
11. The region of the embryonic CNS, differentiating by embryonic day 49, which eventually gives rise to the cerebral cortex, hippocampus and basal ganglia (13)
12. A mutation in this gene causes subcortical band heterotopia (12)
14. The locus of neural progenitor cells in the developing brain (11,4)
15. Swiss psychologist renowned for theories of childhood cognitive development (6)

VERTICAL
1. A defect that may arise from an improperly sealed neural tube (Latin: 'split spine') (5,6)
2. An extracellular protein essential for neuronal migration (6)
3. The germ layer that will eventually become the nervous system (8)
5. A peptide hormone required for neural induction (or defeating Dr Robotnik) (5,8)
6. The structure that folds to form the neural tube (5)
7. A rare malformation caused by impaired neuronal migration (13)
8. Renowned psychologist who invented the Air-crib/Baby box/Heir conditioner (7)
9. The process by which the blastula invaginates to form the three germ layers (12)
10. The process of cortical folding (12)
13. The psychologist who developed a widely used (and eponymously named) scale of infant cognitive and motor development (6)



Answers to the crossword from Issue 3: Summer 2016 – HORIZONTAL: 3. nucleus, 5. amnesia, 8. knockout, 11. patient, 13. akinetic, 14. degenerate, 15. mouse, 16. late-onset, 17. prion, 18. braak. VERTICAL: 1. tau, 2. glia, 4. Charcot, 6. huntingtin, 7. mutant, 9. tangle, 10. risk factor, 12. oligomer, 13. atrophy, 19. APP.