Bright Brains Newsletter

Issue No. 5
Spring 2017

Welcome to the spring 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.

This edition is special as it is the first of a three-part series, in which the last page of 'Varietas' will be dedicated to the exploration of the mind and the brain from an artistic perspective. This provides you with the opportunity to express neuroscientific phenomena and ideas in artistic form. To add a poetic touch to the contemplation of the mind and the brain, this edition's 'Varietas' features the section 'Poesis', which includes a series of poems about the mind and the brain varying in length from a pantoum to a haiku.

While the relationship between neuroscience and art can be studied by how art is perceived by the brain, i.e. how we hear sounds, view colours and feel rhythm, it is equally useful to consider the brain through the lens of art. By studying the brain during the execution of art, art will present itself as a reflection of the inner neural scenery of one's subjective experience. This branch of the interdisciplinary field termed neuroaesthetics by Semir Zeki, is captured by John Onians' idea of 'neuroarthistory'. It can be studied to better understand artistic aspects such as style, and more complex questions such as what the origin of art is. By observing and appreciating one's consciousness first-hand while engaging in artistic activities, one can experience how one's nervous system gives rise to art.

Moreover, creating art provides ample mental health benefits such as relieving stress, as well as symptoms of depression and anxiety. It can serve as a vehicle for alleviating the burden of chronic disease. Engagement with art can also stimulate creative thinking, and increase brain connectivity and plasticity. There are different ways to engage with art: music, visual arts, movement-based creative expression, and expressive writing. Writing poetry, specifically, encourages emotional and intellectual growth as it involves the symbolic representation of experience through language. 'Bright Brains' has therefore provided you with poems in 'Poesis' to inspire you to engage in writing poetry and let the inner poet in you express how your brain makes you feel.

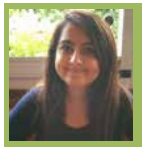
In addition, this special 'Bright Brains' spring edition has many more magnificent features in store for you! The 'Nuntia' section reviews two exciting neuroscience meetings from a student perspective. Our 'Socialia' section introduces you to the very recently formed student group 'Neural Networks' in Leeds, which will be collaborating with 'Bright Brains' to organise its first major event by hosting the student neuroquiz at BNA2017: Festival of Neuroscience. Furthermore, 'Socialia' brings you the highlights of the panel discussion on the use of animal models in neuroscience that was organised by the student-run neuroscience society 'Cortex Club' in Oxford. Our 'Varietas' section paints a colourful picture of the neuroscientific consequences of sensory stimulation. 'Numquid sciebat...?' discusses evidence suggesting that Alzheimer's is a newly uncovered form of diabetes, and 'Quid novi?' presents you the first part of the new 'Journey to the Centre of Scandinavia' series, with the second part to follow in the next edition.

To bring science and art closer together, 'Bright Brains' has given science a poetic form of expression by creating 'Neuropoetry' in its new section 'Poesis'. To add an interactive aspect, each poem in 'Poesis' represents a poetic riddle, the answer to which the reader is being challenged to guess. Can you do it? Let's find out! Answers to each poetic riddle will be revealed in the next edition.

Finally, we sincerely, hope that you will have as much joy in reading our fifth '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

NUNTIA



Jamini Thakrar
PhD student in Neuroscience, University of Bristol

Meeting of Minds 2016

For the first time, on 29 September 2016, the BNA and the Association of British Neurologists (ABN) came together, for a 'Meeting of Minds'. The one-day meeting was held at the Hadyn Ellis Building, at Cardiff University, and the delegates were also able to attend a tour of the recently opened, state-of-the-art Cardiff University Brain Research Imaging Centre (CUBRIC) before the first session. The talks entwined the two strongly related topics of epilepsy and amnesia throughout the day.

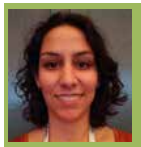
Beginning with an introduction from Phil Smith, the president of the ABN, it was an exciting day of talks, combining both clinical and research perspectives on epilepsy and amnesia. The morning session explored several aspects of epilepsy and began with Liam Gray speaking about 'Comorbidity and cognition', followed by talks entitled 'What a mouse can tell a neurologist', 'Genetics of epilepsy' and 'Circuitry of epilepsy' by Andrew Trevelyan, Sameer Zuberi and Vincenzo Crunelli, respectively. We were also given special insight into the mechanism by which epilepsy and amnesia could be linked and how neuronal transplantation could provide new advances in epilepsy research. In addition, learning how early genetic screening for epilepsy in children could improve management of the condition was one of many highlights in the morning session.

The afternoon session focused on memory and amnesia, offering multilevel views into the research field with stimulating talks by John Hodges speaking about 'Degenerative amnesias', Clea Warburton on 'Animal models of amnesia', Adam Zeman on 'Transient amnesias' and John Aggleton on 'Memory circuitry'. A highlight of the afternoon was when the audience was presented with a series of clinical scenarios at the beginning of Professor Zeman's talk, and then asked to diagnose the different types of amnesia presented at the end, which we accomplished!

Overall, this meeting offered a great insight into two areas of research that I had not previously known were highly related to one another and the short talks were exciting snapshots into each of the speaker's fields. 'Meeting of Minds' was highly successful and provided a fantastic opportunity to present my very first poster at a conference, and hopefully this event was the first of many BNA-ABN collaborations.


Hanna Isotalus

CUBRIC's OT scanner, which simulates the MRI scan environment without a working magnet.



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

Brain Prize Lecture 2016

"... memory provides our lives with continuity. It gives us a coherent picture of the past that puts current experience in perspective. We are who we are because of what we learn and what we remember (1)."

This quote by Eric Kandel, from his autobiography *In Search of Memory*, partially describes why I have pursued learning and memory as my field of study. It is for this reason that I have never felt so lucky in my life when the invitation from the Lundbeck Foundation to attend the Brain Prize Lecture (2) arrived via the BNA in my mailbox. The 2016 Brain Prize was given to three researchers who have shaped our understanding of how memory works in our brains – Tim Bliss, Graham Collingridge and Richard Morris – and I had the chance to see them talk.

The lecture started with Tim Bliss who talked about how long-term potentiation (LTP) and transmission are linked. By explaining his experiments, he was able to show that the chance of neurotransmitter release is increased with LTP induction. Then, Graham Collingridge illustrated the steps he undertook to explore the influence of glutamate receptors on LTP, and to see how different receptors were responsible for different phases of potentiation.

Just listening to these two talks was already a great experience. But as a behavioural neuroscientist, I would never have imagined that I would have the chance to hear Richard Morris describe how research linked LTP to behaviour. He talked us through John O'Keefe's discovery of place cells, a finding that inspired his most famous work on the water maze. Next, he went on to show that Willshaw and Dayan's work on associative networks has important implications to linking LTP to memory representation. He could not finish without mentioning Whitlock's work on how learning induces LTP, thus linking LTP to behaviour.

Finally, to see a man who has achieved so much in his career tell us with great pride and excitement about his most recent work on dopamine release by the ventral tegmental area for novelty signalling should be inspiration enough for anyone in academia. And if that still was not enough, then the quick chat we had following the talks was a memory to be stored for the long term.


Duncan Banks

Richard Morris, Graham Collingridge and Tim Bliss at the Brain Prize Lecture 2016.

1. **Kandel ER** (2006) In Search of Memory: *The emergency of a new science of mind.* (New York: W W Norton & Co.).
2. The Brain Prize Lecture. Available at http://www.thebrainprize.org/ [Accessed 6th January 2017].

Stefano Vrizzi
Undergraduate student in Neuroscience, University of Leeds

Creating Neural Networks, the new Undergraduate Journal Club in Leeds

In May 2015, a friend of mine and I were walking back home after a class, when I had a sudden insight: 'What if we used one of the empty rooms on campus to present to each other what we are revising for our exams? I believe that you have truly learnt something only when you are able to explain it; feeling confident about what you understood from a lecture or a paper may not be enough.' My friend appreciated this idea, but there was not time to explore it further while we were rushing for our final exams.

That idea kept on bouncing around my mind and I had the feeling that it could potentially benefit many of my peers, if I let it take shape. September came, I left for the USA for my research placement year, and I brought that idea with me. One day the action potentials encoding that idea reached the neuromuscular junctions of my hand muscles, and so I e-mailed a few undergraduate peers of mine and proposed to found a student neuroscience society in Leeds.

Once I received positive responses to the idea, I contacted faculty members in Leeds, who endorsed this initiative. My peers and I advertised it around campus via a video. Enthusiastic people contacted us to help us set up the committee of the new Undergraduate Journal Club in Neuroscience at the University of Leeds. At the inaugural meeting in June 2016, the committee decided upon the name, inspired by what neural networks do: grow and connect. Those action potentials finally became Neural Networks. We aim to grow personal skills and connect young neuroscientists, to share knowledge and foster collaboration, core actions for a respectful and inclusive society.

Neural Networks now meet twice a month: once to provide a platform for student presentations, and the other to have informal chats at the pub about the latest updates in neuroscience. We are also keen to get involved in extracurricular activities: for example, we organised a trip to the BNA Christmas Symposium and we have initiated a collaboration with 'StudentsIntoSchools' teaching neuroscience in secondary schools during the upcoming Brain Awareness Week.

Finally, we are genuinely excited to collaborate with 'Bright Brains' to organise the neuroquiz night at BNA2017: Festival of Neuroscience in Birmingham this April. So grab some friends together to form a team and join us for three rounds of rousing questions ranging from molecular to systems neuroscience. See you there!

Maria Rüsseler
PhD student in Neuroscience, University of Oxford

Animal models in neuroscience research – A panel discussion

Neuroscience research makes use of animal models ranging from insects to more complex vertebrates such as monkeys. Although it is widely recognised that animal research is necessary to understand complex brain functions, the strengths and limitations of different animal models have been subject of continuous debate. The Cortex Club at the University of Oxford organised a panel of eminent neuroscientists to discuss what we can learn from different animal models. The panel included Gero Miesenböck, who studies neural circuits in fruit flies, David Bannerman, who studies memory formation in rodents, Andrew Parker who investigates vision in macaques and Heidi Johansen-Berg who studies plasticity in humans and rodents.

Neuroscientists acknowledge that brain functions should be studied at different levels of complexity including the molecular, cellular, network and behavioural levels. According to Professor Miesenböck, the relatively simple brains and complex behaviour of fruit flies make them ideal to probe fundamental molecular, cellular and circuit mechanisms of behaviour. He argued that the basic neural circuits in flies are the building blocks for any brain and ultimately underlie behaviour and cognition in other species. Nonetheless, as mentioned by Professor Parker, it is still necessary to study brain structures such as cortex that the fruit fly lacks altogether in order to understand complex brain function.

A common point of agreement was that it is essential to be aware of which questions can be addressed in each animal model. For instance, Professor Bannerman pointed out that using mice for drug screening in psychiatric disorders is not always useful, as phenotypes resembling human diseases may have different underlying mechanisms. Hence, it is important that a scientific question is studied in a suitable animal model, for example to study the role of specific cellular processes in behaviour.

Finally, Professor Johansen-Berg argued that research on humans is also necessary because it allows insight into human cognition and behaviour that is not possible in animals. Additionally, continuous advances in sophisticated imaging techniques such as high-field MRI allow a more detailed investigation of human brain function that was previously limited to invasive methods. Nevertheless, non-invasive techniques cannot replace all invasive methods – for example, invasive tract tracing is still more accurate than non-invasive diffusion-weighted imaging.

In conclusion, the debate on the contribution of different animal models to neuroscience research continues. Only through cooperation and translation between research using different animal models can our understanding of the brain be advanced.

Melissa Large
Undergraduate student in Neuroscience with Forensic Science, Keele University

Game of Neurons

Chasing butterflies in the spring. Running through fields with grass sighing at the hem of your summer dress. The crunch of autumn leaves. Catching winter snowflakes in the palm of your hand. A life made in perfect harmony. So how do life's pleasures transform into a memory that can last a lifetime?

From seeing the first flutter, hearing the first swish and crunch and feeling water droplets in your hand, the senses are heightened. Neurons fire bringing to life the great pyramids of the hippocampus. CA1 pyramidal neurons await the fall of magnesium blockades that oppress the NMDA receptor guards. In combat: glutamate molecules and AMPA receptor neighbours, coming together to attack from both sides of the cell to stop this siege. Magnesium surrenders. Sodium and calcium file in, creating parties full of cascades (1) (see Figure 1).

Calcium erupts from internal stores, fuelling the fire for change. The awakening of protein kinase C (PKC) and Ca2+/ calmodulin-dependent protein kinase II (CAMKII) ensures that the AMPA receptor squadron supply is meeting the demand of the membrane. Brain-derived neurotrophic factor (BDNF), a welcomed outsider, arranges the actin scaffolds to uphold the structure of the new reforms (1).

The powerhouse is not left untouched. An allegiance between calcium and cascade creations transforms cAMP response element-binding protein (CREB), unlocking the power of cAMP response elements (CRE) to manufacture the building blocks needed to continue the need for sustainability and flourishing of the new city's actin networks (2).

Neurons using these pathways build a new world from deep within to the very edges of its geography. Each time our senses are stimulated by something new, this internal war starts. Even the most beautiful of things start something ugly.

1. **Bear MF *et al.*** (2007) *Neuroscience Exploring the Brain* (Lippincott Williams and Wilkins: Baltimore).
2. **Rudy J** (2014) *The Neurobiology of Learning and Memory* (Sinauer Associate, Inc.: Massachusetts).

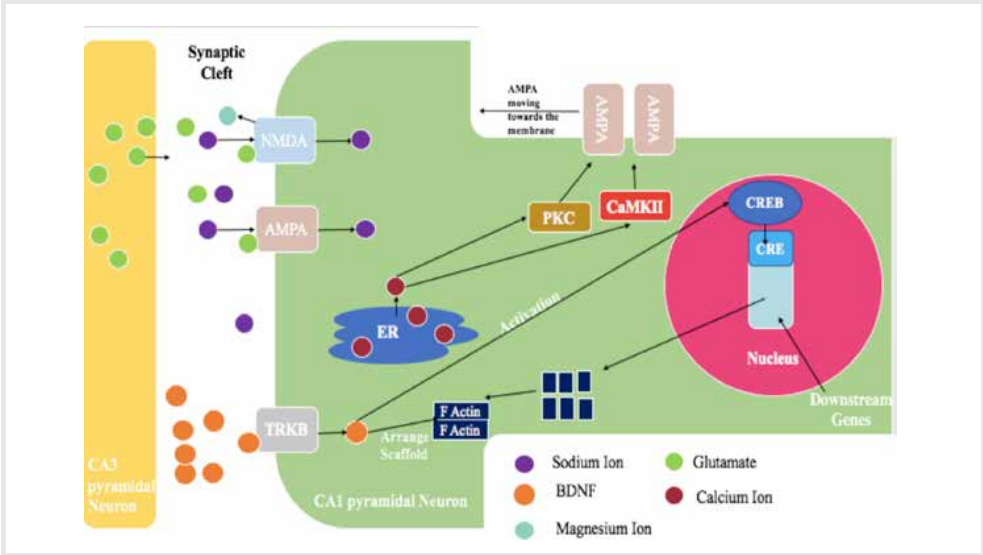
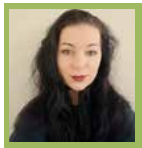


Figure 1. A schematic highlighting the pathway used to enhance the glutamate transmission in the CA1 pyramidal neuron of the hippocampus. BDNF orchestrates gene transcription needed to generate actin filaments. The endoplasmic reticulum (ER) is stimulated to release Ca^{2+}, which activates the kinases PKC and CAMKII. The kinases cause AMPA receptors to be transported to the postsynaptic membrane, increasing the glutamate signal.

VARIETAS NUMQUID SCIEBAS...?



Emily Benn
Undergraduate student in Neuroscience, Keele University

Is Alzheimer's disease a brain-specific type of diabetes?

Research has shown us how amyloid-β oligomer aggregates and hyper-phosphorylation of tau proteins into neurofibrillary tangles causes the neuritic plaques characteristic of Alzheimer's disease. However, recent research from Suzanne de la Monte suggests that insulin deficiency in the brain may be the driving factor causing cell death. In other words, Alzheimer's disease may be 'type 3 diabetes' (1).

Researchers believe that insulin may be involved in homeostatic metabolism inside the brain, as insulin receptors can be seen on the membranes of nerve cells (2). Proteins involved in the transmission of insulin and insulin-associated signalling proteins have also been detected inside the brain. Furthermore, these proteins are present at high concentrations in the areas normally affected by Alzheimer's disease, such as the temporal lobes and the hippocampus (2).

Insulin signalling has been shown to be impaired in post-mortem examination of patients with Alzheimer's disease (2). Moreover, blocking insulin in rats has led to major cognitive impairment, and caused huge plaques formed from amyloid-β oligomer aggregates and neurofibrillary tangles (1).

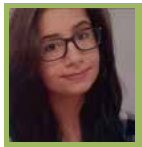
Researchers have used animal models to illustrate that Alzheimer's disease is caused by an insulin deficiency inside the brain, which consequently causes an impairment of energy production from glucose. If cells do not have the required amount of energy, they starve to death, causing neurodegeneration. This starvation has been seen to cause oxidative stress, and major impairments in homeostasis (1).

Using insulin as a treatment for Alzheimer's disease is currently being tested in a clinical environment. Some patients have exhibited significant cognitive improvement upon intranasal administration of insulin across numerous studies (2). Administering insulin has also been shown to have neuroprotective capabilities and memory-improving properties (3).

Research into this theory that Alzheimer's disease is a newly discovered type of diabetes has shown promising results. However, many other impairments in the brain have been shown to cause neuritic plaques characteristic of Alzheimer's disease. Perhaps it is a combination of many factors that can lead to these plaques. Whatever the case, researchers should now focus on how to prevent the plaque formation, and find a definitive answer to what causes it to begin with.

1. **de la Monte S** (2014) Type 3 diabetes is sporadic Alzheimer□s disease: Mini-review. *Eur Neuropsychopharmacol.* 24(12): 1954–60.
2. **Morris J, Burns J** (2012) Insulin: An emerging treatment for Alzheimer's disease dementia? *Curr Neurol Neurosci.* 12(5): 520–7.
3. **De Felice F *et al.*** (2014) How does brain insulin resistance develop in Alzheimer's disease? *Alzheimer's Dement.* 10(1): S26–S32.

VARIETAS QUID NOVI?



Elene Nicola
Undergraduate student in Neuroscience and Psychology, Keele University

Journey to the Centre of Scandinavia

Just over two months ago, I packed up my life in London and moved it 1193 miles away. I will be spending 10 months at the Karolinska Institutet, in colourful Stockholm, finishing a scientific project. I am involved in new, fascinating research that focuses on reducing side effects seen in young brain tumour survivors after radiotherapy treatment. Recent research has shown that radiotherapy cures 80% of all children with brain tumours; however, this treatment may also cause adverse side effects (1). It is thought that radiation induces chronic neuroinflammation, which impairs hippocampal neurogenesis leading to cognitive impairments, especially in children (1). The aim of my project is to assess whether it is possible to regulate these inflammatory reactions through treatment, in the hope of minimising side effects and helping the brain to become more resilient to future stress.

The first couple of months were spent familiarising myself with protocols and learning how to set up equipment around the lab so I am able to reach a point where I can study independently.

Before I flew out here, I was beginning to doubt my decision and wondered if I had made the right choice to leave behind a place I had spent 20 years growing up in – 20 years of building friendships, 20 years' worth of memories – and move somewhere I had never visited before and where I didn't know a single person. I won't sugar-coat the truth: the first week was extremely difficult. I found it challenging to adjust to the city, to the lifestyle, to the independence that came with the move. But as time went on, everything got easier.

Elene with her research team at Christmas dinner.

I started enjoying work, meeting like-minded people, creating friendships, exploring – I had started living. I never imagined that I would get to this point, where I feel like I belong. In many ways, Stockholm feels like home – a numbingly cold home – but a home nonetheless.

I'm hopeful that my journey will continue on an exponential slope, where I'm constantly learning and growing – not just as a scientist, but as a person.

1. **Kalm M *et al.*** (2013) Lipopolysaccharide sensitized male and female juvenile brains to ionizing radiation. *Cell Death Dis.* 4(12): e962.

POESIS NEUROPOETRY

How well do you appreciate poetry about your brain?

In this edition neuroscientific phenomena have creatively been packaged into poetic riddles. Can you guess what each poem is about? Then have a go at the following six neuropoems! Answers will be revealed in the next edition. Answers to last edition's crossword are provided at the bottom of the page.

Please send your answers to each poem to **jayanthinykangatharan@gmail.com**. Entries received before 1 May 2017 will be entered into a prize draw to win a unique contribution towards the 'Bright Brains' summer edition!

Pantoum

by Jayanthiny Kangatharan, Postdoctoral research assistant, Harvard University

In old age
Why did he steal memories?
He was not a criminal:
The symptoms of ageing
People saw one loss after another

He was not a criminal
The mind rested
People saw one loss after another
It was dark, and murky

The mind rested
Why did he steal memories?
It was dark, and murky
The symptoms of ageing

Double tetractys

by Jayanthiny Kangatharan

Little
I
Am small
And I do
Control posture
I receive inputs from the spinal cord
And integrate them to fine-tune motion
I hold eighty
Per cent of
All brain
Cells

Rhyming riddle

by Jayanthiny Kangatharan

When life gets tough

Produced by a wide-ranging network
It will rise under a high load of work
Consistently correlated with complex mental tasks
It is also found to increase at key landmarks
Acts as carrier for cognitive processing across regions far apart
Try to guess this if you are smart

Diamante

by Jayanthiny Kangatharan

Momentary awareness
Intention
Goal-driven, top-up
Endogenous cuing, covert orienting
Train of thought, flash of light in the periphery
Exogenous cuing, overt orienting
Stimulus-driven, bottom-up
Instinct

Haiku

by Jayanthiny Kangatharan

In the mouse brain
Scanning ultrasound –
a promising procedure
to remove plaques

Free verse

by Jack Cooper, Undergraduate student in Cell and Systems Biology, University of Oxford

Outside View
What is a neuron? he asks,
his own soaked in the old-world glamour
of great masters, where Bach and Brahms
battle for remembrance, and for tribute.
Where notes sit on sheets, subjective,
teasing breath through flute to give
new forms, new revisions
of performance first heard lifetimes ago.

He asks, mind soaked with traditions
where interpretation is truth,
and truth is not tested.

What is a neuron? He asks,
and I understand he does not want
answers
to the mundane questions of chemicals
spilling through clefts,
nor membranes that seep ions
like sap bleeding from bark.
He asks how his skin senses the
quickening warmth
of the silver in his palm,
how his fingers and lungs dance on the
razor's edge
between music and disaster.
He asks how he can hear sound,
but feel beauty.

Answers to the crossword from Issue 4: Autumn 2016 – HORIZONTAL: 1. Strange Situation, 4. Rhombic Lip, 11. Telencephalon, 12.Double Cortin, 14. Ventricular Zone, 15. Piaget. VERTICAL: 1. Spina Bifida, 2. Reelin, 3. Ectoderm, 5. Sonic Hedgehog, 6. Plate, 7. Lissencephaly, 8. Skinner, 9. Gastrulation, 10. Gyrification, 13. Bayley.