Brain Health Research Centre

Te Pokapū Rakahau Hauora Hinekaro

University of Otago Te Whare Wānanga o Otāgo New Zealand

Newsletter December 2015

For regular updates visit our website: otago.ac.nz/bhrc

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Brain in Brief

Memory and the Brain

How does the brain store information now in a form that will be accessible in the future? Research indicates that memories are stored as patterns of activity in millions of connected nerve cells within the brain. A part of the brain called the hippocampus is critical to this process. How do we know this? Well, we have known for some time that if you damage the hippocampus on both sides of the brain then you will, in all likelihood, become amnesic; unable to create new memories. More recent research has started to determine how this system works at the level of nerve cells and their connections. Remarkably, the latest studies have shown how new memories can be overlaid into the structure of the hippocampus by artificially manipulating the strength of the connections between these cells. Current brain research aims to further understand these processes and, in particular, understand what happens when memory function is disrupted as can occur in conditions as diverse as Alzheimer 's disease and post-traumatic stress disorder.

All Blacks support hunt for cure

Batten disease is a rare neurodegenerative disorder that begins in childhood and causes blindness, seizures and a steady decline to a vegetative state and finally death. The disease is the result of a genetic malformation that causes the absence of a particular protein in the brain.

It is a disease BHRC biochemist Dr Steph Hughes is studying in the quest for a cure. Dr Hughes' laboratory, in collaboration with a Lincoln University team lead by Prof David Palmer, have recently received a lot of extra attention from an unusual source. The All Blacks, Flight of the Conchord and kiwi singers including Lorde and Dave Dobbyn are all behind a fundraiser in the form of a song; "Team Ball Player Thing." This song became the official All Blacks team song for the recent Rugby World Cup. The song focused on advice from children on how the All Blacks could win the cup; and co-starred a family affected by Batten disease. Clearly, it was a success, with the All Blacks bringing home the cup.

All proceeds from the song go to Cure Kids to support Batten Disease research.

When asked what the best part about getting this type of publicity is, Dr Hughes said: "Now people we meet know what Batten disease is. An American colleague visited NZ recently and took a couple of bus tours. Both bus drivers knew what Batten disease was. Up until now most GPs had never heard of it. CureKids fundraising will allow NZ-led research to be translated into therapies; ones which have implications not just for Batten disease but common neurodegenerative disorders as well. Our team are trying to replace the missing protein by using modified viruses carrying a good copy of the missing gene. This gene therapy has been trialled with success in sheep, and the money raised will extend the research and fund human trials. "Let's hope our trials are as successful as the All Blacks have been" Dr Hughes said.

Dr Steph Hughes – Outstanding in her field.

News in brief

Physiotherapy an important part of the neuro puzzle

At times of neurological crisis people tend to think of the importance of doctors and nurses to a person's recovery. Physiotherapy provides the very practical application of science, assisting people to rebuild their lives after trauma or illness. Professor Leigh Hale, Dean of University of Otago School of Physiotherapy has recently joined the Brain Health Research Centre. Prof Hale has been at the University of Otago for fifteen years, arriving here from her home country of South Africa where she had studied at the University of Cape town. Her area of interest is rehabilitation. Prof Hale explained her philosophy as "Physiotherapy provides the tools to get the limbs moving, enabling better lives for people with Parkinsons, stroke, MS or brain injury. Of particular interest to me is falls prevention and we are collaborating with researchers all round the world on these issues. I have learnt over the years that what we need to do is give people back their life, not necessarily fix them, but make life easier and better"

Part of the new attitude to recovery and rebuilding one's life includes ensuring that people have more say in their therapy. Looking too far ahead can be daunting. There are now a number of programmes that allow people to work at their own pace to achieve certain goals that they set for themselves. If you are interested in learning more about these programmes please contact Jane at BHRC 03 479 4066.

Our brain on the move

Our inflatable brain has been out and about in Southland recently. Over 600 people at the Riverton Health Expo, and pupils at Te Anau and Waikaia primary schools who took part in brain education days, walked through it while we were in the south. We wish Waikaia school well with their school musical, based on the brain. If your area is hosting an event or your school would like us to visit, please get in touch.

Cliff Abraham

Did you see our past director Professor Cliff Abraham in the November issue of the Australian Woman's Weekly? Prof Abraham is working on an early detection test by attempting to identify molecules in the blood that indicate a person has Alzheimers disease. The aim of this work is to develop a tool for diagnosis before people begin to show characteristic symptoms. This would enable drug therapies to be started much earlier, which we already know is the time that the drugs have the best impact.

2015 BHRC Māori summer research recipient named

Witana Petley, a third year physiotherapy student is the recipient of the 2015 BHRC Māori summer research scholarship. Witana will spend the university summer holidays researching Māori attitudes to sports concussion, and developing better ways of communicating the "safe concussion" message to young Māori sports people. Young Māori are over represented in collision sports and experience a disproportionate number of concussive brain injuries.

Honouring the life of Beth Cobden Cox

The Ellis family have generously donated an annual research grant to the BHRC to contribute to research into frontal-temporal dementia (FTD).

The $5000 grant is in memory of their wife and mother Beth Cobden-Cox who died in 2005 after a long illness with Pick's disease, a form of FTD. Beth was in excellent health and embarking on a career in law when the first signs of illness affected her in her mid to late forties. There was no family history of dementia, and the period prior to her diagnosis was very confusing and isolating for her and her family. FTD has no known causes and no known treatments.

By establishing a research fund in memory of Beth, her family wish to contribute to research into FTD, and Picks disease in particular, and to honour Beth who lived her life in service to others.

Beth Cobden Cox (centre) with her proud family.

Our memory storage systems

The brain has several different memory systems, all designed to help us recall information. A useful way of thinking about the memory systems that remember past events and episodes is to show how they work using a metaphor. Think of your memory as operating along the lines of a conveyer belt:

The short-term memory system. Imagine a conveyor belt that grabs information from the world around us as it becomes available through our sensory systems, and then holds it for a short period. Once information is on the conveyor belt it is available to the rest of our memory system for about 15 to 20 seconds. Without further intervention, it falls off and can't be retrieved again. Fortunately, further activity in short-term memory can ensure that some of this information is held for longer periods.

The working memory system describes the active processing the brain conducts on conveyor belt items. Metaphorically it is like having robots working over the conveyor belt and selecting some items for further storage. If something on the conveyor belt is interesting or relevant to you, it will be picked up. Generally, the working memory system is able to process between five and nine conveyer belt items at any one time. Information that is selected for further processing is 'rehearsed' which is the process of integrating that data into current information in your long-term memory. If that integration is successful then you will now have information stored in long-term memory.

The Long-term memory system allows us to remember a seemingly infinite amount of information. It also has the ability to store information over very long time periods. The rehearsal process takes items from the conveyer belt and puts them into long-term memory. Imagine the robots doing this by disassembling items on the belt and labelling the individual components with tags and links, both to the other parts and to other relevant items that are already stored in long-term memory. At memory retrieval time the robots reconstruct the item from the individual links that they have stored and then place that reconstructed item back into working memory. A consequence of this process is that memory retrieval is not simply about grabbing some item from an archive, but it is about reconstruction based on the links and tags that your brain generated at storage time. This is one reason why memories can sometimes be inaccurate; the tags or links have become mixed up, either because of events that occurred at storage time, or because of other related events that might have occurred between storage and retrieval. "Now, where did I put my car keys?"

Laura's work acknowledged internationally

PhD student Laura Boddington (Anatomy) won the Presidential award for best basic science poster presentation at the American Society of Neurorehabilitation Conference in Chicago, recently. This award brings the total of awards she has won at conferences to three. In August 2013 she won the Best Poster prize at the Australasian Winter Conference on Brain Research in Queenstown and in May she won the Best Go-Tech Platform Presentation at the Stroke Rehab: From No-Tech to Go-Tech conference in Christchurch.

Laura's work, that she has been showcasing, involves looking at the effects of applying electrical stimulation to the brain on the opposite side from a stroke. After stroke the way the two hemispheres of the brain communicate can be disrupted, so the aim is to try to restore normal communication between the hemispheres with this electrical stimulation. Her results show how this stimulation might allow the areas around the stroke to take over some of the lost functions and help to aid recovery. We look forward to hearing more about Laura's studies as they progress.

Message from our Director

Professor David Bilkey

Although the newsletter tends to cover a fairly eclectic mix of topics, some of you may pick up on a 'Memory' theme running through this issue. Memory fascinates me. How is the brain able to create a physical trace of experience and maintain it in a stable state for retrieval years later? Over the last few decades we have made great progress in understanding how memory depends on changes in the strength of the connections (called synapses) between neurons. More recently we have been able to step back a little and learn about how networks of interconnected neurons store and retrieve memories. This latter work has been recently boosted by the development of a science-fiction-like technique called optogenetics that allows researchers to have fine control over the activity of neurons by turning them on or off with flashes of light. There are several BHRC researchers already using this technique and many more who are leading world-class research that will further our understanding of how memory works. This research ranges from that which examines what factors influence the changes in strength of synapses through to studies of networks of neurons and the way in which they encode the world around us. The clinical implications are numerous. For instance, work within the BHRC into an understanding of the biology of memory is likely to lead to better treatment for memory loss as it occurs in aging-related disorders such as Alzheimer's disease. Somewhat surprisingly, memory impairment is also a fundamental deficit in schizophrenia, and dysfunction in the mechanisms of synaptic change underlie deficits in disorders as diverse as tinnitus and Parkinson's disease. These are all current research areas within the BHRC and we hope to be able to update you on progress in this work over this coming year.

I want to finish with a message from all of the researchers in the BHRC, thanking all of you for your support during 2015. We have appreciated the financial support, the questions, and of course the interest that you have in the brain and in our research. A special thank you as well to Dr Brian McMahon, who is stepping down as our patron after many years in the position. Enjoy your summer and the holiday season!

What's coming up?

International Brain Week March 2016

If your community group is meeting in March and you are looking for a speaker, give us a call. We are keen to have our researchers come out and speak to your community organisation. We have a number of brain related topics that we can share with you in a fun and informative way. Call Jane 03 479 4066 to organise a speaker

Brain Week events in Dunedin from 11 – 18 March 2016. A full programme will be in our February newsletter.

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Do nootropic drugs that radically increase your cognitive abilities, like in the movies, actually exist (and if so, could we send some?)

This was the question in a recent email to the centre. We thought BHRC pharmacology researcher Dr John Ashton's reply was so good we wanted to share it.

Dear Stephen,

Thank you for your question. Unfortunately no such pills exist. The brain is an incredibly well adapted organ that for most of the time is working as well as it possibly can. Nearly every drug that we know of interferes with the brain's efficient functioning, rather than enhancing it. One possible exception is certain medicines that help people who have a particular type of disorder to concentrate. But this doesn't raise the intelligence of healthy people.

The idea behind those movies is that people only use 10% of their brains. This is just an urban myth, and is completely untrue. The brain is an integrated whole, so that all its parts are working together for its complete function. The brain is not like a car where you can turn the accelerator up or down; it is already working very hard just to be conscious.

These movies are appealing because they present us with the fantasy of instantaneous mastery of some skill. But no such instantaneous change is possible. Mastery and skill takes time, hard work, and persistence. It is estimated that it takes about 10,000 hours of practice to make a chess grand master for instance.

The good news is that modern neuroscience tells us that the brain gradually changes as it learns a new skill, and that this is fastest for some subject or task that you are particularly interested in. This means that if you work on learning the skills that are needed to achieve your aspirations, then with time and persistence, it is possible to become an expert in the field that you are most fascinated by.

John Ashton

Looking for a way to give a Christmas gift without getting caught in the commericalism of it all?

Make a donation of $30 or more to the Brain Health Research Centre and we will send a hand written thank you card to your friend or family member telling them of your kind gesture, made in their name.

Yes, I would like to support the Brain Health Research Centre

I would like to give the following gift:

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☐ My cheque is enclosed made payable to the BHRC University of Otago Foundation Trust,

or please debit my: ☐ Visa ☐ Mastercard

Card number: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ Expiry: ☐☐ / ☐☐

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Gifts of $5 are tax deductible. An official receipt will be issued.
You can also donate online, account number 03 0175-0660254-00 or phone 64 3 479 4150.
Brain Health Research Centre, University of Otago, PO Box 56, Dunedin 9054, New Zealand.

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