HEADBOXING Around

2017 has been a big year for the HEADBOX Lab team. We’ve had five projects running throughout the year investigating the way our brains and bodies function for a range of different conditions. We have been exploring people who are at risk of dementia (subjective cognitive complaints and mild cognitive impairment), healthy ageing, women with endometriosis, and pain.

The Team
Our team has grown in size in 2017 and we are excited to welcome some new team members who will be joining us for 2018.

2017 HEADBOX Lab team members:
Dr Genevieve Steiner, Naomi Fagan, Adele Cave, Jack Fogarty, Diana Karamacoska, Lauren Rispen, Mahmoud Al-Dabbas, Osanna Favre, and Madilyn Coles.

You might have also met some of our extra friends from “Team V” our venipuncture (aka vampire) team who are on standby to collect blood samples:
Dr Andy Liang, Dr Mike Armour, Buck Reed, Sindy Kueh, and Joan Nguyen.

We also have a “Minion Team” that our lab could not do without! Our minions are Western Sydney U undergraduate students who are keen to learn more about research by volunteering their time in the lab. They’re an essential part of our team that we couldn’t do without! Our minion team includes:

What does HEADBOX mean?
We measure the electrical activity of the brain with electroencephalograph (EEG). Neurologists often use EEG to investigate a range of neurological conditions that affect the brain like epilepsy, dementia, and stroke. In our lab, the “headbox” is a piece of equipment that our EEG cap plugs in to. Every electrode in the EEG cap has its own channel that plugs in to the headbox. The headbox isolates, digitises, and amplifies the electrical signal that we are recording from your scalp. It works in a similar way to a music amplifier!

Awards & Accolades
Our team’s achievements and successes have been recognised with several awards, prizes, and accolades this year.

Study Updates
Updates on the five projects that our team was running in the HEADBOX Lab this year.

Did you know?
That just because you have risk factors for dementia, it doesn’t mean there is a 100% chance you will be diagnosed later on? Dr. Genevieve Steiner writes about the paradox known as “cognitive reserve.”

In the News
In 2017, our work received a range of media coverage in local papers, national websites, and prime-time commercial television.
Behind the Brainwaves

The aim of the Behind the Brainwaves study is to discover new, inexpensive, and non-invasive “biomarkers” for Alzheimer’s disease.

WHAT’S A BIOMARKER?

A biomarker is a “biological marker” for a process in the body or a particular disease. Biomarkers can be a genes, markers in the blood, or even patterns you can see in types of brain imaging, such as EEG and MRI.

Alzheimer’s disease is the most common type of dementia. We now know that the changes in the brain of people with Alzheimer’s disease occur decades before there are any changes in their memory and thinking.

Because Alzheimer’s disease is progressive and there is no cure, a lot of research is focusing on prevention and early diagnosis. That’s where our work comes in.

The Behind the Brainwaves study is looking at people who have mild cognitive impairment, or MCI. MCI is sometimes thought of as the early signs of dementia. People with MCI have problems with their memory and thinking that you can measure on tests of mental function, but their day-to-day lives are relatively unaffected.

We are interested in MCI because it may provide a special window, where if we can improve the way that we diagnose and treat people, we may be able to slow down the progression or even stop them going on to develop dementia.

It’s important to recognise that there are lots of different causes of MCI, and not everyone with MCI will go on to get dementia. The Behind the Brainwaves study is looking at people with MCI who show a similar pattern to the early signs of Alzheimer’s disease.

Our study is looking at lots of different measurements to see if we can find a way to classify people with MCI compared to people without MCI that are the same age and gender. We want to see if our measurements can predict the changes in memory and thinking that people with MCI have.

We are looking at neuroimaging measures including EEG and MRI. We are also looking at a new type of neuroimaging measure called DTI (diffusion tensor imaging), which allows us to look at the networks of neurons in the brain (see the “brainbow” on page 5). We are also measuring genetic risk factors, markers in the blood that are a sign of inflammation in the body, skin conductance, and we are interested in the cardiovascular system so we are measuring changes in blood flow to the brain with ultrasound, heart activity (ECG), and blood pressure.

This work is important because if we can find a cheap, non-invasive, and accurate way to detect the early signs of Alzheimer’s disease, then we’ll be able to diagnose people earlier and potentially offer them new treatments that may delay the onset of dementia.

In 2017, we had thirty-one people volunteer their time for the Behind the Brainwaves study. Twenty-two people had MCI and nine people were part of our “control group.” The control group is important because it allows us to compare the brain function of people with MCI to other people who are the same age and gender.

To complete this study, we are looking for another ten volunteers with MCI and twenty-three people for the control group.

WE NEED YOU!

The Behind the Brainwaves study is currently ongoing. Is this you?

- Aged 60 years and over
- Right-handed
- Noticed changes in memory and thinking

Email brainwaves@westernsydney.edu.au or call (02) 4620 3278

We are also looking for adults aged 60 years and over who do not have any changes in memory and thinking to be part of our control group.
Our Work

The work we do in the HEADBOX Lab is multidisciplinary. This means our expertise spans across a wide range of areas including psychology, neuroscience, biology, computer science, and statistics.

ASP2017

This year our team with other friends from Western Sydney U organised and hosted ASP2017: the 27th annual meeting for the Australasian Society for Psychophysiology at the Western Sydney U Parramatta City Campus.

ASP President

At ASP2017, it was announced that Gen (left) would take over the reins from Frances De Blasio (right) as she was elected as the new President of the Australasian Society for Psychophysiology (ASP).

Awards and Accolades

We present the work we do at a range of conferences every year. Our favourites are always the Australasian Society for Psychophysiology (ASP) annual conference and the Australian Dementia Forum (run by the National Health and Medical Research Council (NHMRC) National Institute for Dementia Research).

ASP2017 was a great success, and our team was also awarded prizes for our high-quality research.

Best Abstract Award: Adele Cave

Adele was awarded the Best Abstract award for her presentation titled: Eyes-open resting EEG of women with endometriosis versus age-matched controls.

Runner Up Best Presentation by a PhD Student Award: Jack Fogarty

Jack was awarded the runner-up prize for the best presentation by a PhD student. His presentation was titled: Sequential processing and target probability: linking the Go/NoGo and oddball literatures

Best Presentation by an Undergraduate Student Award: Mahmoud Al-Dabbas

Mahmoud gave a great presentation on the work he completed for his 2016–17 Summer Scholarship project: The effect of KIBRA rs17070145 polymorphism on cortical arousal

Runner Up Best Presentation by an Undergraduate Student Award: Madilyn Coles

Madi received the runner-up award for her presentation on her undergraduate research project: The effects on resting state EEG activity of the catechol-O-methyltransferase (COMT) Val158Met rs4680 polymorphism, and the relationship to schizotypy.

INTERESTED IN RESEARCH PARTICIPATION?

Email: brainwaves@westernsydney.edu.au
Phone: (02) 4620 3278
Study Updates

Clinical Trial for Subjective Cognitive Complaints

Between 25–50% of the world’s ageing population experience Subjective Cognitive Complaints (SCCs) such as forgetfulness, difficulties concentrating, making decisions and thinking clearly. People with SCCs don’t show any change on tests of mental function compared to others who are the same age. But, SCCs are linked to an increased risk of dementia.

We are conducting a study to test the safety and efficacy of a herbal and nutritional supplement on older adults with SCCs. The study will look at investigating whether the supplement can improve mental function, mood, fatigue, and brain activity in older adults with SCCs, compared to placebo.

We are currently conducting screening sessions to determine eligibility for the study, as well as contacting a number of interested individuals. **We do require more people to participate, and will continue to advertise for interest throughout 2018.** As the study progresses, we hope to see some improvements in overall cognitive health, mood and fatigue with use of the herbal and nutritional supplement.

FOR MORE INFORMATION

Email: brainwaves@westernsydney.edu.au
Phone: (02) 4620 3278

Clinical Trial for Endometriosis

Endometriosis is the most common cause of persistent pelvic pain, affecting about 10% of women. Endometriosis is the presence of tissue, which is similar to the lining of the uterus, outside the uterus itself. The presence of endometriosis causes significant pain for most women, including severe pain during their period. Currently, most treatment is focused on pain relief, and often requires opioid based medications. These can have significant long-term health effects and often don’t relieve women’s pain effectively.

Acupuncture has been shown in small studies overseas to help reduce pain and the need to take pain relieving medication. Our study is looking at how acupuncture affects women’s pain levels, but also how it might affect the way their brain processes and manages pain.

We have completed our recruitment and are currently just collecting the final bits of follow-up data from our participants. We have not analysed all our data yet but our initial findings show that acupuncture seems to reduce pain amongst women with endometriosis by around 50-60%.

Understanding Pain in the Brain

Did you know that long-term pain resides in the brain? This is because the brain starts to “rewire” when we first experience pain, making some of us more likely to experience long-term pain. This rewiring is called neuroplasticity.

Finding out more about this rewiring straight after we start to experience pain can help us learn about how long-term pain develops. This is important to help prevent people who have had an injury from going on to have long-term pain in their lives every day.

In this study, we investigated how changes in neuroplasticity can predict pain susceptibility in young adults over 21 days. We gave participants an injection in their arm to induce a low level of pain (similar to the pain you might experience after you’ve exercised) and then tracked their brains and pain scores.

We found that people who had a particular type of brain neuroplastic response to pain experienced worse pain and disability. We also found that we could predict the level of pain people experienced from looking at the patterns in their brain activity at baseline. We hope to use these findings to predict an individual’s predisposition to pain.

Clinical Trial for Mild Cognitive Impairment

As we talked about on page 2, mild cognitive impairment (MCI) is thought to represent the early signs of dementia. MCI is a very important stage to target because we may be able to slow down the changes in memory and thinking that people experience, or even stop dementia all together.

In this study, we are using a standardised herbal medicine formula that contains extracts from *Panax ginseng*, *Ginkgo biloba*, and *Crocus sativus* (saffron). The study drug is called Sailingtong (SLT). SLT is also currently being tested in a large international study for vascular dementia. Early studies showed promising findings that SLT may improve thinking and quality of life in people with vascular dementia.

The SLT for MCI trial is currently open for recruitment and we are seeking volunteers until 2019.
Understanding Cognitive Reserve  

by Dr Genevieve Steiner

Changes in the brain as we age

Like our bodies, our brains need to withstand lots of changes as we grow older. Our brains shrink, we lose synapses, and some of the networks in our brains become weaker, whilst others grow stronger to compensate. Just like in our bodies, the structure and function of the blood vessels in our brains change, and there can be less blood circulation as a result. There are also changes in the concentrations of neurotransmitters (the chemicals responsible for sending signals between brain cells), and an increase in oxidative stress.

Our memory and thinking does decline as we age, but some people seem to be more affected than others. We think that cognitive reserve is a potential explanation for these individual differences.

WHAT IS COGNITIVE RESERVE?

Cognitive reserve is a concept that explains why some people can tolerate age and disease-associated changes in the brain better than others.

People with high cognitive reserve seem to have an innate ability to withstand the onslaught of ageing and dementia. They might have lots of signs of Alzheimer’s disease in their brains, but do not have any changes in their memory and thinking.

What determines cognitive reserve?

Population-based studies suggest that cognitive reserve is largely determined by the richness of our environmental experiences. This includes experiences such as our level of education, how much mental stimulation and social interaction we have had across the lifespan, as well as the kind of jobs we have worked in.

Cognitive reserve and dementia

The concept of cognitive reserve has really become of great interest in the field of dementia research. This work has looked at the brains of people after they have died and compared them to their living brain scans and scores from their tests of mental function. The most fascinating finding is that some people who have brains that are filled with amyloid (the toxic protein that is the hallmark of Alzheimer’s disease) had absolutely no changes in their memory and thinking whilst they were alive. Scientists have called this paradox the “cognition-pathology gap” because the brains of people with high cognitive reserve look similar to people with Alzheimer’s disease, but for some reason the cognitive reserve is protecting them against the disease.

What about cognitive reserve in the brain?

This is the million-dollar question! Although we seem to have a good understanding about environmental determinants of cognitive reserve, we still don’t have a good grasp on what is happening in the brain that allows some of us to withstand ageing and mitigate disease better than others.

We think that neuroplasticity, the brain’s ability to rewire may play a role. People with high cognitive reserve may be able to rewire their brains to combat ageing and disease processes. There is also some evidence that the rich experiences people have had throughout their lives may produce more of a neurotransmitter called norepinephrine. We think that norepinephrine may help to protect the brain through a range of different mechanisms. Watch this space as the HEADBOX Lab team has several cognitive reserve studies planned!

White matter tracts in the brain of one of our volunteers with mild cognitive impairment from the Behind the Brainwaves project. This image was captured using diffusion tensor imaging (DTI). We may be able to use DTI to measure cognitive reserve in the future.

Channel 9 News

Gen and HEADBOX Lab collaborator Dr Mark Hohenberg (staff specialist geriatrician at Campbelltown Hospital and Clinical Dean of the Macarthur Clinical School at Western Sydney U) were featured on the Channel 9 evening news in June 2017 talking about the new memory clinic that they are setting up in South Western Sydney.

The aim of the memory clinic will be to improve the diagnosis, treatment, and management of people with the early signs of dementia. Currently, the care for dementia is fragmented. If people receive a diagnosis, quite often this is unsupported. There is little information given about what the diagnosis means and what families can expect.
HEADBOX Celebrations

One of the best things about working in a fabulous team is celebrating the good times together. We had some mid-year festivities in the lab in July, then a barefoot bowls challenge at “The Bowlo” (Scarborough-Wombarra Bowling Club) in December.

If you’ve participated in one of our research studies, you’ll probably recognise that Naomi’s desk doubles for testing and a kitchen.

At our end of year celebrations, we found out that Lauren represented her school at lawn bowls. We immediately deduced that Lauren must be a national lawn bowls champion. Lauren impressed us with her vast knowledge on what the white ball was called (a jack!) and which way up the mat goes (white side up!). Turns out, Adele’s boys were actually better than all of us.

Adele managed to do more venipunctures this year than all of Team V, earning her the well-deserved title of Lord of Blood, much to Mike’s disappointment. Other awards on the day were:

**Best Trainer: Lauren Rispen**
Lauren has successfully upskilled our team on carotid artery ultrasound. Lauren is a true leader and a great teacher – keep your eye on her!

**Best Minion: Mahmoud Al-Dabbas**
Mahmoud has put countless volunteer hours into helping with various HEADBOX projects throughout the year. Mahmoud has officially taken Diana’s place as head minion; Diana will remain as the original minion aka filet mignon.

**Best Problem Solver: Jack Fogarty**

We are very excited to be welcoming some new team members into the folds for 2018. Elana Andrews-Marney was awarded a 2017–18 Summer Scholarship and will be completing a project on a genetic risk factor for schizophrenia and bipolar disorder. Elana will be exploring how a genetic predisposition for psychosis affects brain function in young adults.

We have two new Honours students from the University of Wollongong, Sapphire Love and Katherine Joannou completing their 2018 Honours projects with us. Sapphire and Katherine will be exploring differences in the brain function of women with endometriosis compared to age-matched controls. This project will hopefully shed some light on the neuroplastic changes in the brain that occur with chronic pain in women with endometriosis.

**Welcome Elana, Sapphire, and Katherine!**

**THAT’S A WRAP!**

Thank you for your involvement in our research throughout 2017.

We look forward to letting you know more updates about our team’s activities and exciting new findings in 2018 and beyond.
Thank you to all our study volunteers, collaborators, and funders of our research.