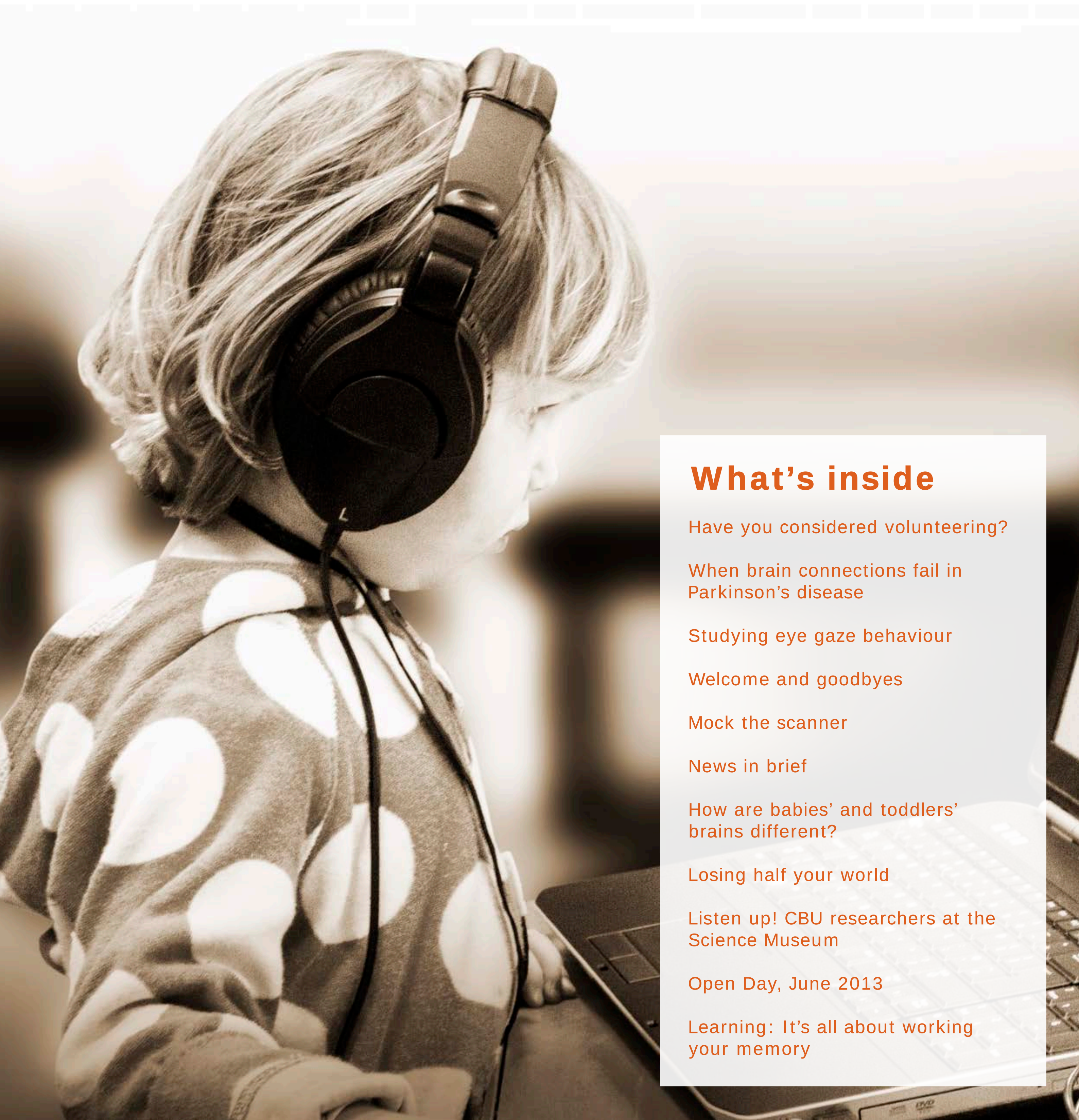
June 2013

MRC | Cognition and Brain Sciences Unit

MEDICAL RESEARCH COUNCIL COGNITION AND BRAIN SCIENCES UNIT

NEWSLETTER



What's inside

Welcome to the CBU

At the Cognition and Brain Sciences Unit (CBU) we study human cognition and the brain. The Unit has about 90 researchers and postgraduate students investigating topics such as attention, emotion, language and memory. We are funded by the Medical Research Council whose aim is to turn scientific knowledge into benefits for health and well-being. For example, we are developing new treatments for depression, improving hearing through cochlear implants, and helping children to overcome memory problems.
With a large collection of scientists engaged in both basic and translational research on the mind and brain, the Unit provides an exceptional training and academic environment that benefits postgraduate students and researchers at all levels.

Most of our work takes place at the Unit's Chaucer Road site, which houses the majority of our staff and our laboratory facilities.
A significant part of our research makes use of brain imaging and we have excellent on-site facilities for magnetic resonance imaging (MRI) magnetoencephalography (MEG) and electroencephalography (EEG). We also have clinical facilities at Addenbrooke's Hospital.
The Unit has close links both with the hospital and with Cambridge University.

Have you considered volunteering?

If you're reading this it could be because you've already been to the Unit and participated as a volunteer in one of our studies. If so, you've already done more than most people do to help our researchers advance their studies into many of the diseases and conditions that affect us all throughout our lives. At the CBU we would be unable to continue our work without your support - but we still need your help. We ask you to keep spreading the word. Statistics show that our biggest recruitment aid is you, i.e. word of mouth. So, keep telling your friends and family about your experiences of volunteering at the Unit and encourage them to join the Panel.

If you're new to the idea of volunteering for our research please read on...

Our volunteer panel, established over 30 years ago, is a unique resource within the neuroscience community in Cambridge. With several thousand volunteers of all age ranges it is an invaluable pool of volunteers for our researchers – but we always need new people to join. Many of our researchers need to test up to a 100 different people for a particular project without using the same person twice, which is why we need a constant supply of new volunteers.

So, if you've already been to the Unit and participated in a test – why not come again and do another one soon – and you don't have to wait for us to contact you. You can sign up for studies directly on our online system, and may even be able to find two studies happening at the same time and come with a friend.

If you're reading about us for the first time, or have been thinking of volunteering but 'putting it off' – take action now! Most people find it a rewarding experience and enjoy learning a bit more about 'brain science'. Our researchers will always be happy to explain their study to you and will never expect you do anything you are not happy with.

One valued volunteer who was recently interviewed for a University article was quoted as saying: 'Since I started volunteering 10 or 12 years ago I've become really interested.....one study I did was about early-onset Parkinson's disease. I had to do a series of brain-hand coordination tests and these were repeated while I was in an MRI scanner. In the waiting room I met the wife of a patient and realised that my volunteering was having a real impact on people with diseases like Parkinson's. It really hit home,' she says. Therefore, if you too want to make a difference, make this the year you do something positive for research.

Sign up for studies now:
http://mrc-cbu.sona-systems.com or contact our Panel Manager on 01223 355294.

When brain connections fail in Parkinson's disease

Charlotte Rae, PhD student

When Helen wakes up each morning, she takes four different pills, and will take them again every three hours until she goes to bed. If she forgets, she finds it difficult to walk, notices her left arm shaking uncontrollably, and can't speak properly. Helen has Parkinson's disease, and to stave off these symptoms she will need to take her cocktail of medicines every three hours, every day, for the rest of her life.

Parkinson's affects one in every 500 people, and is currently incurable. Unfortunately, while the physical symptoms are strikingly obvious, the causes of the disease are less clear.

We do know that in Parkinson's patients brain cells, or neurons, that use a chemical called dopamine start to die. In healthy people a region deep within the brain, called the basal ganglia, uses dopamine to make and control movements. In people with Parkinson's, the dopamine-using neurons in the basal ganglia are gradually lost as the disease progresses. This can happen in people as young as 40, although it is more common in those aged over 60. As the loss of these neurons continues, the symptoms get steadily worse. Patients find it increasingly difficult to perform even basic tasks like making a cup of tea or buttoning up a shirt.

Because the human brain is one big network of neurons, loss of dopamine cells in just one area can affect how the rest of the brain works. This means that in Parkinson's disease, cells dying in the basal ganglia can have far-reaching consequences for how the whole brain functions and result in a spectrum of debilitating symptoms. As well as the movement difficulties, patients can also experience sleep problems, depression, and trouble with behavioural control.

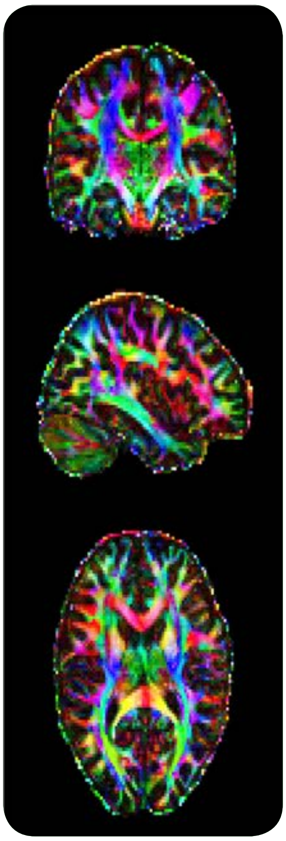
I have been looking at how Parkinson's disease affects these far-reaching connections between brain cells. To do this I use a technique called diffusion MRI scanning to produce maps of brain connections in living people, without the need to cut up and examine their brain tissue under a microscope. Diffusion MRI scans are collected on a doughnut-shaped brain scanner, with the patient's head placed in the centre. The diffusion scans work by measuring the movement of water molecules in patients' neurons, which gives us an indicator of how strong the brain connections are.

Handily for the patient volunteers, these non-invasive scans take only 10 minutes, meaning that we can gain new insights into the disease without them having to undergo lengthy or uncomfortable tests. And unlike MRI scans which measure brain activity, patients don't need to perform a task while being scanned — they can have a nap instead.

Our results so far have shown that the brain connections in the frontal lobe, the part of the brain responsible for deciding on an action and planning it, are being degraded in Parkinson's. When neurons in the basal ganglia die, the connections between the basal ganglia and frontal lobe are lost. This means that decisions about movements, processed in the frontal lobe, can't get to the basal ganglia — which is crucial for making and controlling those movements.

The next step is to use the diffusion MRI technique to look at how the brain connections change over time as the disease progresses. If patients come back for repeat brain scans, then we can compare these over the years with their symptoms and build up an even clearer picture of how the brain is affected by this devastating disease.

One thing we do know is that when searching for treatments for Parkinson's disease, researchers will need to focus not just on preventing neurons from dying, but also on the damage that occurs to the connections between them. The brain only works in harmony as a sum of its parts, so as researchers, we need to continue investigating how to get the whole brain network back in balance.



A diffusion MRI scan of Charlotte's own brain, showing three cross-sections. The colour-coding indicates the direction of the brain connections: blue connections travel between the top and bottom of the brain; green connections travel between the back and front; and red connections travel side-to-side.

Studying eye gaze behaviour in a real social interaction

Naomi Bright, Elisabeth von dem Hagen and Andy Calder

Eye gaze is an important component of social interaction and responding appropriately to others' gaze is essential to understanding the thoughts and feelings of others and interacting successfully. For most of us this process comes naturally. For individuals with autism spectrum conditions (ASC) however, social interactions can be complicated and uncomfortable situations, as they struggle to interpret or attend to others' gaze. Previous research suggests that typical individuals show a strong preference for the direct gaze of others, an important source of social information. However in individuals with ASC, eye contact does not seem to hold the same social meaning, which may underlie or exacerbate their difficulties with social situations.

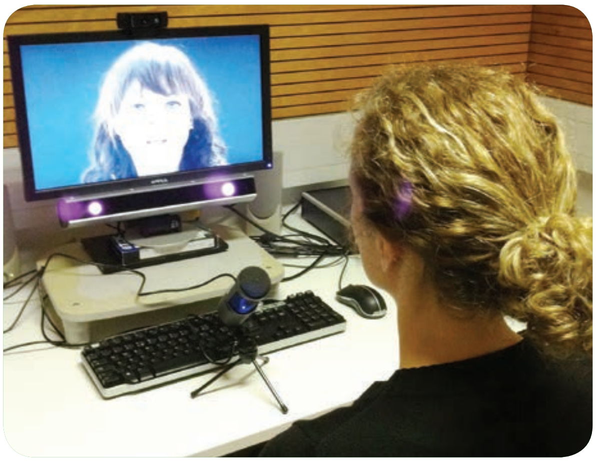


Image 1. The video chat setup.

Traditionally, researchers have attempted to understand eye gaze behaviour by asking participants to view static pictures of faces with different gaze directions. The benefit of this approach is that every participant sees exactly the same images for the same amount of time, but this approach underestimates the complexity of real world situations. For example, imagine how you might inspect a photograph of a face. Now imagine inspecting that face when it belongs to a person standing directly in front of you, knowing they can see you looking at them! We think that people's gaze behaviour changes when they are placed in a situation with scope for social interaction. To study this we have designed a novel experiment in which participant and experimenter interact in real-time whilst monitoring the participant's eye gaze behaviour.

Image 2. Example heat map showing where people typically look when viewing a face. 'Hotter' colours represent areas of particular attention.

In our study, CBU panel members communicate with an experimenter using a video chat setup consisting of webcams and microphones, whilst sitting at a computer in a different room to the experimenter (see image 1). By using an eye-tracker, which precisely determines where the participant is looking, we can study the participant's gaze behaviour in a real social interaction (see image 2). The aim of this study is to investigate whether the presence of another person affects the way we look at and extract social cues from their eyes.

We are also interested in whether gaze behaviour in social situations affects participants with ASC differently. Our hope is that this will contribute to our understanding of social difficulties in ASC.

We would like to thank all of our participants for their help with this research.

Welcome!

Emily Holmes and team

Professor Emily Holmes joins us from the University of Oxford as a programme leader and senior scientist, having originally done her PhD here in 2005. Emily is a highly respected figure in the world of psychology, winning many prizes and publishing widely. Her overarching research interest is investigating mental imagery and emotion in psychopathology for cognitive therapy. Emily has recently recruited Simon Blackwell and Martina di Simplicio to join her team, and will be taking PhD students from October 2013. We are delighted to welcome Emily, Simon and Martina to the CBU.


Emily Holmes


Simon Blackwell


Martina diSimplicio

PhD students at the CBU

Each October we have a new intake of PhD students here at the CBSU, coming from all over the world to perform research at the Unit and to gain their PhD from the University of Cambridge. Over the last year we have welcomed four new faces, including three MRC funded students, and one funded by the government of Chile. MRC funded students are fully supported through three years of study, with the places restricted to UK nationals and other EU candidates who have lived in the UK for three years prior to study. One of our new MRC-funded students, Francesca, is already well known around the Unit having worked here as a Research Assistant for two years before deciding to do her PhD here too. The new students are already taking part in Unit research and conducting their own experiments, working on such diverse topics such as depressive disorders, pitch perception for cochlear implant users, fluid intelligence and unconsciousness.


Francesca Biondo


Alex Billig


Anna Bevan


Andres Canales-Johnson

Goodbyes

We lost a few well-known members of staff over the last twelve months. Friedemann Pulvermuller, senior scientist at the Unit for many years, has moved to the Frei Universitat in Berlin to continue his work on language, and Eileen Sanderson, a familiar face on Reception and in the Front Office has retired to spend more time with her family, after 27 years with the MRC. Many others have passed through but those two have left behind particularly hard to fill spaces.


Eileen Sanderson


Friedemann Pulvermuller

Mock the scanner

Marta Correia, Physicist

A significant part of our research at the CBU makes use of brain imaging and we have excellent on-site facilities for magnetic resonance imaging here, including our recently installed mock-MRI scanner room.

Magnetic Resonance Imaging (MRI) is a very powerful medical imaging technique which opens a window into the brain by allowing us to obtain detailed images of brain anatomy, as well as information about neural activity during a particular task.

In order to get good quality images, we need to make sure our subjects are comfortable enough in the scanner to be able to lie on their backs and be very still for up to 90 minutes. Any head movements, no matter how small, will result in poor quality images which may not be usable. If you now take into consideration that one hour in the scanner costs about £500, you will begin to understand why we decided to install our new MRI mock scanner!

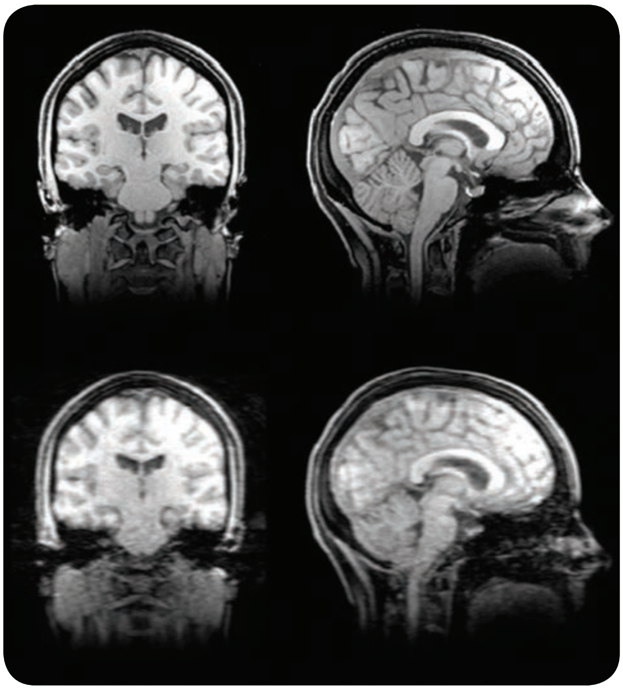
In the mock scanner we simulate a realistic scanning environment where participants can undergo practice MRI sessions. This includes the MRI 'tunnel', the coil which goes over your head, headphones, button boxes and all the other bits of kit which you will have around you during an experiment in the MRI. These practice sessions allow for participants to become accustomed to the setup before the real MRI session takes place, helping to reduce anxiety and ultimately resulting in calmer and more compliant subjects who are less likely to move during the MRI scan and/or drop out before the experiment is finished. This period of acclimatisation is particularly important for special populations such as children and the elderly, who are more likely to suffer from anxiety or claustrophobia. Studies have shown that the percentage of usable data in MRI experiments with children can be increased to 90% from 20-50% if a preparation phase involving a mock scanner has been implemented.

Another potential source of discomfort during an MRI scan is how loud it gets, and if you have ever been in a MRI scanner I am sure you know what I mean! MRI scanners are made up of very large coils which generate a strong static magnetic field (about 600 times stronger than a fridge magnet and 50,000 times the Earth's magnetic field), which remains switched on 24 hours a day, 365 days a year. When the scanner is acquiring data, a different set of coils (called the gradient coils) generate weaker and spatially varying magnetic fields, which allow the machine to differentiate between signals coming from different parts of the brain. All the loud banging and beeping occurs during the rapid changes of currents within the gradient coils necessary to generate these spatially varying fields. The physics gets a little complicated now, but basically these currents interact with the static magnetic field and generate forces which result in motion and vibration of the gradient coils as well as their surroundings. Depending on the type of images being acquired, the noise levels can reach up to 120 dB (which is equivalent to a jet at take-off).

During an MRI scan you will be given ear protection in the form of earplugs or noise attenuating ear defenders so that there is no risk of harming your hearing. However, some people are still more sensitive to noise than others, so in order to make sure our participants are comfortable we have recorded the noise from the real MRI scanner and can play it to subjects in the mock scanner through headphones, hence reducing the dropout rate if the subject is not able to cope.

If you have read this far, you are probably thinking that going in an MRI scanner sounds like a very intimidating experience, and there is no way you would ever volunteer for one! So before I finish I feel I should say a few kind words about MRI.

MRI has been around since the 1970s and over the last 40 years it has completely revolutionised the field of medical imaging. Firstly, there are no side effects resulting from overexposure, in contrast with X-rays and CT scans where the subjects receive a significant dose of radiation. Secondly, it has been used to aid diagnostic and monitor treatment in a number of medical conditions, including degenerative diseases, stroke, and tumours, amongst many others. Moreover, the use of MRI in cognitive research has contributed to ground breaking advances in understanding how the brain works. And lastly, believe it or not, many of our subjects are comfortable enough to fall asleep while in the scanner, so surely it cannot be all that bad!



Effects of head motion in MRI data quality - Still images above, motion images below

News in brief

1. Cambridge Science Festival – Science evening at CBU

A full house of visitors enjoyed an entertaining and educational evening of demonstrations and lectures at the CBU science evening held in March. Our annual event titled "A window on the brain" is given as part of the Cambridge Science Festival and features lectures from three of our leading scientists highlighting our varied research, plus the chance to take part in some of our experiments exploring how the mind and brain work, with time to meet the scientists and students doing the research. Hands-on activities are run for the first hour, followed by three short talks. See elsewhere in this newsletter for information about our MRC Centenary Open Day being held in June 2013, which will be even bigger and better.

2. Susan Gathercole awarded Suffrage Science prize

Director Susan Gathercole was presented with a bespoke jewellery heirloom as part of Suffrage Science event celebrating women in science held on International Women's Day, March 8th 2013. Previous winners also include the CBU's new programme leader Emily Holmes.

Awards for CBU staff and students

3. John Duncan receives Heineken award

John Duncan received the prestigious Heineken Prize 2012 from HRH Prince of Orange, Crown Prince of the Netherlands, as part of a week of celebrations and events. John becomes Laureate of the Dr. A.H. Heineken Prize for Cognitive Science for his remarkable innovative, multidisciplinary research into the relationships between psychology, behaviour and intelligence on the one hand and neural processes on the other. His concepts have become a cornerstone of cognitive neuroscience.
A video portrait of John, made by Henk Visser/Heineken and shot in the garden at the CBU is now available on Youtube.

4. New MRC funding scheme rewards Early Career Scientists at CBU

Four CBU scientists will receive additional funding under a new scheme launched to mark the MRC Centenary in 2013. Richard Meiser-Stedman, an MRC funded Clinician Scientist Fellow based at the Unit, will use his award to further his work on understanding the nature of Post-Traumatic Stress Disorder and developing early stage treatments; Michael Ewbank, a CBU post-doctoral scientist, will investigate understanding the functional architecture of face processing in humans using transcranial direct current stimulation; Elisabeth von dem Hagen, also a CBU post-doc, will research linking gaze behaviour in a real social interaction with the cortical response to eye gaze; and Ediz Sohoglu, a completing PhD student, will investigate brain connectivity underlying successful perception of degraded speech. All four awards are made under the MRC Centenary Early Career award scheme and CBU is delighted to support these four excellent research projects.

5. Emily Holmes wins Humboldt Foundation award

Emily Holmes, senior scientist at the CBU, has recently been awarded €45,000 as a Friedrich Wilhelm Bessel Research Award from the Alexander von Humboldt Foundation, Germany. The award is given in recognition of Emily's past accomplishments in research and teaching.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6. Young Investigator Award for CBU scientist

Dr Matti Stenroos, a post-doctoral scientist in the Methods group, has been awarded the Young Investigator Award in the category of modelling and methods at the Biomag 2012 conference in Paris. Matti develops methods that allow us to estimate electrical brain activity from non-invasive measurements of electric potentials and magnetic fields outside the head, as measured by EEG and MEG, respectively. These methods are fundamental for many researchers using EEG and MEG methodology in cognitive neuroscience.

7. PhD student awarded British Academy fellowship

Dr Johan Carlin, previously a PhD student and now a Research Associate at the Unit, has been awarded a post-doctoral fellowship from the British Academy. Johan will collaborate with Dr Nikolaus Kriegeskorte, a programme leader at the Unit, in a project that explores how social information about a person shapes brain responses to their face and voice. The fellowship was awarded following a competitive application process in which fewer than 5% of applicants were successful.

8. PhD student gains Girton College research fellowship

Nadja Tschentscher, a third-year PhD student at the CBU, has just received a Research Fellowship in Science from Girton College, University of Cambridge. This will allow her to carry out post-doctoral research at the Unit for three years after her PhD. Focusing on EEG/MEG methodology, Nadja will investigate brain oscillations and network connectivity in mental arithmetic and other problem solving processes.

9. PhD student wins EPS Frith Prize

Dr Aidan Horner, a former PhD student of the CBU, was recently awarded the Experimental Psychology Society (EPS) Frith Prize for 2013, which is given for outstanding PhD research. Aidan will be giving a prize lecture at the Lancaster meeting of the EPS in April.

Aidan, now at the Institute of Cognitive Neuroscience, UCL, said: "I am honoured and humbled. I have always admired the EPS, a society that sparked my interest in experimental psychology". His former supervisor, Rik Henson, said "I am delighted for Aidan, who was truly an exceptional student".

10. PhD student wins Neuroscience poster prize

Corinne Bareham, a second year PhD student won the Neuroscience Award for the best poster at The Association for the Scientific Study of Consciousness (ASSC) 16 Conference in Brighton in July last year. From around 300 posters in total, submitted by an international field of researchers from Neuroscience, Psychology and Philosophy, Corinne was awarded the Best Poster prize for the Neuroscience section. Her poster described an EEG study examining changes in awareness as people transition in and out of sleep.

We would like to congratulate all our recent winners and achievers.


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How are babies' and toddlers' brains different? And how does this affect what kinds of TV they like to watch?

Sam Wass,
Post-doctoral scientist

How are babies' and toddlers' brains different? And how does this affect what kinds of TV they like to watch?

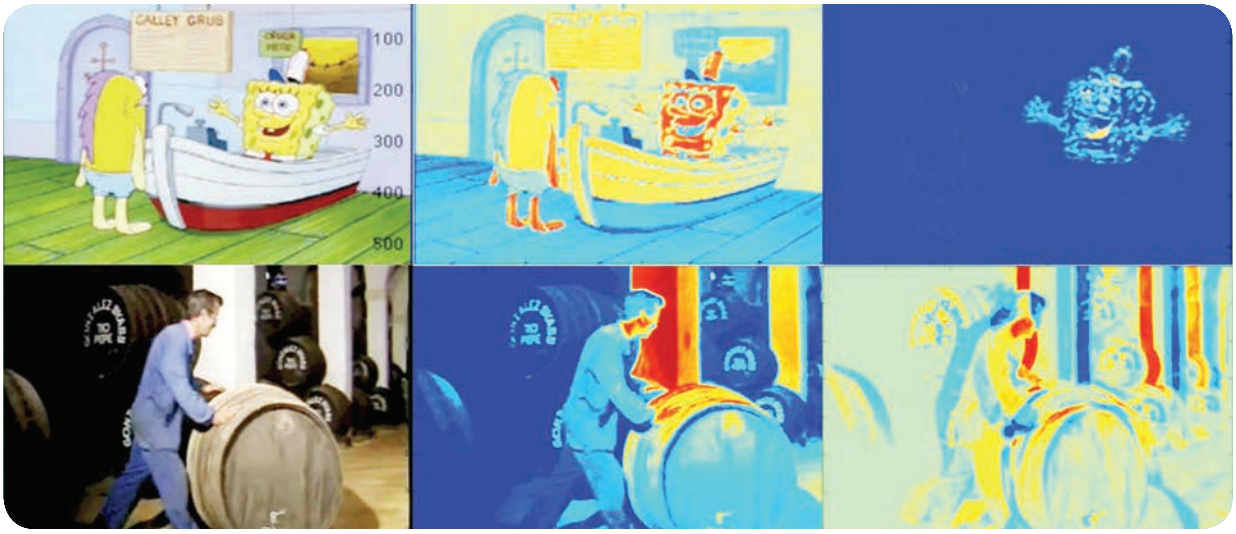
William James, an American psychologist writing in 1890, proposed that babies experience the world as a 'blooming, buzzing confusion'. Recent research into brain connectivity (the study of how different parts of the brain talk to each other) has suggested that he could have been right. Whereas an adult's brain has different regions specialised for performing different tasks, in an infants' brain it appears that lots of different regions have a go at performing most tasks that get thrown at them. Imagine that a lightbulb needs changing and everyone in the room jumps up and says 'Me! I can do it! I'll have a go!'. That's pretty much what a baby's brain is like.

How does this affect what the world feels like from the point of view of a baby? Well, we think that it's probably similar to what the world feels like when you get very old, when your hearing starts to go. When you've got a clean signal (i.e. when there's just one person talking with no background noise) then you can hear just as well as you always could, but when it's a noisy signal (i.e. when there are lots of other people talking in the background), that's when it becomes difficult to pick out the voice you are interested in. This idea of a 'noisier' brain - i.e. one that's not so good at filtering out important from unimportant information - impacts in other ways, too. For example Research has suggested that adults can identify different images when they are presented up to a speed of 10Hz (i.e. 10 different images per second), whereas the maximum speed that a baby can cope with is 1Hz (i.e. 1 image per second). If information is presented faster than that, then babies' brains can't process the information fast enough to cope.

Babies' brains are noisier and less efficient at processing information. This means that they experience the world very differently to how an adult does.

It's important that the designers of TV programs aimed at babies or toddlers understand these differences. The average 0-6-year-old spends 80 minutes per day watching television, and 15% of 5-year-olds watch more than three hours a day. This means that TV is potentially a very powerful learning tool for teaching things to children, if we can work out how to design it effectively. But research has suggested that the TV programs we have at the moment aren't very effective at teaching things such as language to babies and young children. So what can we do to improve it?

The top picture is from In The Night Garden from CBeebies (aimed at 0-6-year-olds), the bottom is from Gossip Girl, made by the CW network (aimed at teenagers/adults). From left to right we have tried different ways of 'automatically identifying visual features in the image. The left is the original frame, the second shows a Gaussian blur, the third shows just the edges, and the fourth shows the feature congestion (the areas where there are abrupt changes in luminance and colour). On each of these images the key features (ie the edges of the face and the eyes) are still clearly visible in the baby TV sample but are not visible in the adult TV sample. This suggests that the simplified faces of the baby TV characters may be easier for babies' immature visual systems to process.



The top picture is from Sponge Bob from Nikleodeon, the bottom is from a BBC news program. The left shows the original frame, the middle shows the luminance (brighter areas are drawn red and darker areas blue), and the right shows the movement (areas with higher movement are drawn blue). In the top image, the frame has little movement other than the character who is speaking - so the movement is guiding the child's attention to where to look. In the bottom image (which is from a panning shot) there is movement all over the frame, so the movement doesn't help you in deciding where to look. Our analyses suggested that most baby TV appeared to be designed like the top sample, and most adult TV like the bottom sample.

With a colleague of mine, Tim J. Smith, from Birkbeck College in London, I've just written a paper that looks at this. Tim does research looking at the role that different types of visual information play in deciding where we look. The information that reaches our eyes has different types of information bundled into it - ranging from luminance (which parts of the image are brighter than others), colour, through to edges (what are the points where one object stops and another starts) and movement. Research has suggested that these different types of information are processed in different parts of the brain, and Tim's research has suggested that some of these types of information are more important in deciding where we look than others. The biggest guiding factor in helping us decide where we look is motion - our eyes are always drawn to motion, sometimes whether we want it to or not. If you have ever tried to concentrate on reading a book with the TV on in the background, or if you have stood waiting for a train on the London underground and tried not to look at one of the video advertising screens there, you may agree with this already.

Babies' brain are less efficient at processing information. This means that they experience the world very differently to how an adult does.

How does this relate to TV aimed at preschool children (what we refer to as Tots TV)? Well, Tim and I decided to look at whether the structure of low-level information (luminance, colour, edges, movement) differs between Tots TV and adult TV. In particular we wanted to see whether there are differences between Tots TV and adult TV in how low-level information is used to guide attention to the most important part of the screen, which most often was the face of the speaking character. We looked at two different types of visual information – first we looked at luminance, colour and edge contrasts and second we looked at motion (see images opposite and above).

What we've shown in this research is that Tots TV uses subtle attention cues to guide information to the correct parts of the screen - so that babies look at the right part of the screen even though they don't necessarily understand why they're looking there. Put another way, cartoons are easier for babies', with their noisier brains, to understand. As far as we can tell this is the first scientific explanation of why so many of the most popular kid's TV programs are cartoons.

Of course, this is just a start in attempts to use developmental cognitive neuroscience to help us to understand the design of Tots TV. Another thing that we're hoping to investigate in future is the short and long-term impact TV has on a child's concentration. Recent research has suggested that watching short clips of fast-paced cartoons may make children perform more poorly on concentration tests - but nobody understands why certain types of TV might hurt your concentration abilities. Given how much TV the average child watches, we think that these are really important questions, and we're hoping to look into them in future research at the CBU.

Losing half your world

Polly Peers, post-doctoral scientist

In her mid-forties a healthy, active mother lost half her world. The sudden onset of an acute headache out of the blue prompted her to call her husband and an ambulance. Following life saving surgery at Addenbrooke's Hospital to repair a burst blood vessel in her brain, she awoke in hospital to be told she might never walk or talk again. She spent two years at a rehabilitation centre regaining her speech, and improving her mobility and independence. Despite these improvements she was left with limited use of her left arm and leg. Added to this was a striking 'neglect' of one side of the world. This inability to direct her attention to one side of space, left her unaware of much of the world and makes it difficult for her to carry out everyday tasks. Eating a meal, for example, may seem straightforward to most of us, however, she will often fail to eat the food from one side of her plate, and jokes that her husband knows if he places the plate in front of her correctly he can eat her chips without her noticing! Now, over a decade later, she, and others like her are helping us to see whether we can improve attentional skills in patients with 'neglect' and reduce disability.

'Neglect' of one side of space is relatively common following stroke, and as this woman demonstrates for some people it can be a very long lasting, and debilitating condition. Unsurprisingly, as the spatial difficulties are so apparent in patients with 'neglect', current rehabilitation strategies tend to focus solely on trying to improve spatial awareness. Sadly, the rehabilitation strategies currently available have had limited success and none has been shown to make a clinically relevant difference to patients lives.

Previously, we and others have demonstrated that individuals with 'neglect' have problems with other attentional skills in addition to their spatial difficulties. For example they find it more difficult to selectively attend, or focus, on things that are currently important, in other words they are more distracted by things that are currently not relevant them. Additionally, they often appear to have visual memory difficulties and so they recall less information than healthy individuals. These problems, though less easily observable could nonetheless have a considerable impact on their spatial problems.

Our current work is aimed at seeing whether daily internet based training focused on improving either selective attention or visual memory skills will help patients with neglect, not only in improving their spatial awareness but also in their everyday lives. Giving affected people back half their world is the ultimate goal.

Listen up! CBU researchers at the Science Museum in London

Matt Davis, Programme Leader

What's the difference between a bear and a pear? Knowing which one is hiding at the bottom of your fruit bowl is clearly important in everyday life! Being able to hear the small acoustic differences between spoken words is just as important. Listeners need to distinguish between the sounds in these words to understand speech, and we make rapid and tiny changes to the movements of our lips, tongue and larynx when we are speaking.

Keen voluteers taking part in the listen up experiment

Although hearing the difference between these words feels easy and effortless in your native language it can be very difficult to hear similar differences between spoken words in a second language, particularly if you learn that language in adulthood. This is one of the clearest examples of 'critical periods' for learning that we encounter in our everyday life. People who learn a language in adulthood carry with them an audible trace of their early life experience in a detectable foreign accent. In contrast, those who learn a language in childhood (typically before the age of 10) are able to acquire a fully-native sounding accent. However, we don't really understand how children can so readily learn to do something that adults find impossible. Or what changes in the brain as you grow up prevent learning.

In order to learn more about the listening skills that children and adults use in understanding speech, a group of MRC scientists led by Matt Davis set up a test of speech perception at the Science Museum in London. Between the middle of January and the end of March the CBU team asked visitors to the museum to "Listen Up!" to measure how able they were to hear small acoustic differences between spoken words, like bear and pear. Nearly 3000 visitors took part in the experiment, including children under 5 and an 84-year old great grandparent. By comparing results among speakers of different ages and with different language backgrounds, we can now can begin to answer key questions about what changes as children grow up that help or hinder language learning. We hope to report our findings soon.

MRC Medical Research Council
CENTENARY 1913-2013

Cognition and Brain Sciences Unit

Open Day

Saturday June 22nd, 10am-4pm

The Medical Research Council celebrates 100 years of life changing discoveries in 2013. Come and find out more about world-leading research on the mind and brain at our centenary Open Day.

- **Lectures**
- **Guided lab tours**
- **Hands-on experiments**
- **Exhibits**
- **Children's activities**
- **Meet the scientists**
- **Explore our history display**
- **Find out about volunteering**
- **Tea room**

Free and open to all, no booking required

For more info: www.mrc-cbu.cam.ac.uk

15 Chaucer Road, Cambridge, CB2 7EF Tel:01223 355294

Learning: It's all about working your memory

Joni Holmes, Francesca Cormack, Agnieszka Jaroslawska, Sally Butterfield and Susan Gathercole

Sally Butterfield working with some of our younger participants

We, the Working Memory Group, have been at the CBU for just over 18 months. During this time we have been busy setting up our new research programme. This has involved a lot of planning, a great deal of time getting to know local schools and plenty of hard work, but we've had lots of fun along the way!

We are interested in an important aspect of cognition called working memory. This system enables us to hold information in mind for short periods of time and use it, or other relevant information, in the course of our ongoing everyday activities. It is an active mental workspace that we use for almost everything, from understanding what we hear and read to focussing our attention or following directions. Children with disorders such as ADHD or dyslexia often have impairments in working memory. Similarly, many children who do not have a diagnosed disorder but who are struggling in reading and maths at school have working memory difficulties. It has been suggested that poor working memory skills cause many of the problems these children face in learning, following instructions, and maintaining focussed attention.

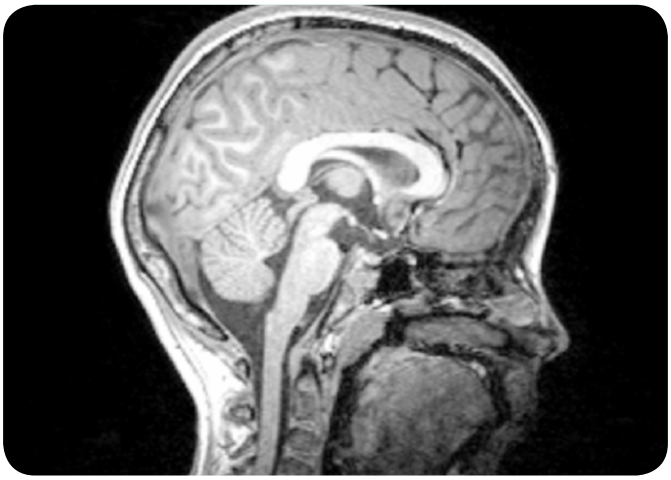
Promising research conducted by researchers at the CBU (Joni Holmes and Susan Gathercole in one team, and Susanne Schweizer and Tim Dalgleish in another) suggests that it might be possible to improve working memory skills. Using computerised training programmes that increase in difficulty as the trainee becomes more proficient, we and others have shown that a person improves not only on the tasks on which they practice, but also on other working memory tasks. In our work in schools, we are currently investigating whether training leads to improvements in other areas of a person's life that depend on working memory.

One of the goals of our current work is to identify the causes of the working memory problems that some children have. To help do this, we have developed an assessment tool, the Working Memory Diagnostic Instrument (WMDI) which is part of the Cambridge Brain Sciences website that the CBU has helped set up. The WMDI consists of 12 tests of different mental abilities that children complete online. Their performance should enable us to determine whether a child has a core difficulty in working memory or elsewhere in the cognitive system. Over the next few years we will be using the WMDI with various groups of children with reading, language, maths, memory and attention problems.

Over the past 12 months we have been busy working in Cambridge primary schools. Here we have started to select different groups of children for a study that is investigating both the causes of working memory problems and whether they can be overcome with training. We are currently working with a group of children who have language difficulties, who are now engaged in memory training in school with Sally Butterfield. Over the coming years, we will continue to recruit different groups of children to this study.

One of our working memory trainees

Children who are recruited to our memory training project will also be invited to the CBU for a brain scan, if they would like to do this. Francesca Cormack is currently leading this part of our work, which will help us understand how strengths in memory and attention link with the structure of the brain. For this study, the children lie in the scanner and watch a cartoon while the scanning takes place, so that they are relaxed and distracted. At the end of the scanning session the children are given a picture of their own brain, which they're usually very keen to take in to school the next day.



A scan of one of our younger participant's brain showing some of the structures important for learning

Children making "brain hats" at a local primary school

We also want to understand how working memory problems have a practical impact for the children as they are learning in school. Our previous research indicates that children with poor working memory skills have particular difficulties in learning activities in which they have to remember large amounts of information, in carrying out lengthy instructions and in keeping track of their place in complicated tasks. A new PhD student, Agnieszka Jaroslawska, is investigating these problems using a new virtual reality task, My School, which we have developed with researchers from the universities of Aberdeen and Leeds to simulate some of the memory demands of the real classroom. Part of this will involve the child 'travelling' around the school following instructions given by a virtual 'head teacher'. Agnieszka is interested to know how important working memory and other mental abilities are to performing this task.

A scene from the My School virtual reality environment

To increase public awareness of our work and share our scientific discoveries, we regularly visit schools to host INSET days and run fun learning sessions with children. Most recently, we visited a Cambridge school to teach a class of Year 4 children (8 and 9 year olds) about the brain, neuroplasticity and memory training. The children had great fun making anatomically correct "brain hats" and trying out some of the working memory training activities!

An important new development at the CBU is the creation a new facility for research on children and learning. The new Centre for Attention, Learning and Memory (CALM) is located in a separate building on the Chaucer Road site. It consists of rooms suitable for working with children, and a pleasant waiting room area for families. We have many exciting plans for the new Centre. It will provide a great location for research on how children's mental skills - such as remembering and paying attention - develop as they grow older. Also, many of our scientists want to understand more how some children have difficulties in these areas that make it harder for them to learn. The Centre will make it possible for us to work with them and their families to help overcome these difficulties. We have already opened the doors of CALM to babies, and will be using lots of new fun methods that we hope will help their development.

One of the first of many children to use the new Centre for Attention, Learning and Memory