Introduction

The Wales Autism Research Centre is a vibrant group of autism researchers based in Cardiff University’s School of Psychology. The team bring expertise across a number of research areas and we currently have research projects focusing on diagnosis and identification of ASD, the sensory symptoms of ASD, and intervention.

One area of research interest in the Wales Autism Research Centre is brain imaging. In the last few years, there have been some exciting new research findings from imaging the brain. These findings are showing distinct brain patterns related to autism. These patterns are seen in the pattern of activity of the brain when a task is carried out and also in the structure of the brain. This information is helping to advance knowledge about developmental changes in the brain, links between the brain and behaviour, and also the genetics of ASD. This improved knowledge will help us to understand more about ASD as a whole and develop interventions more likely to have a long-lasting benefit.

In this booklet, we will introduce some of the methods of brain imaging that are used by the Wales Autism Research Centre and describe what it is like to take part in a brain imaging study. We have also developed a DVD about brain imaging at Cardiff University, which includes interviews with people who have taken part in our brain imaging studies.
Cardiff University Brain Research Imaging Centre (CUBRIC)

CUBRIC is part of the School of Psychology at Cardiff University and is where we run our brain imaging studies. It is based in a building just next door to the School of Psychology, and is home to several machines that can be used to investigate both the structure and function of the brain.

CUBRIC has a dedicated team of researchers who are experts in using these machines to investigate the brain. Researchers from all over Cardiff University use the facilities, and projects include investigations of activity in the brain, brain structure, and studies of how brain function or structure may be altered in people who have conditions such as epilepsy and ADHD. The wide-range of projects and expertise within CUBRIC has made it a world-leading centre for brain imaging. Members of the Wales Autism Research Centre work at CUBRIC to learn more about how behaviours that we see in Autism Spectrum Disorder might be related to differences in the brain. The members of the Wales Autism Research Centre who are involved in brain imaging studies are:

Dr Sarah Carrington  
Dr David McGonigle  
Dr Louise White  
Dr Miriam Cooper  
Ms. Rachel Kent

This booklet will describe two different types of brain scanner that we have at CUBRIC. The first is a Magnetic Resonance Image (MRI) scanner and the second is a magnetoencephalography (MEG) scanner.
Before we look at what the different brain scanners do, here is a brief introduction to the brain

The two hemispheres – or halves – of the brain are each divided into four lobes; called the frontal, parietal, occipital, and temporal lobes. The cerebellum sits at the back and bottom of the brain, just behind the brain stem, from which the spinal cord extends down.

1) The layer of the brain closest to the surface is called the cortex or grey matter (due to its colour).

2) The bodies of brain cells are arranged within the cortex.

3) A long fibre – called an axon – extends from brain cell bodies and may reach to different regions of the brain.

4) These axons form the white matter, and can be thought of as the wiring of the brain.

5)
- This wiring is what allows different regions of the brain to communicate, and it is now thought that this communication is essential for abilities such as language, emotion, and memory.
- Electrical signals pass along the axons in white matter and can cause chemicals to be released from the end of the axon.
- These chemicals can stimulate other brain cells, setting off an electrical signal within those cells. This is how messages can be passed from one brain cell to another.
Magnetic Resonance Imaging (MRI)

What is MRI?
Magnetic resonance imaging (MRI) is a well-established method of scanning that is safe to use with people of all ages. It uses strong magnetic fields and low energy radio waves to make pictures of the inside of the human body. MRI is non-invasive – this means that no needles, chemicals, or radiation are used.

Is MRI dangerous?
There are no known risks associated with MRI, and many studies have now been run with both adults and children with no adverse effects. The magnetic fields in MRI are not dangerous unless you have some metal either in or on your body, so we check very carefully to make sure that nobody goes near to the scanner with any metal on them. CUBRIC has a very detailed screening process that we go through before anybody takes part in a study.

What can MRI tell us about the brain?

Structure
Using the MRI scanner, researchers can collect detailed information about the structure of the brain. For example, we can look at certain regions of the brain and see if their size is related to how well somebody is able to perform a certain task, such as reading. We can also look specifically at the white matter – or wiring – of the brain.

Substance
The same machine can also be used to investigate different substances in the brain. Some of these substances are chemicals that nerve cells use to communicate while others can tell us about the brain’s energy usage or metabolism.

Activity
We can use MRI to look at brain activity. For example, we might ask someone to play a game or watch a film while they are in the scanner. What they do or see will affect activity in the brain and we can use functional MRI (fMRI) to record this activity.
What is it like to have a MRI scan?
If you decide to take part in a MRI study, you will always be asked to complete a safety questionnaire before the scan. This questionnaire is to check that you do not have any metal either in or on your body. If anybody comes with you for your scan, they may also have to complete the questionnaire.

When you are in the scanner room:
1) We know that some people with ASD are very sensitive to noise, so you will be given some ear plugs to reduce the noises that you hear from the scanner.

2) You will then be asked to lie on a bed with your head resting on a small pad.

3) When you are comfortable, the researcher will put the head coil on.

This picture shows a little boy lying on the scanner bed as the head coil is put in place. The head coil is a piece of equipment that allows us to look at your head rather than the rest of your body. It is like an arch that goes over but does not touch your face. The researcher will put some pads at the side of your head to cover your ears. This gives you some more protection against the noises made by the scanner and can also help you to keep your head still. The padding is soft, and we will check that you are still comfortable when it is in place.

4) The researcher will then give you a call-button to hold; this is like a small rubber balloon, and if you want to stop the scan, you can squeeze the balloon to alert the researchers. The researchers will stop the scan straight away and check if you are OK.

5) Sometimes, the researcher may also put something on your finger that records your pulse.

Once you are comfortable, the researcher will move the bed slowly into the scanner. Once inside it’s a bit like lying in a giant Smarties tube.

In this picture, you can see a research volunteer being moved into the scanner.
While you are in the scanner:
- The researchers can talk to you over an intercom system when the scanner is quiet.
- If you need to stop, you can press the call-button at any time.
- During the scan, it is best if you can lie nice and still.
- The researcher will do everything they can to make sure that you are comfortable, but please do tell us if we can help to make you more comfortable.

There is a mirror on top of the head coil which means that you can see a screen at one end of the scanner. Depending on the sort of scan you are doing, you may be able to watch a DVD on the screen or the researcher might show some words or pictures that they need you to look at during the scan. This picture shows one type of task on the screen (the screen is not always red). The room may be a little dark when you are in the scanner.

To help you decide whether you would like to take part in a MRI study, you can visit the mock scanner at CUBRIC. The mock scanner is exactly the same as the real scanner, but it does not have a magnetic field. Because of that, you can explore the mock scanner without some of the restrictions that apply with the real scanner. You can lie inside the scanner to get an idea of what it feels like and we can even play you some of the noises that you would hear in the real scanner. If the study involves doing a task in the scanner, you can practise it in the mock scanner.

Is there anything I should do before I have a MRI scan?
- We usually ask people if they would like to go to the toilet before starting.
- It is also a good idea to where loose, comfortable clothes.
- Women should not wear an under-wired bra.
- We may also ask you to take off eye make-up, as this may contain metal.
- We have some spare clothes that you can borrow if you would like.
Magnetoecephalography (MEG)

What is MEG and how is it different to MRI?

- MEG scanners measure brain activity by measuring tiny magnetic fields around your head using special sensors.
- Unlike MRI, MEG doesn’t involve using strong magnetic fields; instead, it simply records the magnetic fields that are naturally generated by your brain.
- For a MEG scan, you usually sit in a special chair that is slowly moved upward until your head is in the MEG helmet. The MEG helmet contains lots of sensors, which means that we can record the magnetic fields all around your head.
- MEG scanners do not make any noise, so you will not usually have to wear earplugs.

Is MEG dangerous?

There are no known risks associated with MEG.

What can MEG tell us about the brain?

MEG is used to measure brain activity only; it cannot tell us anything about the structure of the brain. It is very sensitive to the timing of brain activity and can give very detailed information about when activity happens in the brain. Because there are sensors recording the magnetic fields all around your head, we can also get some information about where the activity is in your brain.

The coloured area in this picture (right) is where activity was recorded in the brain using MEG while volunteers were given a slight buzzing sensation on their finger tips.

This picture was taken when Gwenda Thomas (AM, Deputy Minister for Children and Social Services) came to visit the Wales Autism Research Centre in January 2011. She is sat on the chair of the MEG scanner with Dave McGonigle on her right. Dave is one of our researchers who uses MEG. The other man in the picture is Dylan Jones, the head of the School of Psychology.
What is it like to have an MEG scan?

As MEG records brain activity, you will be asked to do a task while you are in the scanner. There are lots of different sorts of tasks you could do, but they may involve watching images on a screen or listening to sounds. The researcher running the study will explain the task to you before the scan.

The MEG scanner is in a special, shielded room that keeps magnetic signals from things like mobile phones or moving metal objects outside.

Before you go into the scanner room:
- A researcher will use some medical sticky tape to attach some sensors to your forehead and next to your eyes. It does not hurt to take this tape off. These sensors help us to keep track of the position of your head when you are in the scanner.
- The sensors are attached to wires that will be plugged into the scanner.
- The researcher will take a picture of you before you go into the MEG room so they will know exactly where the sensors were on your forehead.

When you are ready, the researcher will take you into the MEG room. Once you are in the MEG room:
- You will be asked to sit in the seat and make yourself comfortable.
- When you are ready, the researcher will move the seat up so that your head is inside the helmet.
- Your head will not be touching the machine.

Once you are ready to start:
- The researcher will leave the room and close the door – the researcher will still talk to you over an intercom system.
- There is a camera inside the room, so the researcher will be able to see you and check that you are OK.
- The researcher will tell you how long each task will take.

While you are doing the task:
- The researcher will ask you to stay as still as possible.
- The researcher will tell you over the intercom when the scan is starting and they will also talk to you when there are breaks.
- The MEG scanner will not make any noise.

Is there anything I should do before I have a MEG scan?
- If possible wear loose clothing.
- We will ask you to take any belts and jewellery off.
- Try to avoid wearing clothes with metal buttons or zips.
- Women should not wear an under-wired bra.
- We have some spare clothes you can borrow for the scan if you would like.
- If possible, please do not wear any eye makeup on the day of the scan, as this may contain metal.
FAQs

Is brain imaging really suitable for children and adults with ASD?
Brain imaging is now a common technique and people with ASD have taken part in brain imaging studies around the world. In the UK, several different research groups have successfully run brain imaging studies with volunteers with ASD, including the British Autism Study of Infant Siblings (www.basisnetwork.org) and the Autism Research Centre in Cambridge (www.autismresearchcentre.com).

At the Wales Autism Research Centre, every member of the imaging team has lots of experience brain scanning volunteers with ASD and we understand the sorts of things that can cause concern for our volunteers and do all that we can to minimise them. We make sure that we get to know our volunteers before they come to have a brain scan, and we always encourage people to visit the mock scanner before they decide to take part in a project.

Volunteering to help with a brain imaging project is not for everybody and we are happy to discuss any concerns that you have about taking part, either for yourself or for your child. However, we have found that many children and adults have been fascinated by the technology and enjoy their visit, both to the mock scanner and for the real scan.

What happens if you see something wrong with my brain scan?
CUBRIC is not a hospital and the researchers will not usually be medical doctors. These scans are not being conducted for medical purposes. Occasionally when we scan volunteers, the researcher may think they have seen something unusual in the scan. In this case, they will ask a specialist to have a look at the scan. If appropriate, a report can then be sent to your GP. A specialist will not usually look at your scan unless the researcher raises a concern, so if you have any health concerns, you should contact a qualified medical practitioner.

Can you tell if I have a condition such as ASD from my brain scan?
These scans will not help us to provide a diagnosis of any condition.

Can I see a picture of my brain?
If you have an MRI scan, you can see a picture of your brain. It takes some time to process this, so we will send it to you some time after your visit.

Why is the MRI scanner so noisy and why does MEG not make a noise?
When the MRI scanner is running, it is applying magnetic fields. The production of these magnetic fields causes a loud noise. During some sorts of MRI scans, you may feel the bed vibrate slightly. MEG scanning does not make a
noise because it does not need to apply magnetic fields. Instead, MEG passively records the magnetic signals produced by your brain.

**Why do I have to stay still when I am in the scanner?**

For both MRI and MEG, the researchers will ask you to stay as still as possible. This is to help us get the best information about your brain that we can. It is easiest to stay still if you can make yourself really comfortable before the scan starts. We know that it can be difficult to lie still, especially for children and we can correct for some slight movements. To help us with this, we may ask children to wear a special hat while they are in the MRI scanner. This hat helps us to see when children have moved.

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**Contact Details**

If you have any questions about the information in this booklet, please get in touch with Dr. Sarah Carrington. Her contact details are:

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You can find out more about the Wales Autism Research Centre on our website (http://www.walesautismresearchcentre.com) and on our Facebook page (http://www.facebook.com#!/pages/Wales-Autism-Research-Centre-WARC/103033943068748).

If you would like to learn more about the brain imaging centre (CUBRIC), you can go their website (http://psych.cf.ac.uk/cubric/)