frontiers FOR YOUNG MINDS

Neuroscience
Published: 24 April 2014
doi:10.3389/frym.2014.00010

MEG for kids: listening to your brain with super-cool SQUIDs

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Reviewed by:

Essie
9 years old

Your brain is made up of billions of neurons all chattering away to each other. MEG allows us to listen in on their conversations by measuring your brain's magnetic field.

Inside your brain, you have over 80 billion neurons – tiny brain cells, all working together to make you the person you are. Neurons talk to each other by sending electrical messages. Each message creates a tiny magnetic field. If enough neurons are talking together, we can listen in on their conversations by measuring the magnetic field around your head (Figure 1).

We call this MEG, which stands for magnetoencephalography (mag-netto-en-keffa-logra-fee) [1].

MAGNETIC SHIELD

In our everyday lives, we are surrounded by magnetic fields, coming from computers, mobile phones, and even from the earth itself. Our brain's magnetic fields are tiny in comparison. Listening in on your neurons is like trying to hear the footsteps of an ant – in the middle of a rock concert!

For this reason, MEG machines have to be in a special room with thick metal walls that stop all the other magnetic fields getting in (Figure 2).

SUPER-COOL SQUIDS

The real heroes of MEG are small wire coils called SQUIDs, which pick up your brain's magnetic field. SQUID stands for super-conducting quantum interference device.

SQUIDS are very sensitive but they only work if the temperature is extremely low – about 270°C below

FIGURE 1 - A young girl undergoing an MEG recording.

FIGURE 2 - Engineers building the magnetically shielded MEG room in our lab.

zero! To keep them super-cool, the SQUIDs are covered in liquid helium – the coldest liquid on earth.

Over time, the liquid helium gradually warms up, turns into a gas, and floats away. In our lab, we capture as much of the gas as we can and turn it back into a liquid (Figure 3). Then we put it back into the MEG machine to make sure our SQUIDS stay super-cool!

MEG FOR KIDS

In the MEG machine, hundreds of SQUIDs are arranged outside a helmet. The normal MEG helmet is designed for adults but is way too big for many kids. The SQUIDs end up being a long way from the brain, so they struggle to pick up a good signal.

FIGURE 3 - These machines squash and cool the helium gas until it becomes a liquid again.

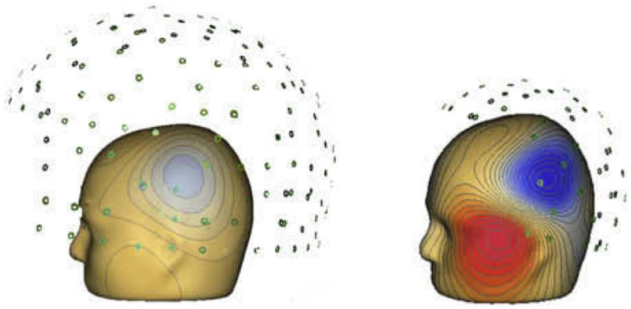

FIGURE 4 - On the left is a child's head in an adult MEG helmet. The dots show each of the SQUIDs. Because they are so far away from the head, they do not get a good signal from the brain. With the special smaller helmet, the SQUIDs are much closer and can pick up the brain's magnetic field very nicely.

Luckily, we now have an MEG machine with a smaller helmet, which is a nice snug fit for kids. This can give us a much clearer picture of what your brain is doing (Figure 4) [2].

GETTING INSIDE YOUR BRAIN

After the MEG recording has finished, we use a computer to try and figure out what was going on inside your brain.

The computer guesses what might have been happening and works out what all the SQUIDs

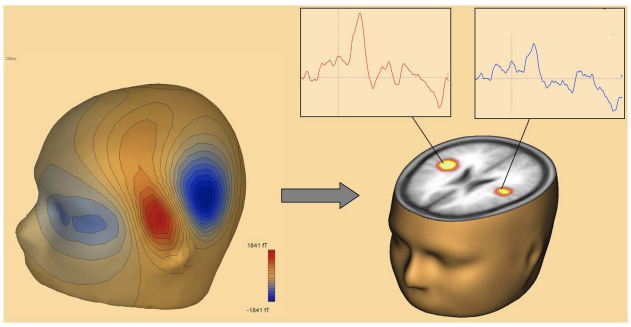

FIGURE 5 - The picture on the left shows the magnetic fields produced by listening to lots of beeps. The computer works out that these are coming from the auditory cortex on both sides of the brain and tells us what sensors placed inside the auditory cortex would have recorded.

would have measured if that guess was right. It keeps adjusting its guess until it matches as closely as possible what the SQUIDs really did record.

The computer can then tell us what we would have measured if we had been able to put sensors right inside your brain! (see Figure 5).

WHAT CAN MEG TELL US?

Listening in on your neurons is not easy. But MEG can help us to answer some very interesting questions. How does your brain make sense of the things you see, hear, and touch? How do neurons in different parts of your brain talk to each other? How does this change as you get older?

MEG can also help us understand conditions like epilepsy, which happens when all the neurons start shouting at once. In our lab, we test kids who struggle to speak. We use MEG to see what happens in their brains as they are trying to say a word. We also test kids with autism, who have difficulties interacting with other people. Scientists think this may be because of differences in how their neurons talk to each other.

MEG is a great tool for helping us understand kids' brains. And it is all thanks to those super-cool SQUIDs.

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Submitted: 24 February 2014; Accepted: 24 March 2014; Published online: 24 April 2014.

Citation: Brock, J., and Sowman, P. (2014). MEG for kids: listening to your brain with super-cool SQUIDs. Front. Young Minds. 2:10. doi: 10.3389/frym.2014.00010

REVIEWED BY:

Essie, 9 years old

I was born in Florida and then became a Hoosier. My favorite thing is reading. I also love to dance and play the piano. I enjoyed dancing in "Nutcracker." My dad is an MRI physicist. I think the human brain is fascinating. I am ready to explore more about it.

AUTHORS

Jon Brock

My main job is being dad to a little boy called Elliott. He thinks it would be cool if you could look up your nose and see into your brain. Unfortunately, that does not work, so I use a brain imaging technique called MEG instead. I am interested in how your brain makes sense of sounds and pictures and how some kids, such as those with autism, have brains that might work a bit differently to other kids.

Paul Sowman

I am a scientist who works in Sydney, Australia. I am really interested in how human movements work, especially how your nervous system controls your mouth. Have you ever wondered why you do not break your teeth when you accidentally bite something hard? Or why some kids cannot speak fluently? Or why some people grind their teeth while they are sleeping? These are the things I spend my time trying to figure out.