

Wearable brain imaging provides a precise picture of children's developing brains

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Child wearing one of the MEG-OPM helmet style brain scanners. Credit: University of Nottingham

New research has given a precise picture of young children's developing brains, using a wearable brain scanner to map electrical brain activity. The work opens up new possibilities for tracking how critical

developmental milestones, like walking and talking, are underpinned by changing brain function, and how neurodevelopmental conditions like autism emerge.

The research team, led by scientists from the University of Nottingham's School of Physics and Astronomy, used a novel design of magnetoencephalography (MEG) scanner to measure brain electrophysiology in children as young as two. The findings [have been published](#) in *eLife*.

Brain cells operate and communicate by producing electrical currents. These currents generate tiny magnetic fields that can be detected outside the head. Researchers used their novel system to measure these fields, and mathematical modeling to turn those fields into high fidelity images showing, millisecond-by-millisecond, which parts of the brain are engaged when we undertake tasks.

The wearable brain scanner is based on [quantum technology](#), and uses LEGO-brick-sized sensors—called optically pumped magnetometers (OPMs)—which are incorporated into a lightweight helmet to measure the fields generated by brain activity. The unique design means the system can be adapted to fit any age group, from toddlers to adults. Sensors can be placed much closer to the head, enhancing data quality. The system also allows people to move while wearing it, making it ideal for scanning children who find it hard to keep still in conventional scanners.

In all, 27 children (aged 2-13 years) and 26 adults (aged 21-34 years) took part in the study, which examined a fundamental component of [brain function](#) called neural oscillations (brain waves). Different areas of the brain are responsible for different aspects of behavior and neural oscillations promote communication between these regions. The research team measured how this connectivity changes as we grow up, and how

our brains use short, punctate bursts of electrophysiological activity to inhibit networks of brain regions, and consequently to control how we attend to incoming sensory stimuli.

The work was jointly led by Dr. Lukas Rier, and Dr. Natalie Rhodes from the University of Nottingham's School of Physics and Astronomy. Dr. Rier said, "The wearable system has opened up new opportunities to study and understand children's brains at much younger ages than was previously possible with MEG. There are important reasons for moving to younger participants: from a neuroscientific viewpoint, many critical milestones in development occur in the first few years (even months) of life. If we can use our technology to measure the brain activities that underpin these developmental milestones, this would offer a new understanding of brain function."

Dr. Rhodes was a University of Nottingham undergraduate student in Physics, and a postgraduate student when the work was carried out. She has now moved to a postdoctoral position in Toronto, and explains, "This study is the first of its kind using wearable MEG technology and provides a platform to launch new [clinical research](#) in childhood disorders. This means that we can begin to explore not only healthy brain development, but also the neural substrates that underlie atypical development in children."

Neuroscientist Dr. Margot Taylor—also an author on the paper—is leading research into autism in Toronto. She said, "Our work is dedicated to studying brain function in young children with and without autism. This study is the first to demonstrate that we can track brain development from a very young age. This is hugely exciting for possible translation to clinical research and work such as this helps us understand how autism develops."

The wearable system has been installed in a number of high profile

research institutions across the globe, including SickKids hospital in Toronto. The research teams in both institutions are now working together to expand the amount of neurodevelopmental data on both healthy and atypical brain function

More information: Lukas Rier et al, The neurodevelopmental trajectory of beta band oscillations: an OPM-MEG study, *eLife* (2024). DOI: [10.7554/eLife.94561](https://doi.org/10.7554/eLife.94561). elifesciences.org/reviewed-preprints/94561

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