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Brain connections may explain why girls mature faster

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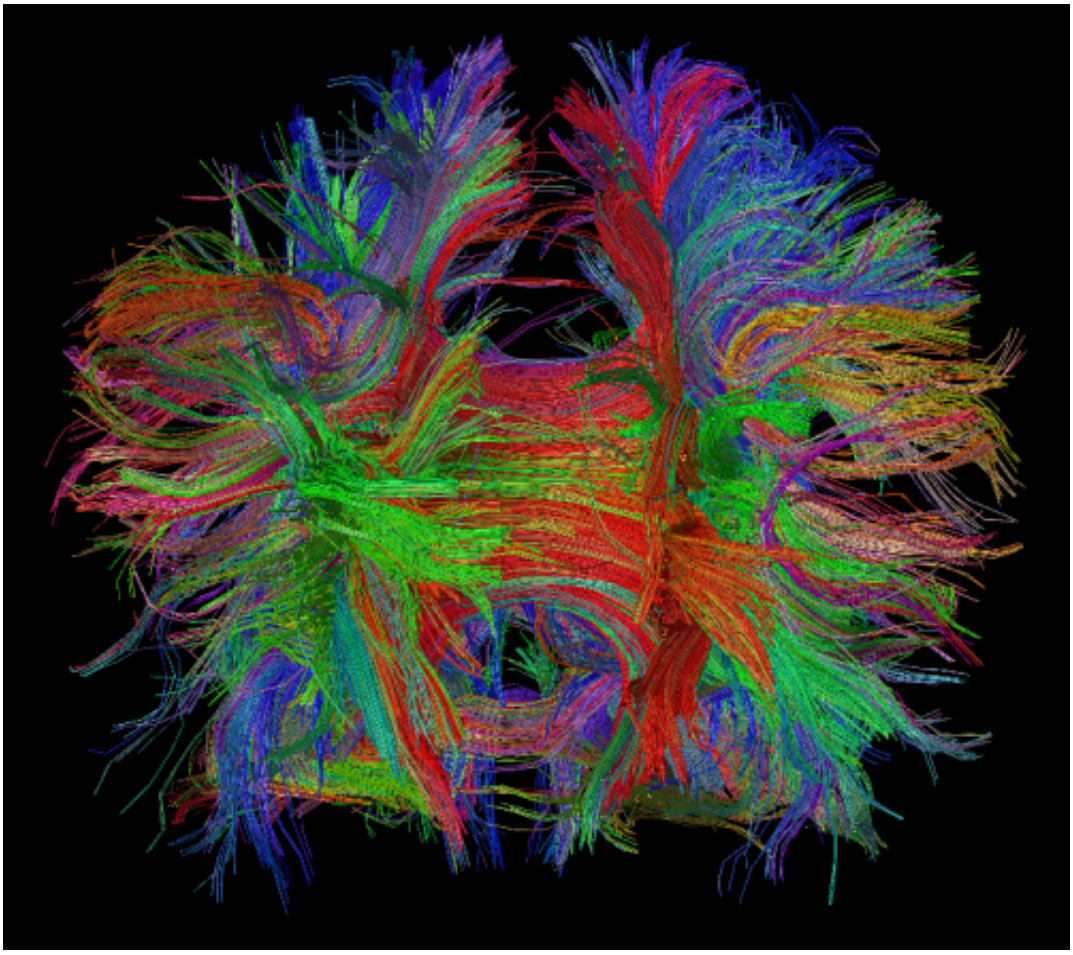

This is a colored image illustrating the brain connections for one of the 121 subjects (male, 4 years old). Credit: Newcastle University

As we grow older, our brains undergo a major reorganisation reducing

the connections in the brain. Studying people up to the age of 40, scientists led by Dr Marcus Kaiser and Ms Sol Lim at Newcastle University found that while overall connections in the brain get streamlined, long-distance connections that are crucial for integrating information are preserved.

The researchers suspect this newly-discovered selective process might explain why brain function does not deteriorate – and indeed improves –during this pruning of the network. Interestingly, they also found that these changes occurred earlier in females than in males.

Explaining the work which is being published in *Cerebral Cortex*, Dr Kaiser, Reader in Neuroinformatics at Newcastle University, says: "Long-distance connections are difficult to establish and maintain but are crucial for fast and efficient processing. If you think about a social network, nearby friends might give you very similar information – you might hear the same news from different people. People from different cities or countries are more likely to give you novel information. In the same way, some information flow within a brain module might be redundant whereas information from other modules, say integrating the optical information about a face with the acoustic information of a voice is vital in making sense of the outside world."

Brain "pruned"

The researchers at Newcastle, Glasgow and Seoul Universities evaluated the scans of 121 healthy participants between the ages of 4 and 40 years as this is where the major connectivity changes can be seen during this period of maturation and improvement in the brain. The work is part of the EPSRC-funded Human Green Brain project which examines human brain development and is being published in *Cerebral Cortex*.

Using a non-invasive technique called diffusion tensor imaging – a

special measurement protocol for Magnetic Resonance Imaging (MRI) scanners – they demonstrated that fibres are overall getting pruned that period.

However, they found that not all projections (long-range connections) between brain regions are affected to the same extent; changes were influenced differently depending on the types of connections.

Projections that are preserved were short-cuts that quickly link different processing modules, e.g. for vision and sound, and allow fast information transfer and synchronous processing. Changes in these connections have been found in many developmental brain disorders including autism, epilepsy and schizophrenia.

The researchers have demonstrated for the first time that the loss of white matter fibres between brain regions is a highly selective process – a phenomenon they call preferential detachment. They show that connections between distant brain regions, between brain hemispheres, and between processing modules lose fewer nerve fibres during brain maturation than expected. The researchers say this may explain how we retain a stable brain network during brain maturation.

Commenting on the fact that these changes occurred earlier in females than males, Ms Sol Lim explains: "The loss of connectivity during brain development can actually help to improve brain function by reorganizing the network more efficiently. Say instead of talking to many people at random, asking a couple of people who have lived in the area for a long time is the most efficient way to know your way. In a similar way, reducing some projections in the brain helps to focus on essential information."

More information: Preferential Detachment During Human Brain Development: Age- and Sex-Specific Structural Connectivity in

Diffusion Tensor Imaging (DTI) Data. Sol Lim; Cheol E. Han; Peter J. Uhlhaas; Marcus Kaiser.*Cerebral Cortex* 2013; DOI: 10.1093/cercor/bht333