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Peering into the aging brain
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This is my grandfather Ed. Ed had the most amazing senior years. In his 70s he started rebuilding computers for fun, just to learn how they work. In his 80s he took up hiking and completed multiple-day backpacking trips. Right until his death at 94, Ed lived independently, and he was the one my family would call if we were having computer problems. Amazing, right? Why is it that some people can maintain such incredible cognitive health well into old age, whereas for others, their thinking, language and memory start to slip, and they might even experience the profound cognitive loss of dementia. Well, one reason for this cognitive loss is the development of white matter hyperintensities in the brain.

White matter hyperintensities are a form of brain damage that appears as these bright patchy regions on specialized MRI scans. This brightness is caused by changes to the underlying blood vessels. The blood vessels stiffen, and it becomes harder for them to deliver the blood that our brain cells need to survive.

Factors that are bad for your heart, like smoking or high blood pressure, can also cause damage to the tiny vessels in your brain. And this process happens very slowly, over the course of years, so people might not even realize that their cognition is declining until it's too late. But what if we had a way to peer into the brain, and identify that this process is happening early on, before any permanent damage has occurred?

My thesis uses an MRI technique called diffusion tensor imaging, or DTI, which creates these beautiful colourful maps of connections in your brain. These connections are your brain's information highways that it uses to communicate between different regions. And I'm investigating how white matter hyperintensities disrupt communication along these highways.

What we've found is that DTI is extremely sensitive to white matter hyperintensities. We can measure a change in DTI metrics in response to only a tiny amount of damage, well before the point at which a person notices any changes in their cognition. This is exciting because it means DTI might one day be used as an early detection system, to warn us when our brain's health is at risk.

I'm imagining a future where, as part of a routine screening at your doctor's office, you might go into an MRI machine and have a DTI scan. Your doctor could measure the underlying health of your brain tissue and could warn you if you are at risk of developing a cognitive impairment as you get older. This would give us a golden window of opportunity to intervene with aggressive lifestyle modification, to delay or even prevent the loss of cognition with aging. Ultimately, I hope

one day these MRI technologies could be used to help us achieve a goal that everybody wants:
to maintain healthy active lives well into our late years, just like my grandfather Ed.