Ask a neuroscientist…

AJDC is aimed at all who work with people with dementia, including those who are new to the dementia workforce and may want to learn more about the basics of dementia. This article is the second in a four-part series by neuroscientist and *AJDC* Editorial Advisor **Dr Lezanne Ooi**, who is presenting short, easy-to-read answers to questions about neurological changes to the brain with dementia. In her second article, Dr Ooi answers this question:

'What is brain plasticity and does it offer hope for people living with dementia?'

Remember the days of playing with plasticine? As children, we would spend some considerable time creating an ornate and beautiful structure, only to squish it flat so that we could make a different shape. This concept of remoulding a material to make a different shape or structure can also be applied to the brain. To put it another way, the brain can be described as having plasticity, meaning that the cells within it can be reshaped under certain conditions.

The plasticity of the brain is important because it allows the brain to change in response to our environment. This underpins our ability to learn.

Humans have around 100 billion neurons (the brain cells that do the thinking) and each of those communicate with other neurons through connections called synapses. The average neuron has around 1000 synapses, so in other words each neuron is connected to around 1000 other neurons via super-highways – creating dense networks. The more dense these networks are, the more connections they have, and the greater the capacity of the brain to deal with disease-causing pathology or damage. (Pathology in the context of dementia means structural changes to the brain that are either a cause or an effect of the disease).

Brains with more dense networks have what's described as higher 'cognitive reserve'. Cognitive reserve is thought to provide protective effects that buffer the brain and allow it to compensate for injury. Brain plasticity and the dynamic ability of neurons to alter their organisation likely protect the brain by contributing to cognitive reserve.

Tips for practice

- People with dementia do have the capacity for brain plasticity.
- Physical exercise and activities that stimulate the brain can improve brain plasticity.
- Promoting engaging and meaningful activity with people living with dementia can play an important part in promoting brain health.

Imaging methods

- Positron emission tomography (PET) measures regional blood flow in the brain.
- Functional magnetic resonance imaging (fMRI) measures blood oxygen level dependence.

Do people with dementia also exhibit brain plasticity?

Even when pathology impacts parts of the brain – as explained in my previous *AJDC* article on brain changes in dementia (www.journalofdementiacare.com/ask-a-neuroscientist/) – plasticity can allow the brain to compensate by using different areas or networks to perform tasks.

Different types of tests described as 'functional neuroimaging' (for example, PET and fMRI, see box) allow clinicians to visualise how efficiently the brain is operating and track its changes throughout the course of normal ageing or disease, or analyse the success of treatments. These imaging methods allow us to assess in real time how much blood is flowing to certain parts of the brain while a person is performing specific tasks. Particular areas of the brain are activated when we perform certain tasks, and therefore require blood flow to provide oxygen and energy.

People with a diagnosis of dementia show symptoms that progress at different rates. Functional neuroimaging has shown that people with dementia who are able to counteract symptoms for longer are able to recruit other areas of the brain to complete operations. This suggests that people with greater levels of brain plasticity are able to compensate for pathology by using different pathways.

How do you increase brain plasticity?

Evidence from functional neuroimaging shows that plasticity provides an opportunity for intervention at any time of life, including following a diagnosis of dementia. Dementia is progressive and there are limits to the potential of plasticity with respect to dementia, however brain plasticity can be improved by aerobic exercise, weight training or activities that stimulate the brain. All of these activities can delay the progression of dementia as they stimulate the generation of new neurons, new connections and/or strengthen those connections.

Just last year, a study using another brain imaging technique that is sensitive to changes in brain activity (MEG or magnetoencephalography), showed that people living with dementia have the capacity for brain plasticity and that non-pharmacological treatments (such as physical exercise, role-playing, nursing care, horticultural therapy and self-cognitive training) could be used to induce plasticity that improved cognition in those people (Shigihara *et al* 2020).

So, the good news is that the evidence shows that brain plasticity can be increased to boost cognitive reserve and it is never too late to make a positive difference to your brain health. ■

Reference

Shigihara Y, Hoshi H, Shinada K *et al* (2020) Non-pharmacological Treatment Changes Brain Activity in Patients with Dementia. *Scientific Reports* 10 6744.

■ Dr Lezanne Ooi is a neuroscientist at the Illawarra Health and Medical Research Institute, Wollongong, and the School of Chemistry and Molecular Bioscience, University of Wollongong, NSW. To follow up with the author, email lezanne@uow.edu.au. The author is supported by a National Health and Medical Research Council (NHMRC) of Australia Boosting Dementia Research Leadership Fellowship (APP1135720)