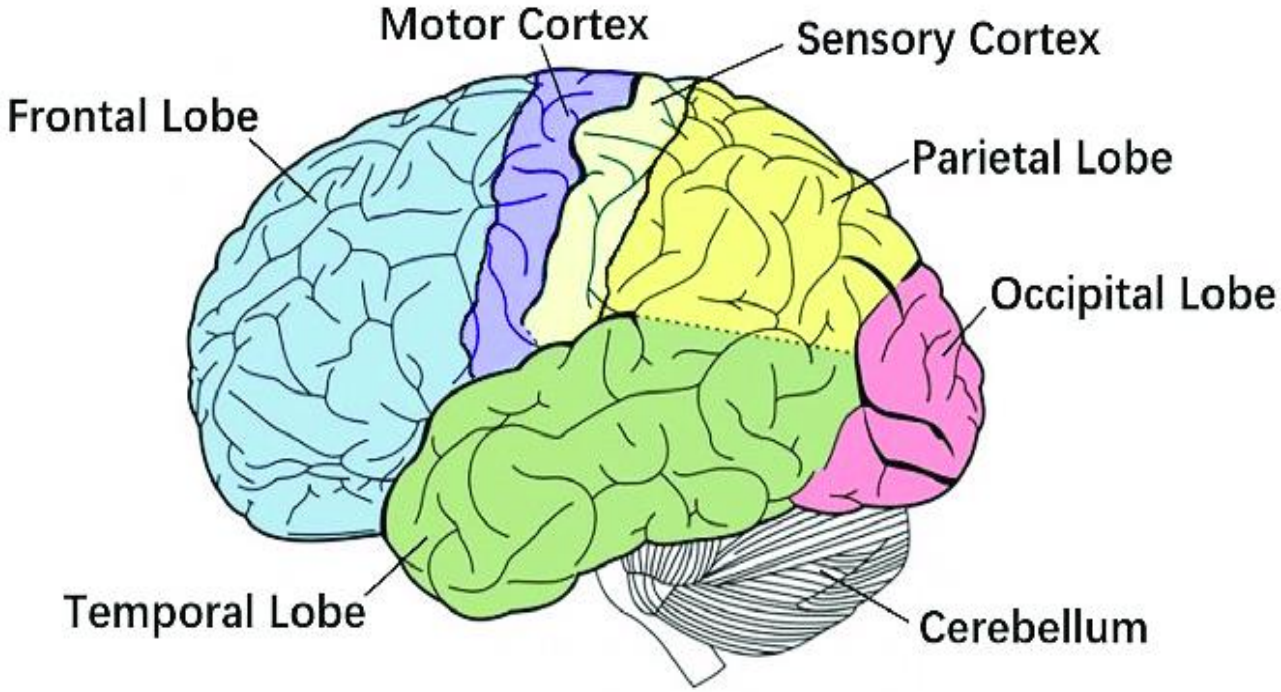
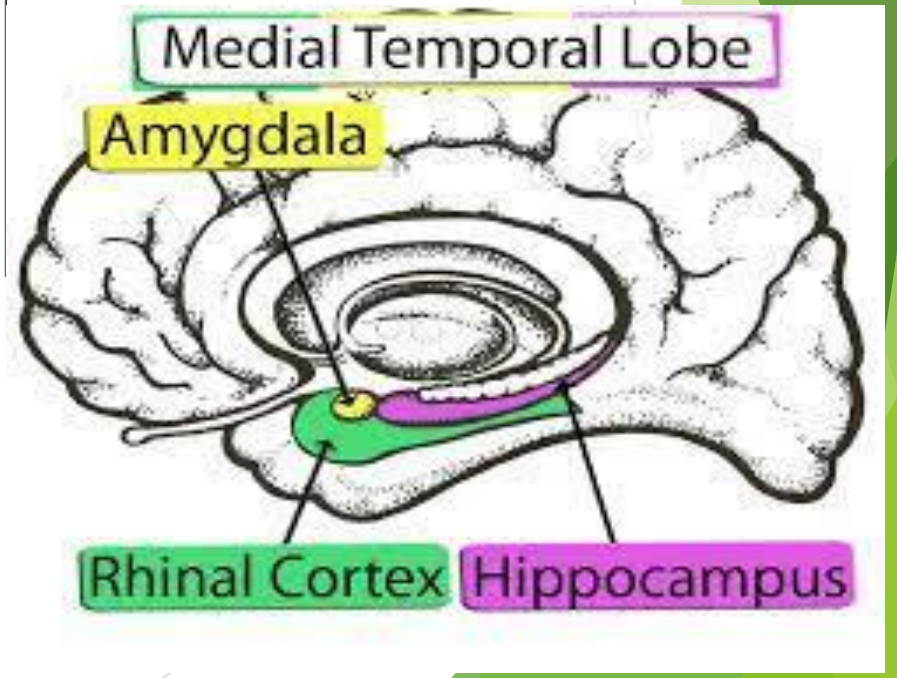
Exercise effects on functional connectivity, the hippocampus and memory.

Gillian Traise

Physiotherapist

Brain Bits….


Motor Cortex
Sensory Cortex
Frontal Lobe
Parietal Lobe
Occipital Lobe
Temporal Lobe
Cerebellum


Medial Temporal Lobe
Amygdala
Rhinal Cortex
Hippocampus

Key Concepts

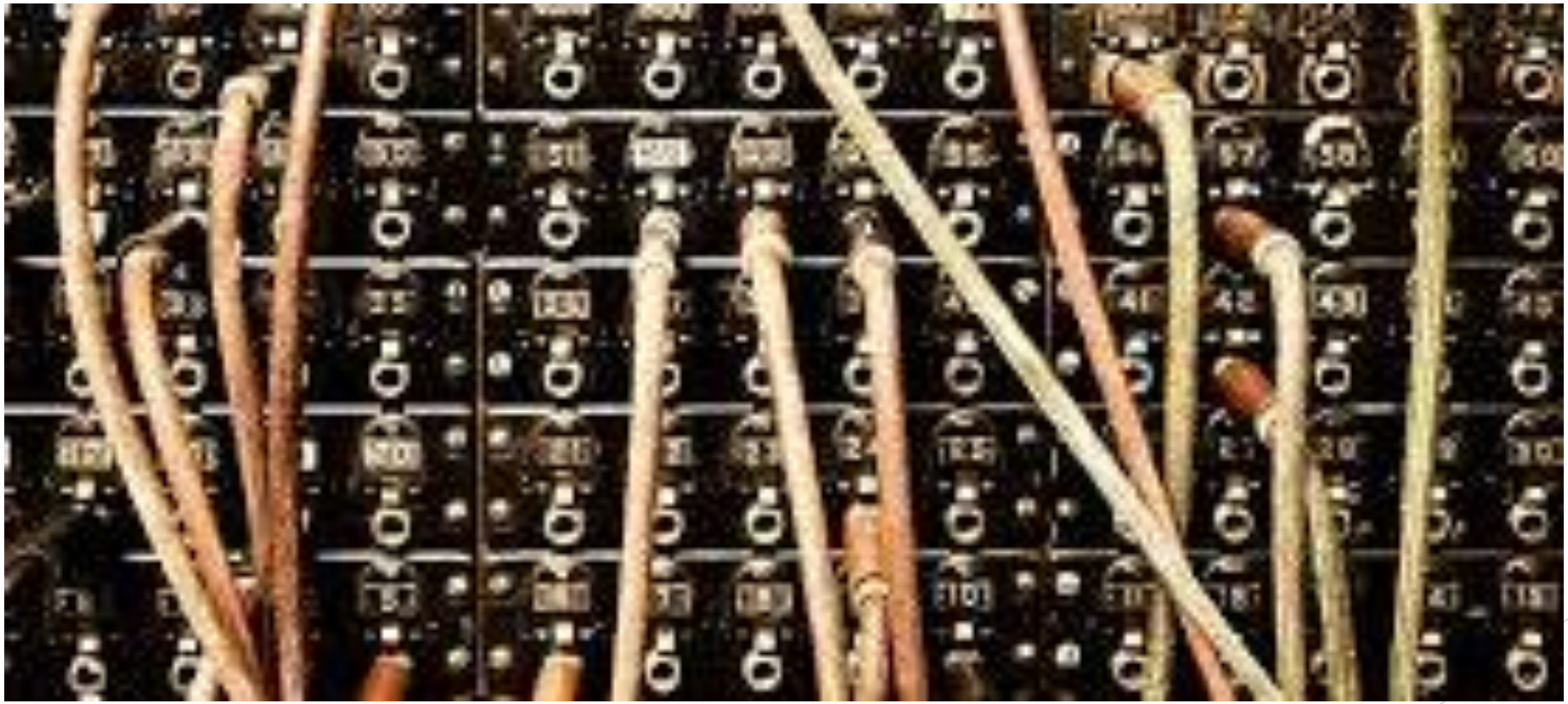
Cognitive Reserve suggests that increased neuronal connections throughout life provide a greater capacity for the brain to cope as pathology develops later (Perneczky, 2019).

Cognitive Resilience is described as the ability of a person to resist neuropathology and maintain cognition or delay decline (Rudrauf, 2014).

Functional connectivity is defined as the temporal dependency of neuronal activation patterns of anatomically separated brain regions (van den Heuvel & Hushoff Pol, 2010).

Neural plasticity, also known as neuroplasticity or brain plasticity, can be defined as the ability of the nervous system to change its activity in response to intrinsic or extrinsic stimuli by reorganizing its structure, functions, or connections (Mateos-Aparico & Rodriguez & Moreno, 2019).

The brain is a big switchboard.



“Talking”in the brain

How does adaptive plasticity happen?

Rerouting

- New neural connections are made between a neuron and other active neurons

Sprouting

- Growth of new dendritic fibres enabling the neuron to form new connections with a variety of other neurons

Benefits of Exercise for those with Dementia

- Improving vascular brain health
- Improving functional lower and upper limb strength strength.
- Improving posture and alignment
- Improving social connection
- Improving sense of wellbeing and having fun
- Improving memory
- Improving functional connection capacity

General Exercise and Hippocampal function

- Loprinzi (2019) undertook a systematic review of 28 studies and concluded that exercise had positive effects on parahippocampal function.

- Other researchers have found that exercise leads to increased neural excitability, reduced volume of lesions, enhanced regional glucose metabolism, increased cerebral blood flow, and increased functional connectivity (Erickson et al., 2011 Loprinizi, 2019 and Maass et al., 2014).

Stimulating the brain through dance.

- Complex movements such as dancing, requires balance, coordination, spatial planning, side integration and integration across many neurological centres.

- Increasing difficulty and complexity results in greater neuroplasticity and dendritic spine growth (Peters et al., 2017).

What does the research say about dance as exercise?

- Researchers have found that dance practice leads to structural changes such as increases in hippocampal volume, grey matter volume in the hippocampus, and improved neuroplasticity (Lui et al.,2019)

- Stam et al. (2007) used fifty-four older adults to compare an active exercise programme and a dance programme using EEG. The EEG measured cortical activity and cortical synchronisation during the choreography performances. These researchers found that the dancers had a significant increase in developing functional connections through dance.

Dance specific training and the Hippocampus and Memory- 4 studies…

- The Train the Brain Consortiun (2017) assessed the combination of dance and cognitive training in patients with MCI. The results found that in the control group there were changes in brain function and cognition with the researchers suggesting that the beneficial effects of multidomain training appear to be related to improved functional connectivity.

- Muller et al. (2017) used fMRI in 63-80 year olds to compare dance and other physical activities. They found that those dancing had increased parahippocampus volume and an increase in memory function even after 18 months.

Dance and Hippocampus Function cont..

- Qi et al. (2019) used fMRI to assess brain activity, along with cognitive testing in 38 older adults with mild cognitive impairment (MCI). The dance exercise group had significantly improved cognitive testing and increased functional connectivity in several areas, including the bilateral fronto-temporal and parohippocampal cortex.

- Kopacova et al. (2019) evaluated a dance-movement intervention. The 99 subjects were assigned to a either a dance exercise group or to a life-as-usual control group. The study was over a 6-month period, with the dance group undertaking 60 lessons. The dance group showed a significant improvement in cognitive testing.

How Much? How Often?

- **What level of exercise has been found to lead to neurological changes?** Erickson et al., (2011) found that mild-to-moderate intensity, 50–70% of maximal cardiac output led to hippocampal changes whilst Maase et. al. (2015) has found that vigorous levels up to 75% of maximal cardiac output had benefits.

- **What intervals of training have been found to be effective?** We need to encourage those with MCI and dementia risk to be exercising or dancing at least 5 times a week for 30-40 minutes at least at a moderate level.