MSc Computational Cognitive Neuroscience

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Postgraduate Open Day

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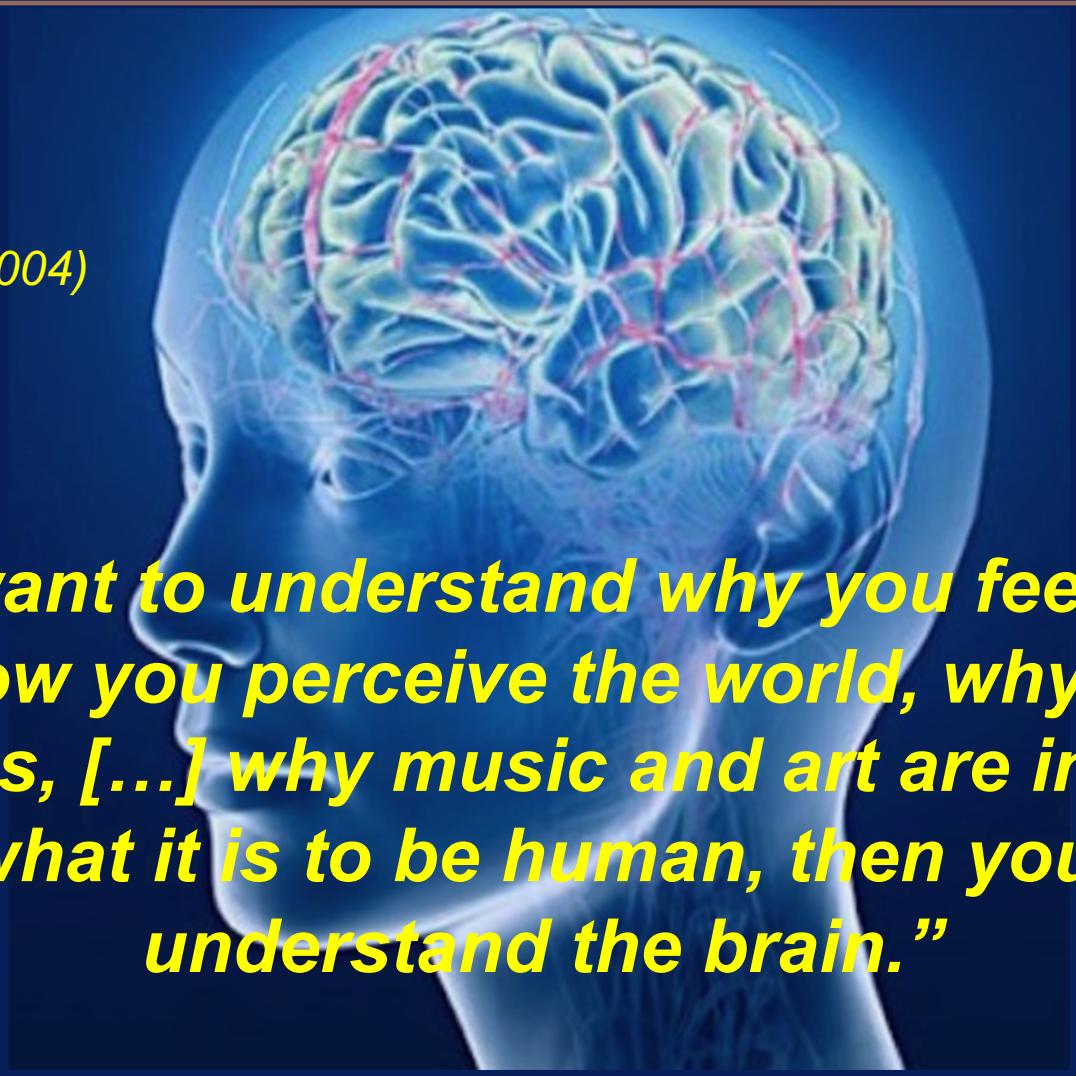
Goldsmiths, University of London

“You are your brain”

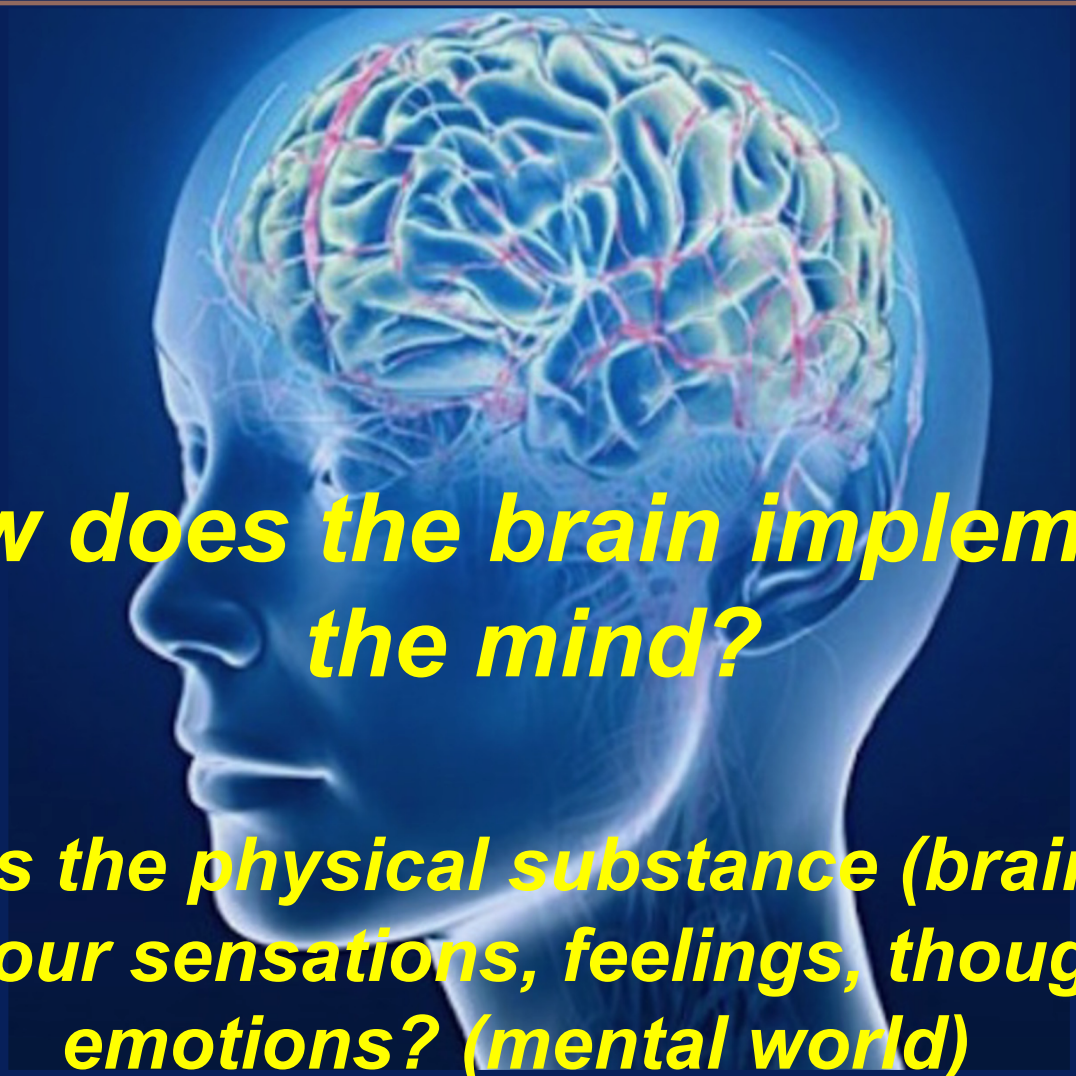
J. Hawkins,
On Intelligence (2004)



“If you want to understand why you feel the way you do, how you perceive the world, why you make mistakes, […] why music and art are inspiring, indeed what it is to be human, then you need to understand the brain.”

Picture from: coursera.org

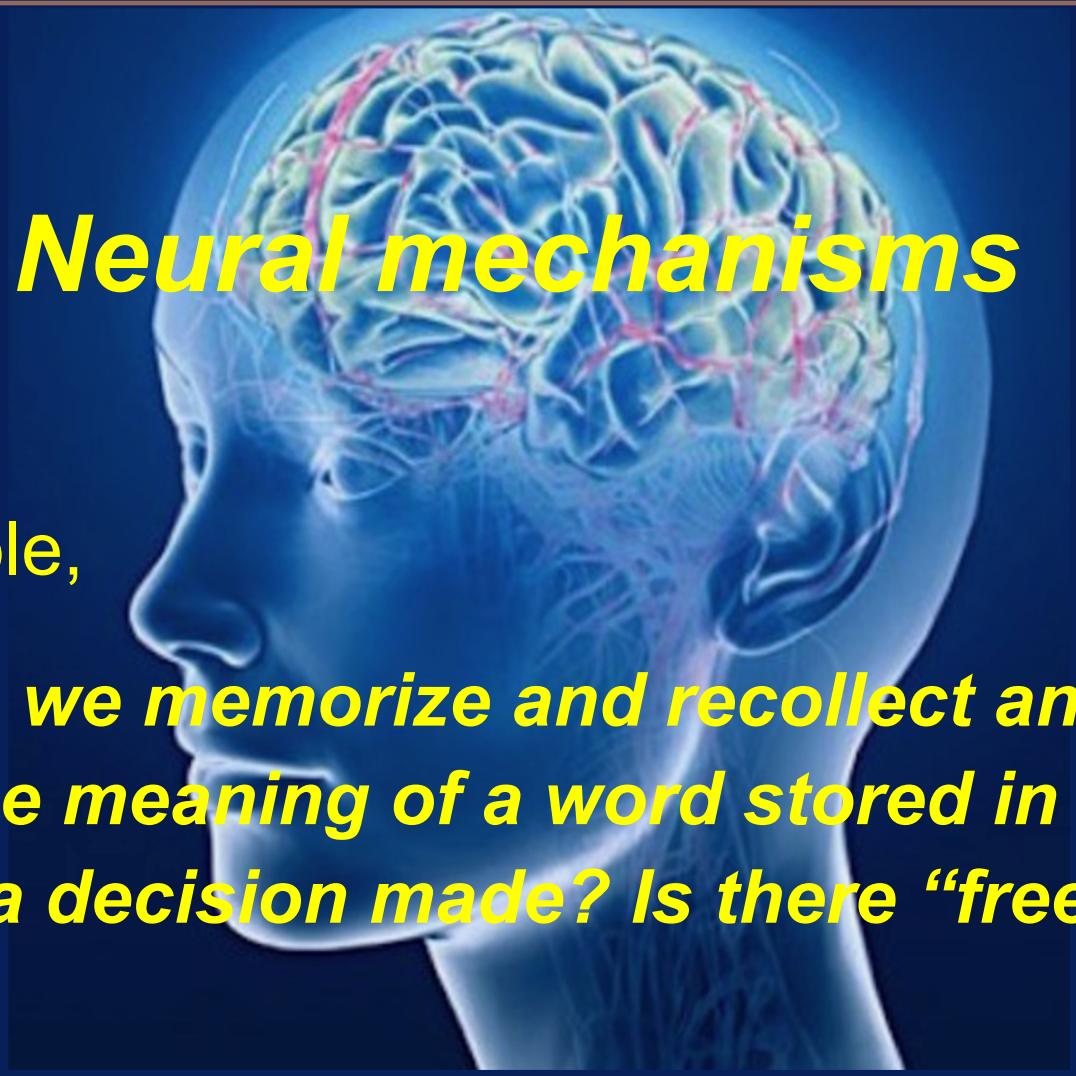
Computational Cognitive Neuroscience



How does the brain implement the mind?

How does the physical substance (brain, body) produce our sensations, feelings, thoughts and emotions? (mental world)

Computational Cognitive Neuroscience



Neural mechanisms

For example,

How can we memorize and recollect an event?
Where is the meaning of a word stored in the brain?
How is a decision made? Is there "free will"?

Why does this matter?

Understanding how the brain works can be used to:

A. Help cure brain-related diseases

- Mental illnesses (e.g, autism, OCD, schizophrenia..)
- Cognitive impairments (e.g., speech, memory...)
- Neurodegenerative diseases (Alzheimer, Parkinson)

HEALTHY BRAIN

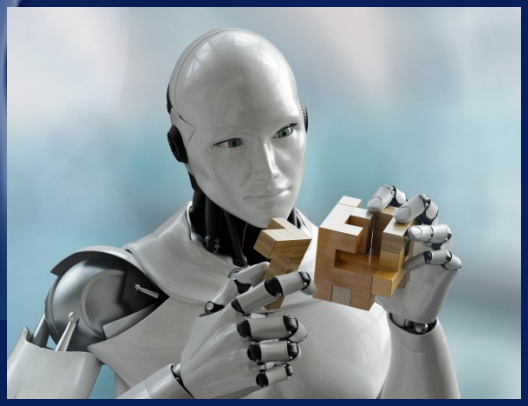
BRAIN of FTD PATIENT

Why does this matter?

Understanding how the brain works can be used to:

B. Build new, *human-like* cognitive systems

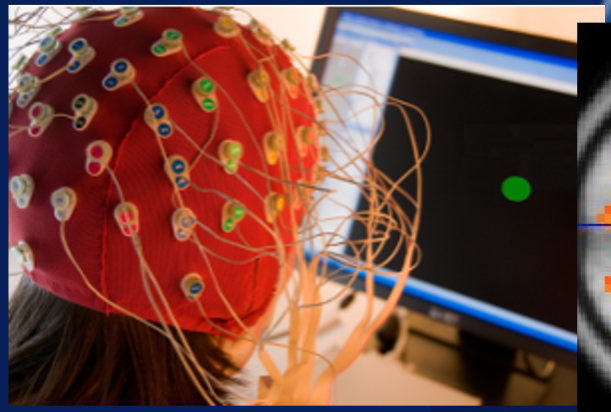
- improve the *quality of our lives* (speech recognition, deep learning applications, robotic assistants…)
- help us *explore* and better *understand* the world (e.g, machines endowed with *creativity*, or "*general*" – i.e. human-like – *intelligence*)



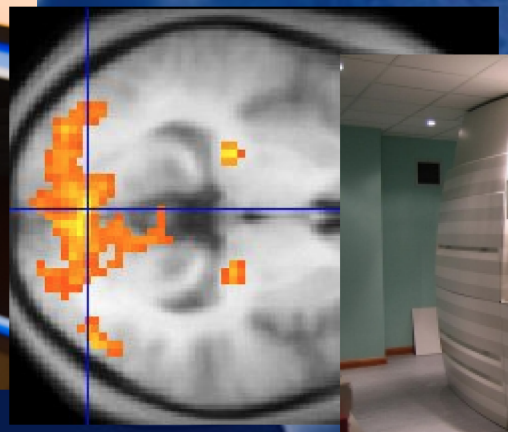
Why **Computational Cognitive Neuroscience?**

1. Cognitive Neuroscience

Uses experimental and computational methods to understand how the **brain & mind work**



ELECTROENCEPHALOGRAPHY



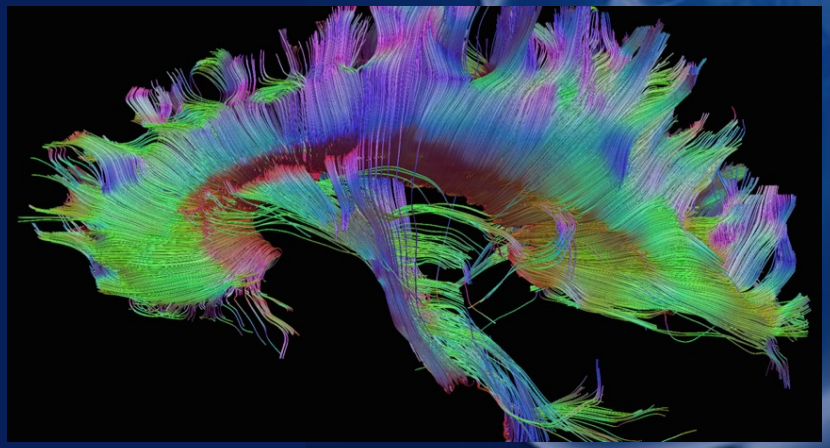
STRUCTURAL & FUNCTIONAL MRI

MAGNETOENCEPHALOGRAPHY

Why **Computational Cognitive Neuroscience?**

2. Computational Neuroscience

Build computer models that mimic structure & function of brain components, to explain how they interact..



ANATOMICAL STRUCTURE

CELLULAR-LEVEL FUNCTION

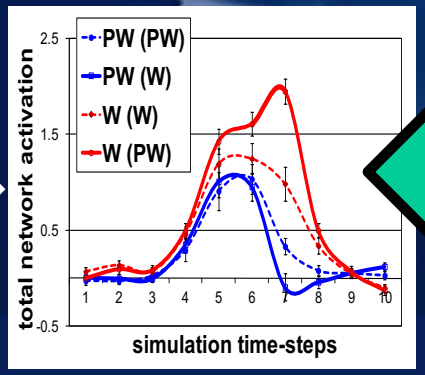
.. and, together, give rise to the ***mind***

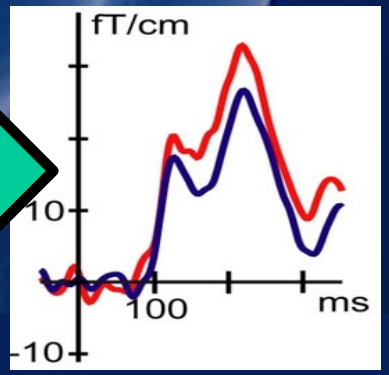
Why **Computational Cognitive Neuroscience?**

1. Cognitive Neuroscience
+
2. Computational Neuroscience

Data → Theory → computational model (explains data) →
→ Simulations → Novel predictions → New experiments → Data

MODEL





BRAIN

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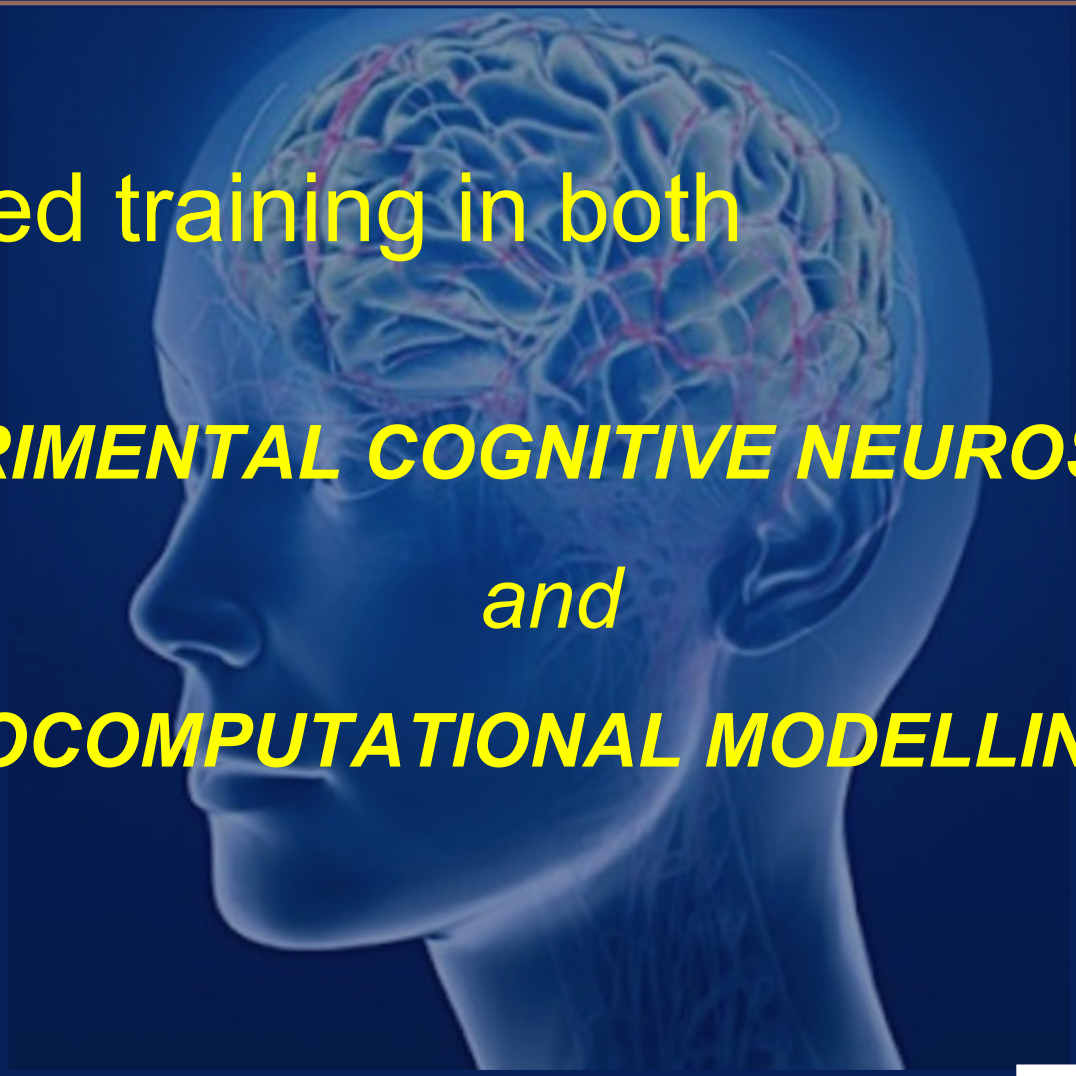

Advanced training in both

1. EXPERIMENTAL COGNITIVE NEUROSCIENCE

and

2. NEUROCOMPUTATIONAL MODELLING

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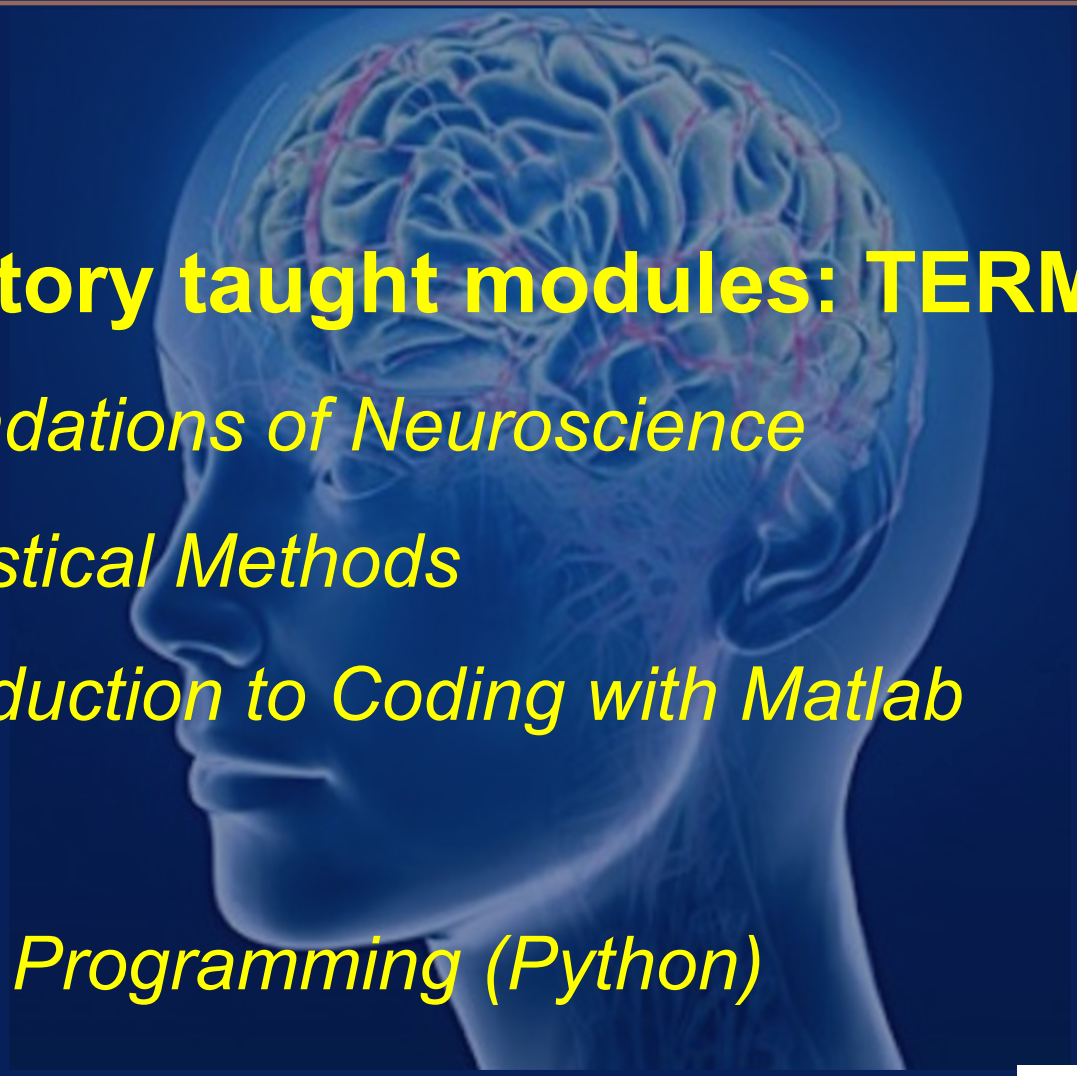

Mandatory taught modules: TERM 1

- *Foundations of Neuroscience*
- *Statistical Methods*
- *Introduction to Coding with Matlab*

OR

Data Programming (Python)

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Mandatory taught modules: TERM 2

- *Cortical Modelling*
- *Modelling Cognitive Functions*
- *Cognitive Neuroscience*
- *Advanced Quantitative Methods*

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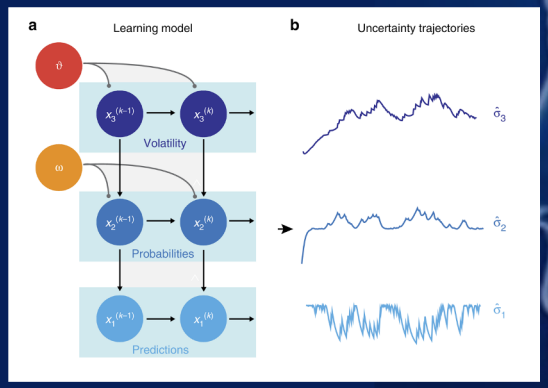
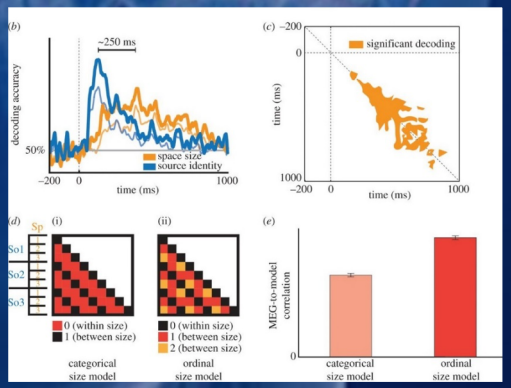
CCN2 Programme Overview

Mandatory TERM 3 (May-Aug) MSc project:

- ***Research Project & Dissertation***



Computational
OR
Data Analysis
(**No data collection**)



Experimental
AND
Data Analysis
(**Data collection required**)

- Examples of previous projects: **https://coconeuro.com/**

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Optional modules (students to choose **ONE**):

- *Research Design and Analysis (**PSY**)*
- *Neural Networks (**COMP**)*
- *Critical Analysis (**PSY**)*
- *Physical Computing (**COMP**)*
- *Behavioural Genetics (**PSY**)*
- *Artificial Intelligence / Deep learning (**COMP**)*
- *Machine Learning (**COMP**, Term 2)*

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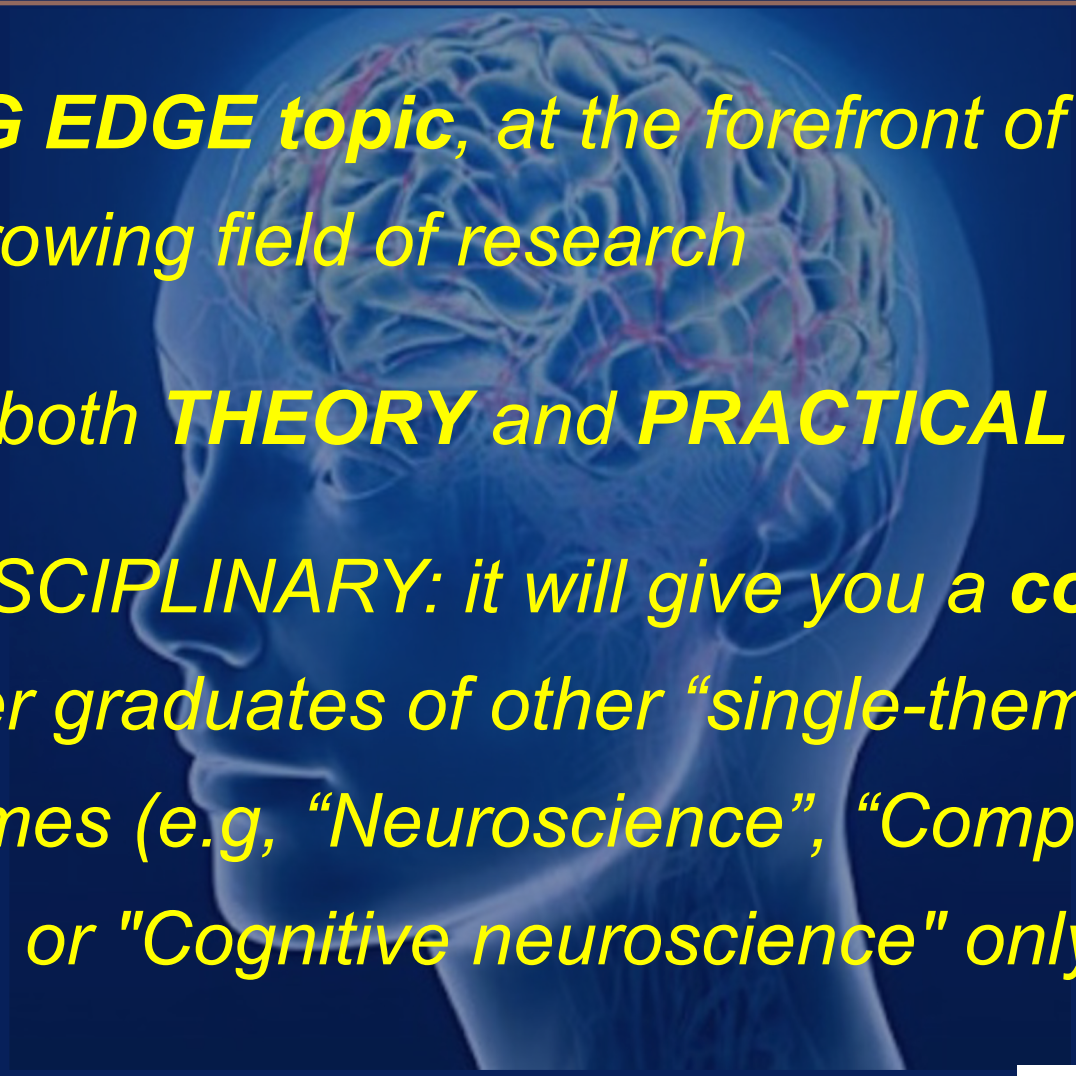
Why enrol on this MSc



- ***CUTTING EDGE topic**, at the forefront of a new, rapidly growing field of research*
- *It covers both **THEORY** and **PRACTICAL** methods*
- *MULTIDISCIPLINARY: it will give you a **competitive edge** over graduates of other "single-theme" programmes (e.g, "Neuroscience", "Computer Science", or "Cognitive neuroscience" only)*

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Links with industry

Sony CSL (Japan)
Bayer (Germany)
LiquidWeb (Italy)
Filament (UK)
DeepWave Technologies (USA)

- **MSc project in collaboration**
- **Possible POST-MASTER internships**
- **Examples of Careers paths:**

https://coconeuro.com/index.php/alumni/

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Careers

1. ***ACADEMIA**: Ideal preparation for PhD studies or R.A. positions in computational / cognitive neuroscience, leading to a career in research (including in **clinically-applied** projects)*

2. ***INDUSTRY**: tech companies developing intelligent systems (e.g., data analyst / data scientist posts) including B**rain-Computer Interface**, **cognitive robotics** and **Deep-Learning** applications (game intelligence, virtual reality, natural language processing, human-computer interaction, web-search engines,... etc. etc.)*

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MSc in Computational Cognitive Neuroscience

THANK YOU!

Any questions?...

For a copy of these slides, see: **https://coconeuro.com/**

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www.gold.ac.uk/pg/msc-computational-cognitive-neuroscience/

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