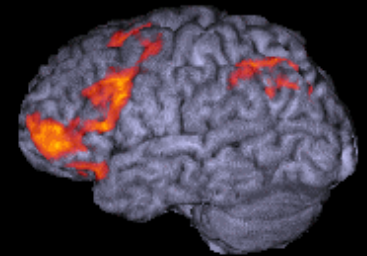


Giftedness and the brain

Day 2

Session 3: 1430-1600

- Future directions in neuroscience?
 - Connectivity
 - Time and place
 - Correlation and causation
 - Context
- Future of educational neuroscience?
 - Careers for gifted children



Functional connectivity

The main new thrust of research in cognitive neuroscience in this next decade is the mapping of functional connectivity ...

... that is, how functional modules transfer information, anatomically, bio-chemically, bio-electrically, rhythmically, ...

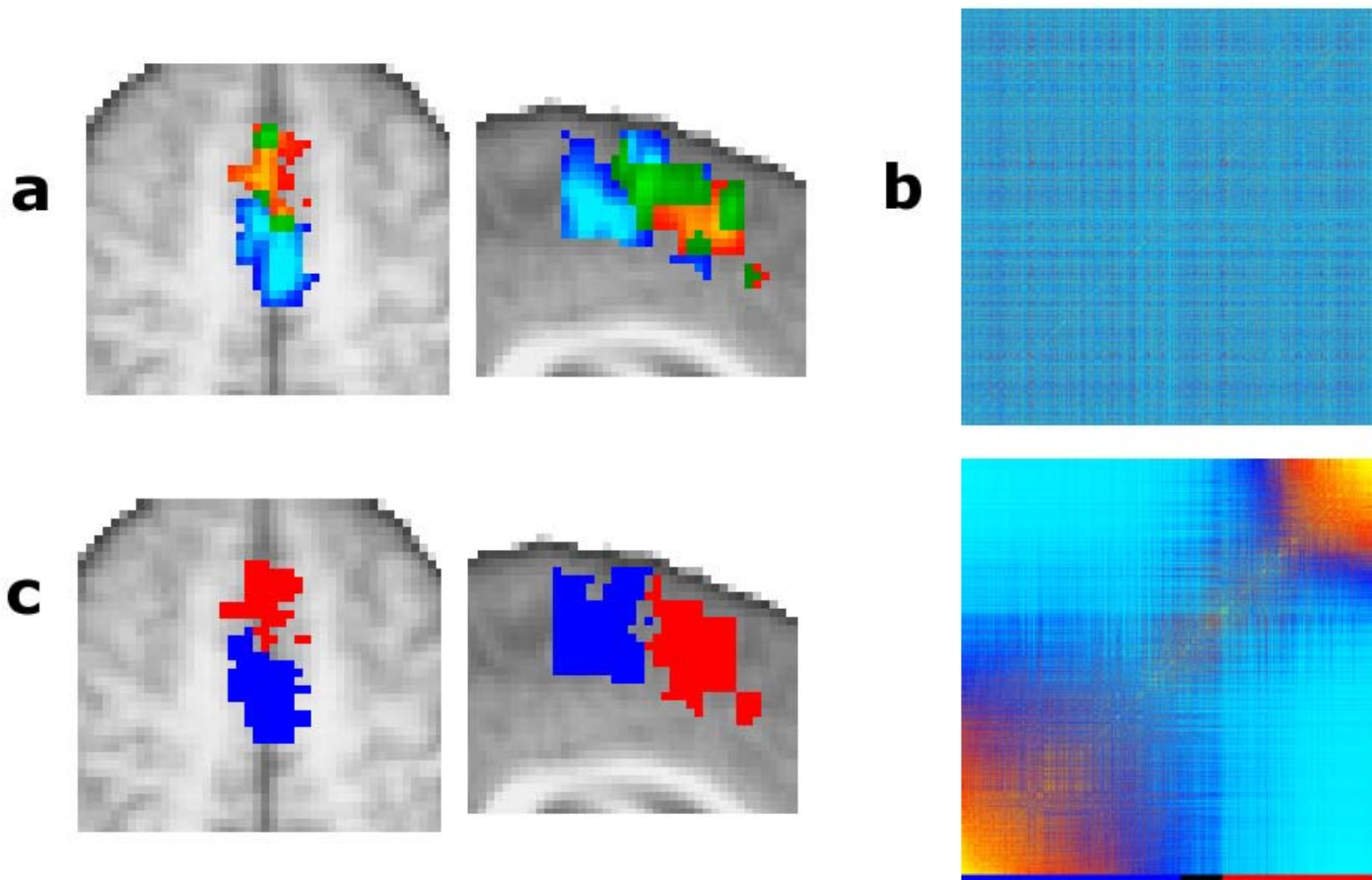
Fibre connectivity from Diffusion Weighted MRI

Tim Behrens, FMRIB Oxford



Connectivity maps of grey matter in pre-motor and motor cortex

Heidi Johansen-Berg, Tim Behrens, FMRIB Oxford



Time course to complement spatial mappings

fMRI and PET are blunt instruments for understanding how functions evolve over time.

EEG and MEG can provide complementary (and synchronised) temporal data.

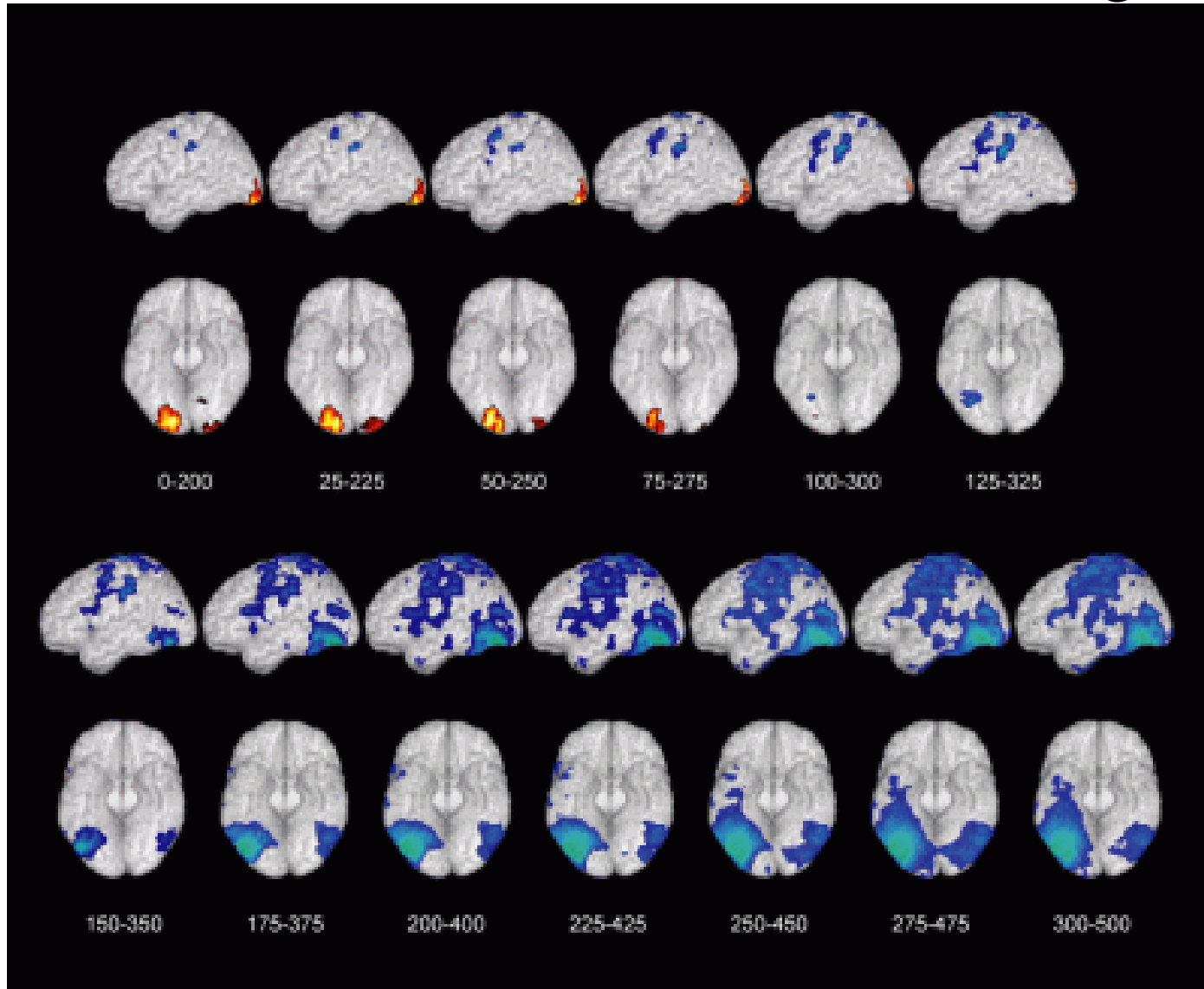
Magnetoencephalography (MEG)

Combine with fMRI
data for improved
temporal resolution



Functional Imaging Laboratory, London

The first half-second of visual word recognition



Morten Kringelbach in collaboration with Kristen Pammer, Peter Hansen, Piers Cornelissen, Gareth Barnes, Krish Singh & Arjan Hillebrand, *Neuroimage*, (2004).

The first half-second of visual word recognition (Kringelbach, 2004)

Contrary to what would be expected on the basis of cognitive models and haemodynamic studies, the component of this activity which spatially coincides with the visual word form area (VWFA) is not active until around 200 ms post-stimulus, and, critically, this activity is preceded by and co-active with activity in parts of the inferior frontal gyrus (IFG, BA44/6).

The spread of activity in the VWFA for words does not appear in isolation but is co-active in parallel with spread of activity in anterior middle temporal gyrus (aMTG, BA 21 and 38), posterior middle temporal gyrus (pMTG, BA37/39) and IFG.

Correlation vs Causation

Most neuroimaging data inform correlations between levels of neural activation and behaviour

Opportunistic neuropsychological analyses of neural lesions or trauma inform necessity conjectures of causation

Transcranial Magnetic Stimulation (TMS)



TMS temporarily disables a small area of brain to test its necessity for an aspect of behaviour.



Experimental switch is a turn-on for the brain

Stephen Brook
Science writers

ALLAN Snyder is looking forward to switching off part of his brain.

The director of the Centre of the Mind says the controversial experiment—in which “gentle magnetic waves” will focus on the left frontal lobe and block the natural flow of electrical current in his brain neurons—is imminent.

“Am I looking forward to the world concentrating on me blowing my brains out?” Professor Snyder laughs, his US accent unmistakable.

“It’s not going to hurt anybody—it’s not a Frankenstein experiment.”

The experiment, being conducted jointly at the Australian National University and Sydney University, is about unlocking creativity and accessing the riches of unconscious brain processing.

Professor Snyder is fascinated by autistic savants, such as the character played by Dustin Hoffman in the film *Rainman*—people who have extraordinary creative and mathematical skills despite suffering brain damage.

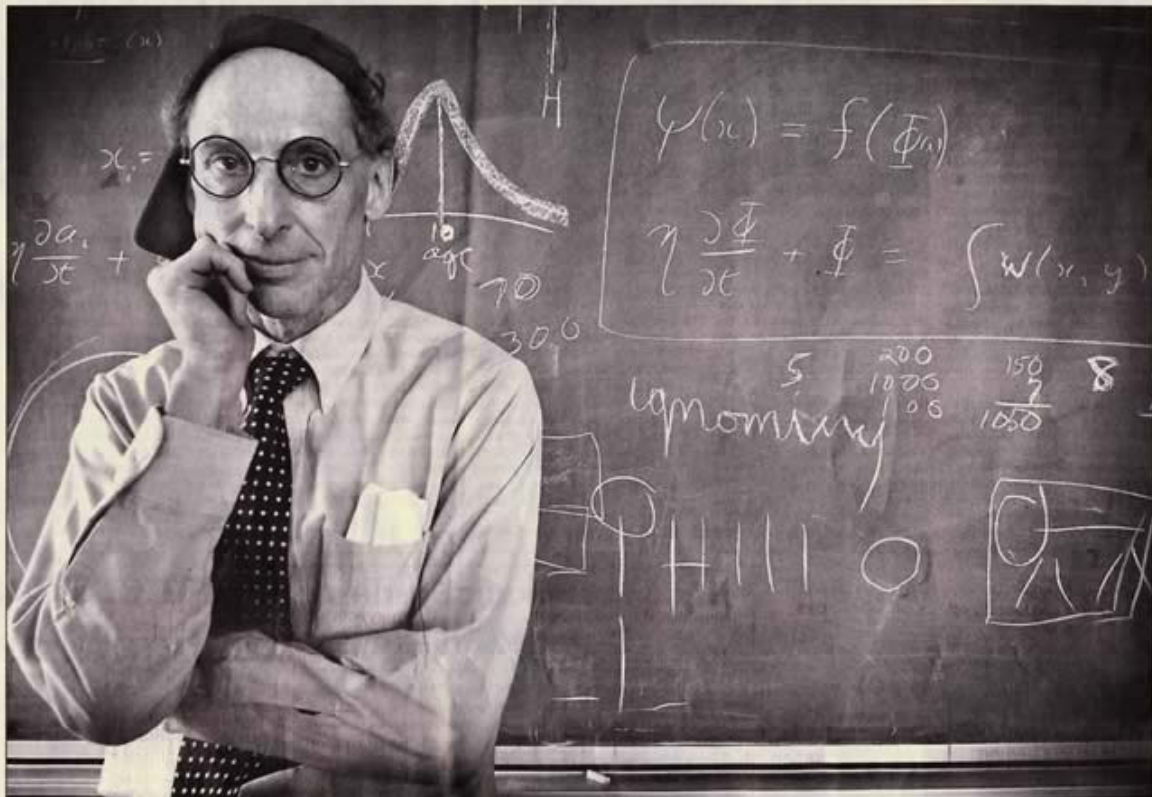
“They see the world literally. That’s a great advantage, but they pay a terrible price for that great advantage—they don’t see the world with meaning,” Professor Snyder says, his curly hair pushed under a red baseball cap.

The experiment’s equipment has been purchased, a post-doctoral student to run the experiments recruited.

“It’s a profound moment in science,” says Professor Snyder.

“Up until now people have believed music and art and certain types of mathematics require certain types of practice and training. What we have found out is that there are many things that are innate—and that is a challenge to what many people would like to believe.”

In 1999, when their original controversial paper was published in the *Proceedings*



Brain drain: Professor Snyder at the Australian National University... ‘no Frankenstein experiment’

Picture: Ray Strange

of the *Royal Society in Britain*. Professor Snyder and colleague John Mitchell asserted that everyone possessed the potential to be a genius.

They hope to test this theory, and also explore how the brain works when we tell people “let me sleep on it”.

It is possible they could produce a new creative tool.

At Professor Snyder’s urging, Flinders University has done similar tests—but its result have not been made public.

Professor Snyder echoes the

belief of the chief scientist Robin Batterham that the knowledge industry will be Australia’s most important export.

“Australia might have great knowledge but no one’s going to buy it from us unless they perceive we are a knowledge country, and one way to do this is to develop things like this.”

In 1997, Professor Snyder won the Australia Prize for his work for work in telecommunications, and he organised the *What Makes a Champion* forum last year, attended by Nelson Mandela.

The recent BBC documentary *Fragments of Genius* has renewed worldwide interest in his work.

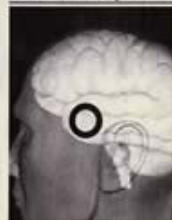
“Of course you pay a price for shutting off part of the brain—otherwise you would not have that part of the brain,” Professor Snyder says.

“We have to have the courage to confront conventional wisdom.

“This work is controversial. We should salute the freedom in this country which allows it to happen.

“Aristotle would have loved it here.”

How the experiment works



The part of the brain affected by the trial

- Snyder will place a cowl containing electronic devices over his head.
- Gentle magnetic waves will be focused on the left frontal lobe to block the natural flow of electrical current in his brain neurons. No probes will be inserted.
- Snyder will then repeat a task he has already done before starting the experiment. He will draw an image or do a mathematical equation. The results will then be compared to see if any temporary enhancements have been achieved.