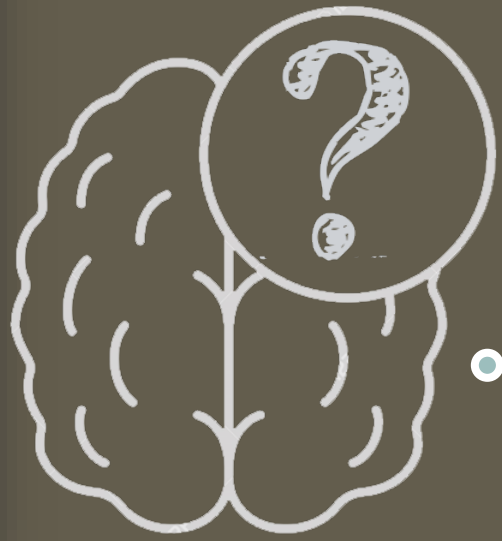
THE BRAIN BEHIND THE SCENES

Mary ET Boyle, Ph.D.

Department of Cognitive Science, UCSD

JUST A PRETTY FACE?

Job candidate employment decisions are not as objective as one would think.



I am irrational when it comes to beautiful faces!

Neuron, Vol. 32, 537–551, November 8, 2001, Copyright ©2001 by Cell Press

Beautiful Faces Have Variable Reward Value: fMRI and Behavioral Evidence

The brain circuitry processing rewarding and aversive stimuli is hypothesized to be at the core of motivated behavior. In this study, discrete categories of beautiful faces are shown to have differing reward values and to differentially activate reward circuitry in human subjects. In particular, young heterosexual males rate pictures of beautiful males and females as attractive, but exert effort via a keypress procedure only to view pictures of attractive females. Functional magnetic resonance imaging at 3 T shows that passive viewing of beautiful female faces activates reward circuitry, in particular the nucleus accumbens. An extended set of subcortical and paralimbic reward regions also appear to follow aspects of the keypress rather than the rating procedures, suggesting that reward circuitry function does not include aesthetic assessment.

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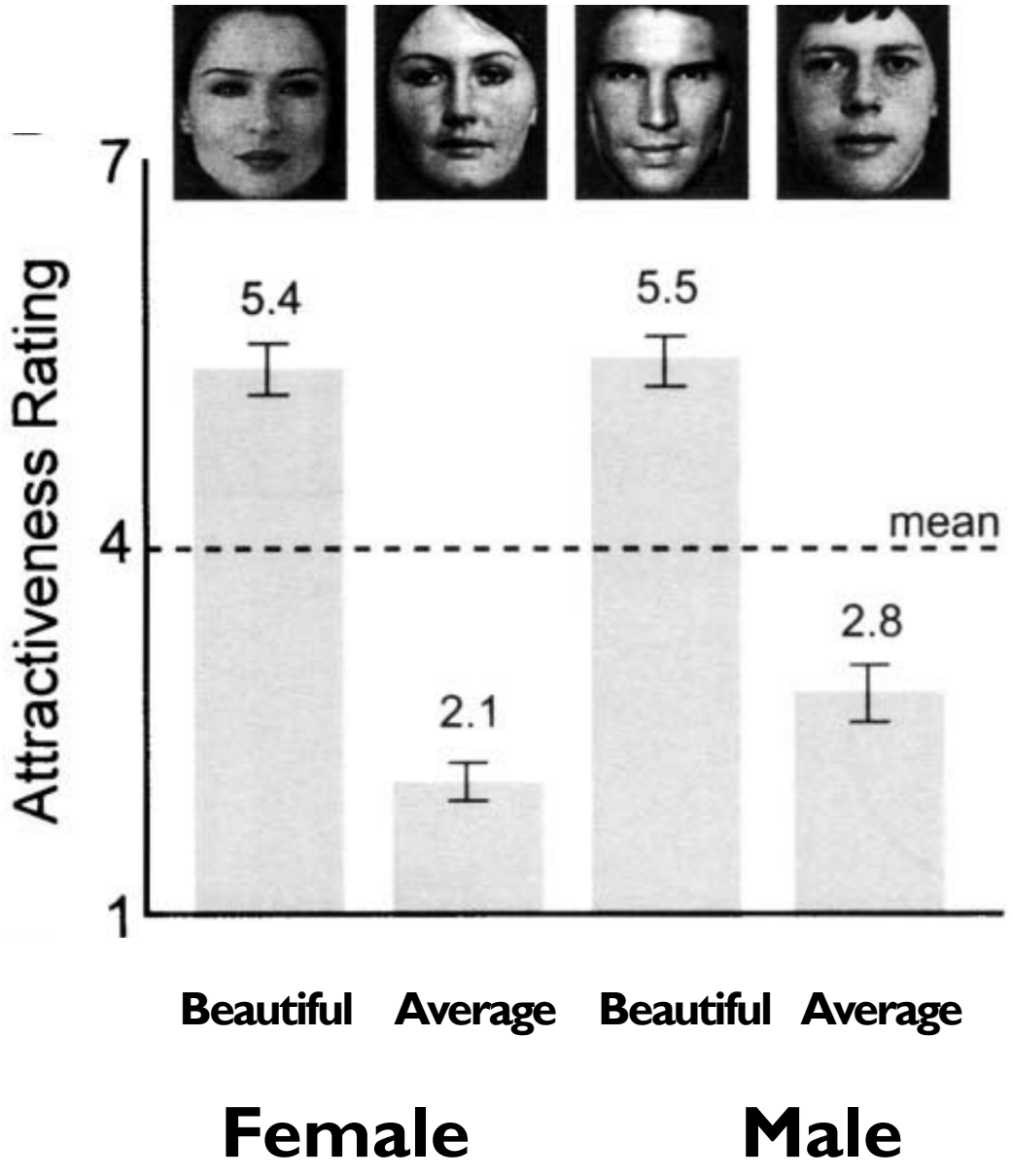
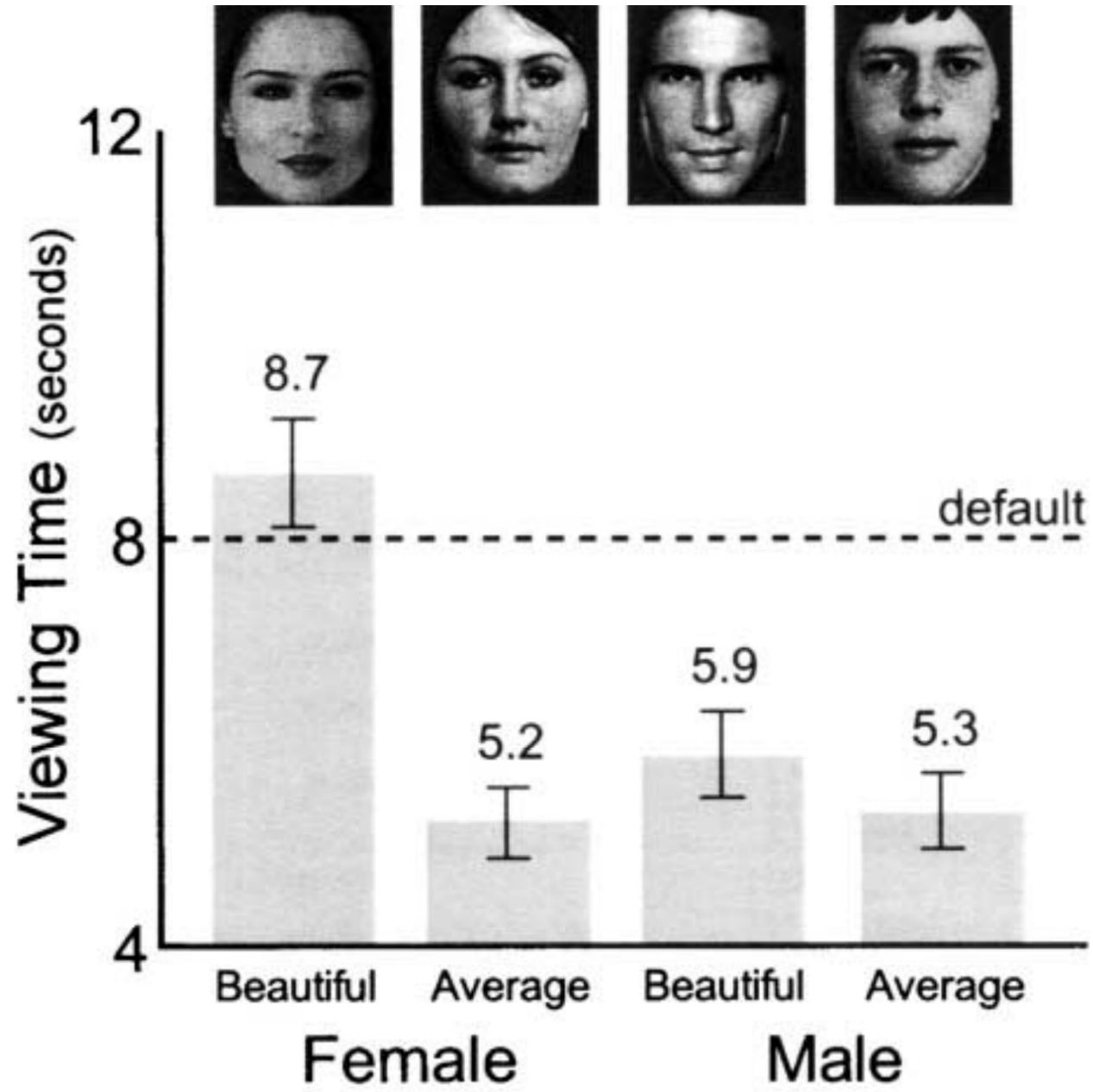
Aharon, I., Etcoff, N., Ariely, D., Chabris, C. F., O'Connor, E., & Breiter, H. C. (2001). Beautiful faces have variable reward value: fMRI and behavioral evidence. *Neuron*, *32*(3), 537-551.



Aharon, I., et al, (2001) Neuron.



Aharon, I., et al, (2001) Neuron.

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The Atlantic

HEALTH

Hot People Are Stressful

The brain appreciates beauty. But not always.

AMANDA MULL APRIL 10, 2019

YOSHIYOSHI HIROKAWA / GETTY

https://www.theatlantic.com/health/archive/2019/04/how-attractive-people-affect-your-brain/586870/

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The problem starts with brain chemistry. “When you see an attractive person, the left ventral tegmental area of the brain becomes active and will pump out dopamine,” says Helen Fisher, a biological anthropologist who studies attraction at the Kinsey Institute. “Dopamine is a stimulant to the brain, so some people might react with surprise or awkwardness.” That feeling is the weak-kneed giddiness that very attractive people can inspire, which can leave you fumbling for words and feeling off balance, even though a dopamine rush is a fundamentally pleasurable experience.

https://www.theatlantic.com/health/archive/2019/04/how-attractive-people-affect-your-brain/586970/

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Based on Fisher’s research, which used fMRI scans to observe the brain lighting up in response to stimuli, the left ventral tegmental area (commonly referred to as the left VTA) is responsible for pleasurable reactions to beauty. Meanwhile, the right VTA provides the dopamine that fuels romantic love; the two responses are similar but neurologically distinct, which means that what people feel when they see a random pretty face isn’t necessarily a desire for romance or even sex. “The same thing probably happens when you look at a good painting,” says Fisher. “It can pump out the dopamine and perhaps make you slightly giddy.”

https://www.theatlantic.com/health/archive/2019/04/how-attractive-people-affect-your-brain/586970/

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The left VTA appraises and appreciates what you see, but lighting up that part of the brain doesn't necessarily make you want to interact with the person whose appearance gives you pleasure, which is why most people don't try to ask out every hot person they see.'

https://www.theatlantic.com/health/archive/2019/04/how-attractive-people-affect-your-brain/586970/

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That’s where a second, potentially more nefarious brain chemical comes in: cortisol.

While people’s brains certainly enjoy beauty, our appreciation is often not that straightforward, because our perceptions are also influenced by everything else about a particular interaction. Indeed, researchers have found that the adrenaline rush created by fear can make other people seem more attractive in the immediate aftermath. And if you’re already feeling good, Fisher says, suddenly encountering an attractive person can make you feel even better by triggering a dip in cortisol levels. In hindsight, that happens to me even more frequently than the panic I had with my surgeon, but humans tend to have better recall for negative memories than positive ones.

https://www.theatlantic.com/health/archive/2019/04/how-attractive-people-affect-your-brain/586970/

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B

Phil. Trans. R. Soc. B (2006) **361**, 2173–2186
doi:10.1098/rstb.2006.1938
Published online 13 November 2006

Romantic love: a mammalian brain system for mate choice

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Mammals and birds regularly express mate preferences and make mate choices. Data on mate choice among mammals suggest that this behavioural 'attraction system' is associated with dopaminergic reward pathways in the brain. It has been proposed that intense romantic love, a human cross-cultural universal, is a developed form of this attraction system. To begin to determine the neural mechanisms associated with romantic attraction in humans, we used functional magnetic resonance imaging (fMRI) to study 17 people who were intensely 'in love'. Activation specific to the beloved occurred in the brainstem right ventral tegmental area and right postero-dorsal body of the caudate nucleus. These and other results suggest that dopaminergic reward and motivation pathways contribute to aspects of romantic love. We also used fMRI to study 15 men and women who had just been rejected in love. Preliminary analysis showed activity specific to the beloved in related regions of the reward system associated with monetary gambling for uncertain large gains and losses, and in regions of the lateral orbitofrontal cortex associated with theory of mind, obsessive/compulsive behaviours and controlling anger. These data contribute to our view that romantic love is one of the three primary brain systems that evolved in avian and mammalian species to direct reproduction. The sex drive evolved to motivate individuals to seek a range of mating partners; attraction evolved to motivate individuals to prefer and pursue specific partners; and attachment evolved to motivate individuals to remain together long enough to complete species-specific parenting duties. These three behavioural repertoires appear to be based on brain systems that are largely distinct yet interrelated, and they interact in specific ways to orchestrate reproduction, using both hormones and monoamines. Romantic attraction in humans and its antecedent in other mammalian species play a primary role: this neural mechanism motivates individuals to focus their courtship energy on specific others, thereby conserving valuable time and metabolic energy, and facilitating mate choice.

Keywords: mate choice; romantic love; dopamine; oxytocin; vasopressin; evolution

According to Fisher et al,
these behaviors are generated in different brain regions.

"The **sex drive** evolved to motivate individuals to seek a range of mating partners;

attraction evolved to motivate individuals to prefer and pursue specific partners;

and **attachment** evolved to motivate individuals to remain together long enough to complete species-specific parenting duties."

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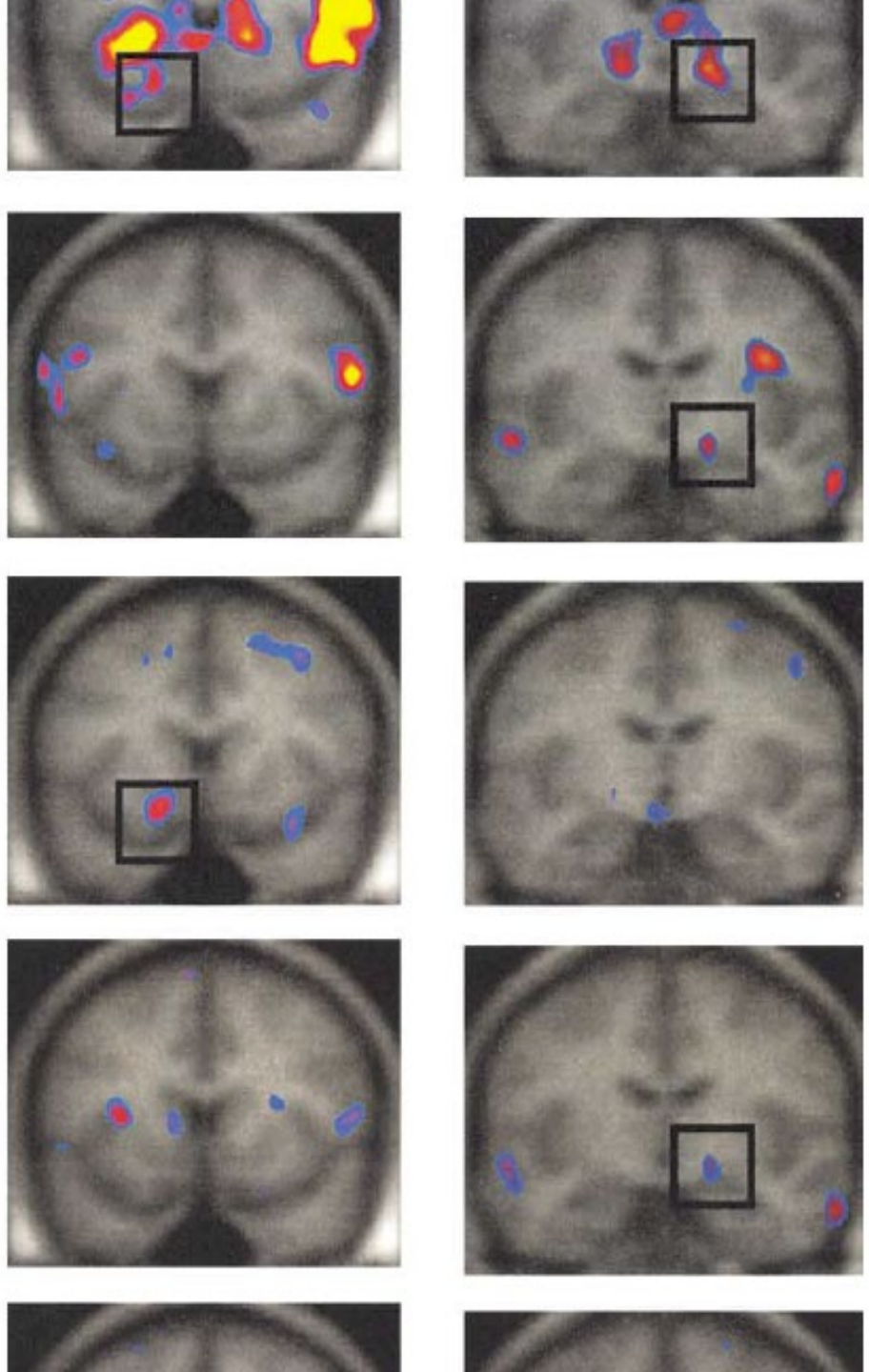


HOW TO INTERPRET THE EVIDENCE?

How do you know what the brain is really doing?

OPEN-UP THE BLACK BOX

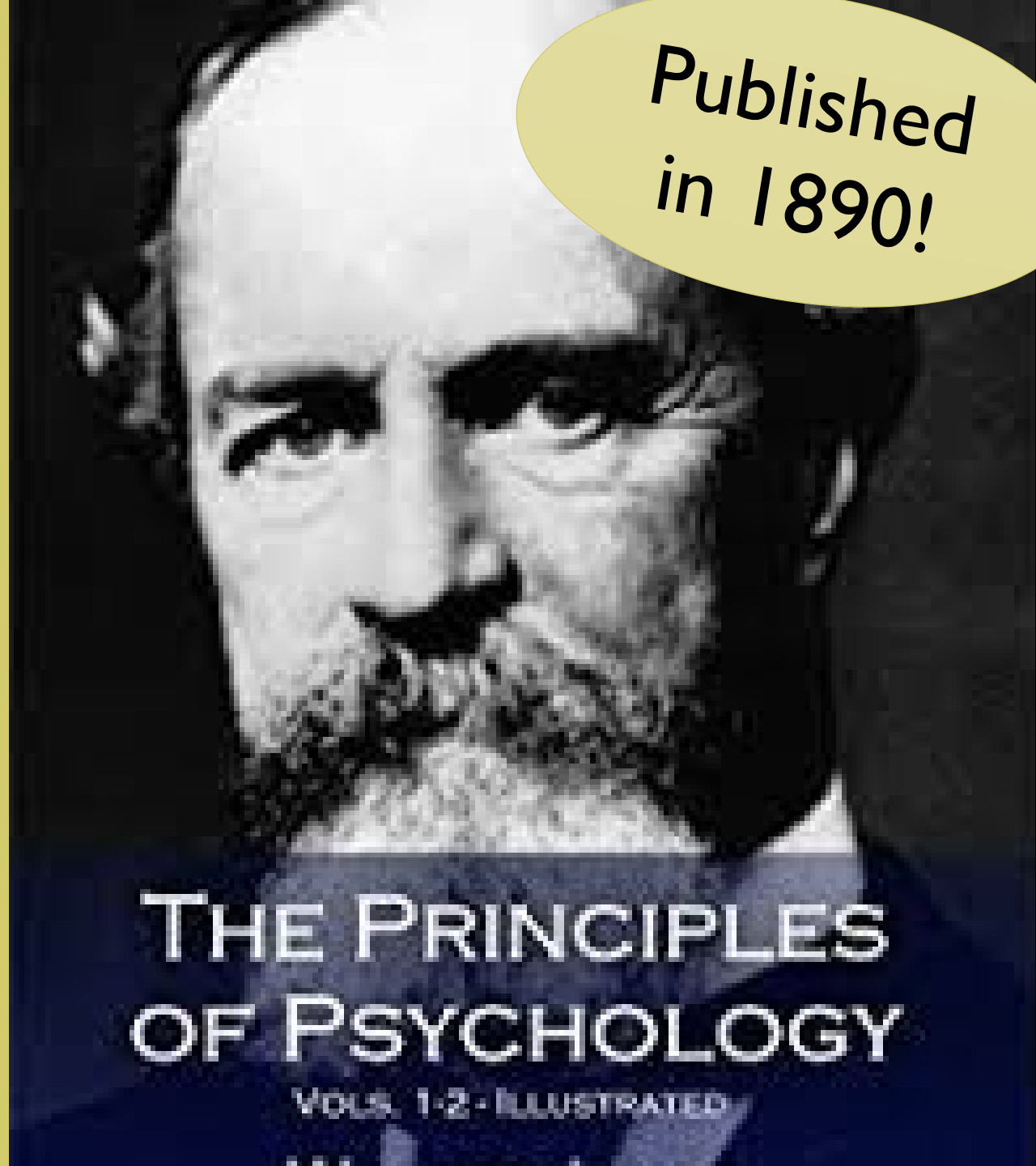
New imaging technique, *old* idea.

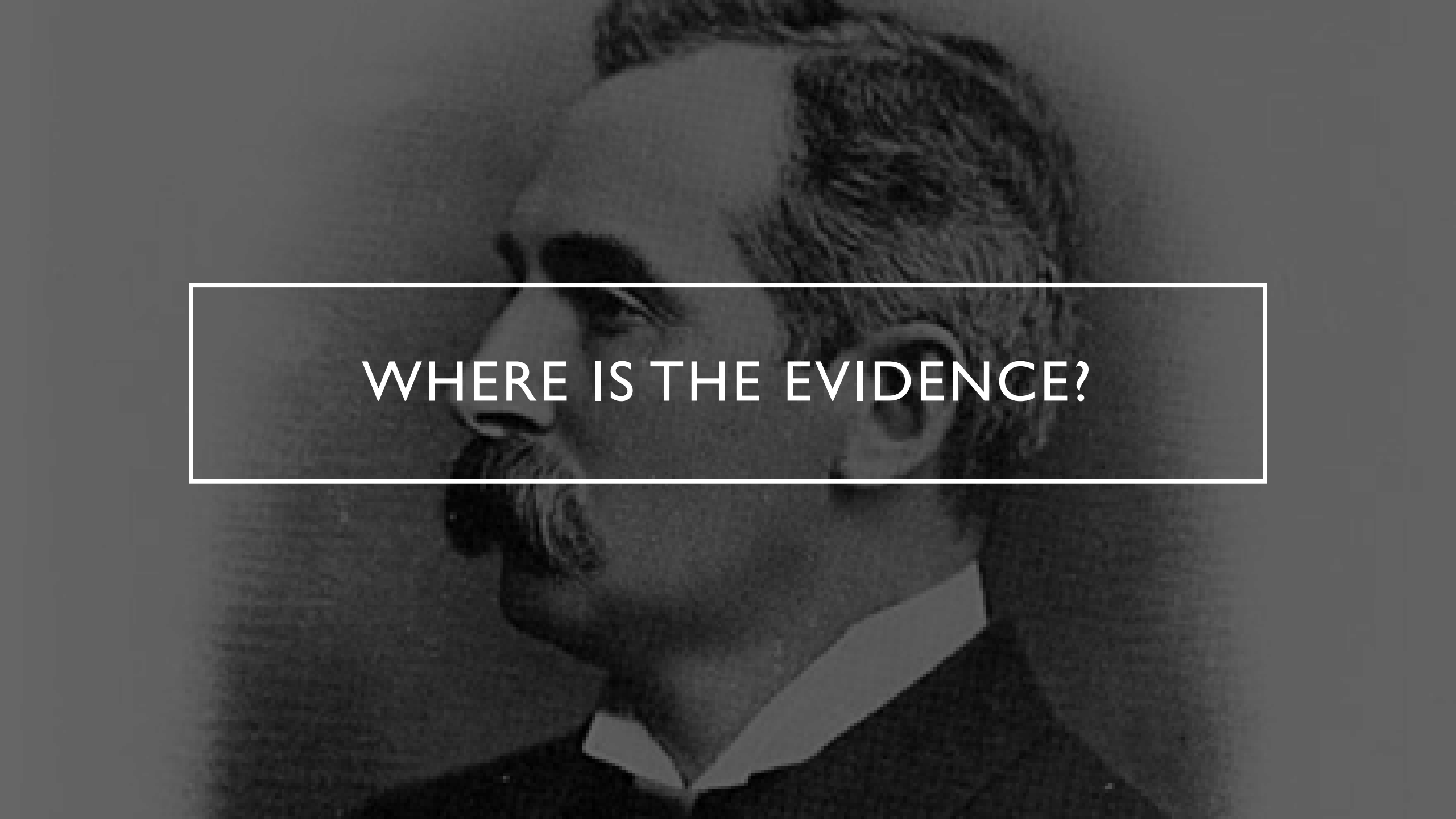
Angelo Mosso

https://scienze.fanpage.it/una-bilancia-per-pesare-le-emozioni/

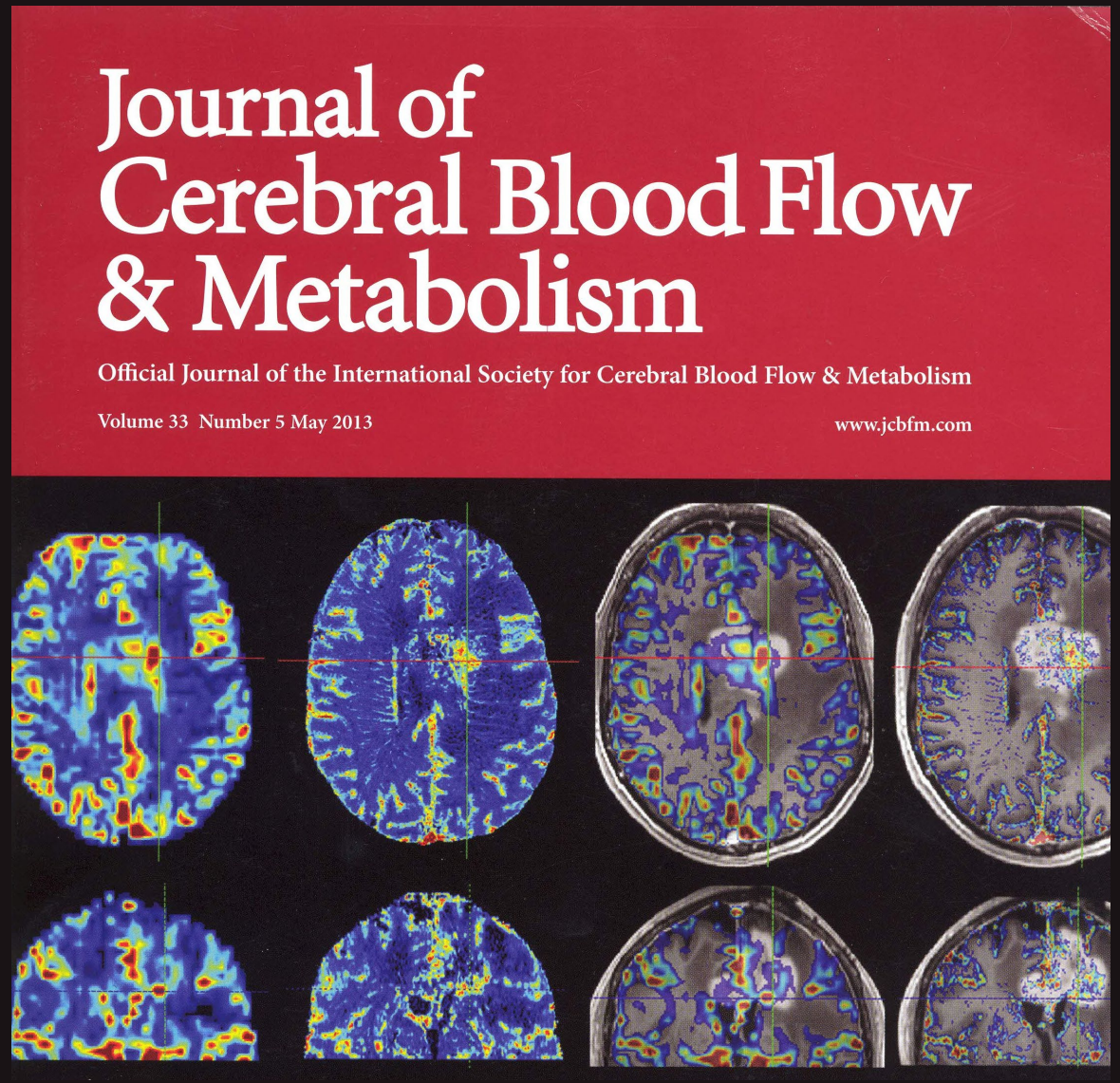
inferring brain activity by measuring changes in blood flow

'The subject to be observed lay on a delicately balanced table which could tip downwards either at the head or the foot if the weight of either end were increased. The moment emotional or intellectual activity began in the subject, down went the balance at the head-end, in consequence of the redistribution of blood in his system…'





WHERE IS THE EVIDENCE?

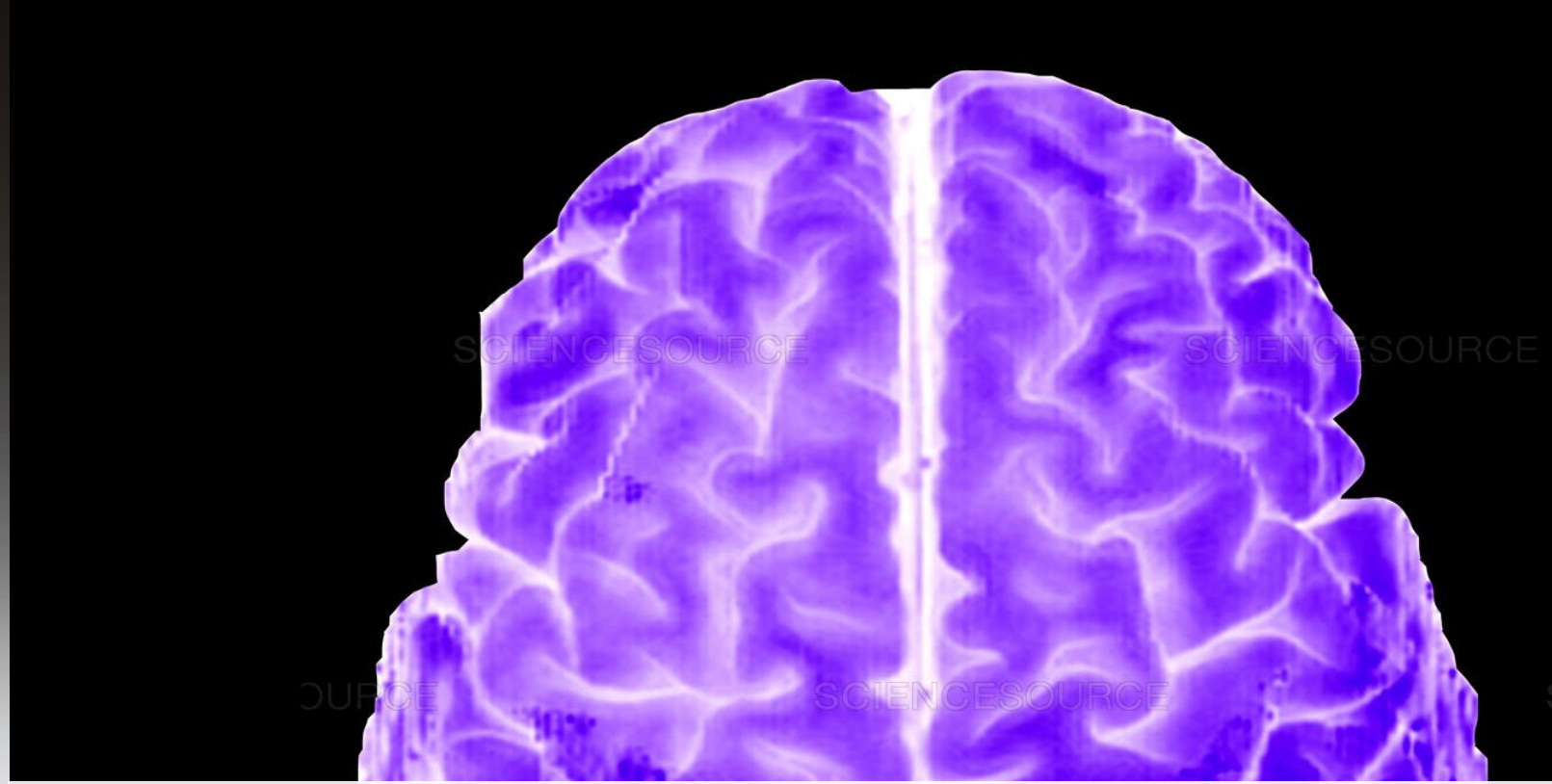


1890's

Charles S. Roy and Charles S. Sherrington provided evidence that there was a coupling between metabolism and blood flow.

Charles S. Roy

Roy and Sherrington



Smart and Sherrington used a kymograph (left) to monitor fluctuations in blood volume.
Their experiments revealed that there were localized changes in blood flow volume in the brain.

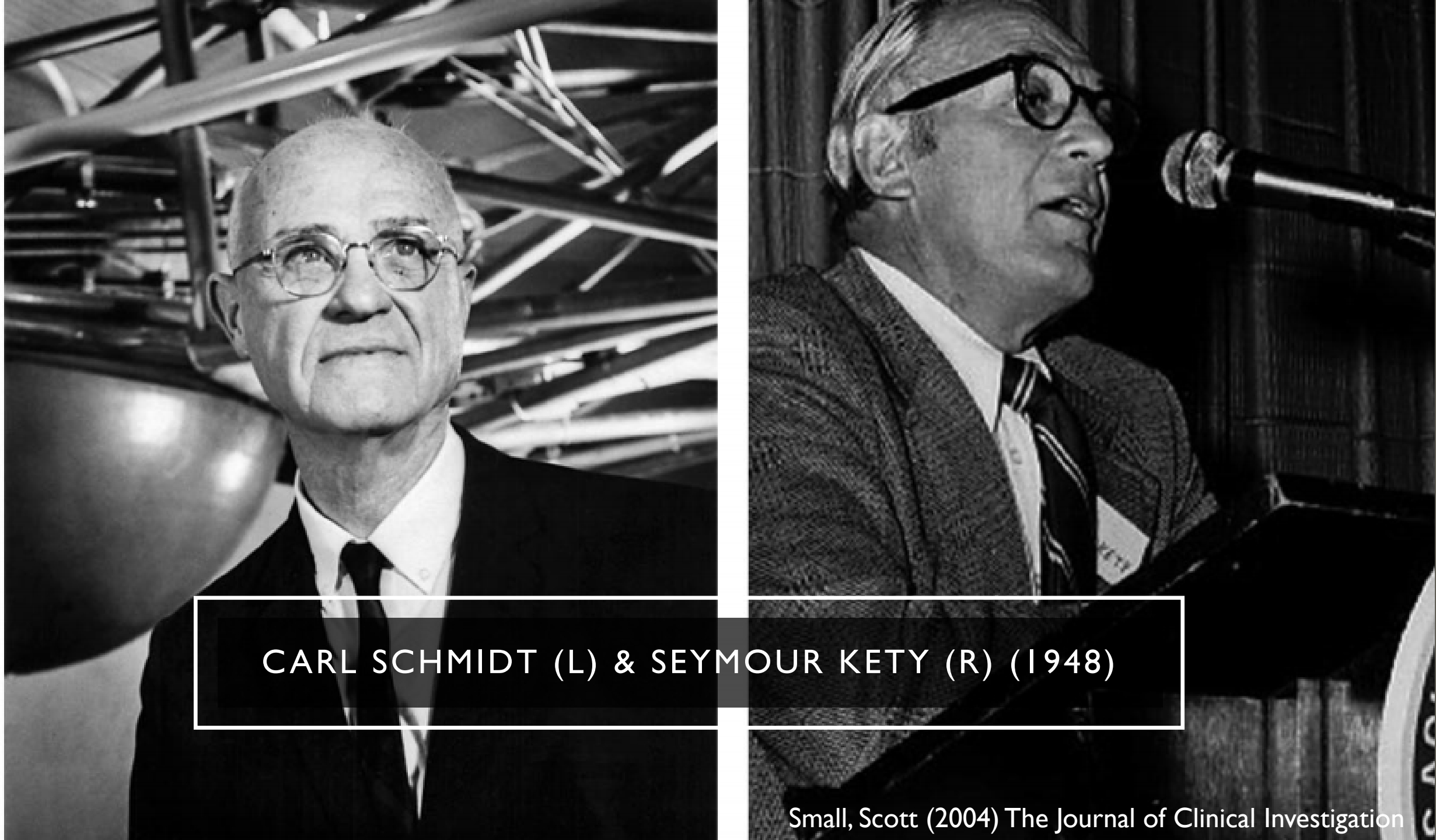
Quantifying cerebral blood flow: regional regulation with global implications

Scott A. Small

Columbia University, College of Physicians and Surgeons, New York, New York, USA.

In 1948, Seymour S. Kety and Carl F. Schmidt published back-to-back papers in the *JCI* that are widely acknowledged as landmarks. Upon publication, the studies resolved a century-old debate, irrefutably demonstrating that cerebral blood flow is regionally regulated. The reported findings turned out to be so powerful in their implications that they provided the inspirational spark that illuminated a brand-new field: functional brain imaging. Thus these papers are landmarks of the rarest kind, not only ending a controversy, but also giving birth to one of the most exciting fields within modern day neuroscience.

Small, Scott (2004) The Journal of Clinical Investigation



CARL SCHMIDT (L) & SEYMOUR KETY (R) (1948)

Small, Scott (2004) The Journal of Clinical Investigation

SCHMIDT AND KETY'S EXPERIMENTAL SETUP TO CEREBRAL MEASURE BLOOD FLOW

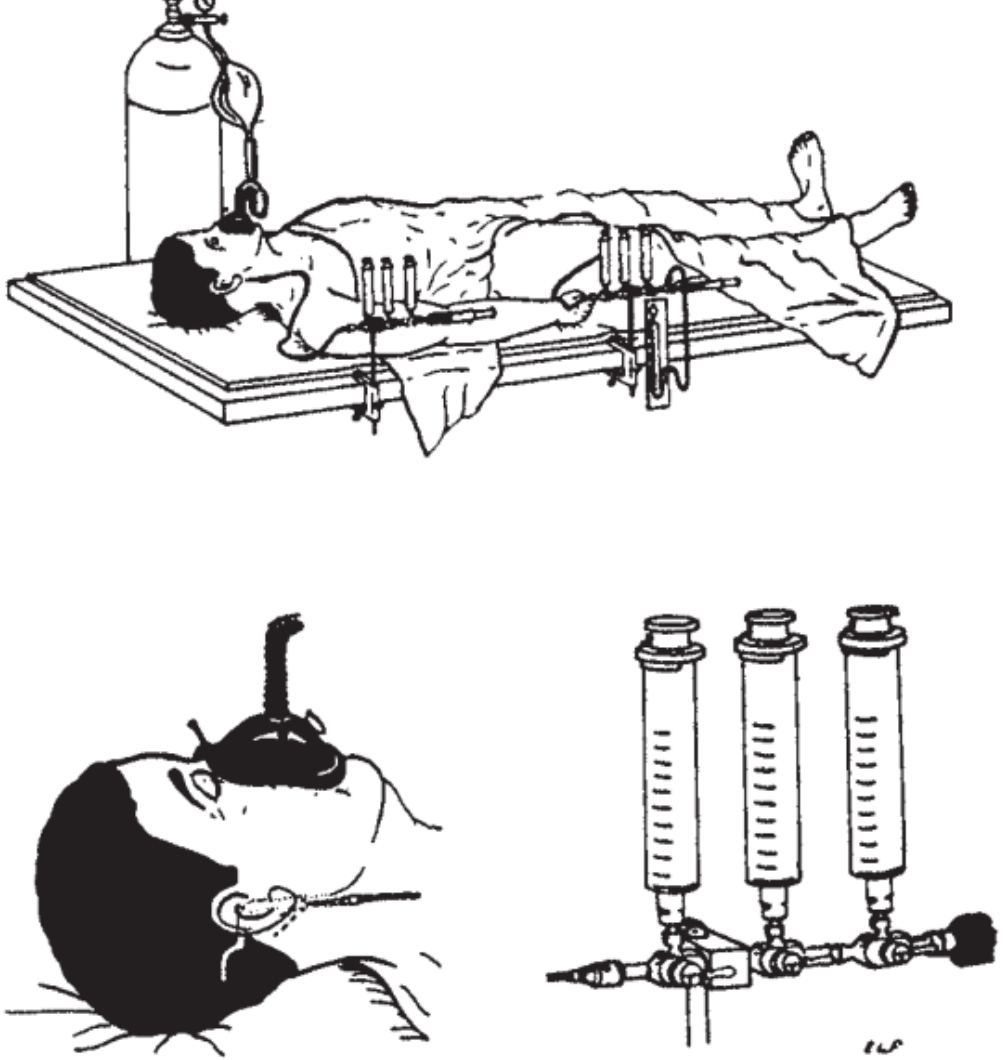
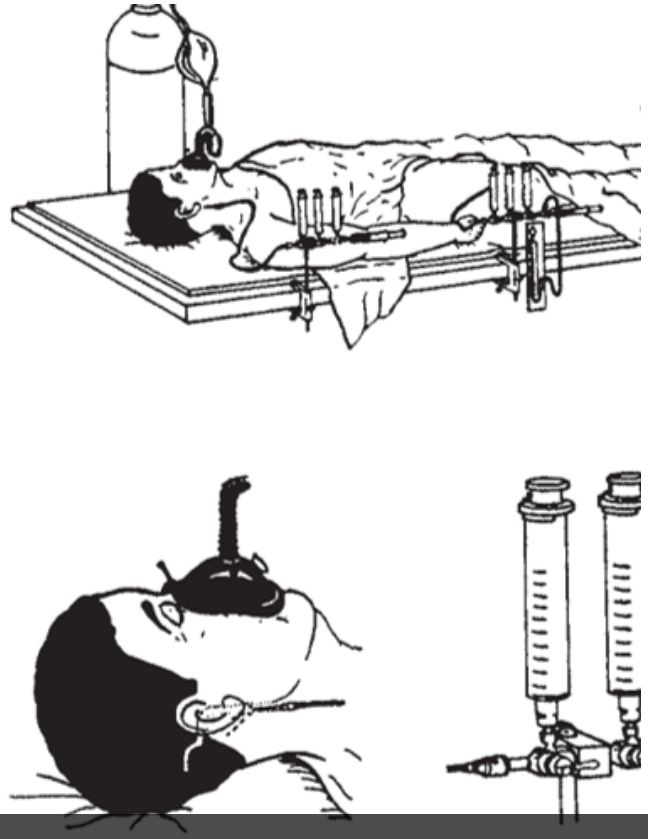


Figure 2
Experimental set-up for cerebral blood flow determination. Position of needles in internal jugular is shown as well as plastic tubing, manifolds, sampling and flushing syringes, and inhalation system. Mean arterial blood pressure is read from a mercury manometer attached to the arterial manifold. Only the expiratory valve on the mask is shown, the inspiratory valve is between the fluted tubing and the mask. Drawings by Dr. E. L. Foltz. Figure and legend reprinted from ref. 7.

Small, Scott (2004)

BRAIN REGULATES ITS OWN BLOOD FLOW!



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Schmidt and Kety showed that when neurons are more active they use more oxygen → which causes the nearby blood vessels to dilate. There is a localized increase in blood volume. It was a big step to correlate cerebral blood flow with neuronal metabolism.

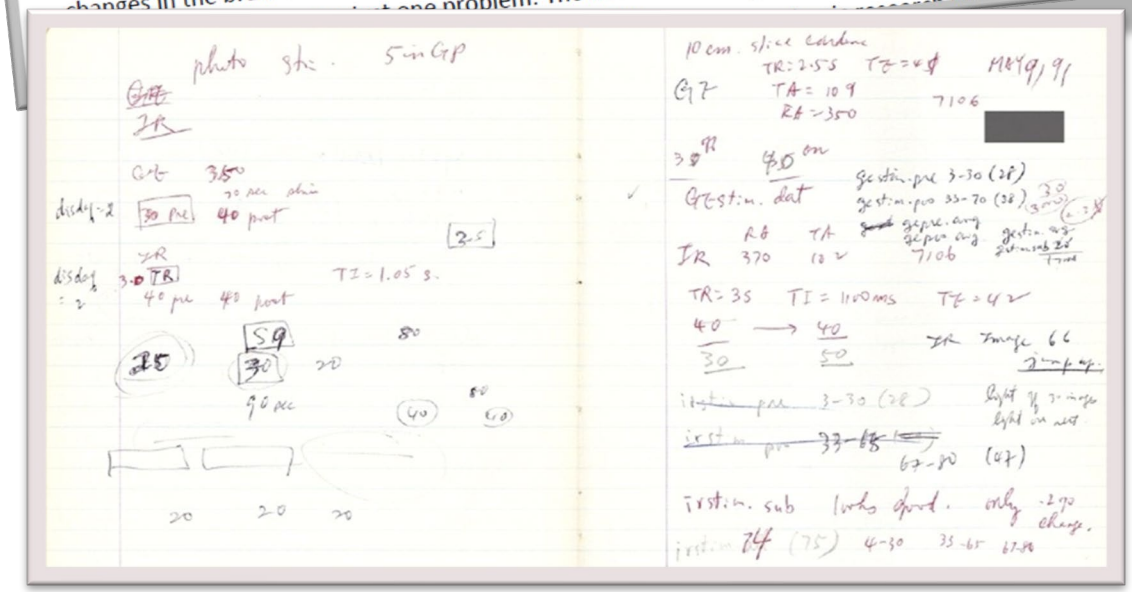
On Introducing Noninvasive fMRI: A Conversation With Ken Kwong

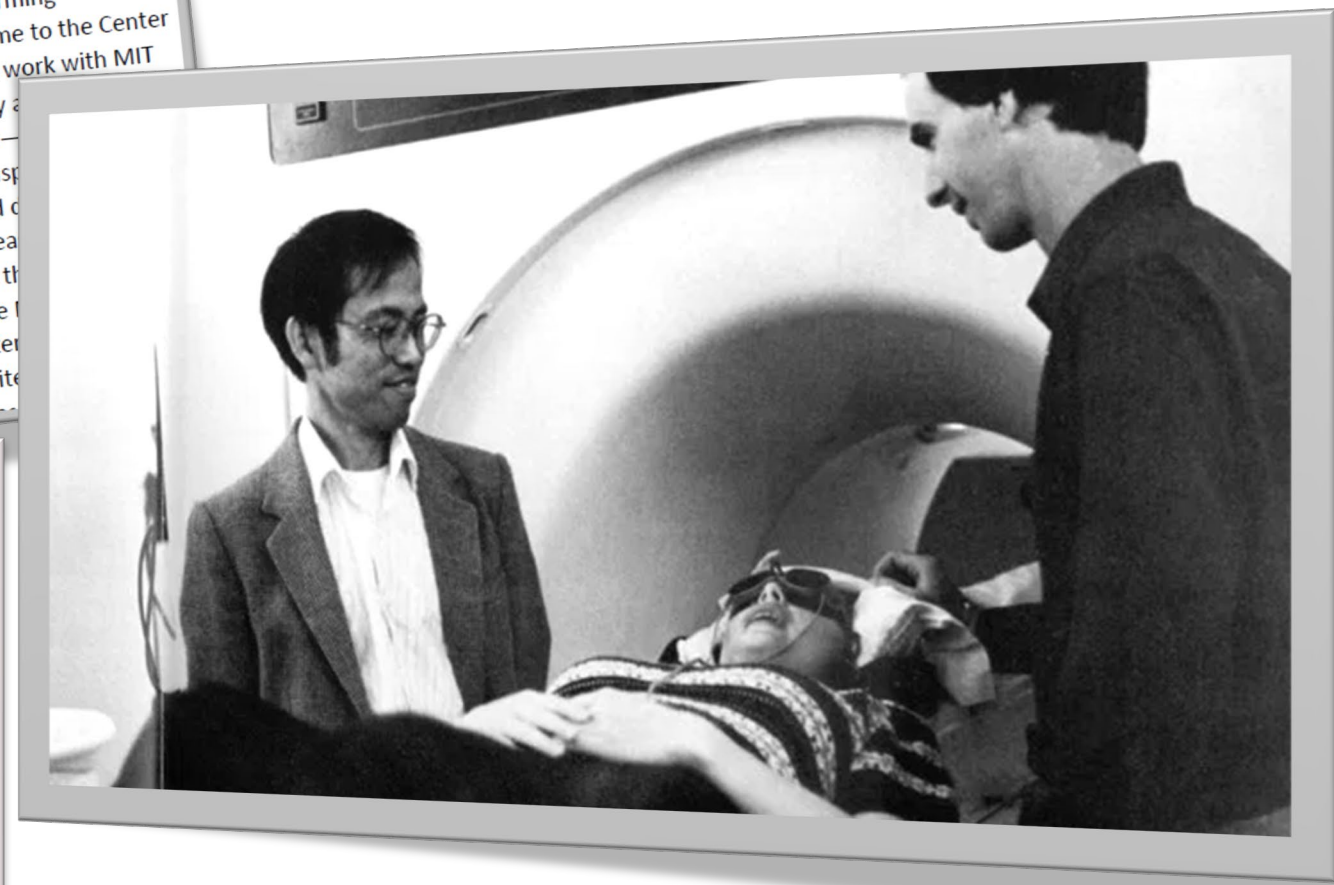
November 29, 2016 Gary Boas

In the early months of 1992 the neuroscience community was flush with excitement. Jack Belliveau, a graduate student with the MGH-NMR Center (now the MGH Martinos Center for Biomedical Imaging), had recently published in *Science* his pioneering work with functional MRI, and the possibilities of the approach seemed truly limitless.

Researchers were particularly inspired by the potential for brain mapping that that was evident in Belliveau's work. They could now see, more or less in real time, changes in the brain occurring in response to particular

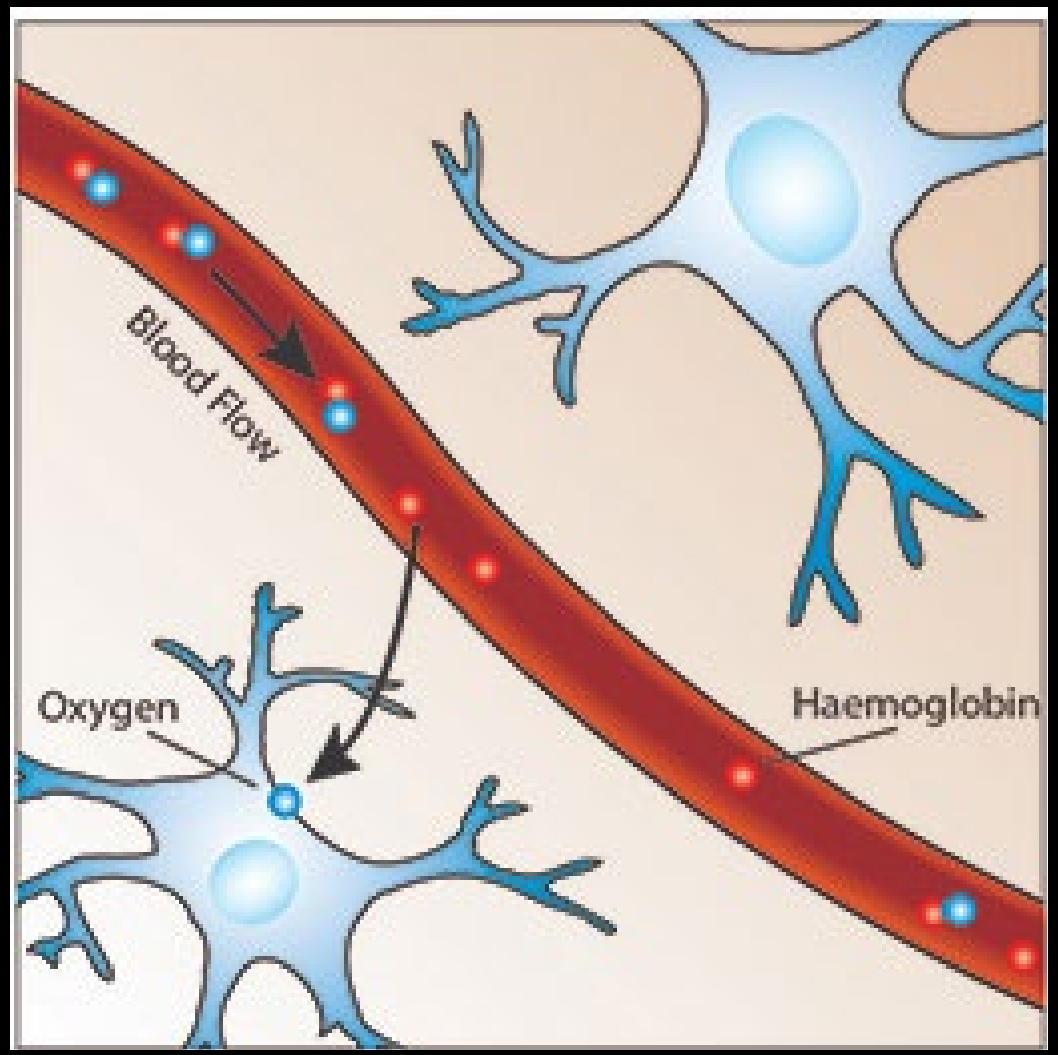
For all the impact his research has had, Kwong didn't actually set out to find the key to performing noninvasive functional MRI. He had come to the Center several years before, in about 1988, to work with MIT graduate student Daisy Chen—an early a Martinos Center Director Bruce Rosen— and applying diffusion MRI methods asp Ph.D. thesis. In 1990, when he started c path, he was seeking new ways to mea perfusion—essentially, blood flow in th possible means could be found in the b that would come to be known as arter This had provoked quite a bit of excite





http://www.fmri25.org/introducing-noninvasive-fmri-conversation-ken-kwong/

What does MRI measure?

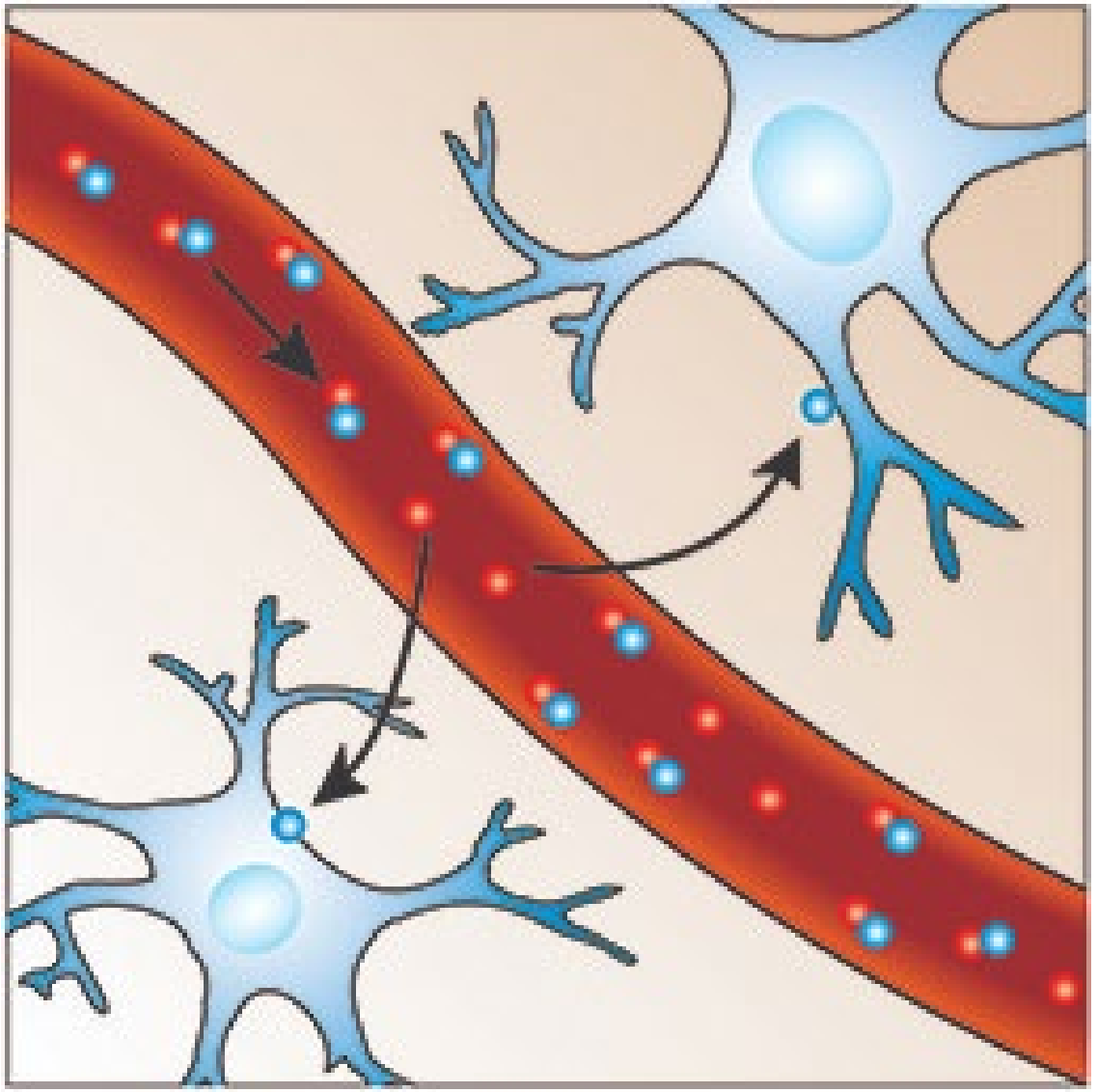


resting

OXYGEN IS DELIVERED TO NEURONS BY HEMOGLOBIN IN CAPILLARY RED BLOOD CELLS

Images from: www.ndcn.ox.ac.uk

When neuronal activity increases there is an increased demand for oxygen and the local response is an increase in blood flow to regions of increased neural activity.

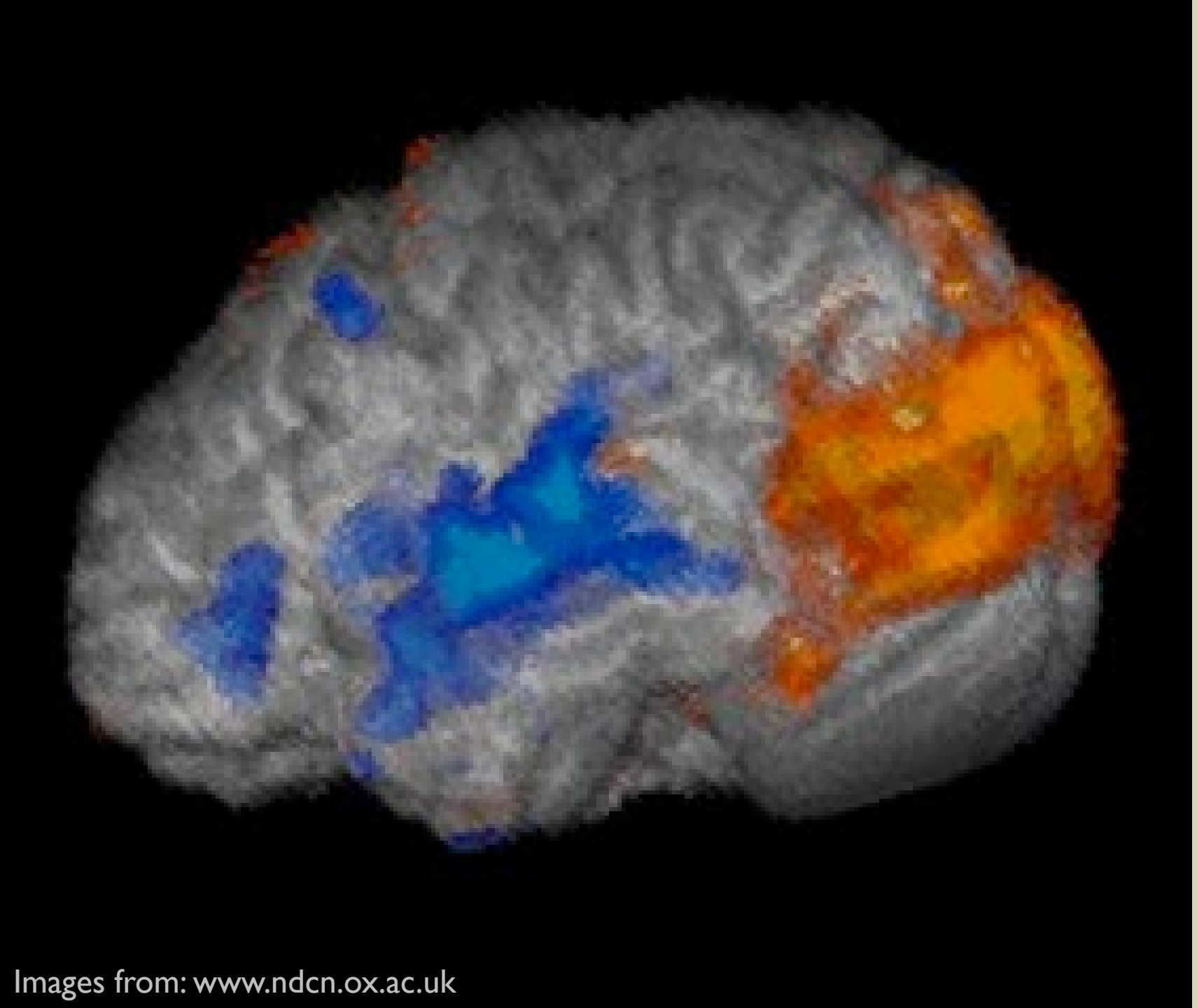


Activated

Images from: www.ndcn.ox.ac.uk

BRAIN DEMANDS OXYGEN!

- The brain requires oxygen
- The oxygen is used for glucose oxidation
- The brain cannot function under anaerobic conditions
- With only a few seconds of oxygen deprivation, one will become unconscious.
- Blood flow and metabolism are tightly coupled.



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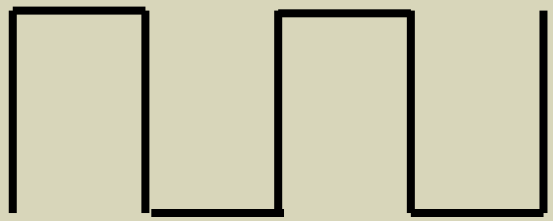

ACTIVATION MAPS

While lying in the MRI scanner the subject watched a screen which alternated between showing a visual stimulus and being dark every 30 seconds.