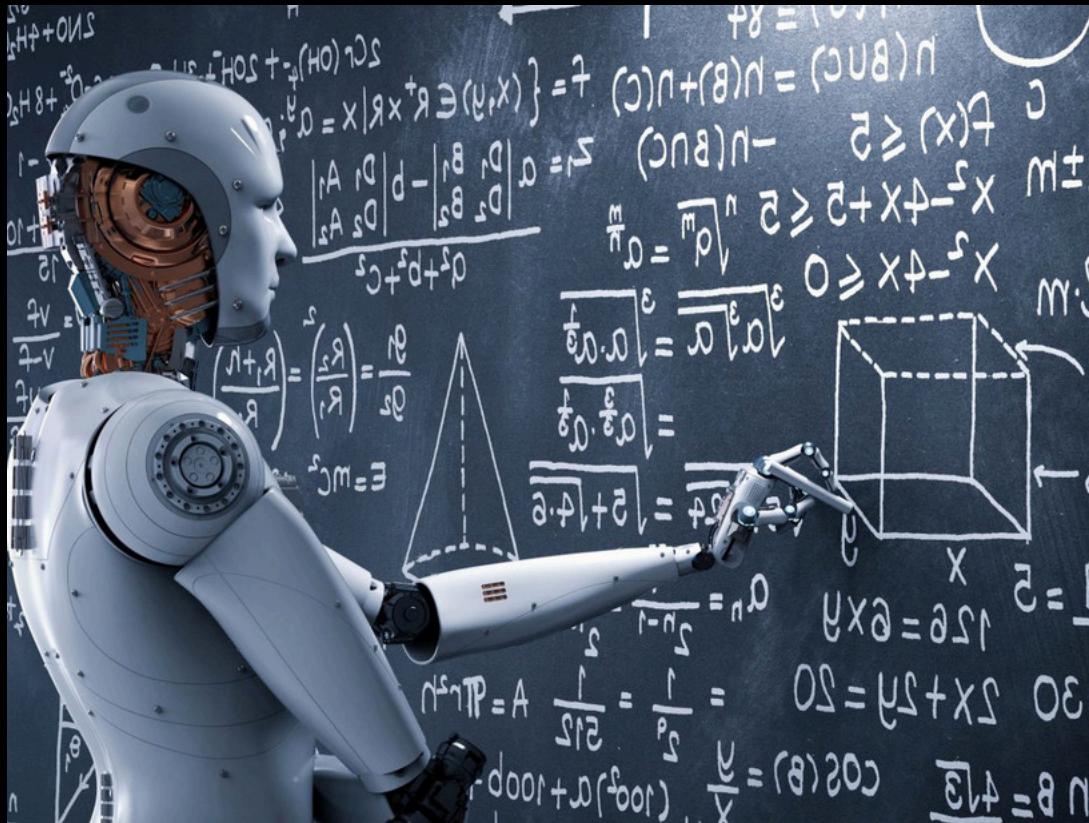


Cognition and Neuroscience



Consciousness and Artificial Intelligence

What is consciousness?

DEFINITION OF CONSCIOUSNESS:

THE SUBJECTIVE PERSONAL EXPERIENCE. How does it fit in the scientific view of the world?

- THE SUBJECTIVE EXPERIENCE OF BEING CONSCIOUS (the hard problem)
- THE FUNCTIONAL ROLE OF CONSCIOUSNESS: A BIOLOGICAL EVOLUTIONARY FUNCTION PROMOTING COMPLEX FLEXIBLE AND ADAPTIVE BEHAVIOUR
(Consciousness contributes to responding more flexibly when automatic actions are unsuitable)
- HOW DOES CONSCIOUSNESS ARISE?

How does consciousness arise? THE GLOBAL WORKSPACE THEORY (GWT)



Bernard Baars, 1988: Consciousness is a supremely functional biological adaptation.

A kind of a gateway: '*a facility for accessing, disseminating, and exchanging information, and for exercising global coordination and control*' (Baars, 1997).

'Consciousness is essential in integrating perception, thought and action, in adapting to novel circumstances, and in providing information to a self-system'.

Baars rejects the idea that consciousness does not play a causal role in the nervous system.

For example, if you make a speech error unconsciously you will not be able to act upon to correct. However as soon as you become aware of the problem, you can fix it because consciousness creates global access to further unconscious resources.

How does consciousness arise? THE GLOBAL WORKSPACE THEORY (GWT)



GWT claims that any piece of information is conscious if it is broadcast widely to many areas of the unconscious brain.

How does consciousness arise according to GWT? Conscious perceptions and actions are those that achieve access to the global workspace and are broadcast to a large audience.

Baars refers to the ‘Theatre hypothesis’, where conscious events happen in the ‘theatre of consciousness’.

One example: The dramatic contrast between items accessible to consciousness at any time and the vast number of unconscious neural processes going on.

How does consciousness arise? THE GLOBAL WORKSPACE THEORY (GWT)



Consciousness act as a ‘bright spot’ on the stage.

The bright spot is surrounded by a fringe of events that are only vaguely conscious.

The unconscious audience sitting in the dark receives information broadcast from the bright spot.

Behind the scenes there are numerous unconscious contextual systems that shape the events happening in the bright spot.



How does consciousness arise? THE GLOBAL WORKSPACE THEORY (GWT)



What makes this theory much more than a theatre metaphor?

It is heavily grounded in psychology and neuroscience knowledge.

Backstage: 'Neural processes'

Bright spot: 'Attention'

The rest of the stage: 'Working Memory' (Baddeley, 2000).

THE INTERACTIONS BETWEEN THESE THREE ELEMENTS ARE BASED ON THE GWT ARCHITECTURE.



How does consciousness arise? THE GLOBAL WORKSPACE THEORY (GWT)



The brain is structured so that a few items at a time are dealt within the global workspace (similar to the 7 + or – 2 items concept of the WM capacity).

The theatre has a numerous input from the senses and the overall context and connection to unconscious resources such as language, autobiographical memories and learned skills.

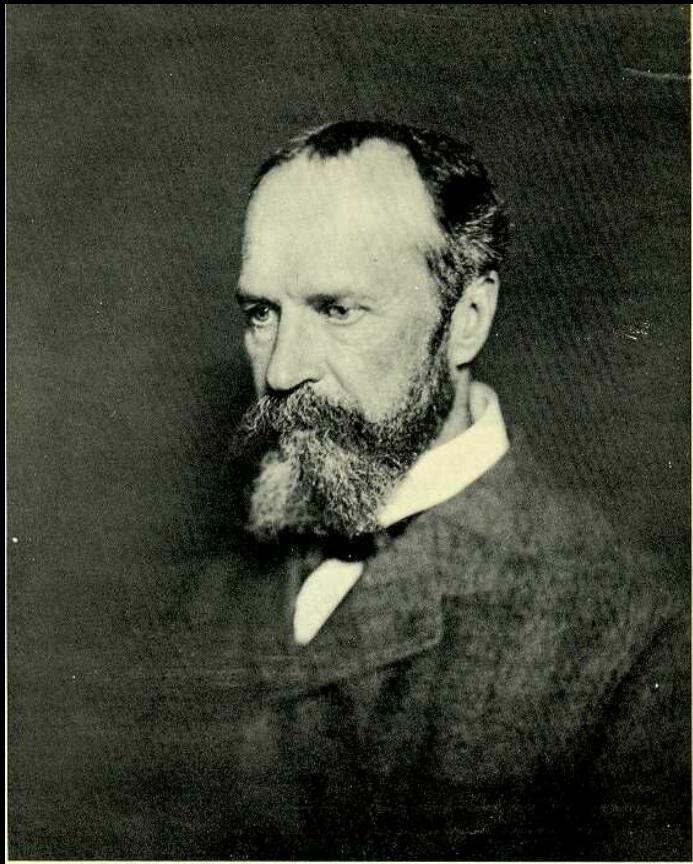
All this provides a real ‘working theatre’ with consciousness acting as a ‘gateway’ providing global access to any part of the nervous system.

Consciousness has very definite effects and functions:

- Provides access to mental lexicon, autobiographical memories, and the ‘self’ system.
- Recruits processors for ongoing tasks, facilitate executive decisions, enables voluntary control over automatic actions routine.

Consciousness is not an epiphenomenon, nor it is mysterious.

Consciousness is a working part of the cognitive system.



“The study... of the *distribution* of consciousness shows it to be exactly such as we might expect in an organ added for the sake of steering a nervous system grown too complex to regulate itself.”

--- W. James, *The Principles of Psychology*, 1890, p. 141

How does consciousness arise? THE NEURONAL GLOBAL WORKSPACE THEORY

Stanislas Dehaene (2006):

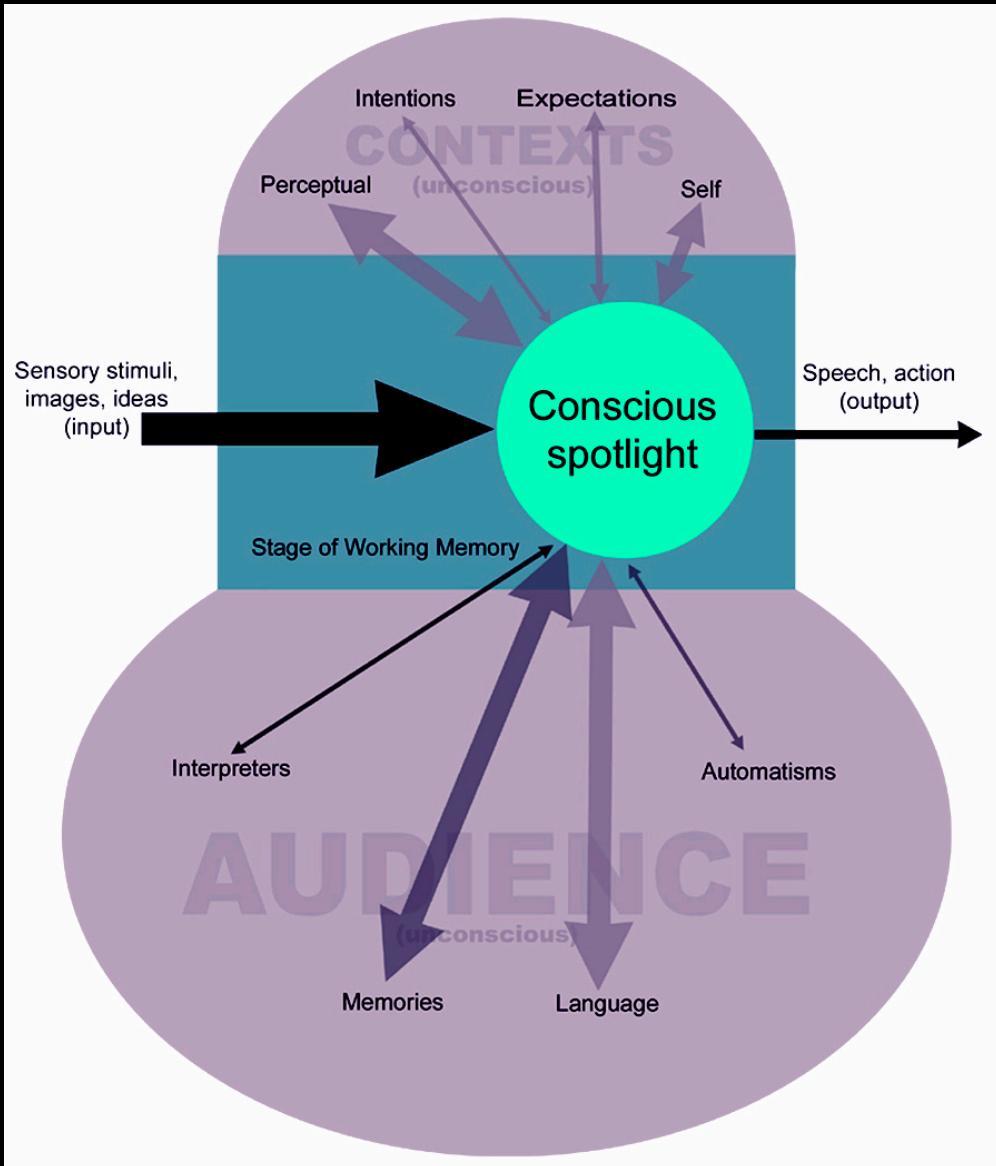


A collection of specialized unconscious processors compete for access to the limited capacity Global Workspace.

The Global Workspace is probably dependent on long-range circuits, involving the prefrontal cortex, anterior cingulate and connecting areas.

Information can be widely broadcast to other brain areas and this brain-scale broadcasting creates a global availability that results in the possibility of verbal or non-verbal reports and is experienced as a conscious state (Dehaene, 2009):

A theater of consciousness - a theoretical metaphor



--- only the bright spot on stage is conscious (consciousness is very limited in capacity)

--- sensory inputs compete for access to the conscious bright spot

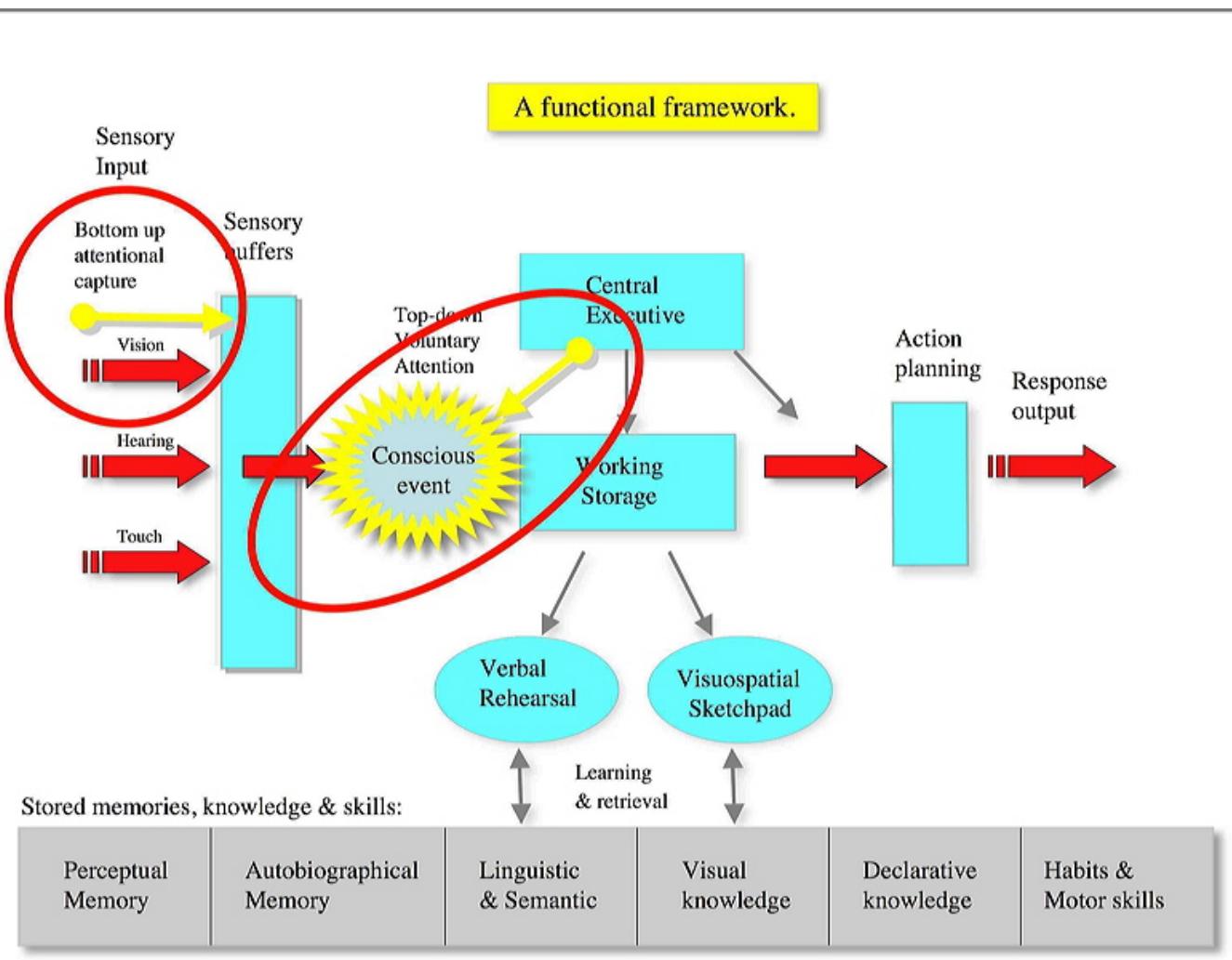
--- the "stage" corresponds to Working Memory

--- all other features as unconscious, including long-term memory, the automatic processes of language, and the events going on backstage

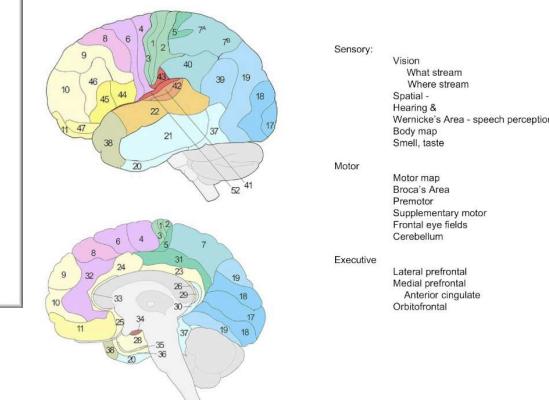
-- the theater metaphor has been turned into several testable models.

Applying GWT to cognitive functions.

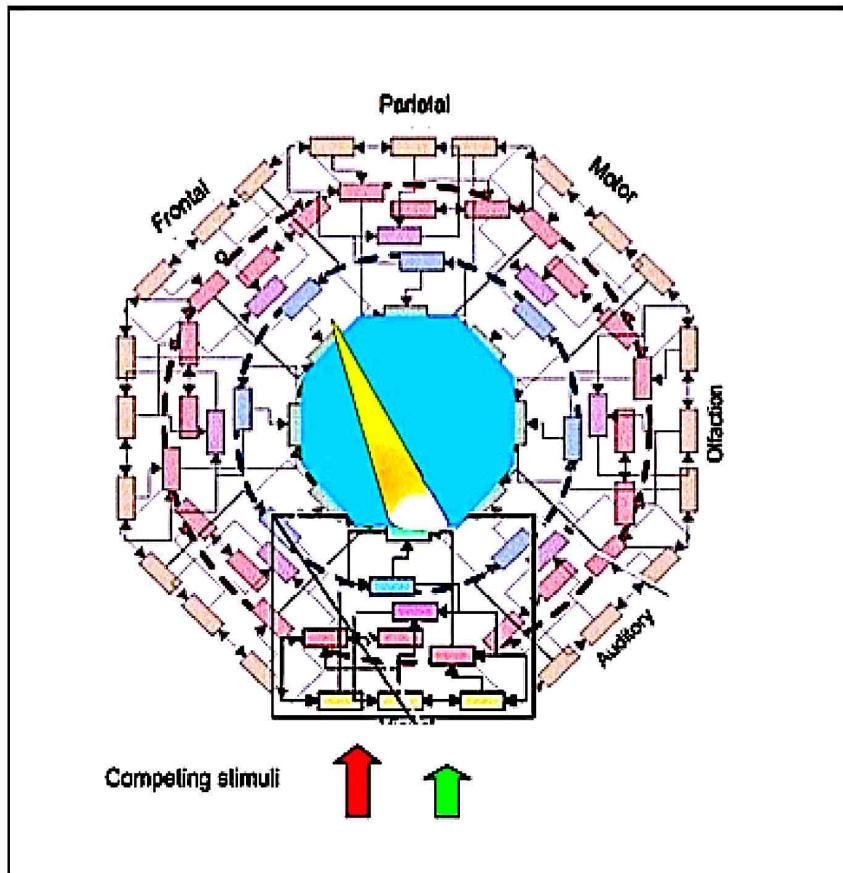
Baars & Gage, 2007.



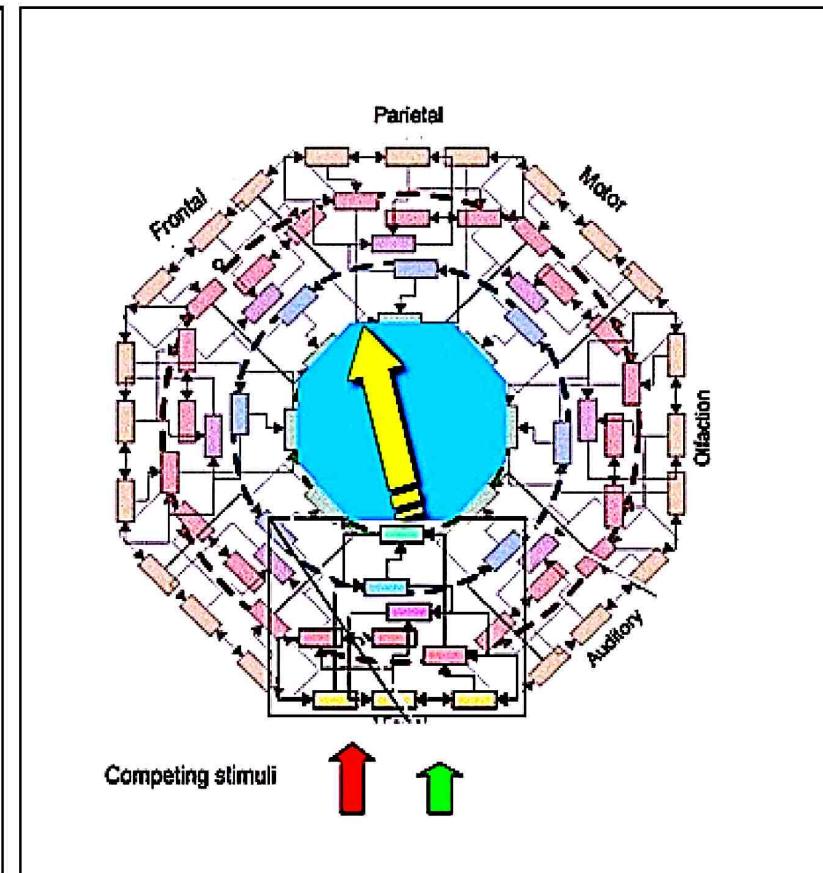
- Brain correlates:



The "spotlight of selective attention" works with the "broadcasting of conscious contents."

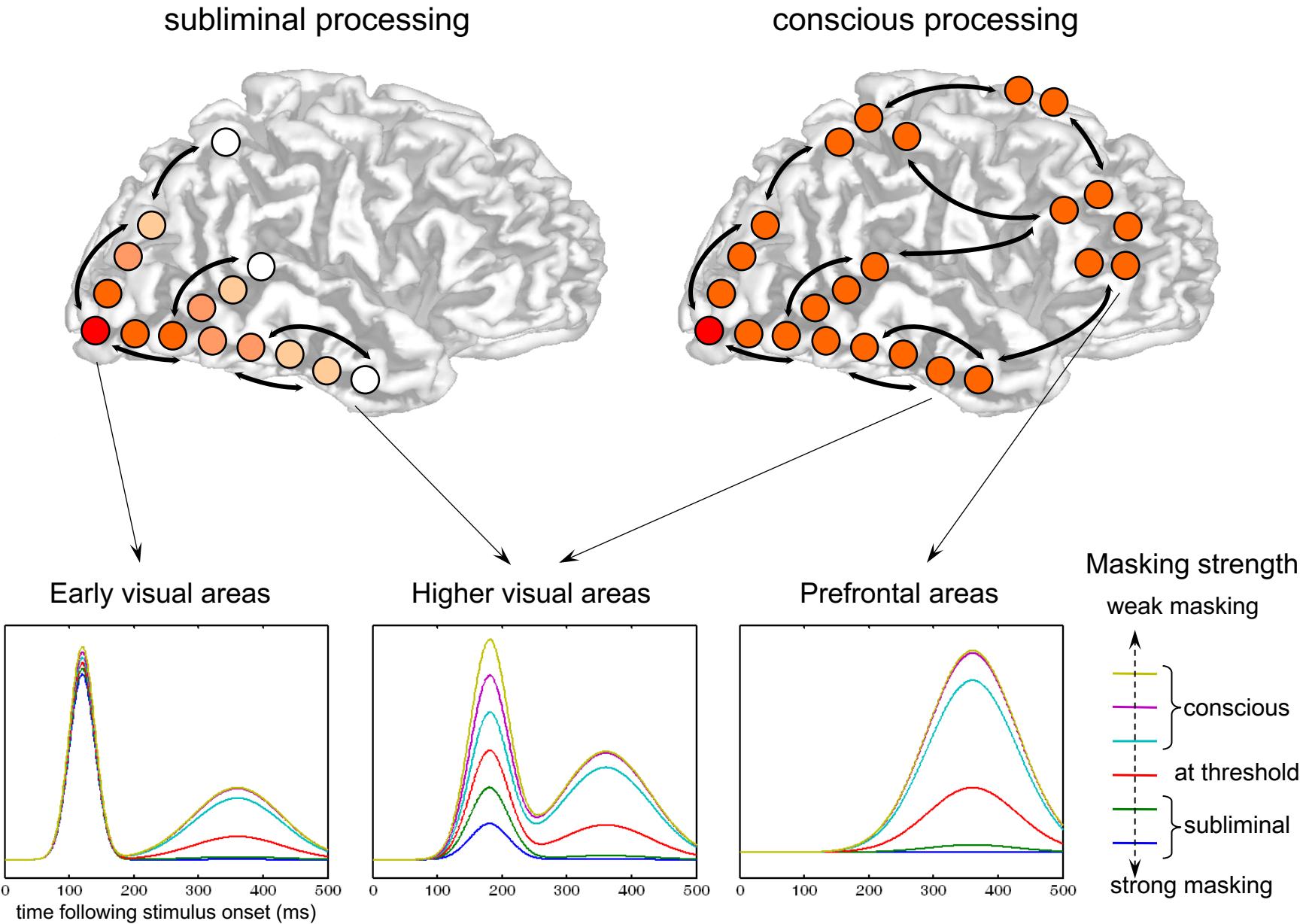


Spotlight - controlled by prefrontal regions.



Broadcasting arrow - from sensory cortex?

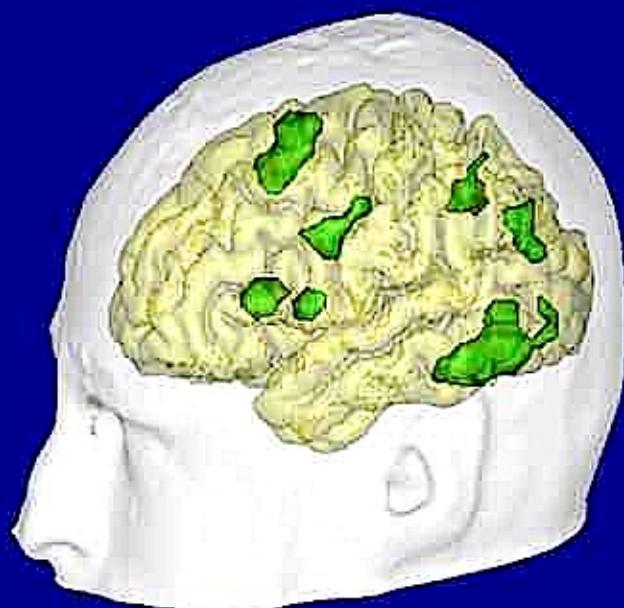
Dehaene's Predictions of the global neuronal workspace model



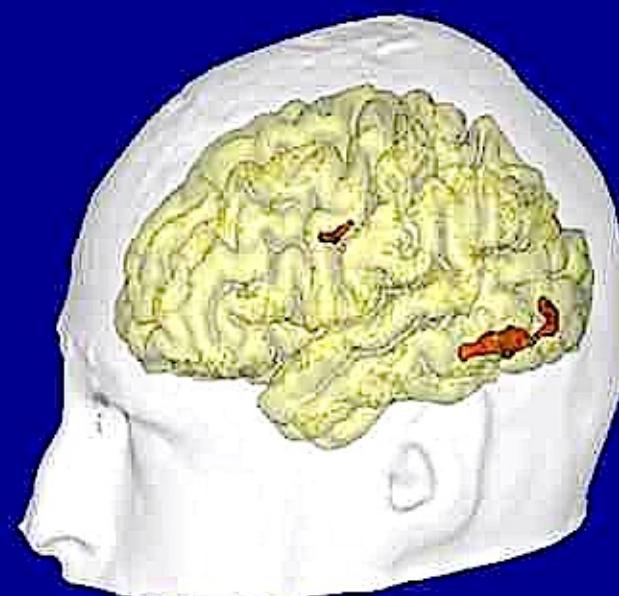
Experimental results:

Functional MRI

visible words
(conscious)



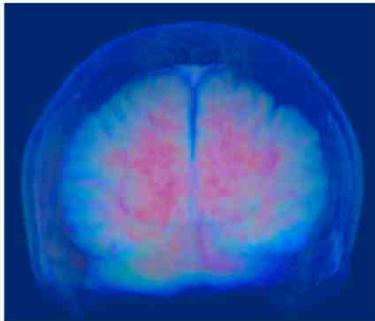
masked words
(unconscious)



ERP's



From Dehaene et al, 2001



Workshop on
**Consciousness,
Brain Rhythms,
and the
Action-Perception
Cycle**

A wave of scientific findings is now emerging on brain rhythms and their cognitive functions including consciousness, perception, episodic storage and retrieval, working memory, action planning and attention. This small, intensive workshop features seven leading researchers discussing their work in relation to this topic. Students, scientists and the public are encouraged to attend as there will be the opportunity for public discussion with the speakers.

Featured Speakers

- | | |
|----------------------------|--------------------------------------|
| ● Bernard J. Baars | The Neurosciences Institute |
| ● David Edelman | The Neurosciences Institute |
| ● Stan Franklin | Computer Science & IIS, U. Memphis |
| ● Wolfgang Klimesch | Physiological Psychology, Salzburg |
| ● Lucia Melloni | Brain Imaging Center, Frankfurt |
| ● Paul Nunez | Tulane U. & Brain Physics LLC |
| ● Satu Palva | Helsinki University Central Hospital |
| ● Lawrence M. Ward | Psychology, U. of British Columbia |

May 3-4, 2008, The University of Memphis

Admission is free for the first 50 registrants.

To register and learn more please visit

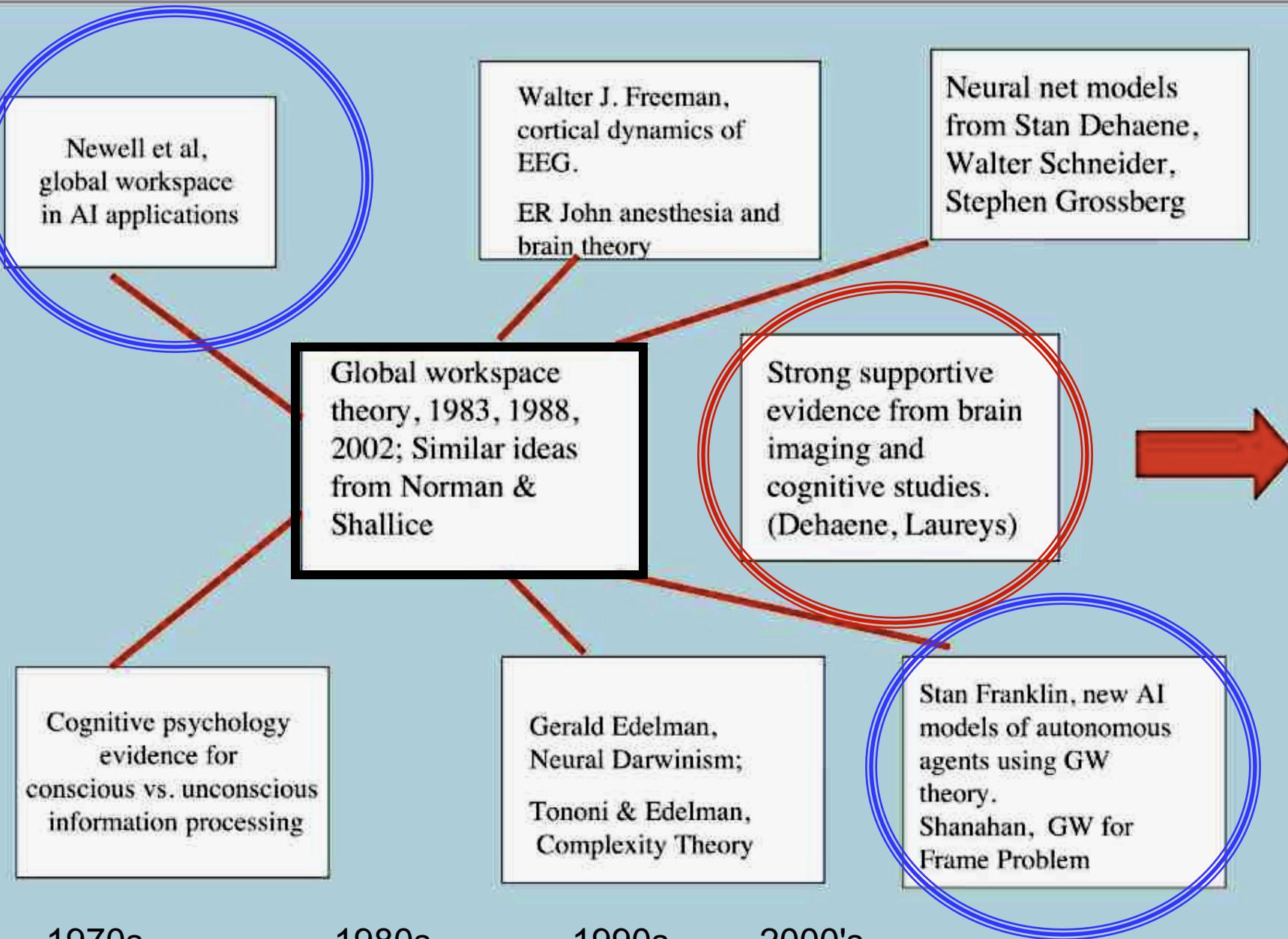
<http://ccrg.cs.memphis.edu/workshop.html>

For other questions, contact the workshop organizers
Stan Franklin
Bernard Baars

franklin@memphis.edu
bbaars@comcast.net

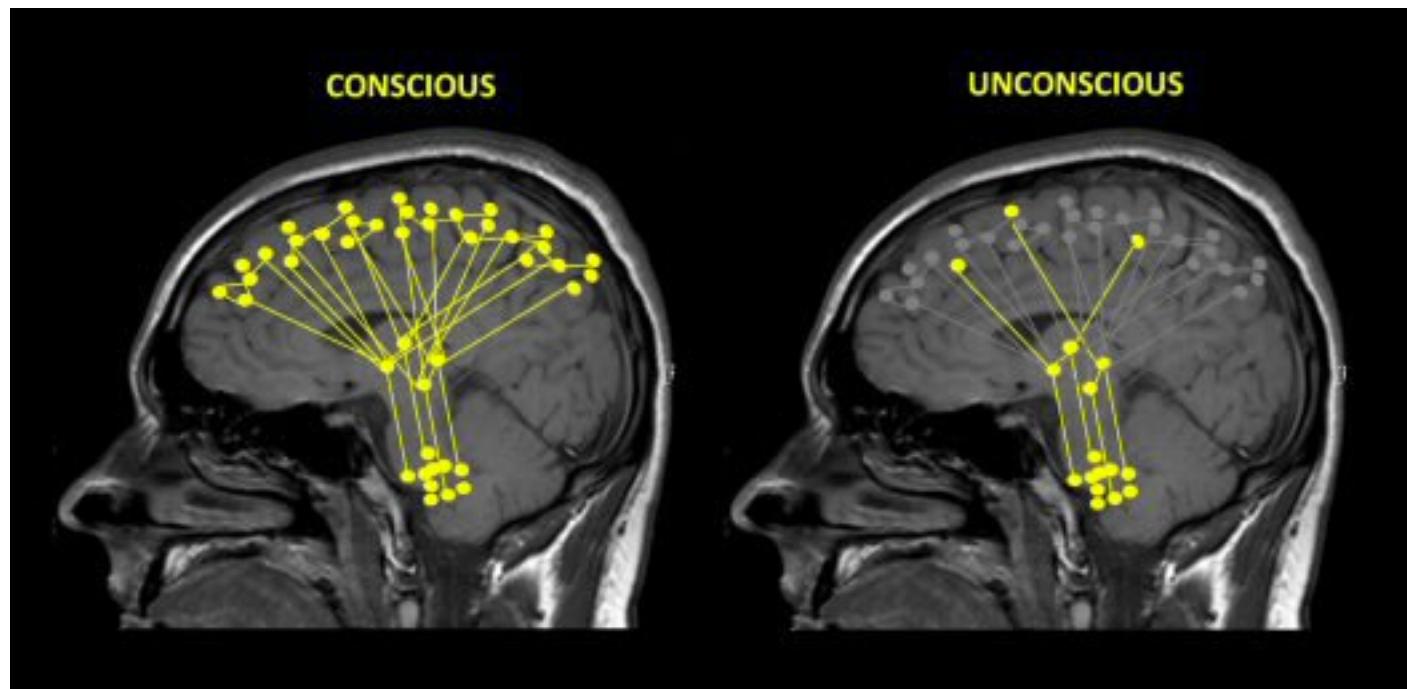


Global workspace theory - developments



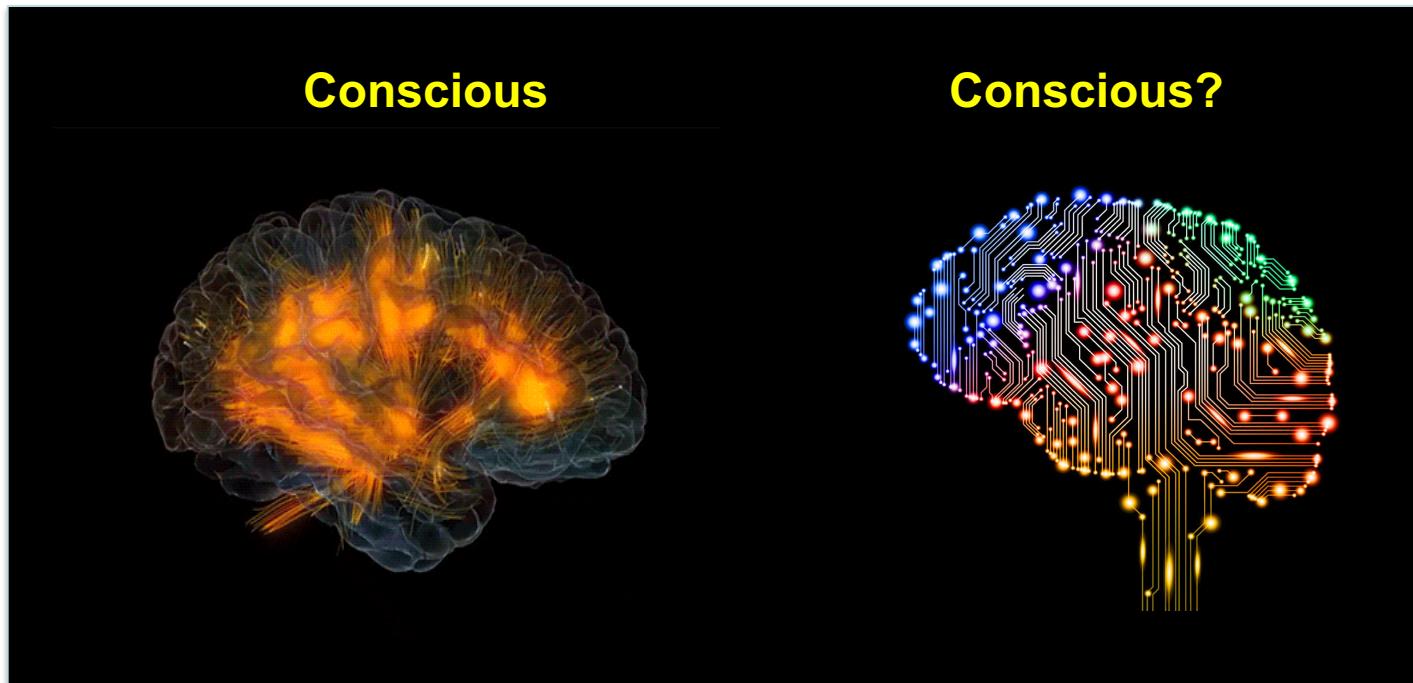
How does consciousness arise? THE NEURONAL CORRELATES OF CONSCIOUSNESS

If you could look right inside the brain and see everything that was happening there, would you then understand consciousness?



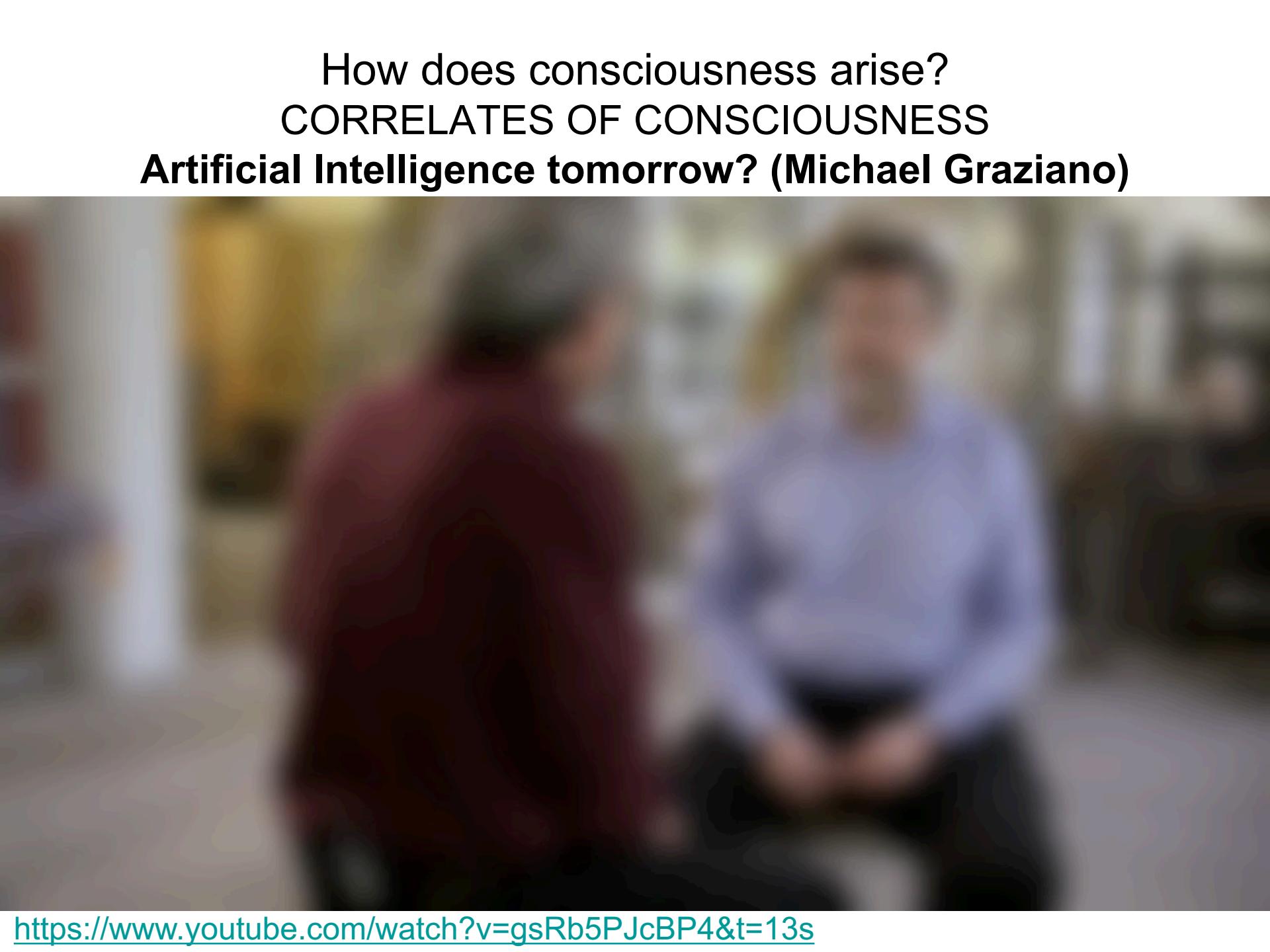
How does consciousness arise? CORRELATES OF CONSCIOUSNESS An artificial intelligence account?

If you could exactly and precisely replicate connections as you find them right inside the brain into an artificial modelling network, would you then have reproduced a conscious network?



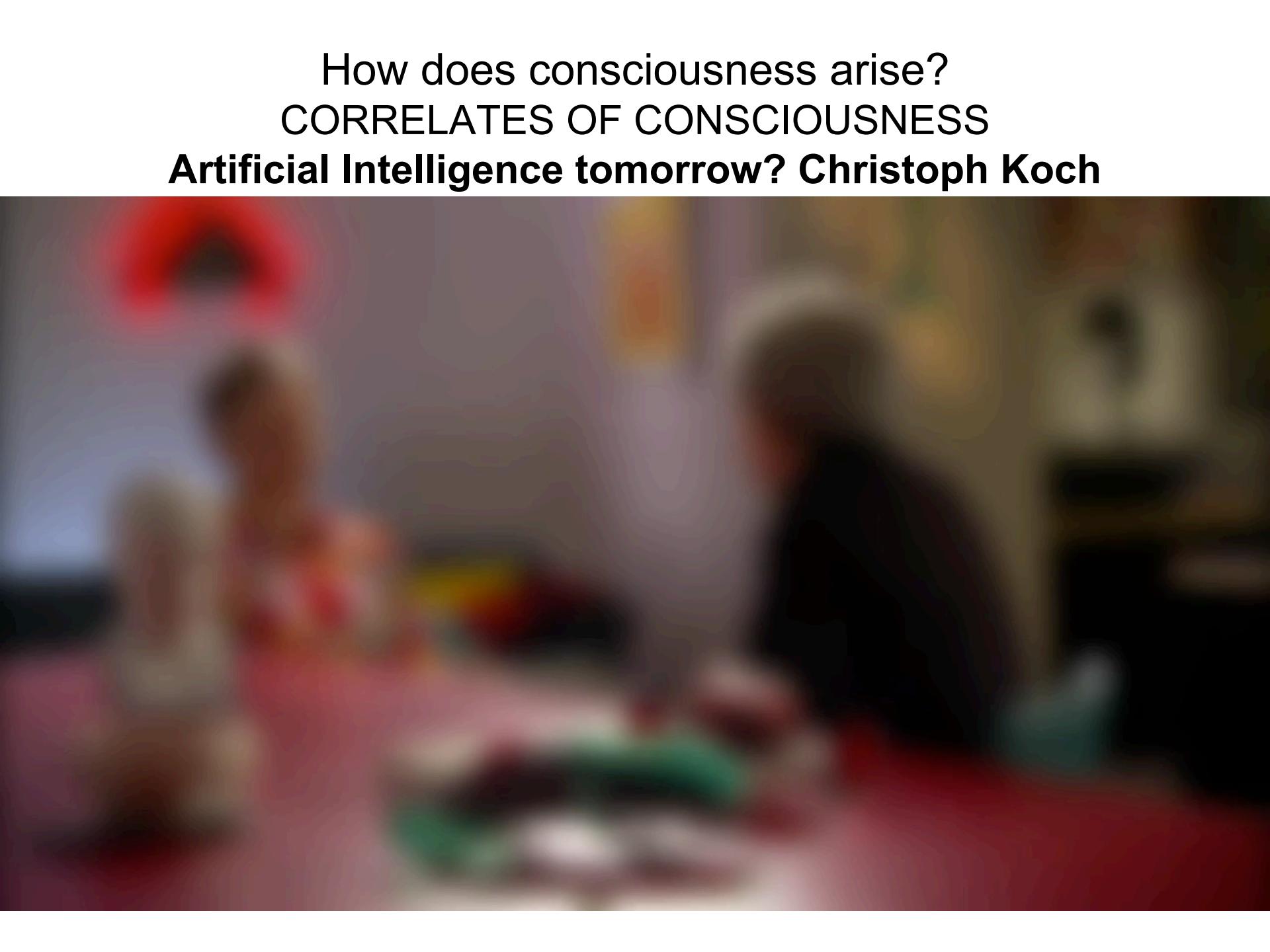
How does consciousness arise?
CORRELATES OF CONSCIOUSNESS
Artificial Intelligence today

How does consciousness arise?
CORRELATES OF CONSCIOUSNESS
Artificial Intelligence tomorrow? (Michael Graziano)

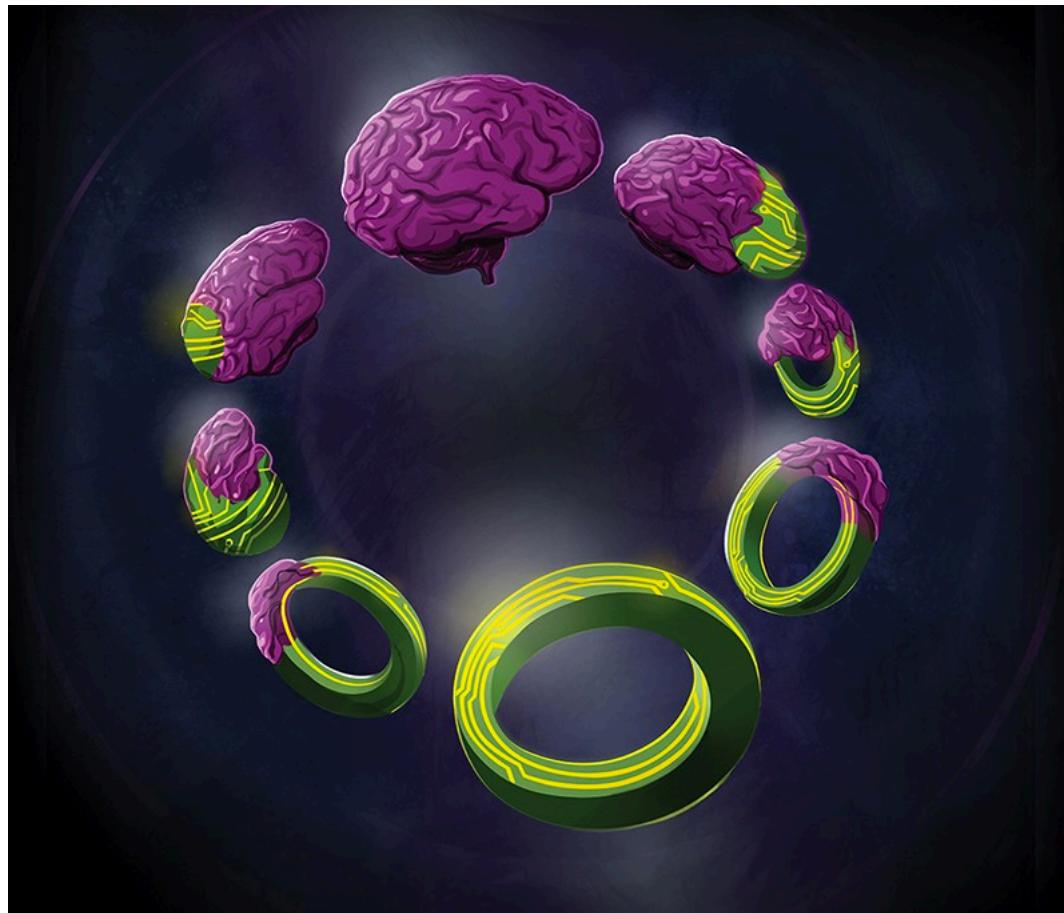


<https://www.youtube.com/watch?v=gsRb5PJcBP4&t=13s>

How does consciousness arise?
CORRELATES OF CONSCIOUSNESS
Artificial Intelligence tomorrow? Christoph Koch



How AI and neuroscience drive each other forwards



<https://www.nature.com/articles/d41586-019-02212-4>