



What defines consciousness?

An introduction

axel cleeremans

WHAT IS CONSCIOUSNESS?

“Consciousness consists of those states of sensation, or feeling, or awareness, which begin in the morning when we awake from a dreamless sleep and continue throughout the day until we fall into a coma, or die, or fall asleep again, or otherwise become unconscious”.

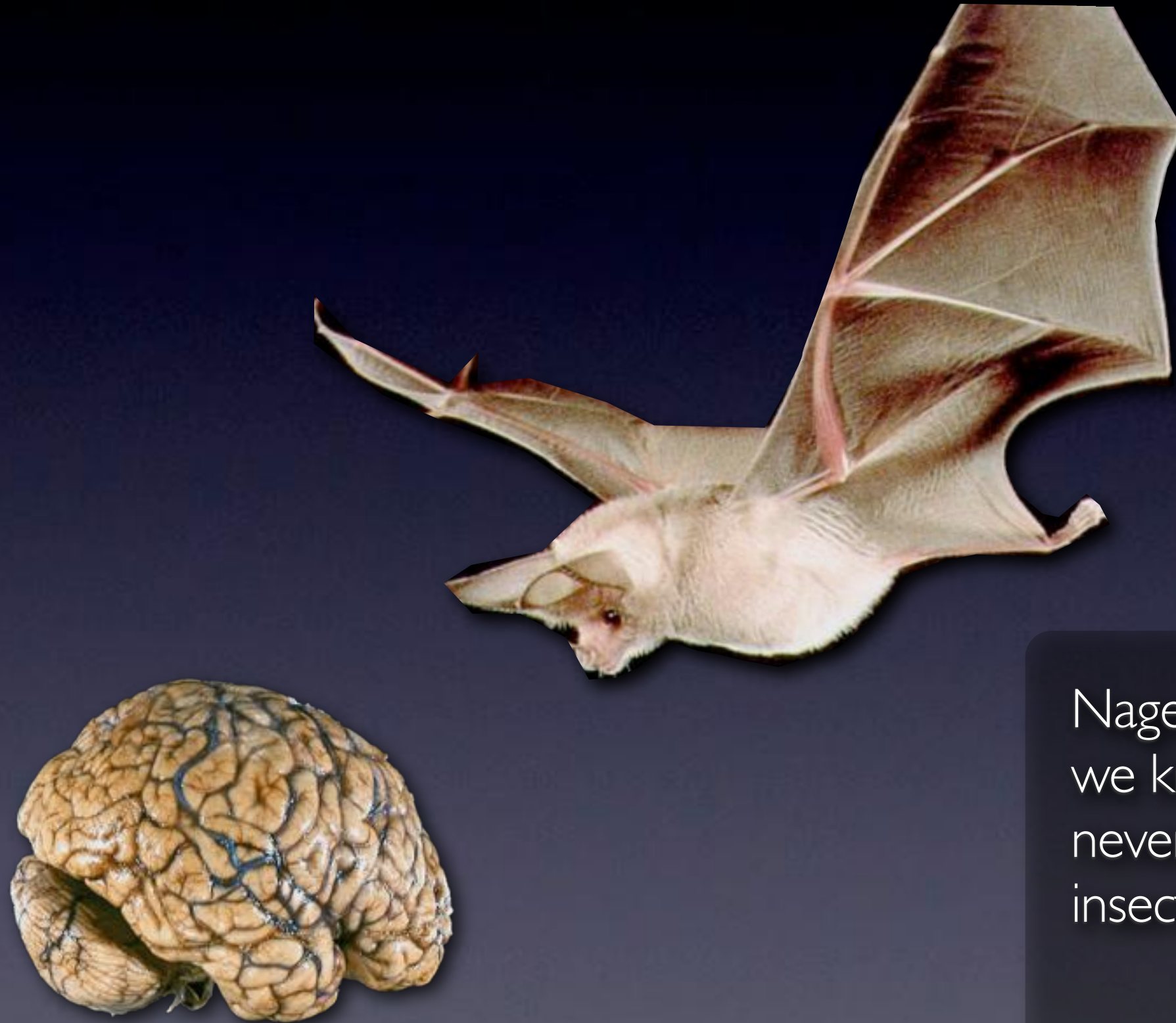


JOHN SEARLE

WHAT IS CONSCIOUSNESS?

Nobody knows!

WHAT IS IT LIKE TO BE A BAT?



Nagel (1974): No matter how much we know about the brain of a bat, we'll never know what it feels like to chase insects at dusk...

THE HARD PROBLEM

“Numerous books and articles dedicated to consciousness have appeared recently, and one might think that there is progress. But in reality, these works have ignored the hard problem. Often, they concern what one might call the ‘easy problems’ of consciousness. How does the brain process information? How does it integrate information? How do we produce verbal reports on our mental states? These questions are interesting, but answering them does not solve the hard problem: Why is it the case that information processing is accompanied by subjective experience?”

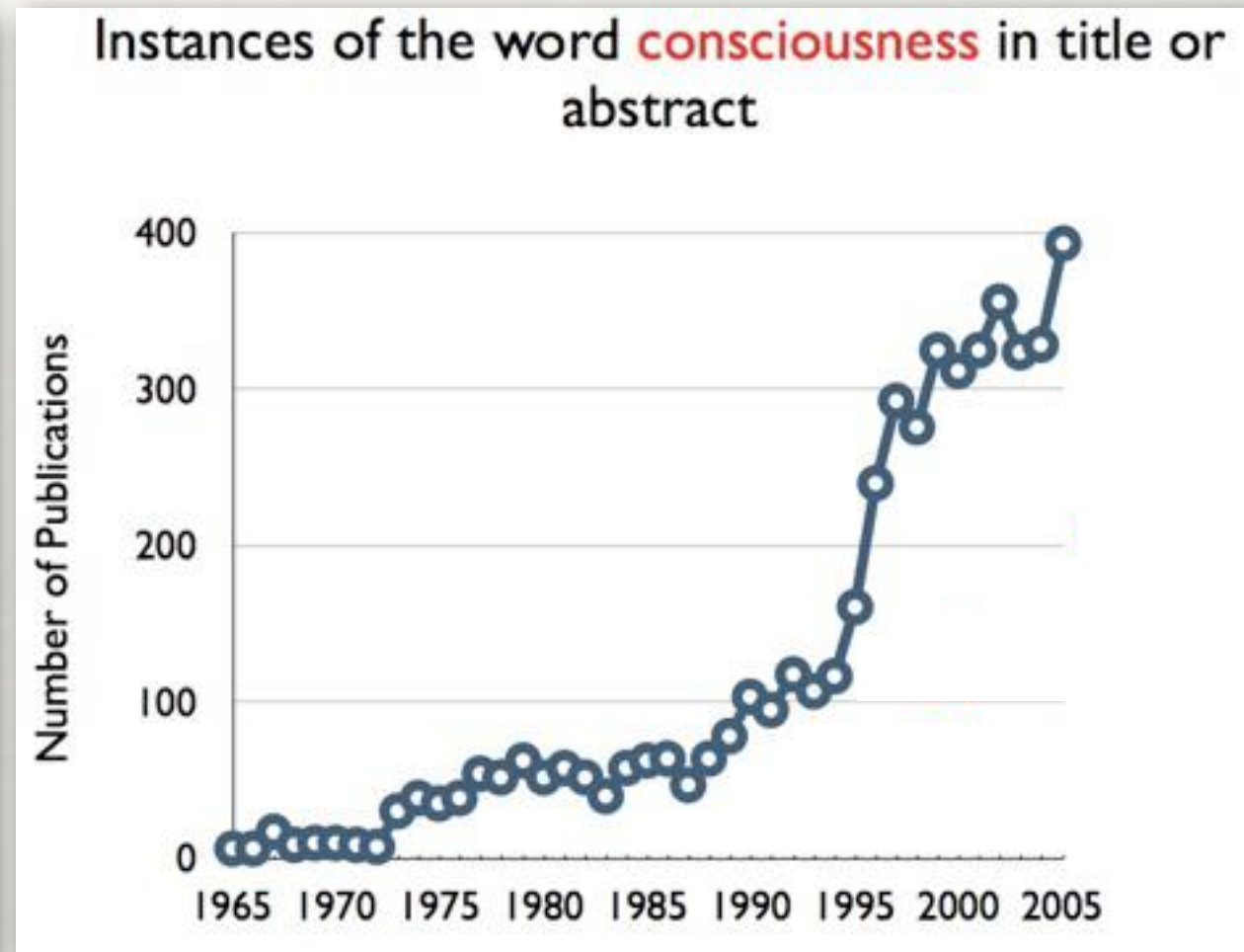
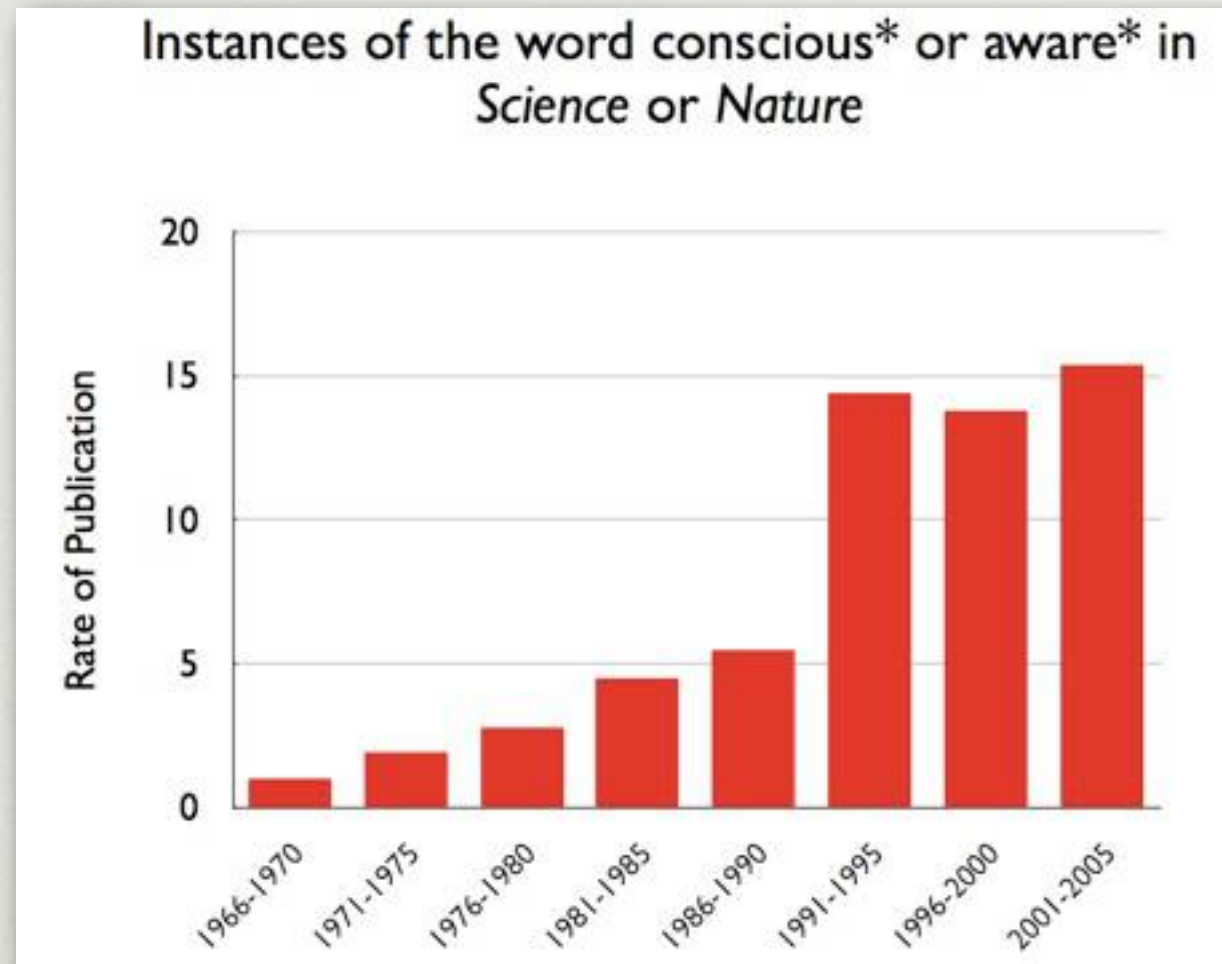


DAVID CHALMERS

CONSCIOUSNESS: A MYSTERY?

- **Long considered as impossible to study scientifically:**
 - **Dennett:** Consciousness is a mystery, that is, something one does not know how to think about yet
 - **Nagel:** Consciousness is a private, subjective phenomenon: What is it like to be a bat? (We will never know)
 - **Chalmers:** Consciousness is “the hard problem”: Why is one conscious?
- **Consciousness is now at the forefront of cognitive neuroscience**
 - Thanks to imaging methods such as PET, fMRI, EEG/MEG, single-cell recording, which make it possible to see the brain in action, thousands of studies are now dedicated to the study of the “neural correlates of consciousness”

THE "BOOM OF CONSCIOUSNESSES



Association for the Scientific Study of Consciousness



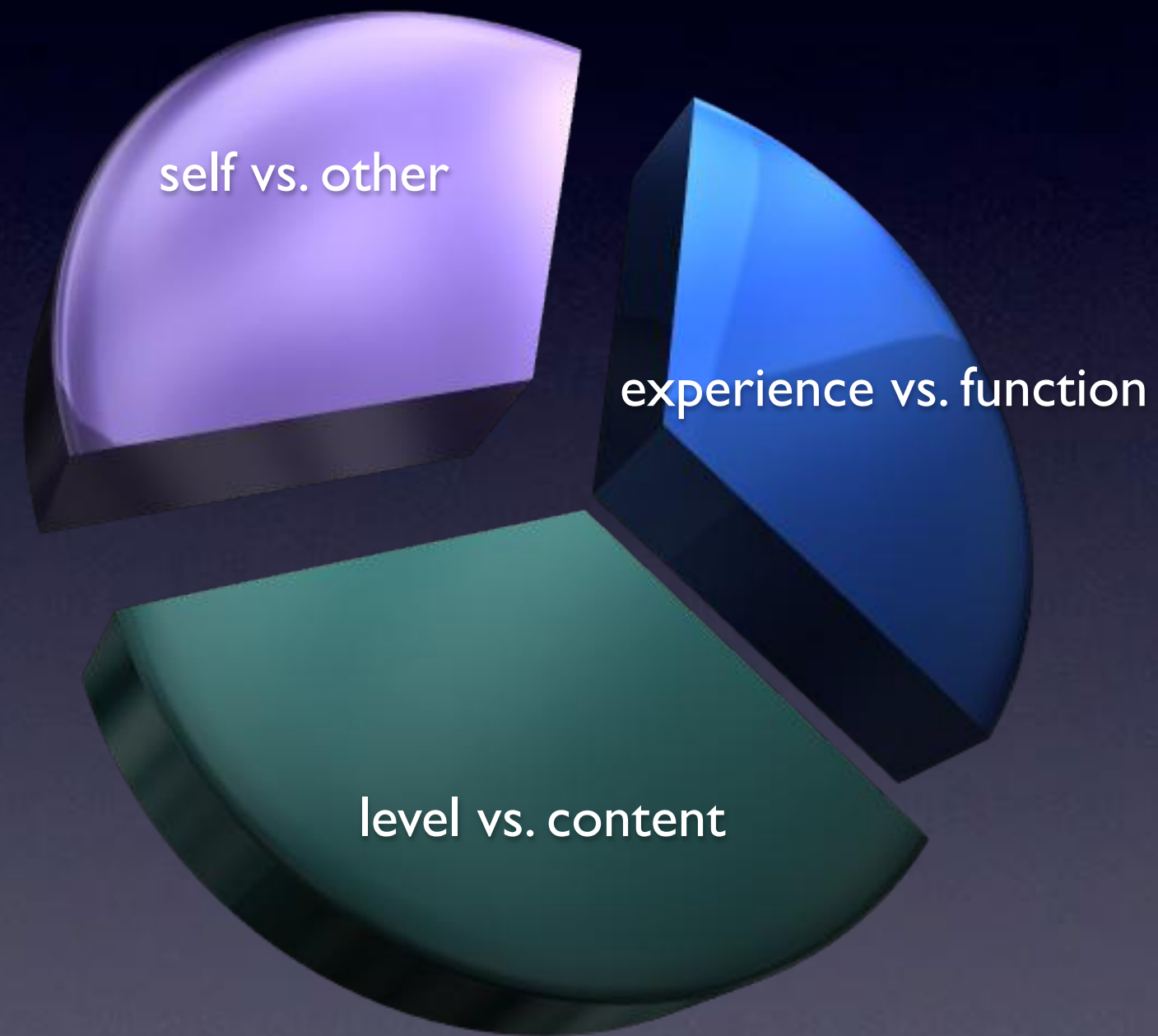
Courtesy Patrick Wilker

Monday, November 28, 2011

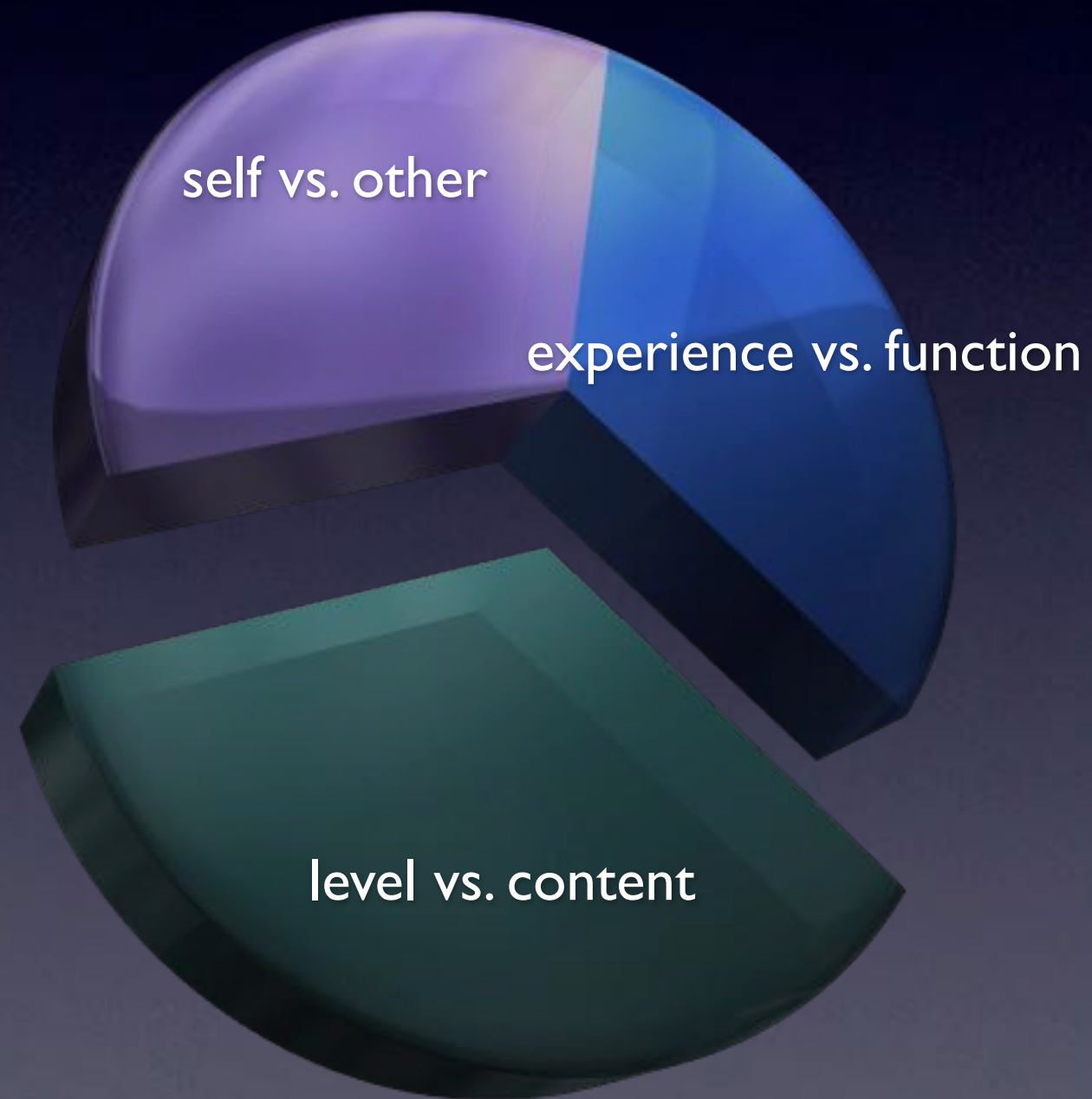
CONSCIOUSNESS IS NOT A SINGLE THING!



CONSCIOUSNESS IS NOT A SINGLE THING!



LEVEL VS. CONTENTS OF CONSCIOUSNESS



LEVEL VS. CONTENTS OF CONSCIOUSNESS

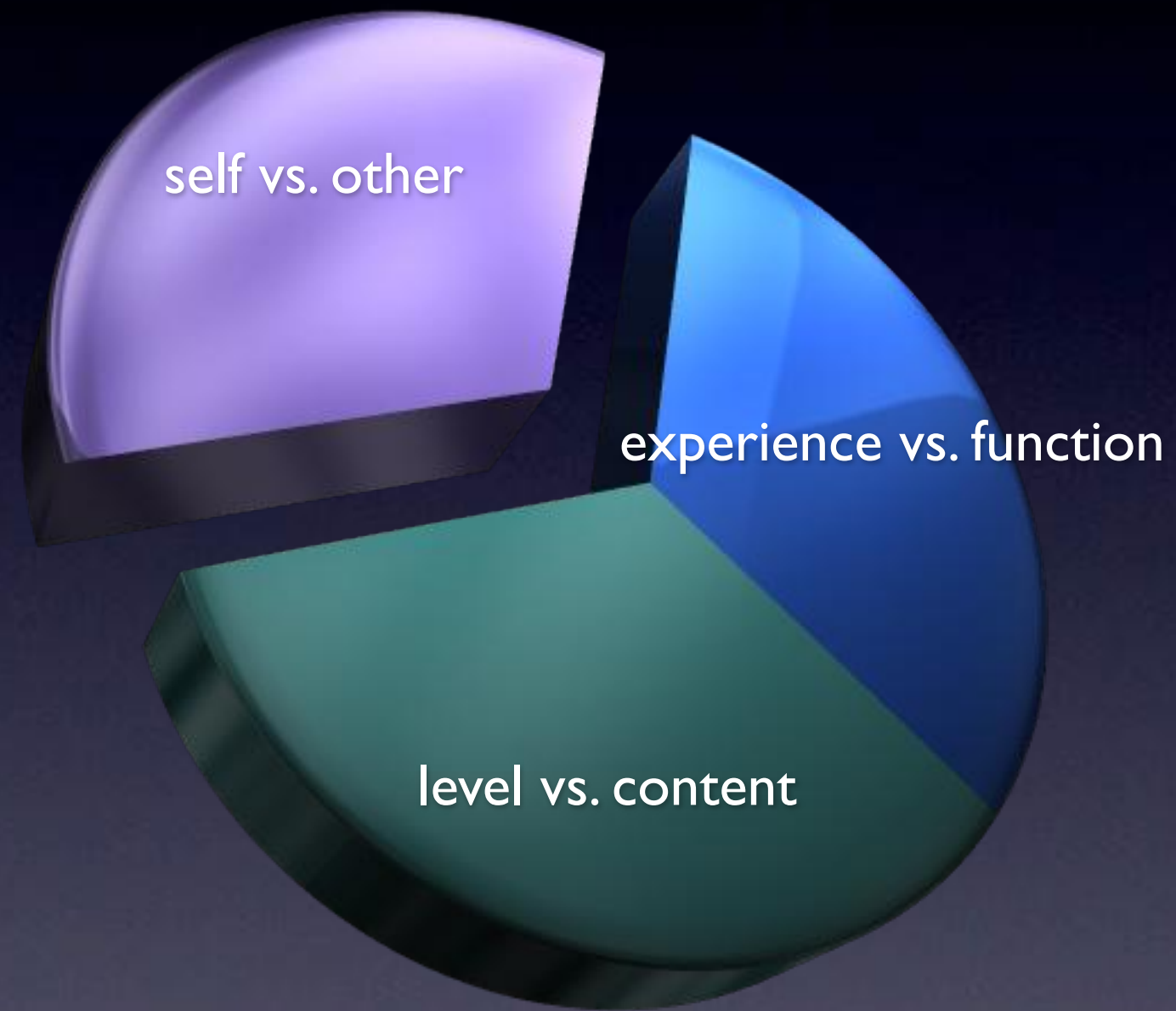
- The notion of “level of consciousness” is intransitive and refers to the **state** of wakefulness.
- The notion of “contents of consciousness” is transitive and refers to what goes through your mind when are **aware of** some state of affairs
- Wakefulness and awareness can dissociate:
 - When sleeping, we are aware but not awake
 - In the vegetative state, patients are awake but not aware

self vs. other

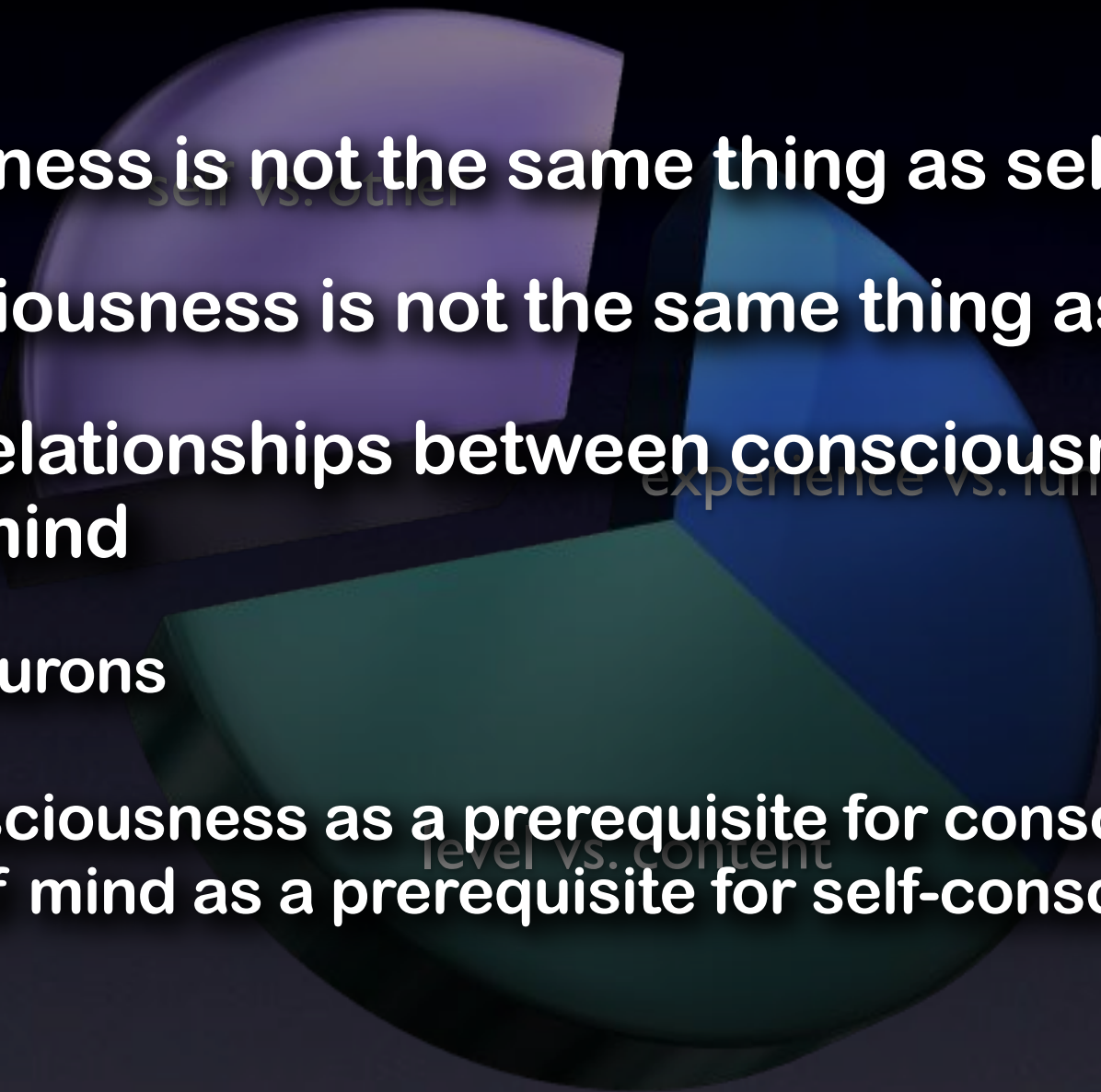
experience vs. function

level vs. content

SELF VS. OTHER



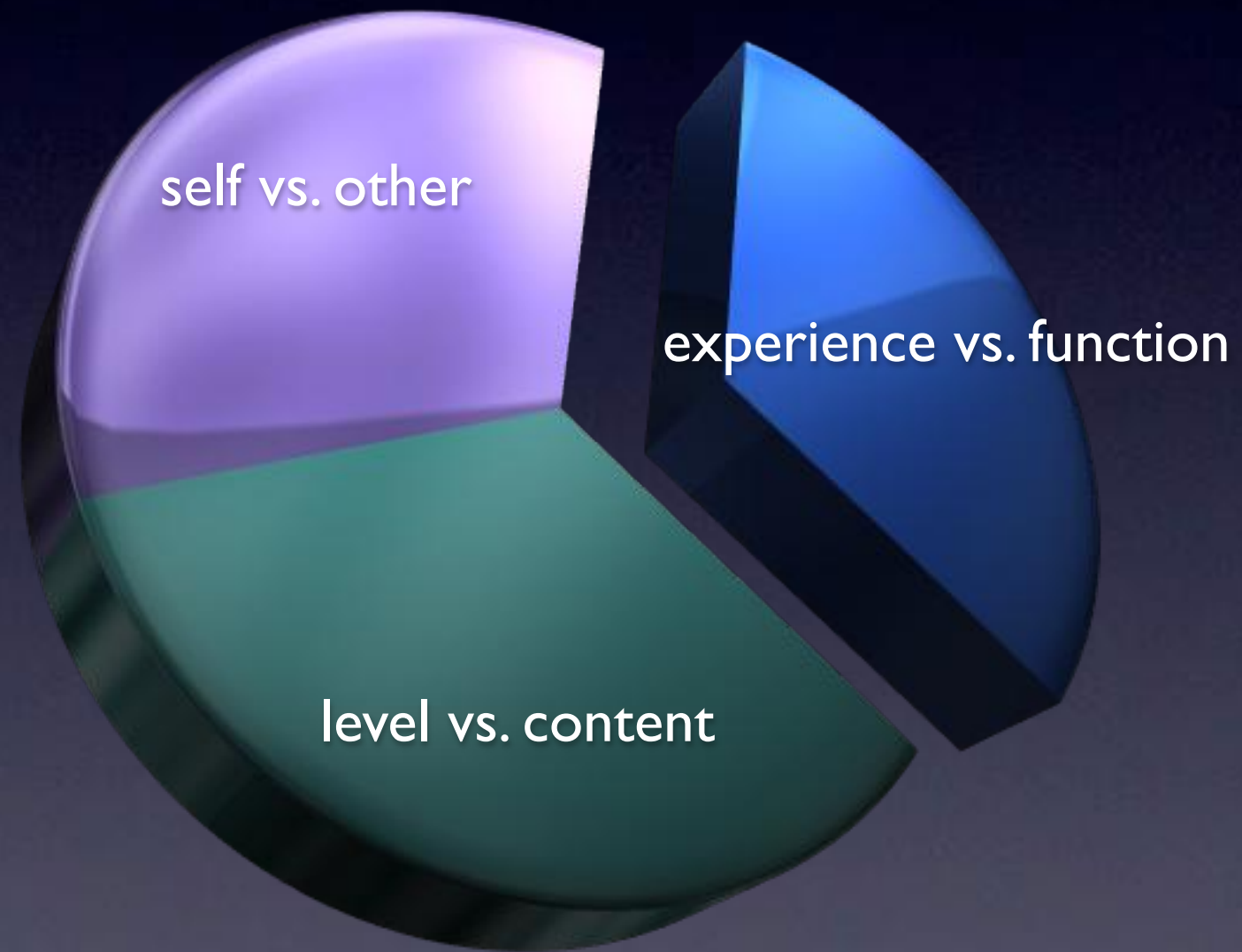
SELF VS. OTHER

- 
- **Consciousness is not the same thing as self-consciousness.**
 - **Self-consciousness is not the same thing as theory of mind**
 - **Complex relationships between consciousness, self-consciousness and theory of mind**
 - **Mirror neurons**
 - **Autism**
 - **Self-consciousness as a prerequisite for consciousness?**
 - **Theory of mind as a prerequisite for self-consciousness?**

SELF-AWARENESS



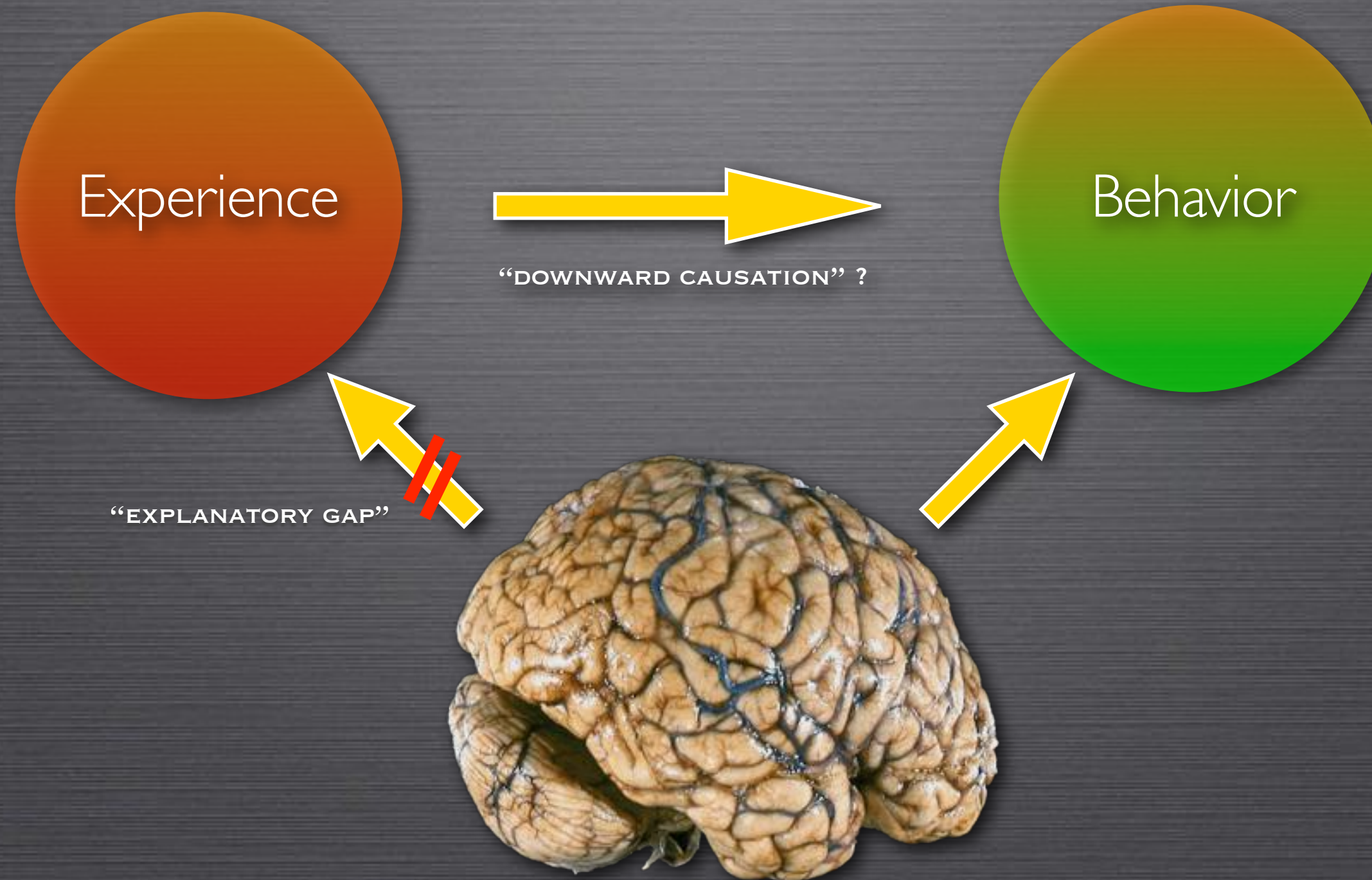
EXPERIENCE VS. FUNCTION



EXPERIENCE VS. FUNCTION

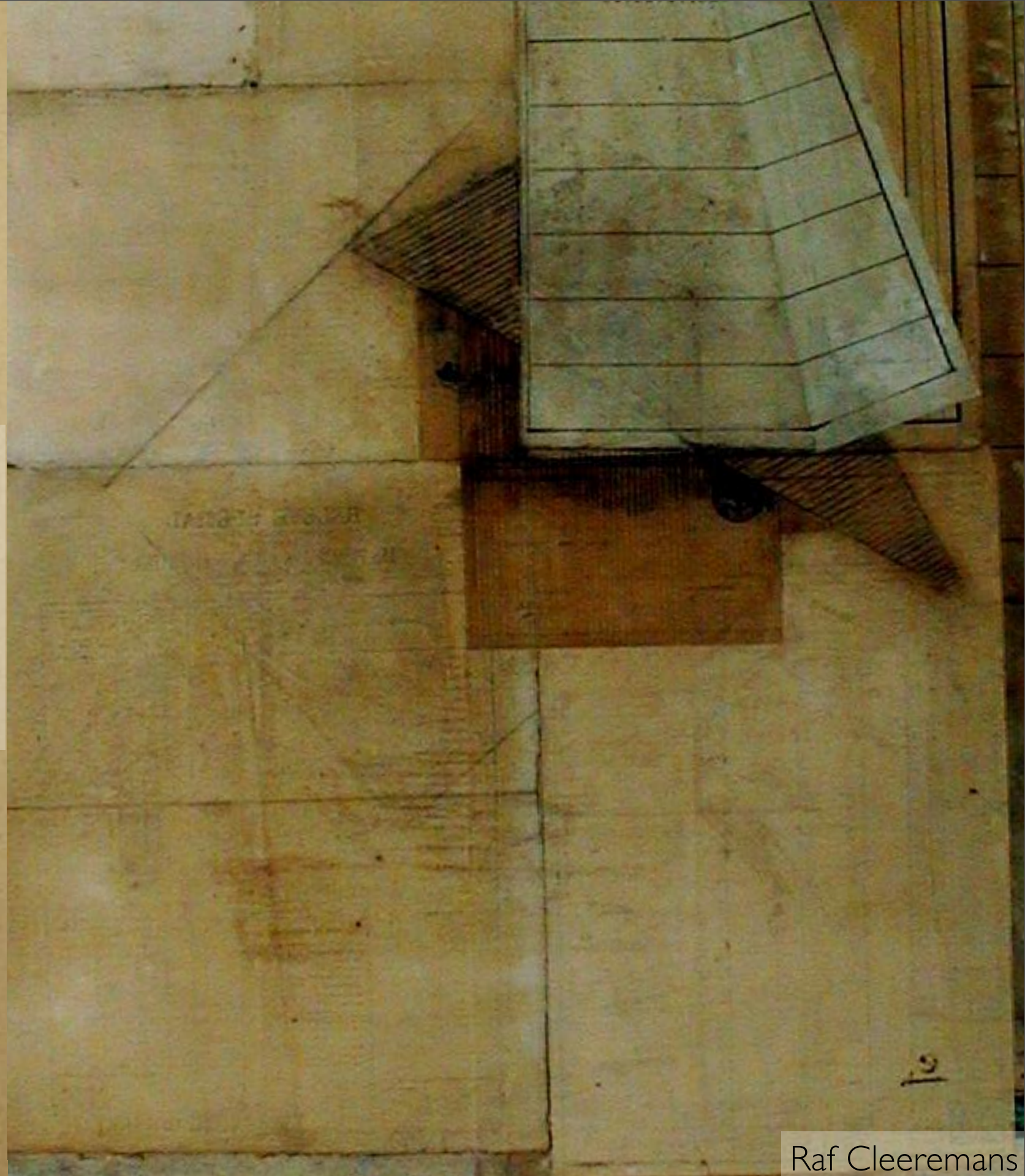
- **Access consciousness:** Conscious representations are globally accessible in a way that unconscious representations are not
- **Phenomenal consciousness:** Conscious representations are experienced; they form the contents of subjective experience
- Whether a- and p-consciousness (the functional and phenomenological aspects of conscious contents) can dissociate is the object of intense debate: Does attention select among conscious contents, or does content only become conscious when it is attended?

MIND AND BRAIN

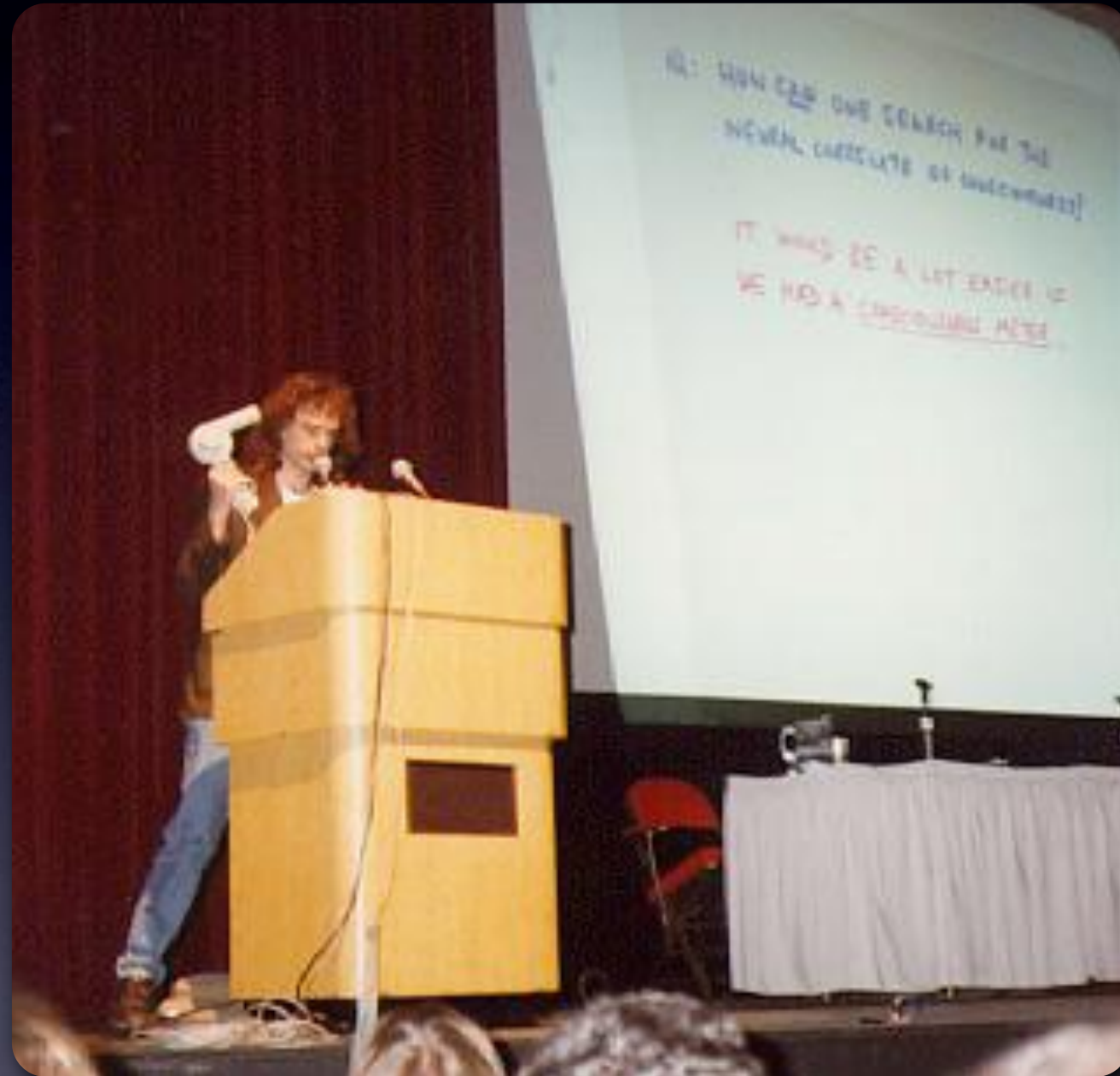


The study of consciousness requires combining subjective and objective data

*Towards a science of
consciousness*

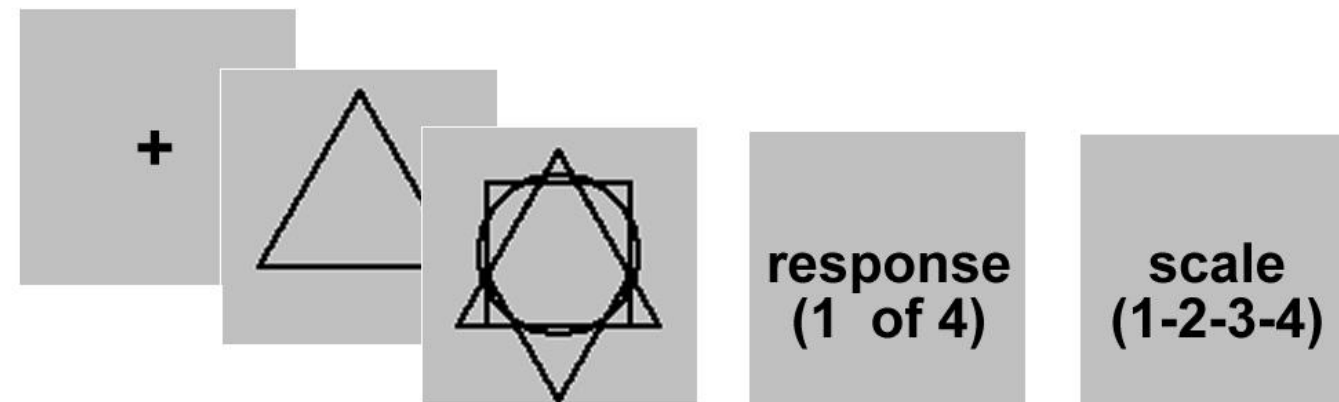


MEASURING CONSCIOUSNESS



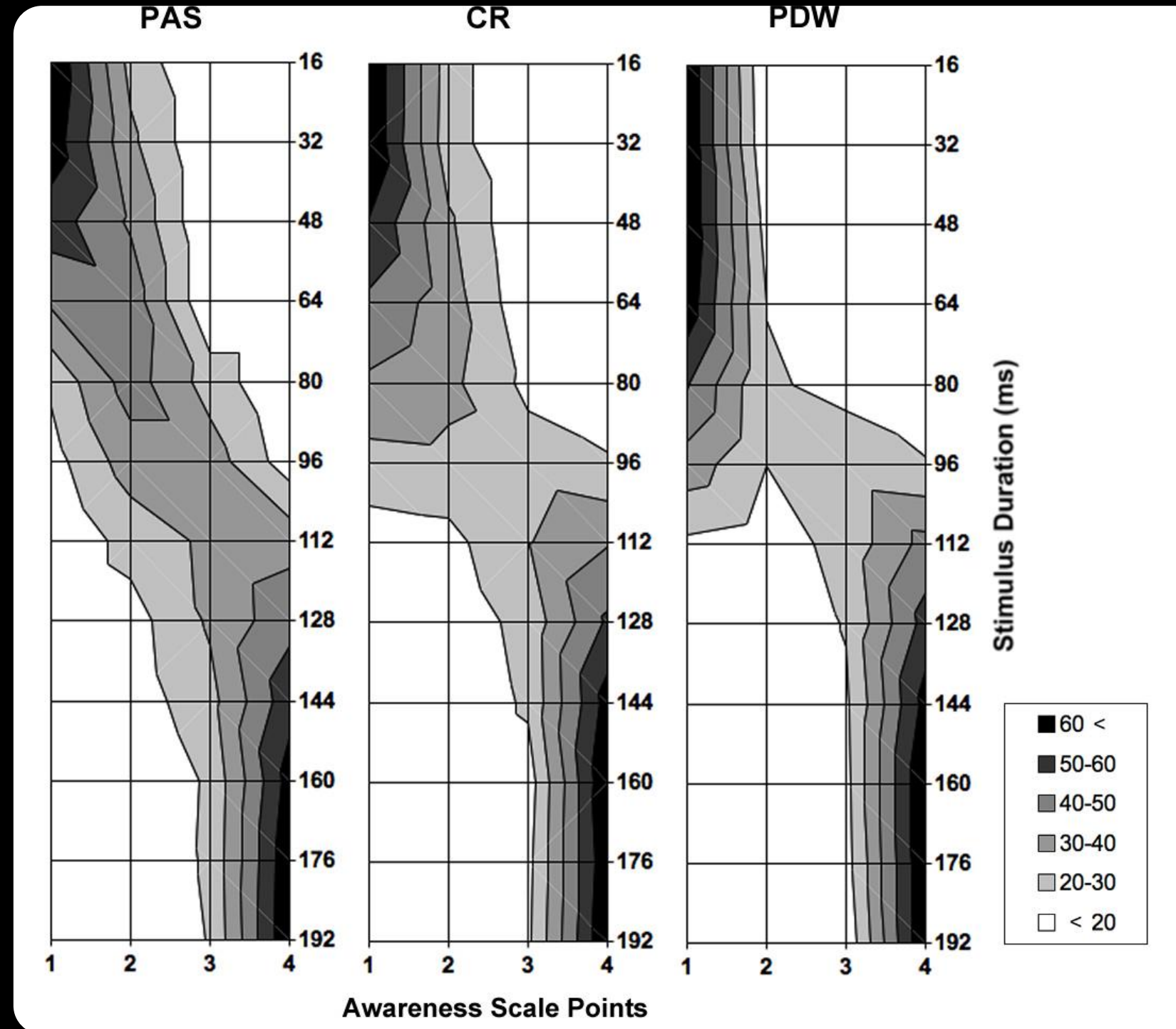
David Chalmers at Tucson II (1996) wielding his "consciousness meter"

PARADIGM



Three scales: PAS, CR, and PDW, all with 4 points

SCALE POINTS DISTRIBUTION



TOWARDS A SCIENCE OF CONSCIOUSNESS

- Every mental event is necessarily a brain event
- To find the neural correlates of consciousness:
 - Use a **contrastive method**: Look for dissociations between information processing with and without consciousness (which requires very good behavioral paradigms)
 - Use **brain imaging methods**: Examine the brain in action
 - **Combine objective and subjective data**: Correlate neural activity with subjective experience so as to identify the cerebral regions specifically involved in conscious processing: The “Neural Correlate of Consciousness”

The study of consciousness is interdisciplinary by necessity

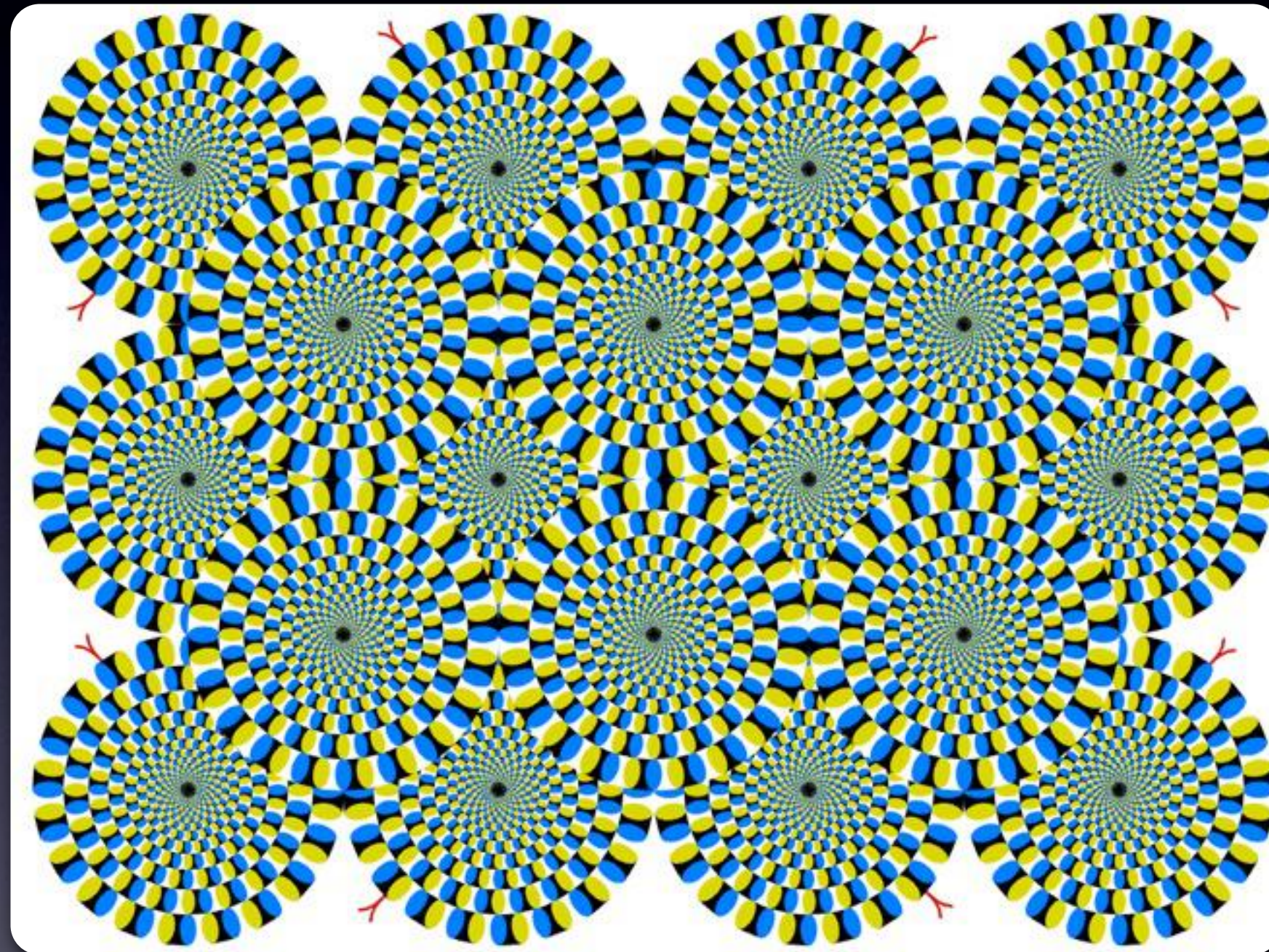
CONTRASTIVE METHODS

	PERCEPTION	MEMORY	ACTION
Subjective experience changes, stimulation & behavior remain constant	Binocular rivalry	Episodic Recall	Awareness of intention
	Hallucinations	Confabulation	Delusion of control
Subjective experience remains constant, stimulation changes	Stimulation changes without awareness	Unrecognized "old" items	action without awareness
	Blindsight	Unrecognized items in amnesia	Stimuli eliciting unintended action
Subjective experience remains constant, behavior changes	Correct guessing without awareness	Implicit learning	Implicit motor behaviour
	Correct reaching in form-agnosia	Implicit learning in amnesia	Unintended action

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A POWERFUL MOVEMENT ILLUSION



There is no movement in the stimulus!

CHANGE BLINDNESS



David, Laloyaux, Devue & Cleeremans, 2006

SOMETHING IS CHANGING NOW IN THE PICTURE. CAN YOU FIND WHAT?

CHANGE BLINDNESS



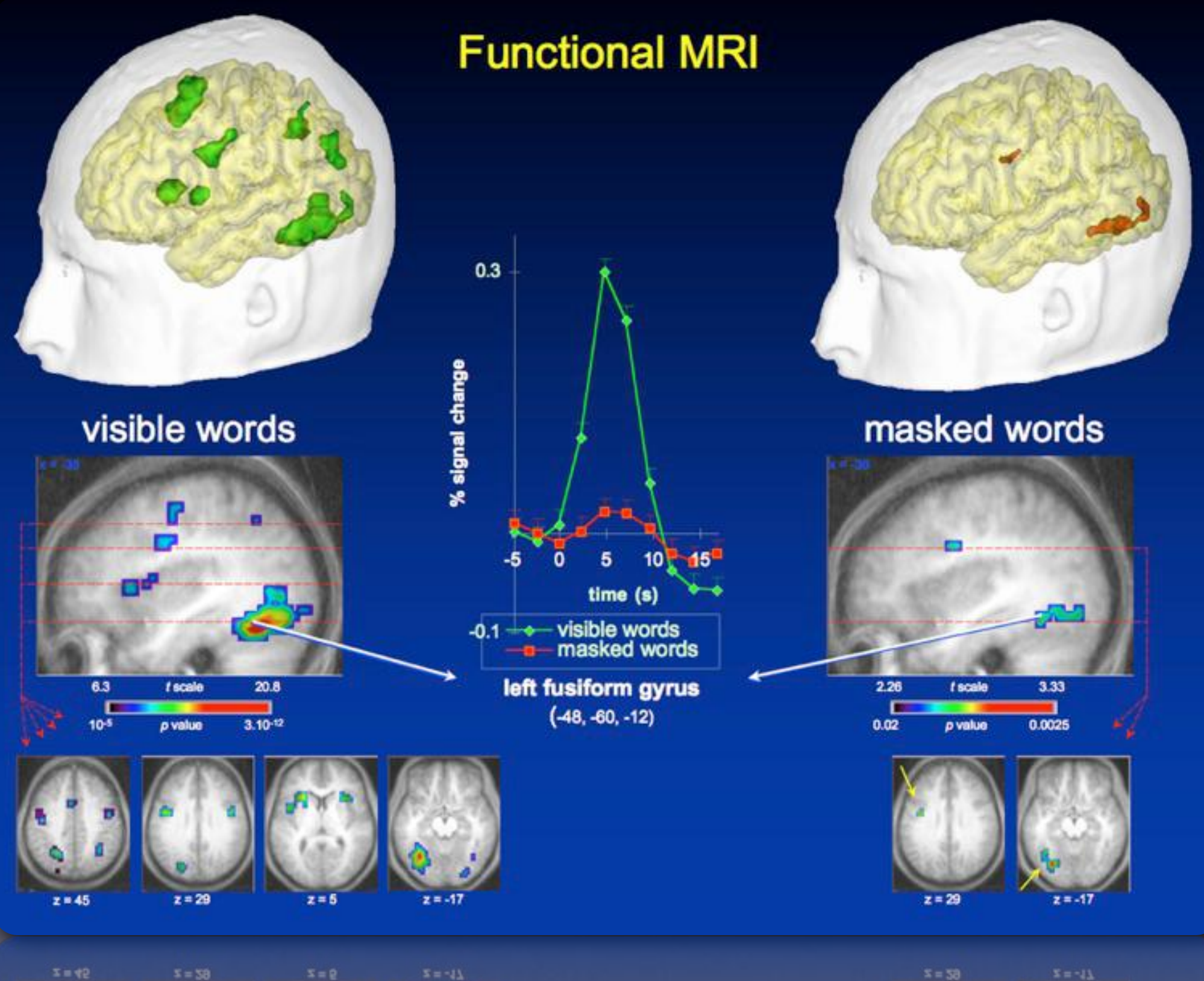
David, Laloyaux, Devue & Cleeremans, 2006

“Change blindness” blindness revisited:
The finding is even more surprising given our expertise in processing facial expressions

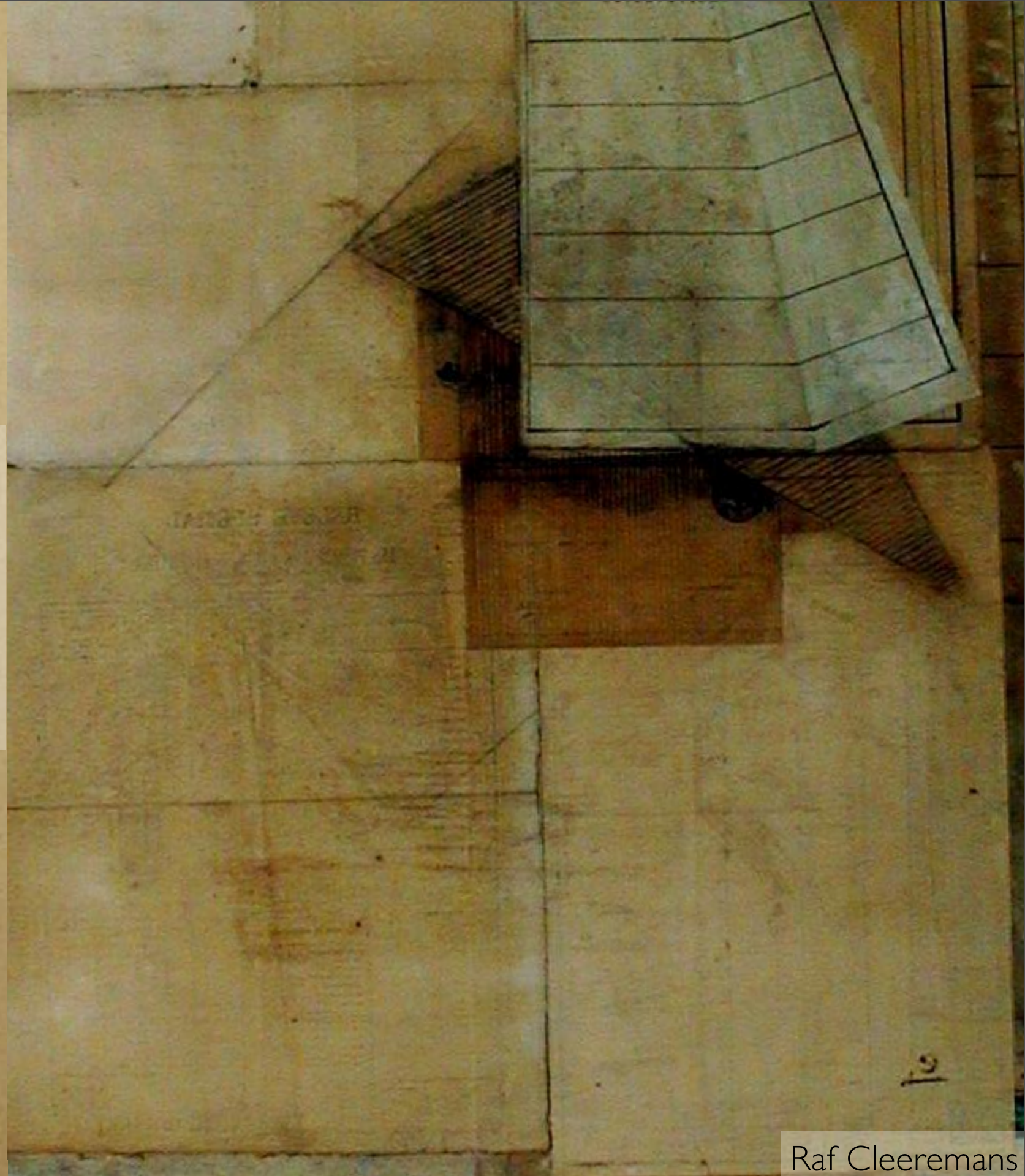
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SUBLIMINAL PERCEPTION



Theories of consciousness



TWO BIG IDEAS

“higher-order thoughts”

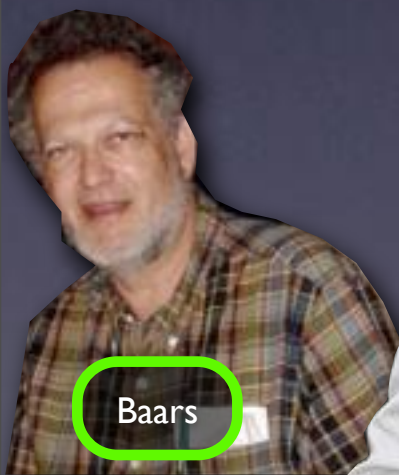
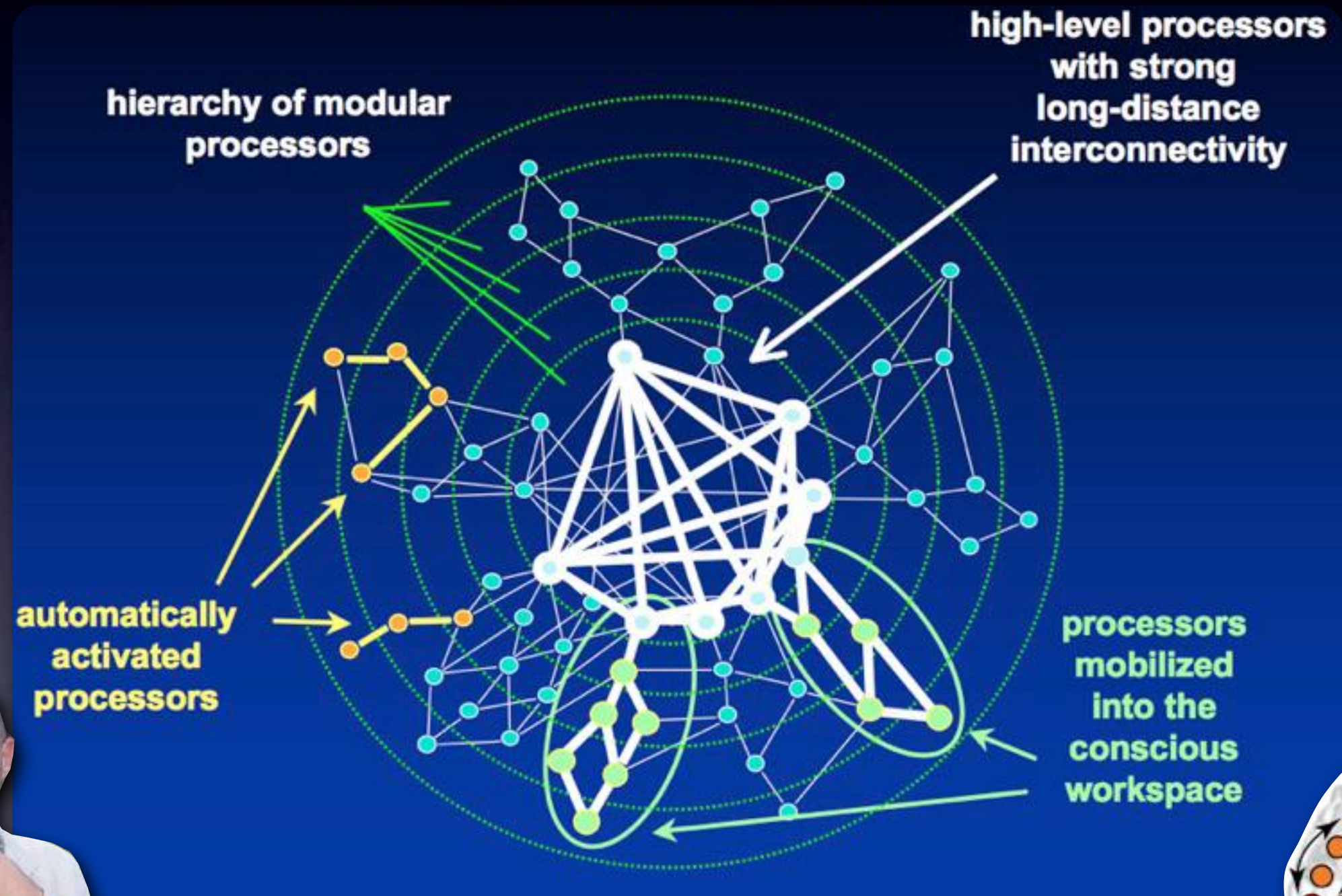
“fame in the brain”



FAME IN THE BRAIN

- Many proposed neural or computational correlates of consciousness converge towards “fame in the brain”
 - Adaptive Resonance (Grossberg)
 - Integration & differentiation (Tononi)
 - recurrence & reentrant processing (Lamme)
 - stability in time (O'Brien & Opie)
 - synchrony (Crick & Koch)
 - Global broadcast (Baars, Dehaene)

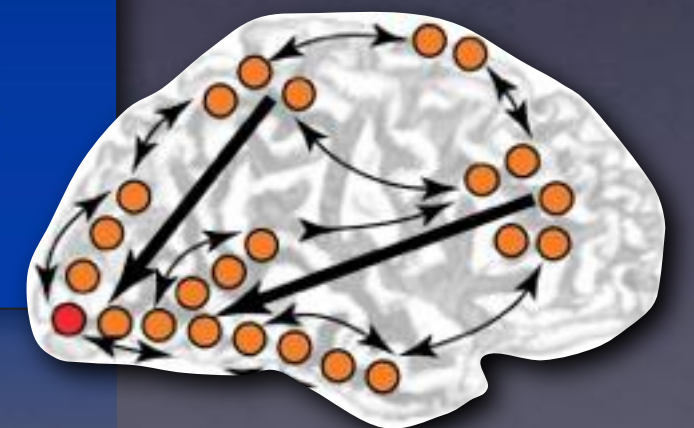
THE NEURAL WORKSPACE



Baars

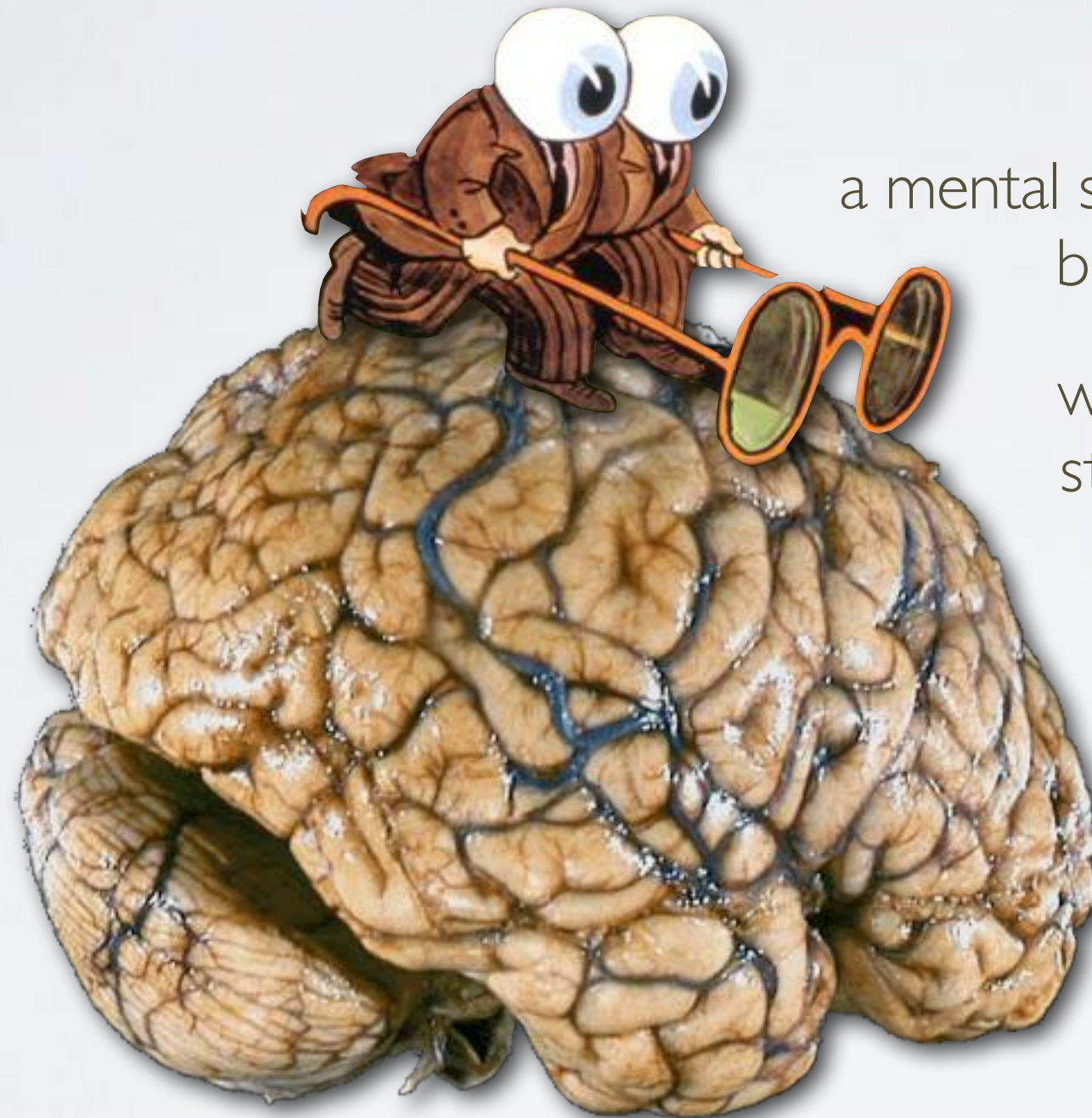


Dehaene



HIGHER-ORDER THOUGHTS

ROSENTHAL 1986, 2004



a mental state is conscious if we are conscious of being in that mental state;

we are conscious of being in a mental state when we have a thought that we are in that mental state;

in sum, a mental state is a conscious mental state in virtue of having a higher order thought that you yourself are in that mental state.

BLINDSIGHT



RADICAL PLASTICITY!

Brain of a white-collar worker

Lionel Feuillet, Henry Dufour, Jean Pelletier

Lancet 2007; 370: 262

Department of Neurology
(L Feuillet MD, J Pelletier PhD),
and Department of
Neurosurgery (H Dufour PhD),
Faculté de Médecine de
Marseille, Université de la
Méditerranée, Assistance
Publique hôpitaux de
Marseille—Hôpital de la
Timone, Marseille, France

Correspondence to:
Dr Lionel Feuillet,

Department of Neurology,
Faculté de Médecine de Marseille,
Université de la Méditerranée,
Assistance Publique hôpitaux de
Marseille—Hôpital de la Timone,
Marseille, France
lionel.feuillet@mail.ap-hm.fr

A 44-year-old man presented with a 2-week history of mild left leg weakness. At the age of 6 months, he had undergone a ventriculoatrial shunt, because of postnatal hydrocephalus of unknown cause. When he was 14 years old, he developed ataxia and paresis of the left leg, which resolved entirely after shunt revision. His neurological development and medical history were otherwise normal. He was a married father of two children, and worked as a civil servant. On neuropsychological testing, he proved to have an intelligence quotient (IQ) of 75: his verbal IQ was 84, and his performance IQ 70. CT showed severe dilatation of the lateral ventricles (figure); MRI revealed massive enlargement of the lateral, third, and fourth ventricles, a very thin cortical mantle and a posterior fossa cyst. We diagnosed a non-communicating hydrocephalus, with probable stenosis of Magendie's foramen (figure). The leg weakness improved partly after neuroendoscopic ventriculocisternostomy, but soon recurred; however, after a ventriculoperitoneal shunt was inserted, the findings on neurological examination became normal within a few weeks. The findings on neuropsychological testing and CT did not change.

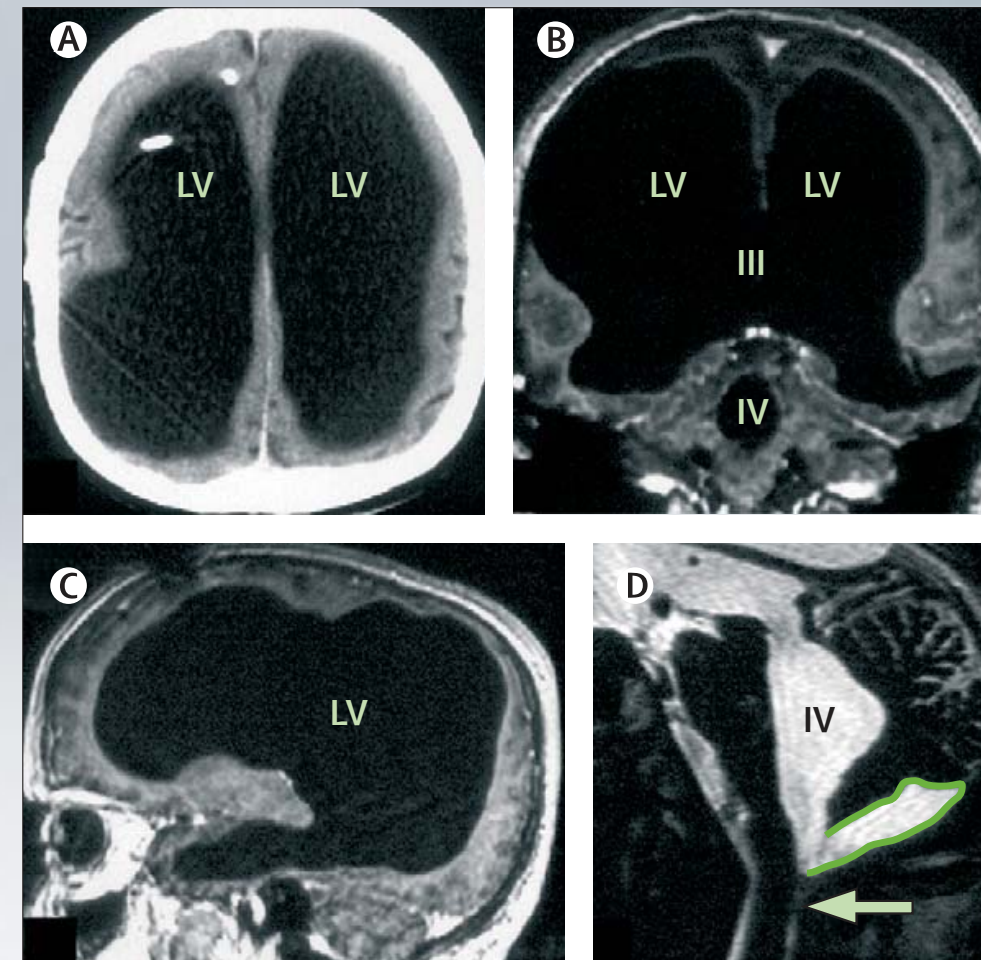
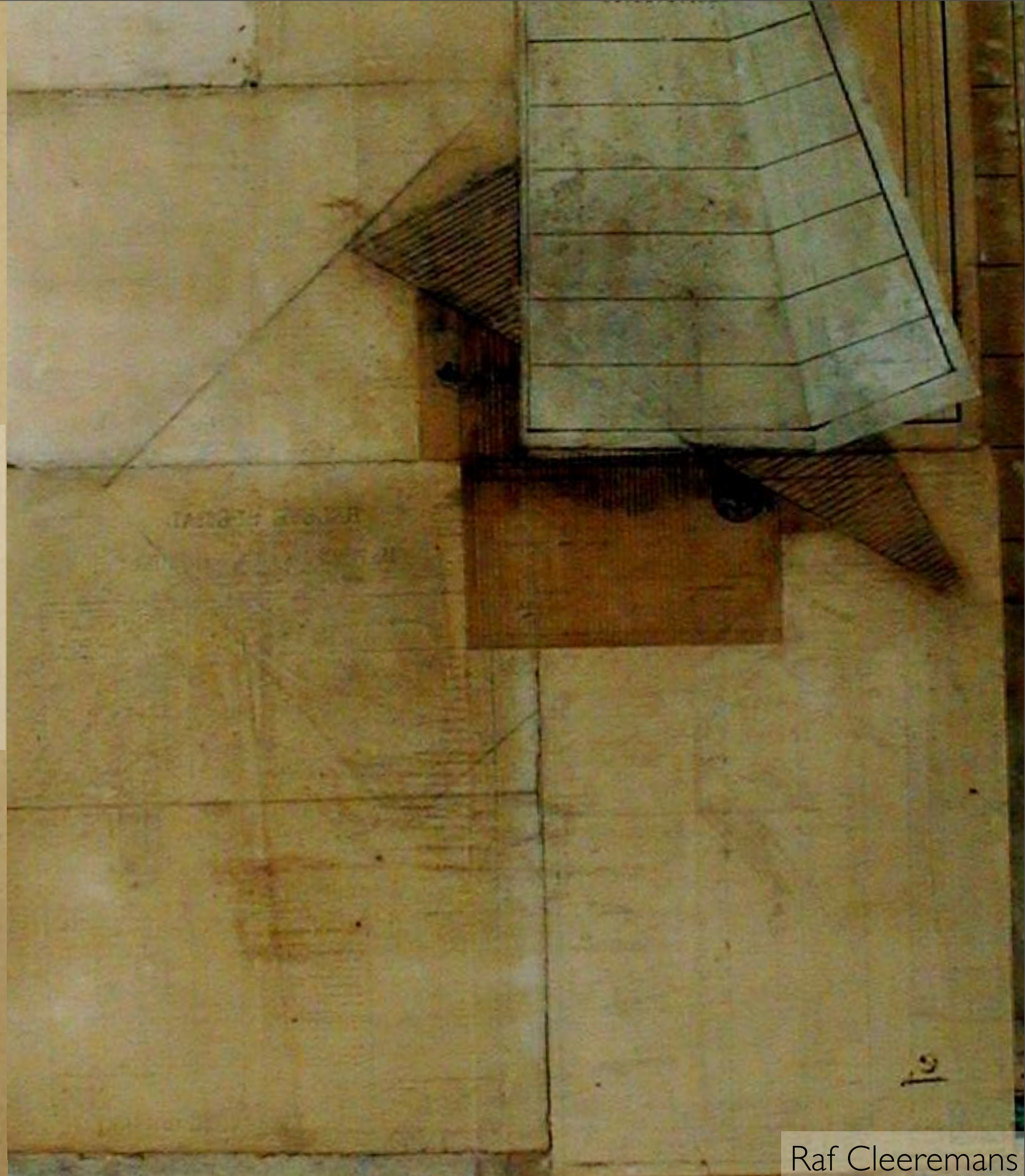


Figure: Massive ventricular enlargement, in a patient with normal social functioning

(A) CT; (B, C) T1-weighted MRI, with gadolinium contrast; (D) T2-weighted MRI. LV=lateral ventricle. III=third ventricle. IV=fourth ventricle. Arrow=Magendie's foramen. The posterior fossa cyst is outlined in (D).

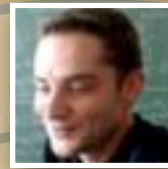
Conclusions



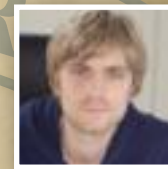
CONCLUSIONS

- **Consciousness** is one of the most important scientific problems today — “a problem about which one doesn’t know how to think about yet”.
- **Contrastive Approach:** Exploring consciousness requires an interdisciplinary approach in which one can correlate objective (the brain in action) and subjective (what it feels like) data so as to contrast what happens with and without consciousness.
- **Strange loop & Radical Plasticity:** The mind is “just” what the brain does, but what the brain does is “just” what has accrued through life-long experience with the world, others, and the brain itself. We learn all the time, whether we intend to or not.
- **Free will** is not what one thinks it is. One is not free to do “anything we please”, we are merely free to make intelligent choices.

Arnaud Destrebecqz



Stéphanie Chambaron



Damien Brevers

Julie Bertels



Vinciane Gaillard

Stéphane Doyen

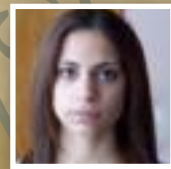


Axel Cleeremans



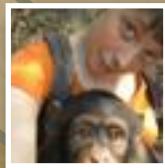
Astrid Vermeiren

Anne Atas



Cora-Lise Pichon

Laure Legrain



Ana Franco

Pedro Magalhaes



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