2025 History of Neuroscience Lecture

The Troubled History of the Emotional Brain

How I see it through
the lens of my fifty-one-years in neuroscience

NEUROSCIENCE IS IN A GOLDEN AGE OF TECHINICAL WIZARDRY

BUT OUR ABILITY TO UNDERSTAND THE BRAIN IS ONLY AS GOOD AS OUR UNDERSTANDING OF THE PSYCHOLOGICAL PROCESS BEING STUDIED

WE SHOULD BE AS RIGOROUS WITH OUR DATA INTERPRETATIONS AS WE ARE WITH OUR DATA COLLECTION AND ANALYSES

TOO OFTEN IMPRECISE PSYCHOLOGICAL CONCEPTIONS BASED ON UNFOUNDED ASSUMPTIONS ABOUT THE RELATION OF MENTAL STATES TO BEHAVIOR ARE RELIED ON

I’m here to talk about
ideas and opinions, not data

Specifically, my ideas
and opinions

Which do not necessarily reflect
what others might say if they
were standing here

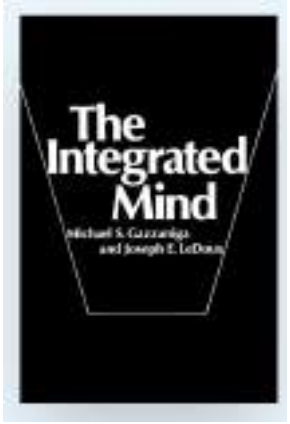
A lot of my ideas came from writing books

At first, I wrote to share what I thought I knew

But writing taught me that I knew
less about what I thought I knew than I did

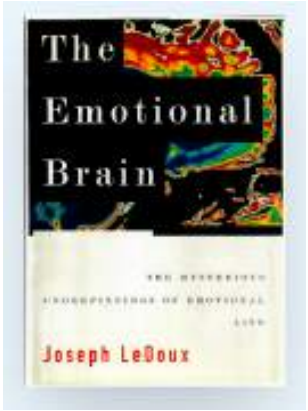
And each book yielded unexpected
revelations and fostered the next book

48 Years of books



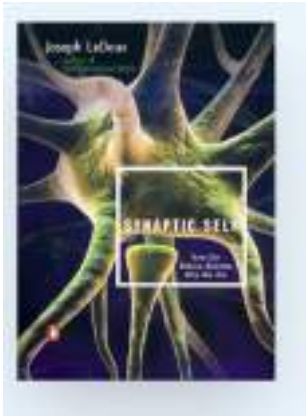
1978

Consciousness as dissonance-reducing narrations



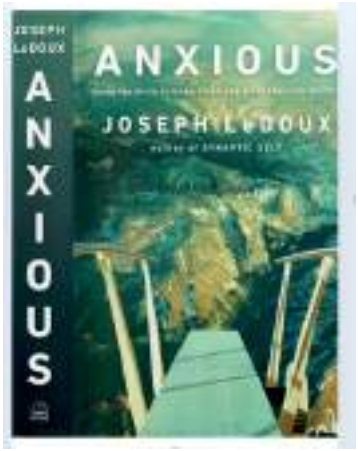
1996

The Amygdala and emotions



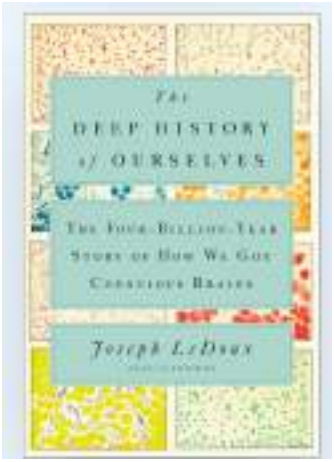
2002

Self, memory, & molecules



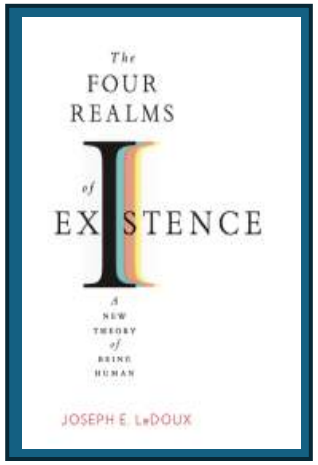
2015

Rethinking emotion and mental problems



2019

The evolution of emotion & consciousness



2023

How behaviors relate or don't to emotion & consciousness

Most Recently

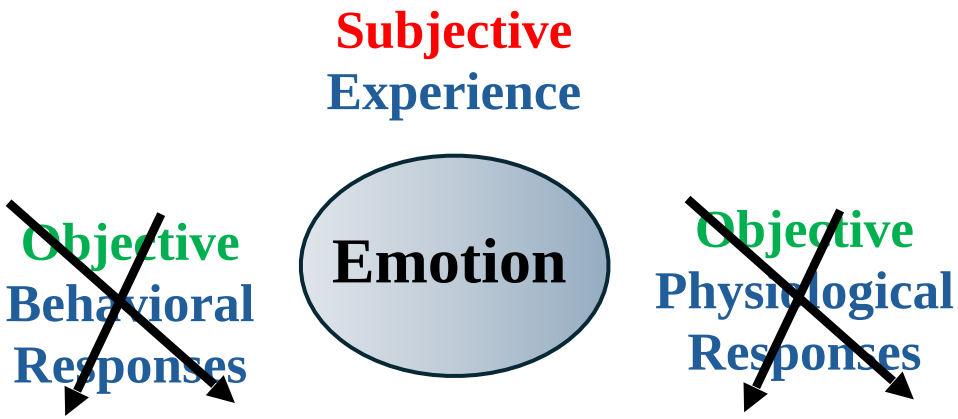
2026

stitches my science together with my personal life and my music

Part 1
The Emotional Consciousness Problem

Emotions define the highs and lows of our lives and are at the heart of human experience. Unfortunately, the scientific study of emotions has long been plagued by arguments about what emotions are and how they function within the brain. Until we pin down what emotions are we won't be able to relieve the emotional difficulties that plague the the lives of so many of people. At the end of the day, our understanding of emotion in the brain is only as good as our conceptualization of what an emotion is. If we don't know what we are looking for, we will surely fail to find it, and we will mislead ourselves and others in the process.

Typical Components of Emotion



only one of these

constitutes an emotion

As I will explain later, the objective responses

reflect a different evolutionary history

Think about why people with emotional problems seek the help of mental health professionals. The answer is simple. They **feel bad subjectively.**

Yet, for decades drug companies and neuroscientists have tended to assume that subjective conscious feelings of patients are quaint folk fictions, irrelevant ghostly qualities, and the best way to understand and treat emotional problems is to develop medications by assessing the effect of drugs on behavioral responses in animals. Although this approach has largely failed, the quest continues because of the dogmatic belief that the magic pharmaceutical bullet is just waiting to be discovered. Sadly though, emotional suffering continues unchecked.

I believe that a new approach is needed, one that fuses the science of emotion with the science of consciousness. Such a ***science of emotional consciousness*** does not presently exist for two reasons. One is that researchers who study emotion in the brain have relatively little contact with the science of consciousness. And the other is that consciousness researchers are far more interested in perception of visual stimuli than in emotional consciousness.

Both fields are diminished by mutual poor understanding of the other, and much could be gained if emotion researchers accepted that **emotions are fundamentally conscious experiences,** and if consciousness researchers accepted that **emotions are our most important conscious experiences.**

These are not separate problems

The Emotion Problem is tied to
the Consciousness Problem

Part 2:
Some Lessons From History

19th Century Origins of Consciousness in Psychology

Philosophy → **Human Psychology**

Biology → **Animal Psychology**

Consciousness in Human Psychology

Psychology was a subarea of philosophy until the late 19th century when it emerged as an experimental discipline in Germany by using the experimental methods of physics and physiology to study the human mind

Wilhelm Wundt **wrote** the first textbook of experimental psychology and established the first experimental psychology laboratory in Leipzig Germany.

Subject Matter: immediate conscious experiences: sensations, perceptions, **feelings and emotions**

Methodology: Introspection (self monitoring of the contents of experiences)

Edward Titchner translated Wundt's textbook at Oxford and moved to Leipzig to work with Wundt

***Subject Matter*:** consciousness, the unconscious, and attention

Methodology: introspection

Quote: "physics views the world with man left out…psychology… views the world with man left in.

,

Comparative Animal Psychology

Charles Darwin (1872)

Expression of Emotions in Man and Animals

***Subject Matter*:** continuity of mind and behavior across mammalian species.

Methodology: analogy with human behavior *(anthropomorphism)*

Quote: "there is no fundamental differences between man and the higher mammals in their mental faculties"

***Modern Quote, Fred Keller* (1973) Darwin bestowed a mental life on man's cousins with a very open hand, without the self-critical zeal that marked his biological endeavors**

Animal psychologists followed Darwin's approach, focusing on continuity of mental states, including emotions, across species, and assessing these by analogy with human behavior

George Romanes (1882)
Behavior is the ambassador of the mind.
If an animal can learn it is conscious

Edward Thorndike (1889)
"Law of effect"
pleasure and pain stamp in leaning

William James (1890)
Coined the term Evolutionary Psychology and extended emotions to other animals

Herbert Spencer Jennings (1906)
Subjective mental states exist in single cell amoeba

1910, Trouble in the works

Some psychologists were concerned about the rampant use of consciousness to explain behavior, including emotional behavior, with little or no objective evidence in animals or humans.

If a behavior looked like it might be conscious it was assumed to be so

Also complicating things was the fact that philosophical metaphysics and Spiritualism were rampant in psychology. Willam James wrote extensively about the “Metaphysics of Experience”, and “The Varieties of Religious Experience”. Both kinds of experience presume a non-physical view of the human mind.

The consciousness ban

In 1913, John Watson, the master mind of Behaviorism, published a paper titled “Psychology as the behaviorist views it.” His message resonated throughout human and animal psychology and led to a rigid focus on objective behavioral responses and the elimination of all things subjective, consciousness and the unconscious, for decades.

Feeling his oats in 1929, Watson wrote: “For fifty years we have kept this pseudo-science exactly as Wundt laid it down. All that Wundt and his students really accomplished was to substitute for the word "soul" the word "consciousness."

Consciousness During the Age of Behaviorism

Consciousness in human and animal Psychology was non-existent

Sir Charles Sherrington, received the Nobel Prize for his work on reflexes and synapses in 1932. Later, he turned to dualistic musings about the brain, mind, soul, zodiac signs, and God.

Later, his student, John Eccles, a Nobel winner in 1963 also explored dualistic ideas such as the “mind-brain liaison (mind and brain are substances that interact) and he explicitly raised the possibility of a “world of mental experience in a higher dimensional space *than the physical world*”.

Consciousness, including emotional consciousness, thrived in Physiology & Psychopathology

These scientists and clinicians typically worked medical environments and were unaffected by Behaviorist dogma

Physiologists
*Charles Sherrington
Walter Cannon (emotion)
Walter Hess (emotion)
*John Eccles
Paul MacLeane (emotion)

Psychotherapists
Sigmund Freud
*Alfred Alder
*Carl Jung

* tended towards metaphysics and/or spiritualism

The Cognitive Revolution

In the 1950s, the cognitive revolution was just beginning to relieve the stranglehold that behaviorism had on experimental psychology which focused on perception. The transition was achieved in part by keeping consciousness out of the game. By focusing on computer-like information processing in the human brain cognitive scientists brought the mind back to psychology, just not the conscious mind that behaviorists had banned. This allowed "mind" to be talked about, but consciousness was more or less still banned

By the 1960s consciousness was popping up here and there, enough to concern George Miller, one of the leading cognitive revolutionaries, to propose that loose use of the word "consciousness" was obstructing research and should be put aside while information processing functions get sorted out. This was a modest move compared to Watson's complete ban of consciousness, but it was as ban and it lasted more than a decade in the new cognitive psychology.

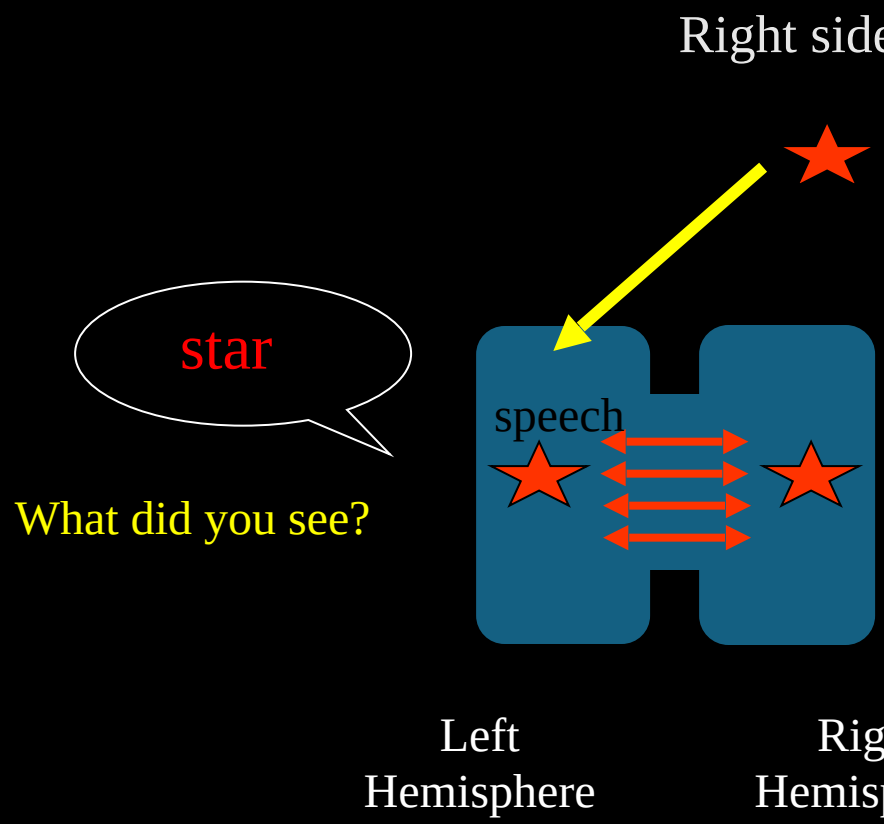
One Kind of Consciousness Research Thrived in the 60s

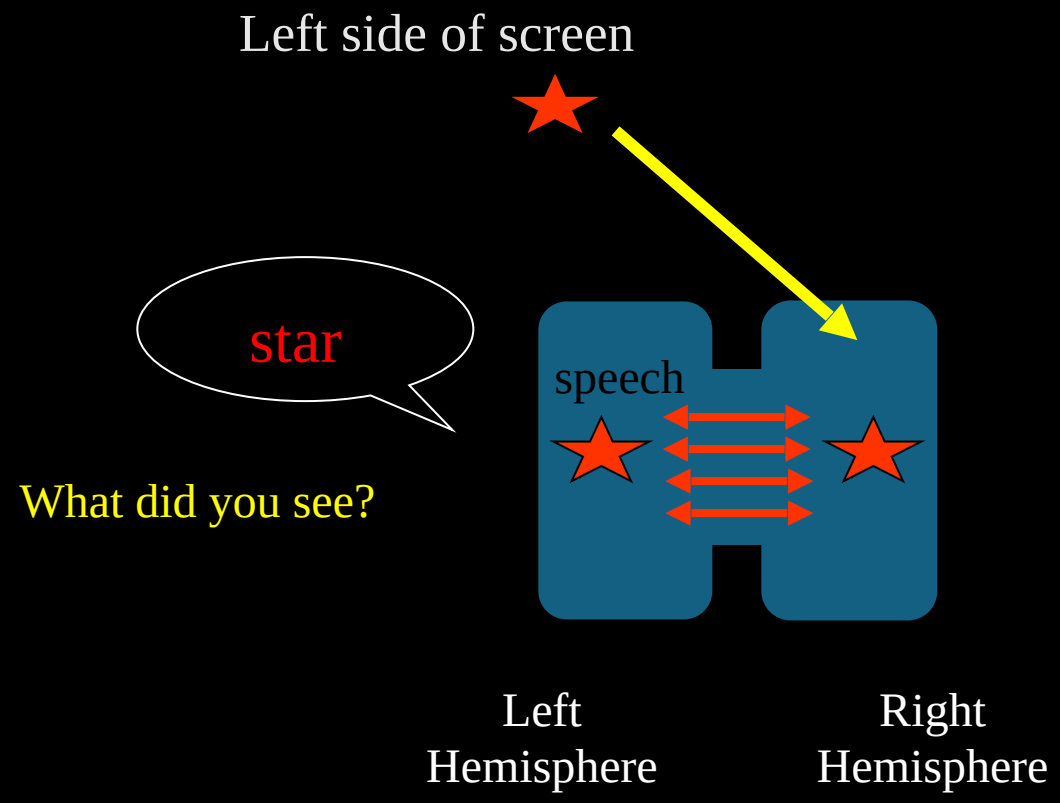
Roger Sperry and his students at Cal Tech, especially Michael Gazzaniga, explored consciousness in people who underwent split-brain surgery. In this procedure the the neural connections between the left and right hemispheres are severed in a last-ditch effort to control otherwise intractable epilepsy.

Because language is typically located in the left hemisphere, these patients can only talk about stimuli seen by the left hemisphere.

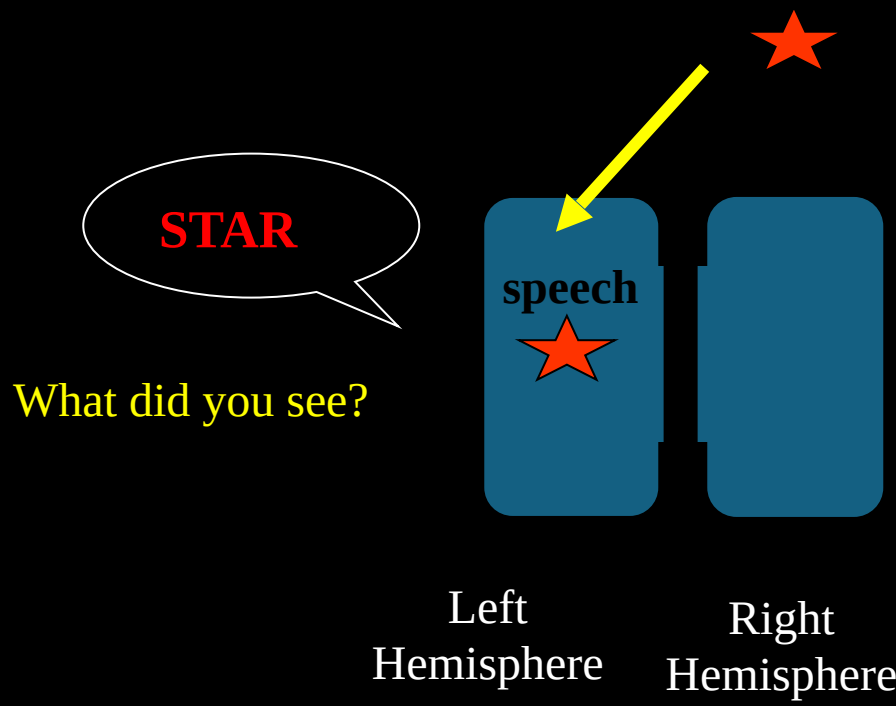
TYPICAL BRAIN

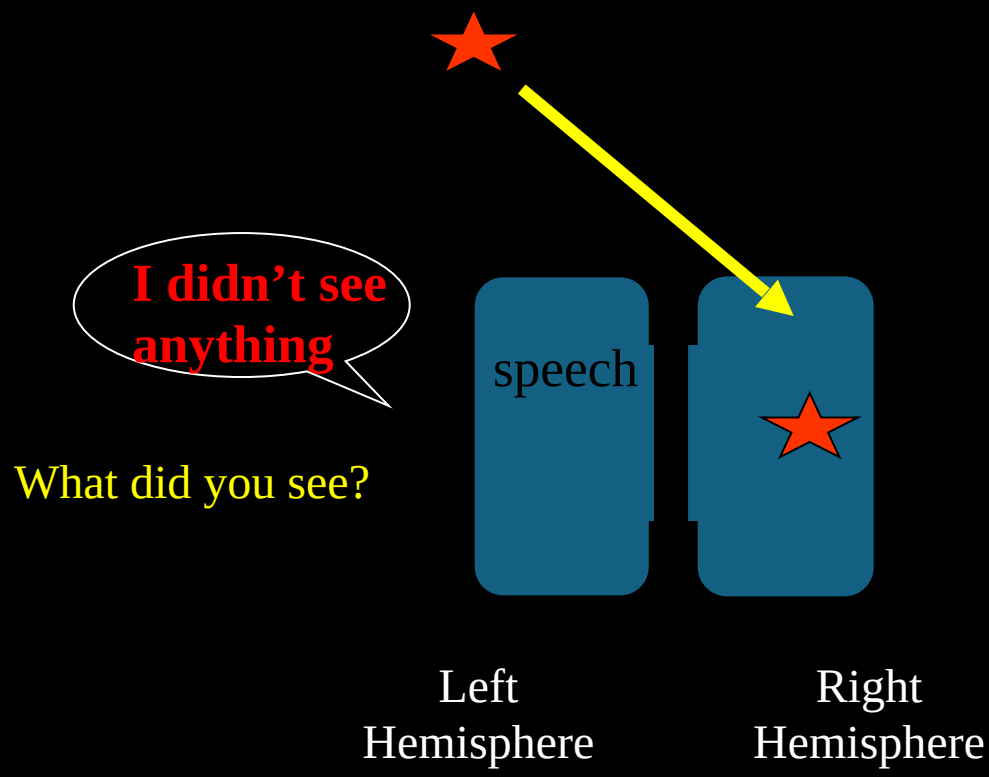
Stimuli seen by either hemisphere
Can be talked about by the left hemisphere





SPLIT BRAIN:
Stimuli in the right hemisphere
cannot be talked about by the left hemisphere





Some thoughts about why split-brain studies were successful & other research on consciousness was not?

- Sperry was a very famous biologist
- He and Gazzaniga mostly published in Neurology and Neurosurgery journals, which means the work was not on the radar of cognitive psychologists
- Their studies were fascinating and compelling

Sperry and Gazzaniga each wrote articles 1969 about consciousness in split-brain patients. Gazzaniga, being junior, explained the research findings to lay people in American Scientist, while Sperry in the Psychological Review ,took on philosophical challenges showing how consciousness is a physical function of the brain.

> “It has long been the custom in brain research to dispense with consciousness as just an "inner aspect" of the brain process, or as some kind of parallel passive "epiphenomenon" or "paraphenomenon" or other impotent by-product, or even to regard it as merely an artifact of semantics, a pseudoproblem”.

Part 3
The Past in the Present

Darwin used folk wisdom about animal minds to project human like emotions on to them. This continues into the present. Proponents of animal consciousness still presume that if an animal exhibits the kind of behavior that is characteristically controlled consciously in human beings, the animal must be having the kind of conscious experience we do when we are in a similar situation. Judging what an animal is experiencing on the basis of what we experience it is not sufficient as a scientific criterion for consciousness. In human research you actually have to have evidence that the behavior can't be explained non-consciously in order to claim it was consciously controlled. Animal consciousness researchers often act as though intuition and belief are sufficient.

We also face challenges from philosophers about the physical basis of consciousness. Unless we accept that consciousness is part of our physical, biological makeup, we'll continue to be mystified about what it is. A commitment to a non-physical (say, dualist) view of consciousness as qualia is perfectly fine as a philosophical position, but it's a deal-breaker as a scientific pursuit.

These various concerns are reminiscent of the past and something needs to be done. A complete ban on consciousness is not the solution. We need to separate scientific from non-scientific views. For example, in the early 1990s a society called The Science of Consciousness" was formed. But it was soon infiltrated with non-scientific ideas. This led some members to form a new society, "The Association for the Scientific Study of Consciousness" (ASSC). For several decades ASSC succeeded in maintaining rigor, but eventually it too suffered from the infiltration of quasi- and pseudo-scientific ideas. Indeed, I was President of AASC in 2023 and left with a bad taste. It may be a perpetual fact of life in conscious research that to maintain scientific rigor you may have to start over again-and-again.

Hakwan Lau: Increasingly, the science of consciousness is being called to the stand to make ethically far-reaching statements on controversial topics such as animals, abortion, organoid and artificial intelligence… But the state of current research necessitates a level of prudence and humility from which we as a community are unfortunately straying. One likely outcome…is that more-and-more serious people will stop taking the discipline seriously. Even more worryingly, this could tarnish the reputation of science as a whole.

PART 4

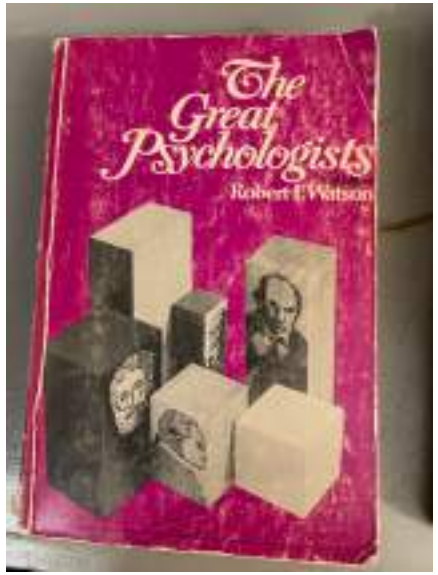
An Accidental Neuroscientist

I grew up in Eunice, a small town in the French-speaking southwestern part of Louisiana called Cajun Country. No one from there would've guessed that I'd end up in this line of work. My main interests as a teenager were pop music and sports. I was a decent student in, but not a great one , and the only science class I took in high school was chemistry, which was required. I also took a watered-down Physics class for non-physics majors in college at LSU. I took no other science courses over the four years. That was easy since I majored in business administration as an undergraduate and then proceeded to a master's degree in marketing.

Why Business?

If my mother had her way, I would have attended LSU Eunice, a junior college which was accepting their first class. But I had spent enough time at LSU Baton Rouge parties to know that there was no way I was staying in Eunice. After some intense negotiating I agreed to study business in Baton Rouge and then come back to Eunice and be banker.

I found business a boring subject and got some relief by taking psychology classes, the first of which was “The History of Psychology’, which used two books that I still possess and use, especially the one on the right, E.G. Boring’s 1950 book, *A History of Experimental Psychology*.



I fell in love with this topic

and am still in love with it

and am so very happy to give this lecture.

More Business?

By my Junior year the counter-culture revolution had arrived in Baton Rouge. Being a Business Administration major was both boring and **super *un-cool***. Fortunately, my focus was moving towards consumer protection, a somewhat acceptable topic in 60s political climate.

I graduated in 1971 and after a year off and not knowing what else to do I applied and was admitted into the two-year Master's Program in Marketing at LSU and continued my work on consumer protection. I felt stuck in a rut. But at least I had psychology classes.

The Wrong Class

For the fall 1973 semester I signed up for a psych class called “Learning and Motivation”. It seemed very relevant to the consumer behavior work I was doing my thesis on. But I was wrong. The class, taught by Professor Robert Thompson, was about his research on the brain mechanisms of memory in rats. I had no idea you could make a living doing that.

Since I had no experience studying the brain, my initial inclination was to drop the class. But as each session went by, I became more-and-more intrigued and started hanging out in his lab. At the end of the fall semester, I told Professor Thompson that I wanted to do a PhD studying the brain. He seemed taken aback. I could almost hear his thoughts churning during a moment of silence—"This kid has zero background in science and has no chance of being accepted into a PhD program.” But what came out was, “Okay, I’ll write a letter of recommendation for you”.

There were no PhD programs in neuroscience back then, as the field had only formally come into existence a few years earlier. Research on brain and behavior was primarily conducted in departments of Psychology, so I sent out a dozen or so applications to programs that offered the training I was looking for.

Emily Dickinson, writing about anxiety, noted, “The waiting is the worse”. In my case, she was wrong. Receiving rejection letter after rejection letter was worse than the waiting. At least you had hope when you were waiting. I was bummed out by the rejections. It seemed that I’d have to settle for a mundane career in marketing after all. The last letter to arrive was from The State University of New York at Stony Brook. They must have struggled over a decision. I could not believe what the letter said. They had offered me a position. The wait was painful, but the result was glorious.

It's hard to know what exactly what makes one’s life play out the way it does. In my case the arbitrary act of misunderstanding the title the course was a falling domino that set off a cascade of events that led me to become a neuroscientist and shaped all other aspects of my future.

Stony Brook

I had been assigned to a professor who studied the behavior of marmosets (very small monkeys) living in a greenhouse that had been converted into a kind of rain forest setting for them. Although they were very cute, and the professor was a distinguished researcher and a kind man, watching marmosets jump from branch to branch in a greenhouse was not why I had come all the way from South Louisiana to Long Island.

That was the first time anyone had ever told me I could write

A fellow student told me about his split-brain work with Professor Gazzaniga. I had never heard of him or split-brain surgery, but it sounded very interesting, and a meeting was arranged. It was brief and ended with him telling me to write up a proposal about what I might work on. Two days later we again met and he accepted me into his lab. And he also said, “Do you want to help me revise my book, *The Bisected Brain?*”

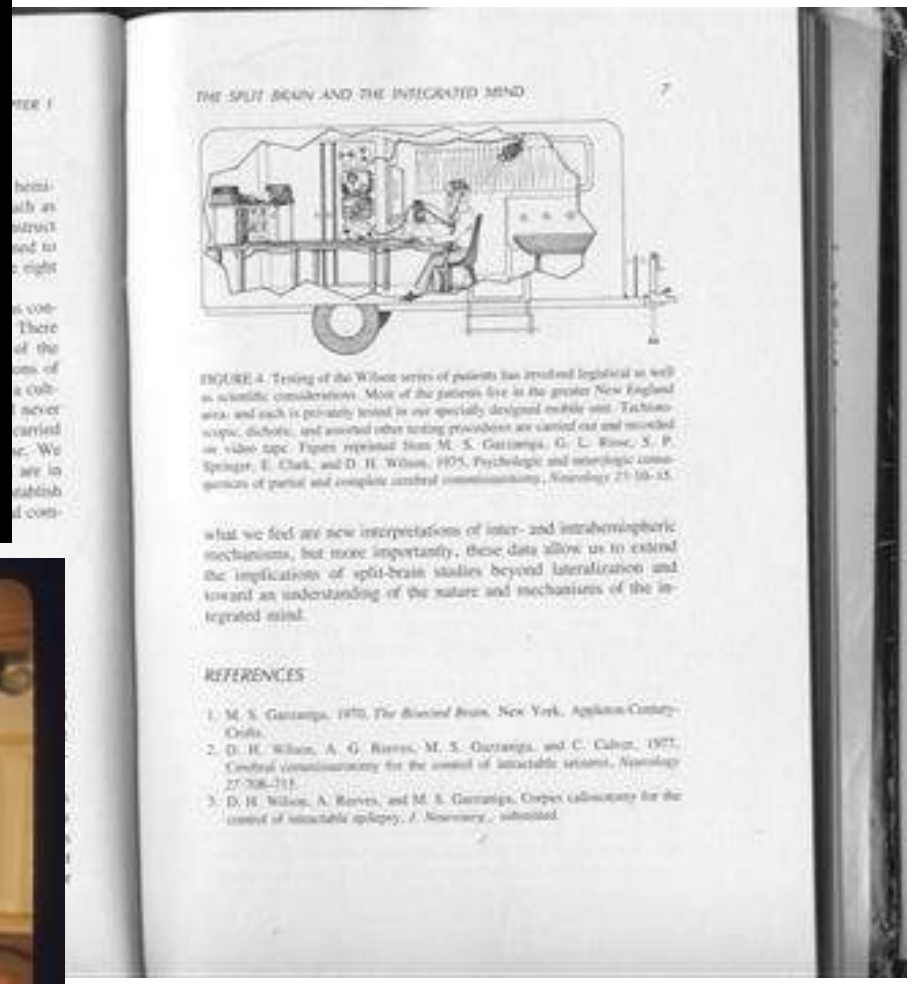
PhD 1974-1978 SUNY Stony Brook

Consciousness in a new group of split-brain patients operated on at Dartmouth

Young Mike

Even Younger Me

On the Road



THE SPLIT BRAIN AND THE INTEGRATED MIND 7

FIGURE 4. Testing of the Wilson series of patients has involved logistical as well as scientific considerations. Most of the patients live in the greater New England area, and each is privately tested in our specially designed mobile unit. Tachistoscopic, dichotic, and assorted other testing procedures are carried out and recorded on video tape. Figure reprinted from M. S. Gazzaniga, G. L. Risse, S. P. Springer, E. Clark, and D. H. Wilson, 1975, Psychologic and neurologic consequences of partial and complete cerebral commissurotomy, *Neurology* 25:10–15.

what we feel are new interpretations of inter- and intrahemispheric mechanisms, but more importantly, these data allow us to extend the implications of split-brain studies beyond lateralization and toward an understanding of the nature and mechanisms of the integrated mind.

REFERENCES

1. M. S. Gazzaniga, 1970, *The Bisected Brain*, New York, Appleton-Century-Crofts.
2. D. H. Wilson, A. G. Reeves, M. S. Gazzaniga, and C. Culver, 1977, Cerebral commissurotomy for the control of intractable seizures, *Neurology* 27:708–715.
3. D. H. Wilson, A. Reeves, and M. S. Gazzaniga, Corpus callosotomy for the control of intractable epilepsy, *J. Neurosurg.*, submitted.

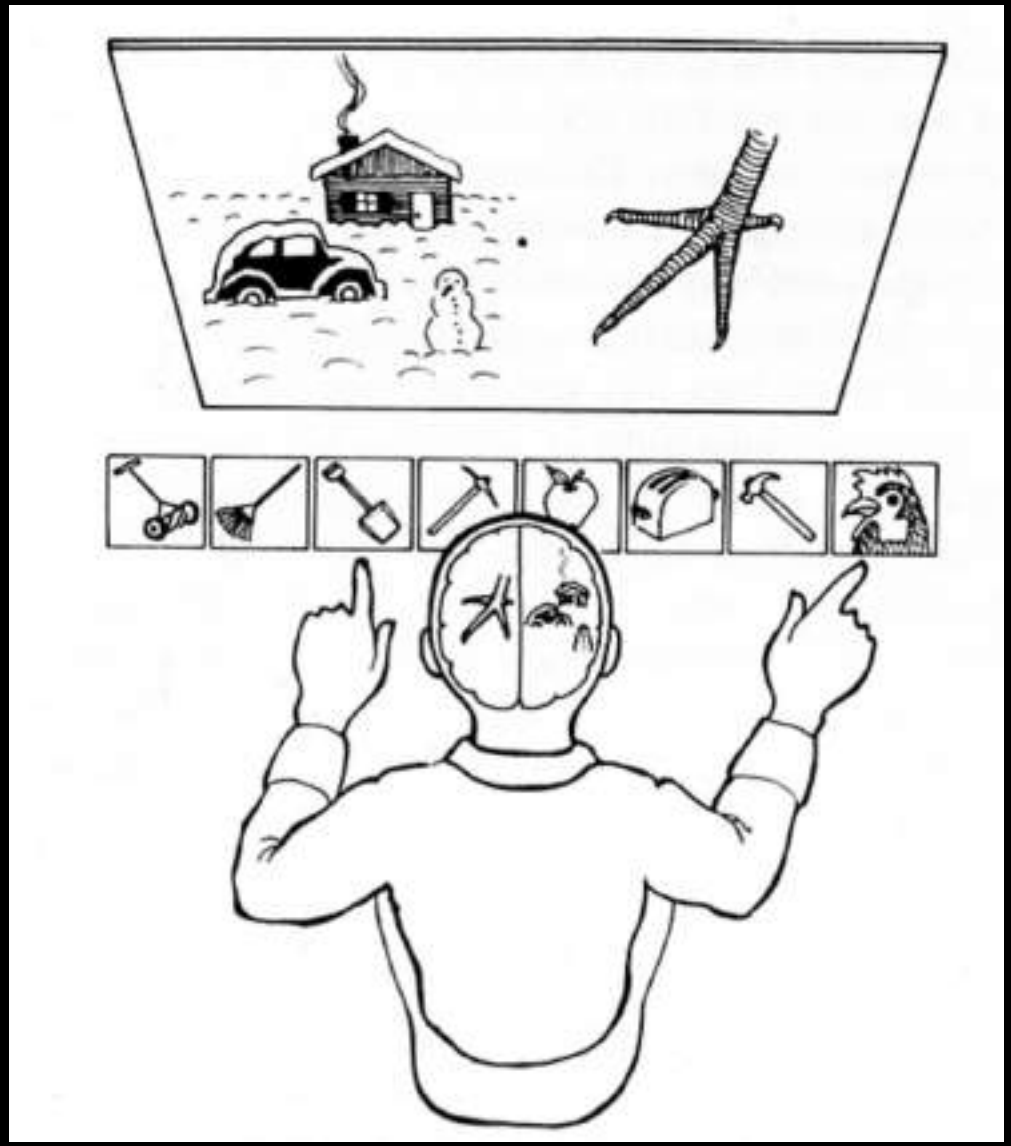
“Why” versus “What”

We ran the usual tasks on the new patients,
flashing stimuli left and right and asking
what did you see

And then something happened with one patient known as PS,
the hero in my dissertation

As Mike pointed out:
For 20 years split-brain researchers asked: “What did you see?”
But then we started asking a different question: “Why did you do that?”

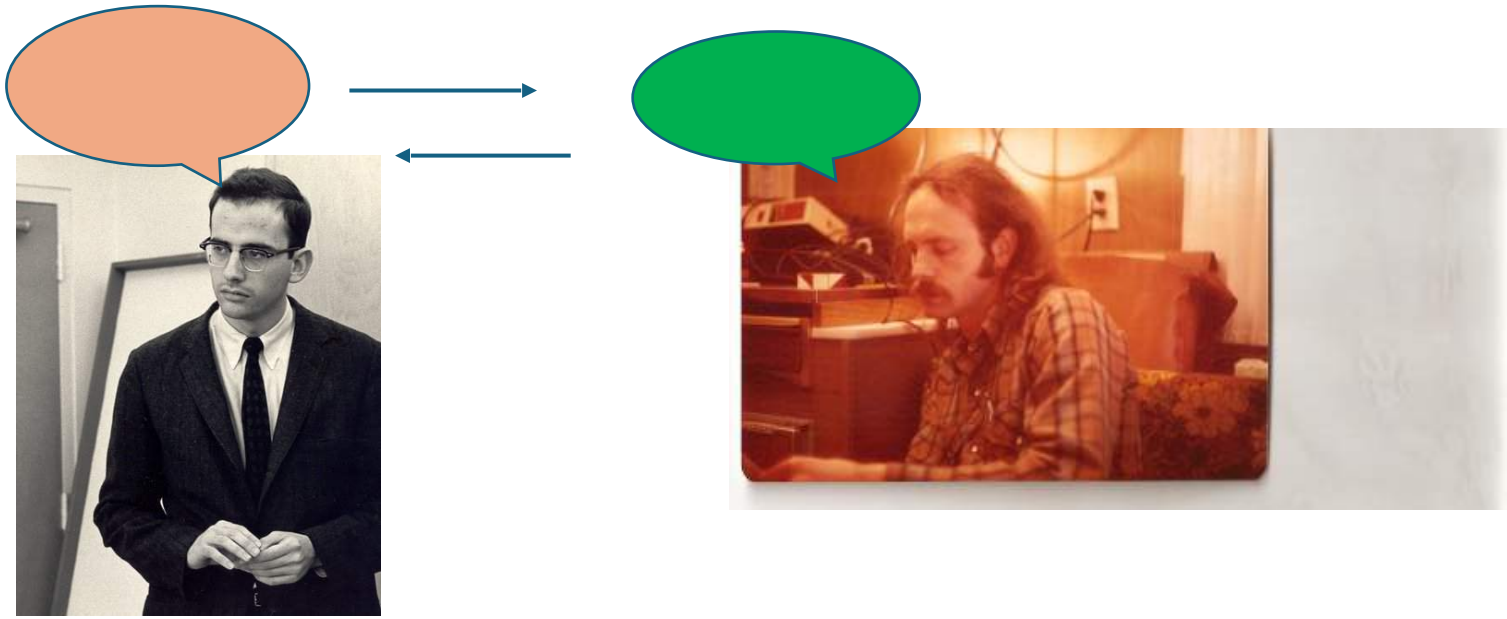
Left-Hemisphere of Split-Brain Patient Generates A Narrative to Explain Right Hemisphere Behavior
(conscious rationalization of non-conscious behavior)



Q: Why did you pick those?

A: I saw a chicken claw so I picked the chicken, and you need a shovel to clean up the chicken shed

That night at the Bar:
chit chatting about the day



Hypothesis: We humans think we control our behavior. Observing ourselves behaving non-consciously is discomforting—it produces cognitive dissonance. Given the multiplicity of non-conscious behavioral control systems in the brain, dissonance-reducing narratives may help maintain a sense of mental unity

Also at the Bar:

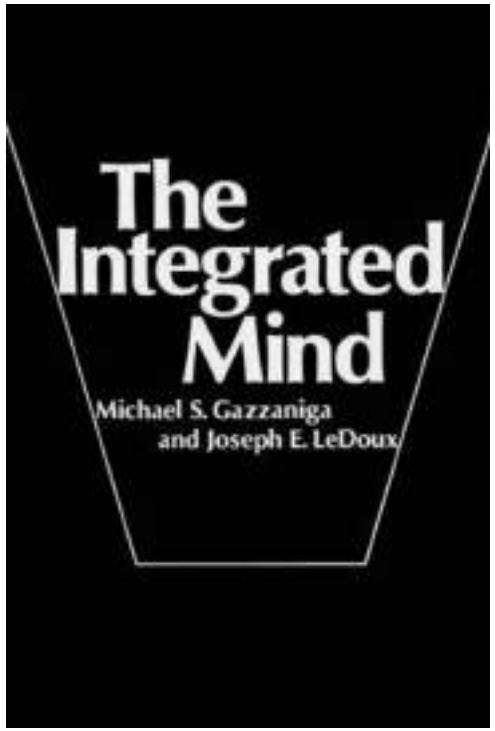
Emotion systems might be the kinds of systems that generate behaviors that demand dissonance reduction

You know, there's not much research on emotion and the brain these days

Hmm.
Maybe I'll try that

From the Bisected Brain to The Integrated Mind

Two years into my PhD, we decided to can the revision of *The Bisected Brain* and instead would write a book called *The Integrated Mind*, which would be about what we learned about the human mind by studying the split-brain. The book was published in March 1978, a month before I defended my thesis. I'm still in disbelief that four years after my Masters in Marketing I had a book and a PhD. I guess I was the right guy at the right time. How else can it be explained?



Part 5:

The Amygdala and Emotion

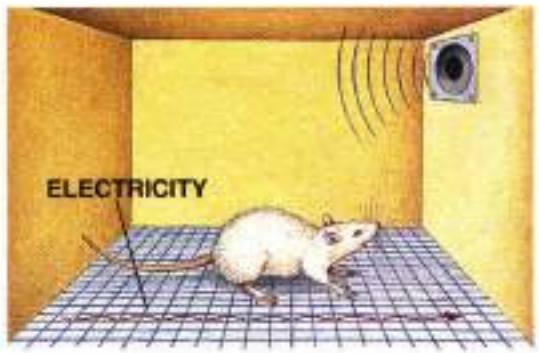
Because of the limited tools for studying the human brain, and the presumed conserved neural circuits of emotion systems across mammals I turned to studies of rats

My goal was instead to understand circuits that might non-consciously control behaviors that in humans demand dissonance-reducing narratives

I had no illusion that I could study emotional consciousness in rats

PAVLOVIAN FEAR CONDITIONING AS A TOOL FOR TRACING EMOTIONAL PATHWAYS FROM SENSORY TO MOTOR NEURONS

Tone



Tone + Shock

Freezing

A simple stimulus and a reliable, stereotyped response seemed Ideal for tracing circuits from sensory to motor neurons

First grant application (1985): The Neural Pathways of Emotion

Study Section Comments

"Emotion is not a neuroscientific topic, and you need a "non-associative control group"

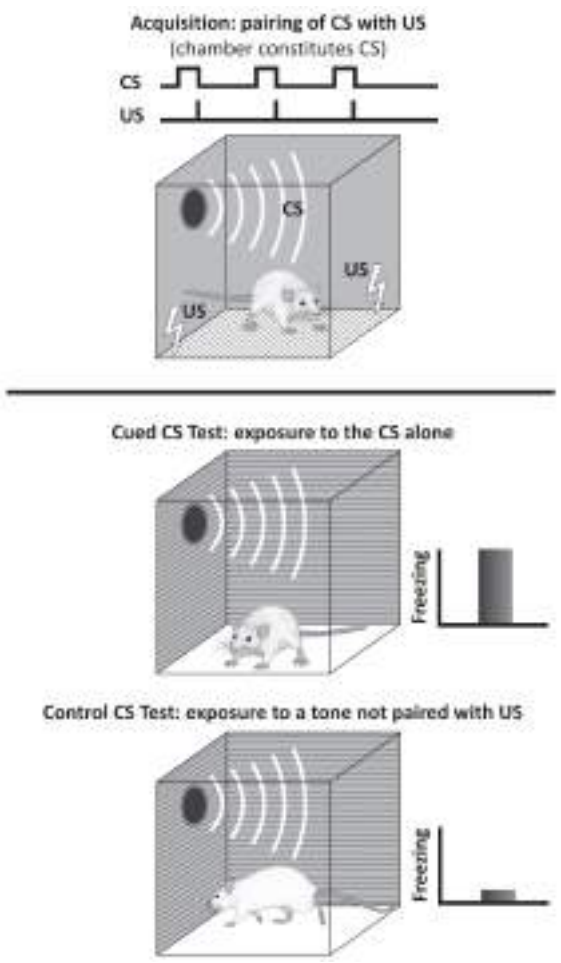
I minimized mention of "emotion" and added the control group, and was awarded the grant

.

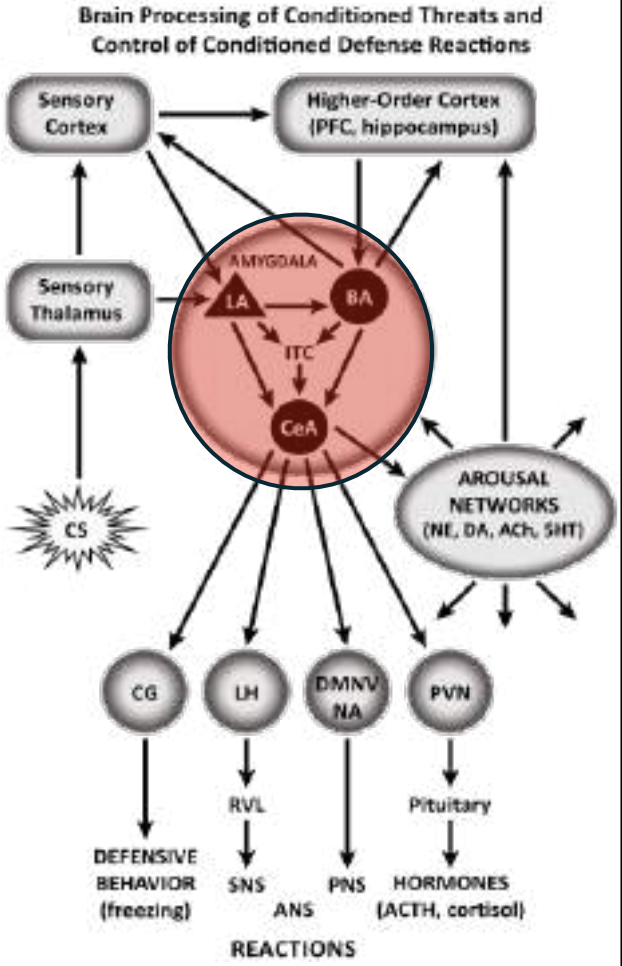
I MADE MY LIVING FOR THE NEXT 3+ DECADES STUDYING FEAR CONDITIONING

SFN 1983 LeDoux, Kapp, Davis **Dudai, Kandel, others**

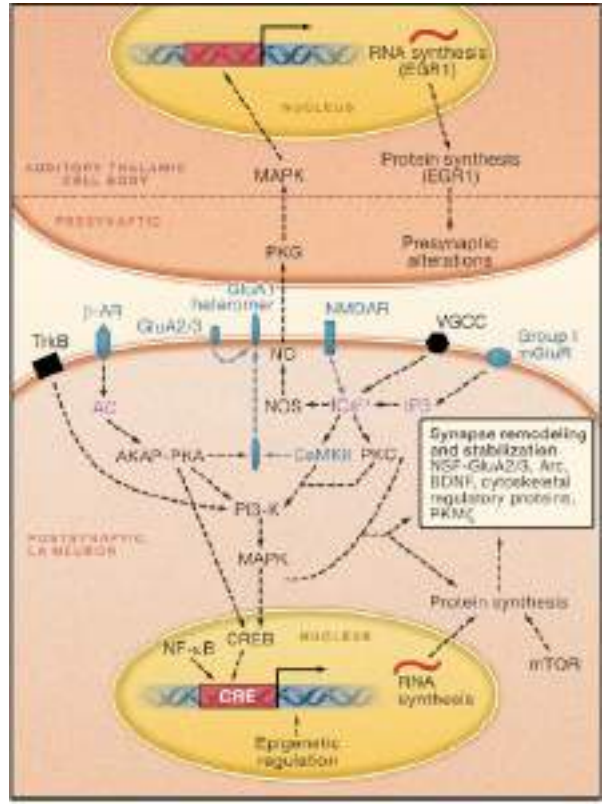
WHAT?
BEHAVIOR



WHERE?
CIRCUITRY

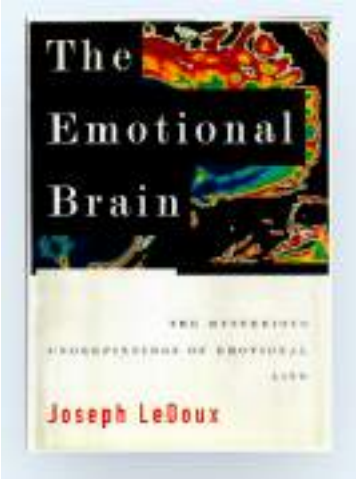


HOW?
CELLs AND MOLECUES



BUT I NEVER STOPPED THINKING ABOUT AND WRITING ABOUT EMOTIONAL CONSCIOUSNESS

1996 THE EMOTIONAL BRIAN



29 years old and still being printed

In The Emotional Brain I Partitioned Emotion by borrowing from Memory research

Memory Research	Emotion Research
Implicit (unconscious) Memory	Implicit (unconscious) Fear
automatic responses	automatic responses (what the amygdala does)
Explicit (conscious) Memory	Explicit (conscious) Fear
subjectively experienced	subjectively experienced fear *(what working memory contributes)*

Implicit vs Explicit distinction did not catch on in emotion research

fear was “FEAR”
And the amygdala was its home

What different researchers thought about the amygdala and fear

Some meant subjective conscious fear (neo-Darwinians)

Others meant non-conscious fear, an intervening variable that connected stimuli with responses (neo-behaviorists)

I was a neo-behaviorist about fear behavior but a cognitivist about conscious fear

By 2010 I was often introduced at lectures as having discovered how the amygdala makes fear and other emotions

No matter how many times I said ”Fear does not bubble up out of the amygdala”, That’s what I was known for

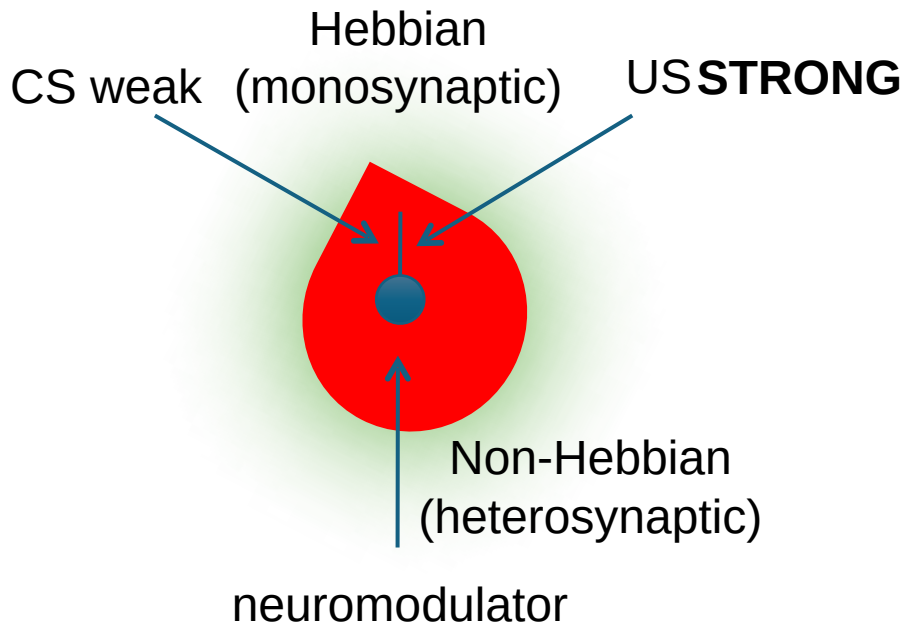
Part 6

Did you ever have to make up your mind?

Separating What
The Amygdala Does and Doesn’t Do

Neuroscientists Explain “Fear” Conditioning in terms of Systems, Cells, Synapses and Molecules

This logic works equally well in all animals (vertebrates and invertebrates)
No Need to Call Upon Concepts Such as “Fear”



THIS DOES NOT MEAN THAT “FEAR” IS AN IRRELEVANT CONSTRUCT.

IT’S JUST NOT WHAT CAUSES INNATE RESPONSES ELICITED BY CONDITIONED THREATS IN ANIMAL OR HUMAN STUDIES

single cell organisms (protozoa and bacteria) also undergo Pavlovian Conditioning

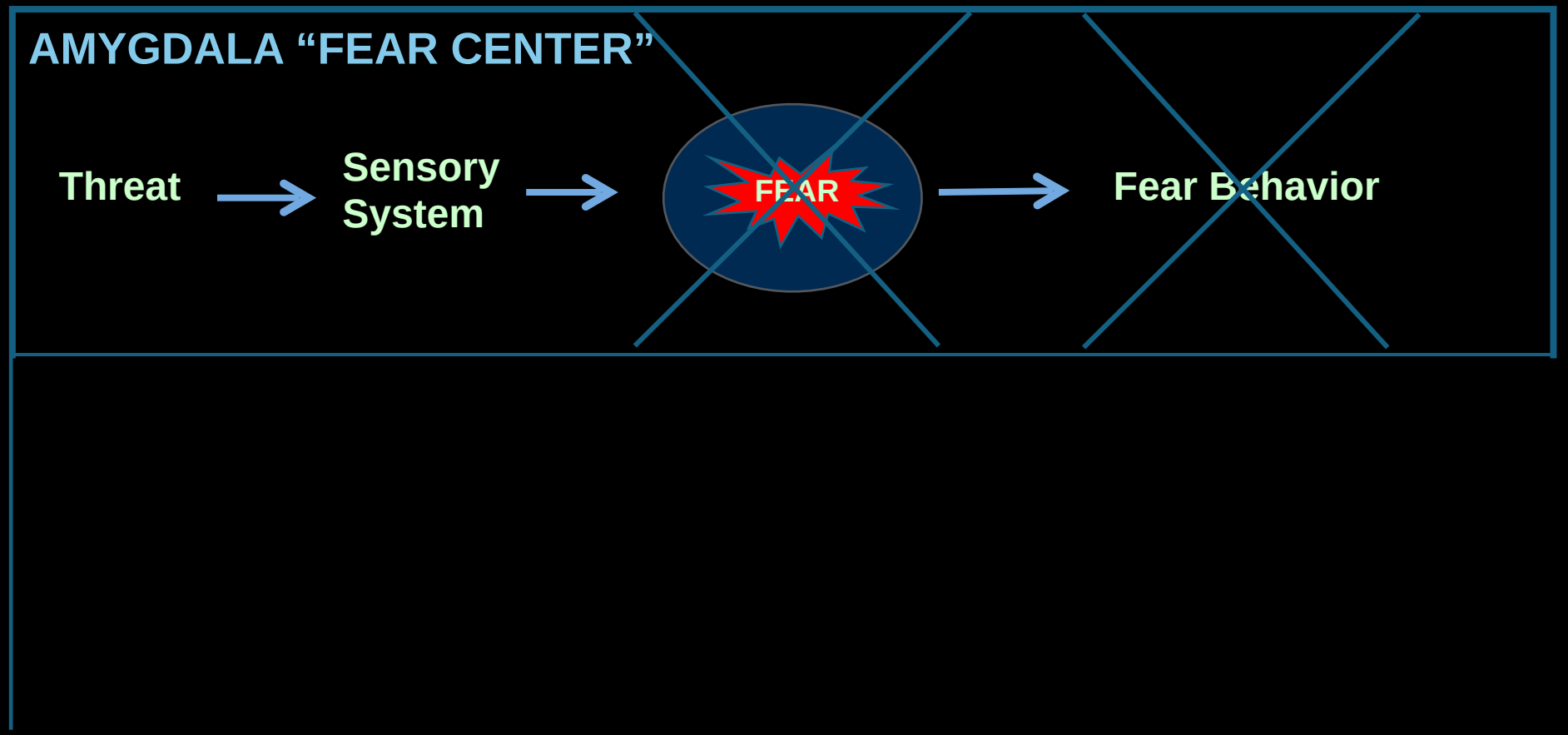
Neuron

Perspective

2012

Rethinking the Emotional Brain

Joseph LeDoux[1,2,*]



All organisms since the beginning of life have had to detect and respond to danger to stay alive long enough to replicate/reproduce. When we use the Same word "fear" for the behaviors and emotion experience we create confusion.

Many scientists, even those that say they are not talking about fear experience, nevertheless talk and write as though are, using expressions like

“we used freezing as a measure of fear,”

”the animals were frozen in fear.”

Readers and listeners naturally assume **fear itself** is the subject.

WHY DOES IT MATTER WHAT WE CALL THINGS

Francis Bacon (1620) Scientists should be vigilant and guard against tacitly granting reality to things simply because we have words for them.

George Mandler and William Kessen (1964) The common language is full of quasi-psychological assertions, and the language in which these are framed is inadequate

Jack Block (1995) Psychologists have tended to be sloppy with words. Summary labels and short-hand ideas come to control the way we think

Melvin Marx (1951) There is a semantic danger that results when a common language term is used as a scientific name for an intervening variable or hypothetical construct… the variable or construct becomes infected with the subjective properties of the common meaning

Psychology and Neuroscience Have Unique Conceptual/Linguistic Challenges

Biologists call a family of genes ‘hedgehog’ but no one in biology believes the gene has anything to do with the animal called hedgehog.

But when psychologists use a word like fear the assumption is that the subject matter is our everyday experiences of fear when in danger.

PRACTICAL EXAMPLE OF WHY WORDS MATTER

Anxiolytic Drug Development

Tests of defensive behavior in animals are assumed to measure a **brain state of fear or anxiety**

Drugs that alter defensive behavior are assumed to change the **brain state** by targeting a fear/anxiety brain circuit

Because humans have inherited this circuit from mammalian ancestors, giving the the drug to humans should change this brain state and make people feel less fearful or anxious

In 2010 Andrew Witty, CEO of GSK, concluded the effort has failed and new investments would not be made because of the low probability of success.

Andrew Holmes, a leading researcher, reached a similar conclusion: “these efforts have been disappointing, as promising results with novel agents in rodent studies have very rarely translated into effectiveness in humans”.

Eric Nestler and Steven Hyman, leading psychiatrists, echoed this sentiment, noting that the molecular targets of current major classes of psychotherapeutics were all reverse engineered in animal studies from drugs discovered incidentally prior to 1960 by clinical observation. Hence, nothing new has been discovered because the same thing has been searched for over and over.

Yet, the effort continues because of a commitment to poorly conceived psychological and psychiatric constructs

Psychological: mental states of fear can be measured by innate or conditioned behaviors in animals and people

Psychiatric: pathological fear is product of a malfunctioning genetically wired fear circuit, and that delivery of the right chemical to this fear circuit will fix the problem, as measured by innate (freezing, fleeing) or conditioned (avoidance) behavioral responses

TWO MEDICATION SCENARIOS IN SOCIAL ANXIETY

Fear/anxiety scenario
-the medication will turn off your fear center.
-you will be able to go to the party and not feel afraid or anxious.

This is what everyone hopes will happen:
It's an anti-anxiety drug and will reduce fear and anxiety

Physiological symptom scenario
-the medication affects systems that control behavioral and physiological responses in challenging situations.
-you will find it easier to go to the party (be less avoidant) and will feel less jittery (less aroused).
-while you will probably still feel anxious, you will be better able to cope with the threatening situation and can use it as a way to become physically more comfortable being there.
-this is not a cure but it might help you cope with your symptoms.

This is what the animal research actually predicts:
The drug reduces behavioral inhibition (timidity) and/or hyper-arousal

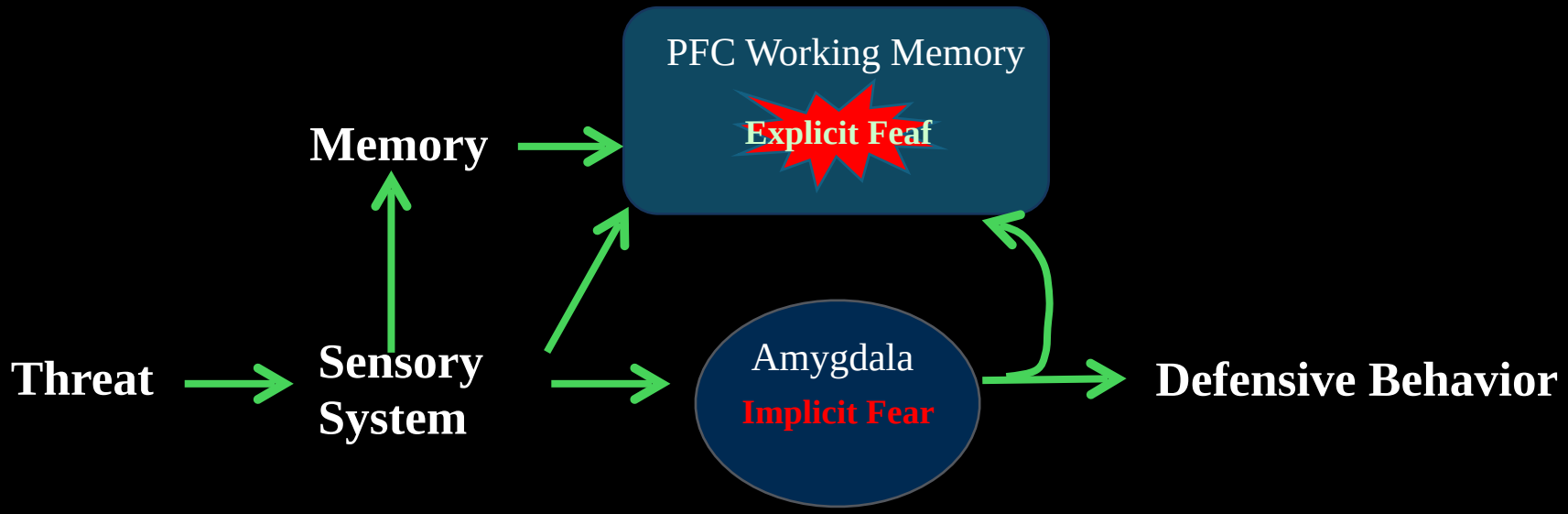
We need a conception of fear and anxiety that recognizes the importance of innate and conditioned circuits we have inherited from animals

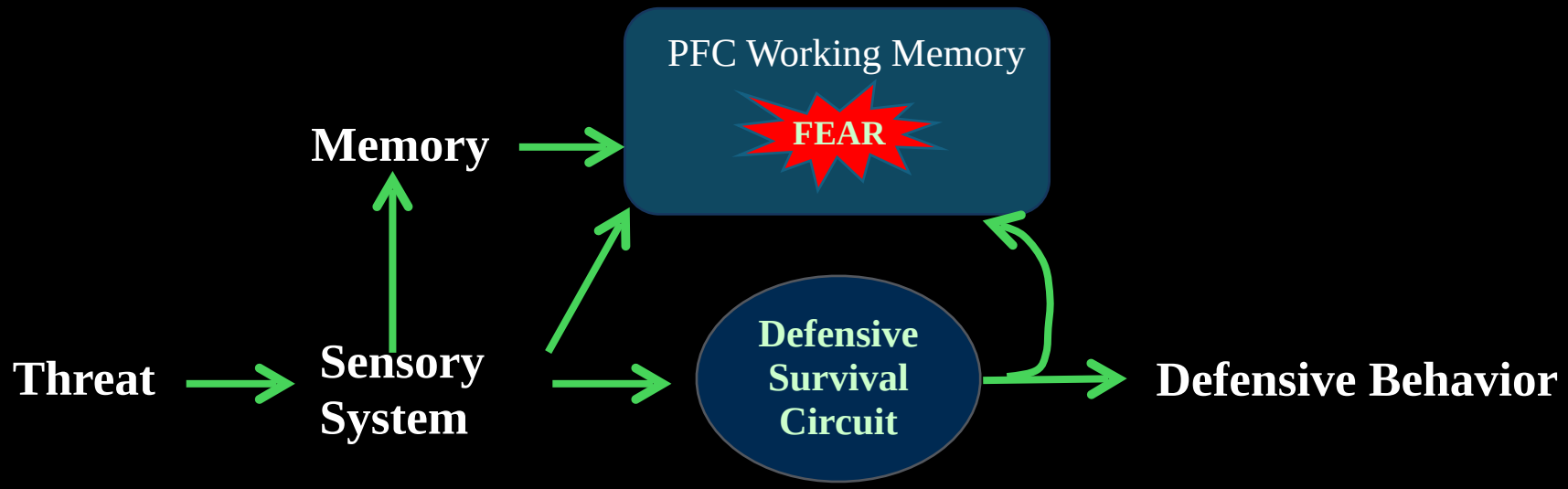
But one that does not confuse those circuits with circuits that underlie conscious feelings of fear or anxiety

WHAT ABOUT CONSCIOUS FEAR?

Think back to PS
Cognitive Interpretation /
Narration

Knowledge about possible neural circuits of cognition were limited in the 70s. Allan Baddeley's idea that working memory is the foundation of cognition had been around for a whil,e but what caught my attention was his newer notion in the 90s that working memory is the gateway to consciousness. I built on this in *The Emotional Brain*, proposing that emotional states of consciousness result from the integration in working memory of information from sensory systems, long-term memory systems , and amygdala feedback I have ever since used working memory to understand emotional consciousness.

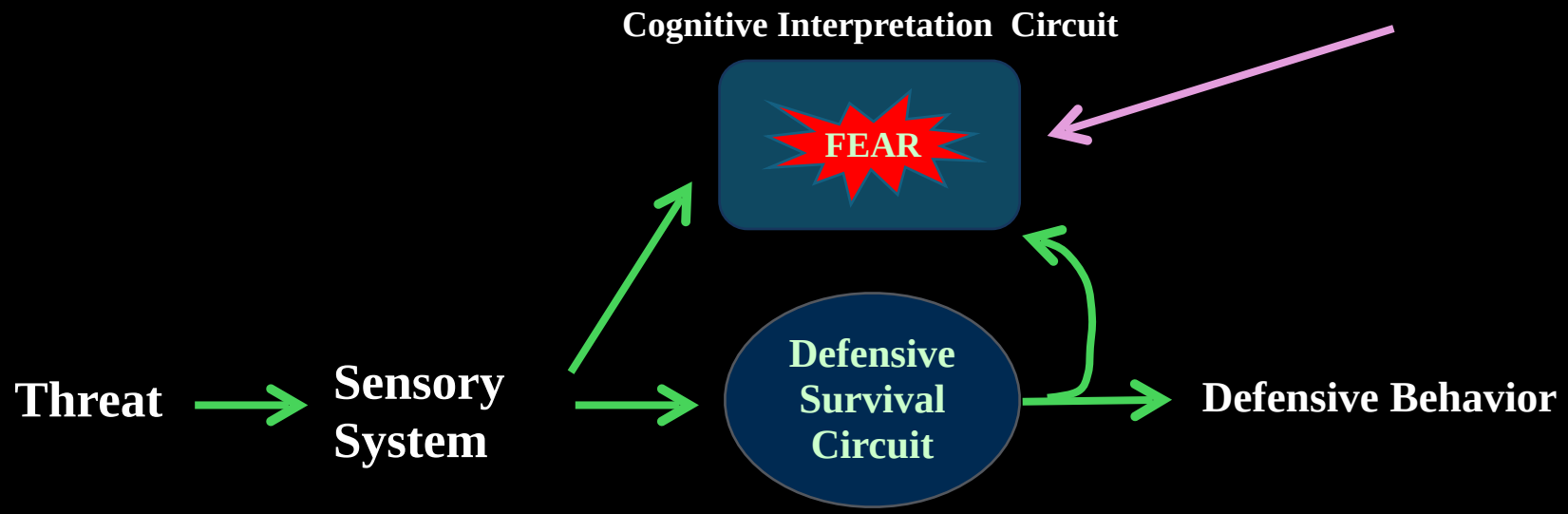

PFC Working Memory
Explicit Feaf
Memory
Threat
Sensory System
Amygdala
Implicit Fear
Defensive Behavior



Survival Circuits
modulate but do not
determine fearful feelings

Here they are inappropriate

But if people experience fear here, it's not surprising that the drugs are not more effective for mental problems



Behaviorist accounts work just fine here

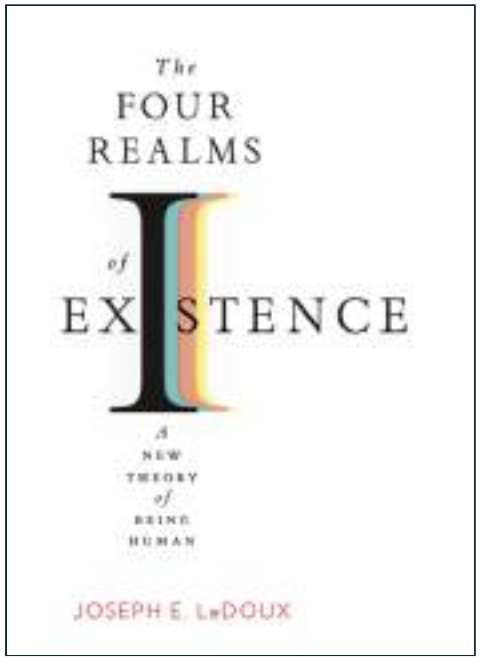
Drugs developed in animal studies are designed to work here to change behavior

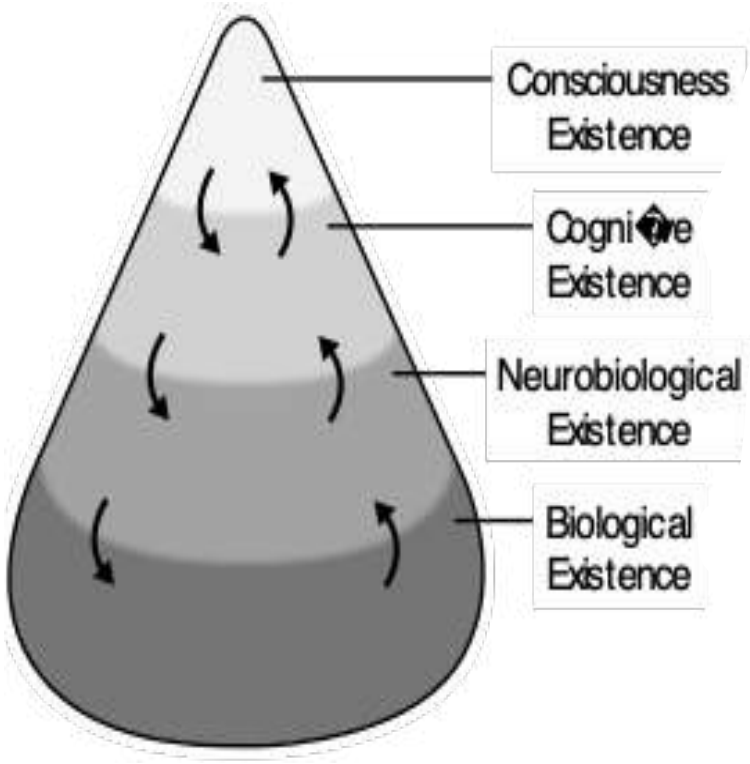
An emotion is a
cognitively assembled,
narrative-driven,
Personally acquired,
culturally shaped,
subjective experience,
in a biologically or
psychologically
significant situation

Part 7

CLOSING THE CIRCLE ON
MY 51 YEARS IN NEUROSCIENCE

IT ALL COMES BACK TO PS

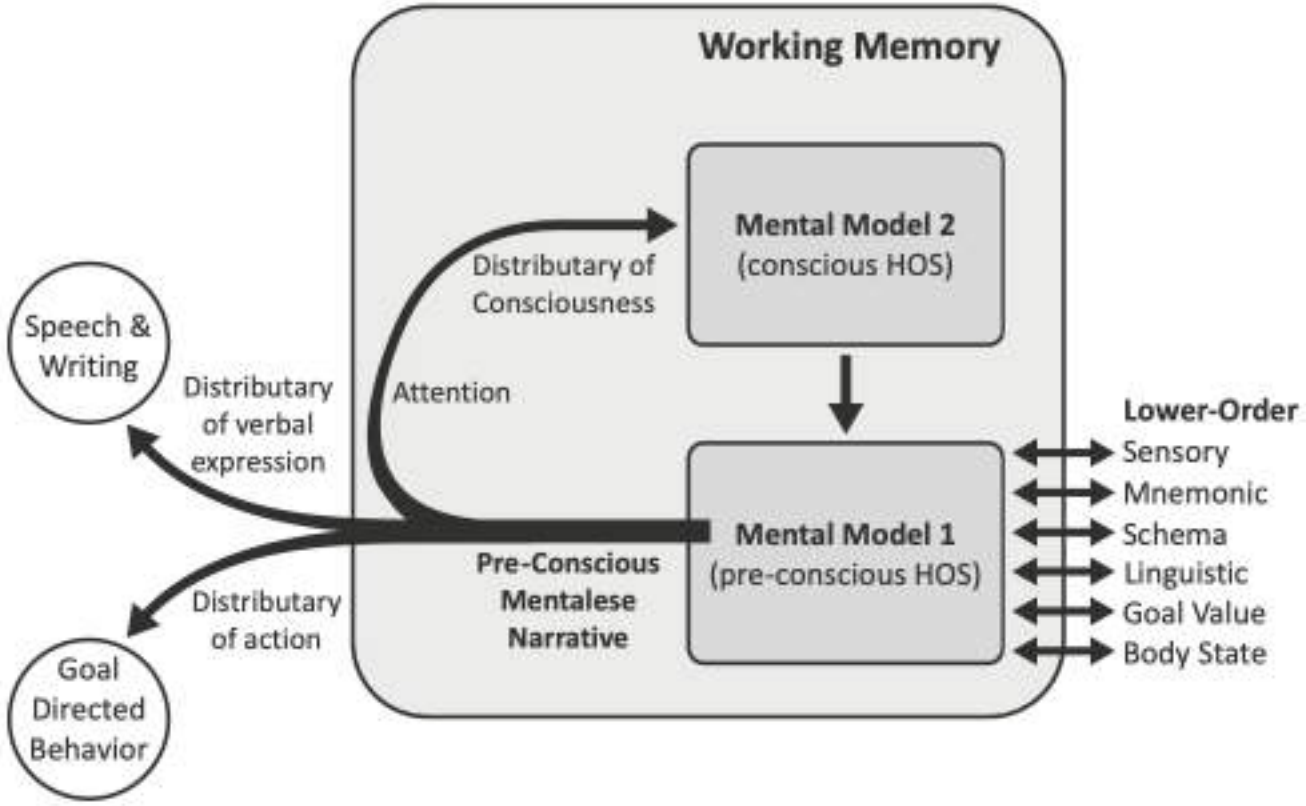


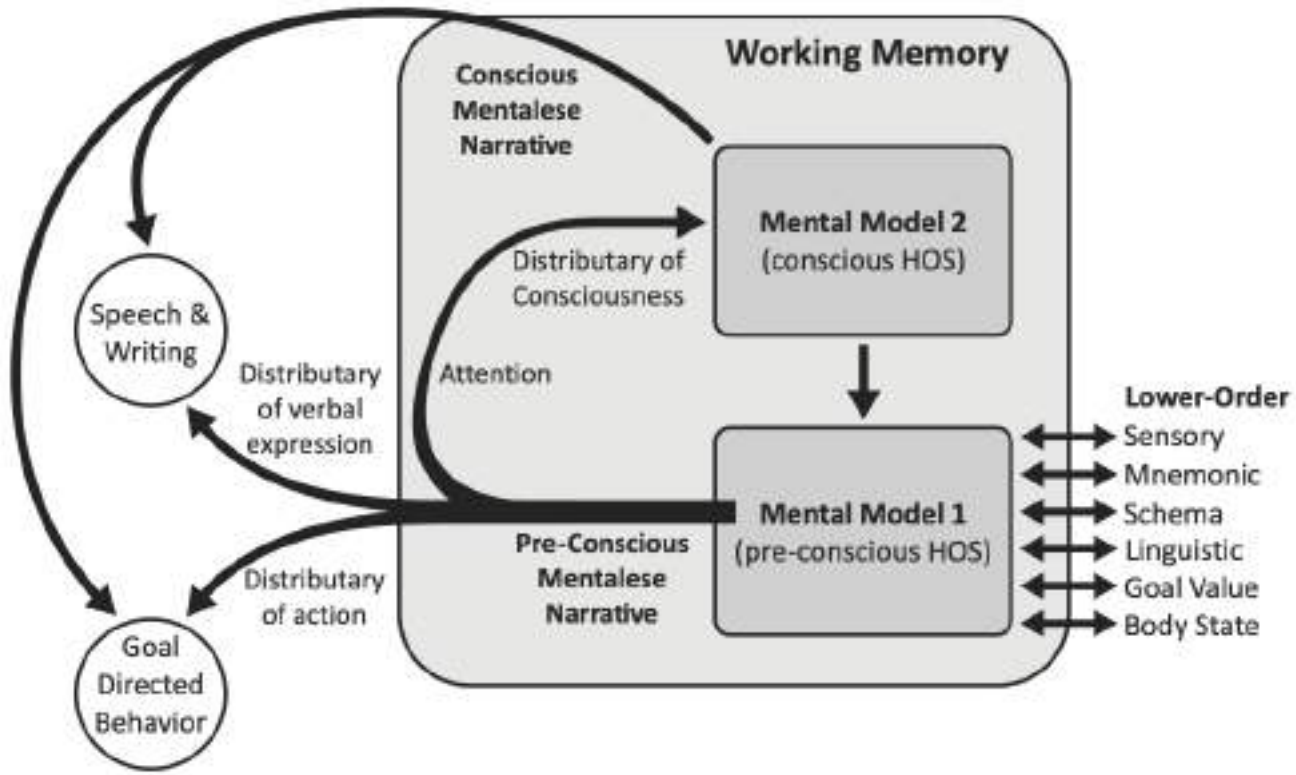


Everything about an individual human being, biologically and psychologically, is subsumed within the entwined, nested, hierarchical, organization of our realms of existence.

While writing the ending part of the book, I had an insight about what might have been going on in PS' brain. When we asked him why he did what he did, his momentary self awareness was colored with with dissonance (a feeling of wrongness) since he (his talking left hemisphere) did not generate the response. In a flash, a ***pre-conscious mental model*** emerged and spun a narrative that flowed to his speech-control processes, allowing an explanation to roll off his tongue non-volitionally. Simultaneously, the narrative spawned a ***conscious mental model*** that interpreted his speech act as an adequate explanation of why he did what he did, thereby reducing the unsettling feeling of dissonance and making him consciously feel coherent.

DUAL MENTAL MODELS (NON-CONSCIOUS AND CONSCIOUS)




Working Memory
Conscious Mentalese Narrative
Mental Model 2 (conscious HOS)
Distributary of Consciousness
Attention
Speech & Writing
Distributary of verbal expression
Mental Model 1 (pre-conscious HOS)
Pre-Conscious Mentalese Narrative
Distributary of action
Goal Directed Behavior
Lower-Order
Sensory
Mnemonic
Schema
Linguistic
Goal Value
Body State

IMPLICATIONS

1.The modality-free, abstract, a-modal nature of the narrative allows its conceptual content to be used by diverse downstream processors.

For example, it allows one to respond verbally through speech, writing, or sign language, or non-verbally through a wide variety of distinct goal-directed behavioral actions

2. Each output of the mental model is a distinct neural pathway that carries the mentalese narrative to its target circuit (speech, action, experience). As a result, each processes the narrative signal in its own way and the content reaching each target can vary somewhat.

For example, because verbal expression and overt action are different consequences of the pre-conscious mentalese narrative, what we say and what we do can be somewhat discordant.

This may also explain why verbal reports, though fairly reliable as measures of momentary conscious experiences, do not always perfectly reflect what one experiences—we can't always put into words everything we are conscious of, and why, when stimuli are degraded or otherwise difficult to process (such as when they occur in peripheral vision), incomplete reports can result.

3. If I am correct that non-conscious and conscious mental models can separately control of overt behavior and verbal expression, the effort to scientifically understand consciousness may be even more complicated than we thought, since it would mean that we would not know, in a given moment, which mental model is in charge of what is bein reported. But if we know the problem, we can search for a solution that makes it a feature of consciousness rather than an impediment.

HOW COULD WE POSSIBLY TELL THE DIFFERENCE?

Joan Ongchoco, graduate student at Yale suggested this:

One possibility is that the difference between verbal reports controlled by the two mental models lies not just in the superficial words (i.e., what people say), but in the relations between these words (i.e., how people move from one idea to another). This is a process known as "semantic progression." The more implicit, "spontaneously" constructed, verbal reports that arise from a pre-conscious state may involve more "jumping" from idea to idea, compared to more "intentionally" constructed reports arising from the conscious model. Semantic progression has been measured through existing natural language processing models (e.g., latent semantic analysis or unsupervised embedders) that compute the semantic similarity between words or sentences (e.g., words in the same paragraph should show greater semantic similarity than words across two different paragraphs). Indeed, these types of analyses have been used to explore the progression of ideas in narrative texts and in film, and might be leveraged to distinguish reports based on pre-conscious versus conscious states of mind.

That, my friends, closes the circle of my 51 years in neuroscience.

Young scientists, I leave you with three interrelated suggestions

- Explore the history behind your work.
- Put as much effort into what your data mean conceptually as you put into collecting and analyzing it.
- When drawing conclusions don’t automatically accept and apply standard interpretations.

Although the future is yours, the past can give you an edge

Collaborators on Emotion and Consciousness

Michael Gazzaniga
Richard Brown
Hakwan Lau
Matthais Michel
Stephan Hofmann
Daniel Pine
Nathaniel Daw
Vincent Taschereau-Dumouchel