

# Neuroscience of Hypnosis

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**CLINICAL WORKSHOP**  
**LEVEL 1**

**January 31, February 1, February  
28, and March 1, 2026**



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Linda Thomson is a Nurse Practitioner and Approved Consultant in Clinical Hypnosis, a Diplomate of both the American Board of Medical Hypnosis and the American Board of Hypnosis in Nursing and a Fellow of ASCH. Linda is a past president of ASCH and was awarded ASCH's Lifetime Achievement Award.

She has lectured and taught workshops across the country and around the world. She is passionate about teaching health care professionals how to incorporate hypnosis and hypnotic language into their practices.

# Continuing Education & Accreditation Statement

- This program has been approved by the American Society of Clinical Hypnosis Standards of Training Committee to be used toward Membership and Certification requirements.
- The American Society of Clinical Hypnosis-Education and Research Foundation (ASCH-ERF) is accredited by the Accreditation Council for Continuing Medical Education to provide continuing medical education for physicians.
- ASCH-ERF designates this enduring material for a maximum 22 CE of AMA PRA Category 1 Credit(s)<sup>™</sup>. Physicians should claim only the credit commensurate with the extent of their participation in the activity.
- This session is approved by the American Society of Clinical Hypnosis and as such is an approved continuing education course.

# Disclosures (Yes Financial, Yes AI)

- ASCH and ASCH-ERF jointly provided this program.
- No staff or committee members involved in the development, planning or execution of educational content have any financial relationships or conflicts of interest to disclose.
- Dr. Thomson has had a significant financial relationships or conflict of interest from the past 24 months to disclose.
  - *For an in-depth definition of what constitutes a financial relationship, please visit the ACCME at <https://accme.org/rule/identify-mitigate-and-disclose-relevant-financial-relationships/>*
- Financial Relationships listed below:
  - Company Name, Nature of relationship, current status of relationship
- All relevant financial relationships have been mitigated.
- Dr. Thomson has used AI in the development of this program/materials.
- Description of How AI was used:

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# Learning Objectives

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At the conclusion of this session the participant will be able to:

- Describe how hypnosis affects the autonomic nervous system and the stress-response.
- Detail three implications of neurophysiological research on the practice of clinical hypnosis.
- Explain two differences and two similarities between hypnosis and meditation in a manner understandable by patient/clients.

# Mind - Body Connection

- Every change in the physiological state is accompanied by an appropriate change in the mental-emotional state, conscious or unconscious, and conversely, every change in the mental-emotional state is accompanied by an appropriate change in the physiological state

Green, Green & Walters

# How Stress Affects Body Systems

# FIGHT OR FLIGHT

Walter Cannon

# FRIGHT & FREEZE

Bruce Perry

# POLYVAGAL THEORY

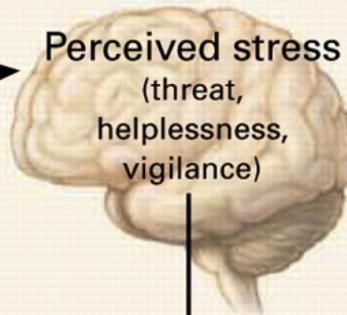
Stephen Porges

Environmental stressors  
(work, home, neighborhood)

Major life events

Trauma, abuse

Individual differences  
(genes, development, experience)



Behavioral responses  
(fight or flight;  
personal behavior — diet,  
smoking, drinking, exercise)

Physiologic responses

Allostasis

Adaptation

Allostatic load

# Hans Selye

(1907 - 1982)

- 1st to demonstrate the existence of biological stress
- 2 components of physiologic stress
  - general adaptation syndrome
  - development of pathological state from ongoing, unrelieved stress

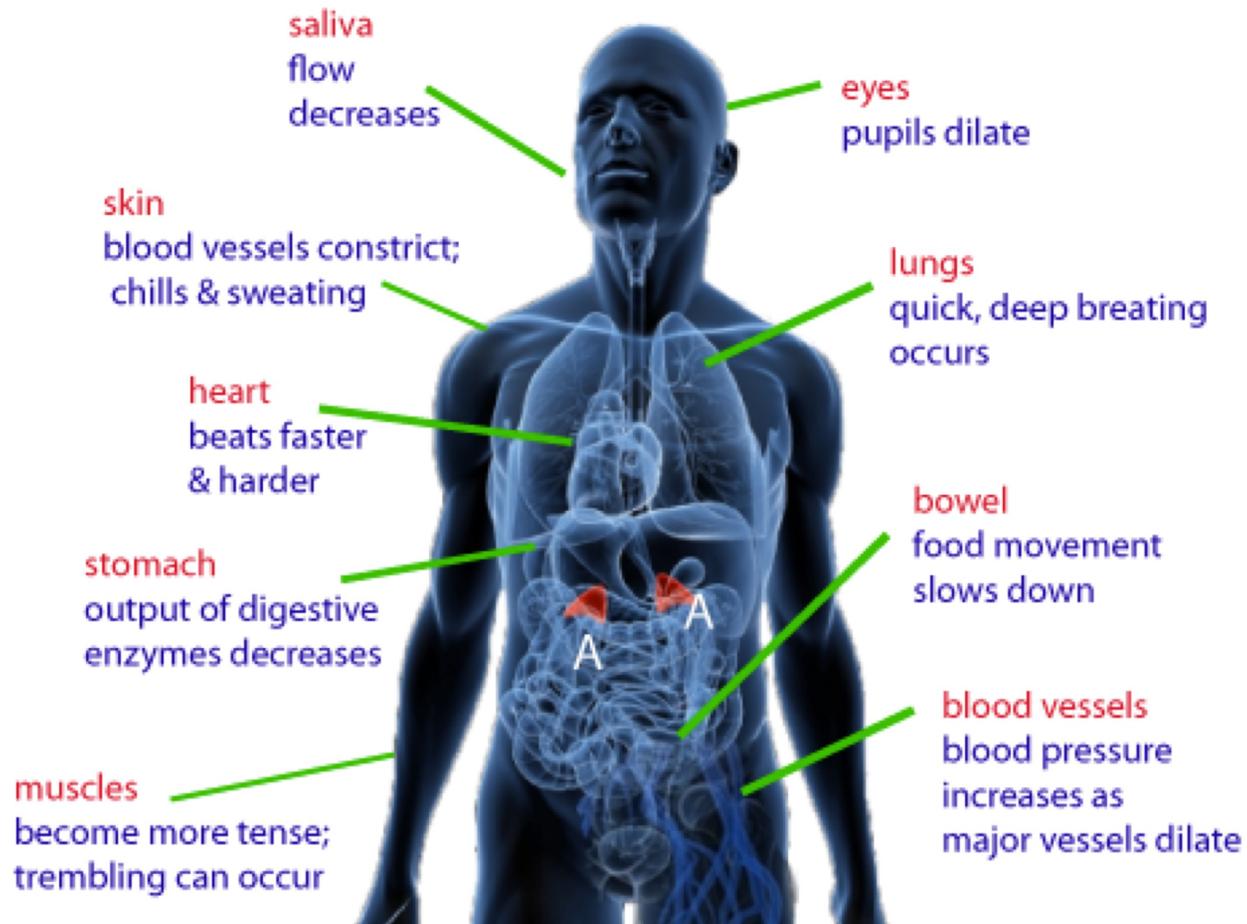
## Life-saving response to deal with saber-tooth tiger

- Heart Rate and BP rise to increase blood flow to the brain to improve decision making
- Blood sugar rises to furnish more fuel for energy as the result of breakdown of glycogen, fat and protein stores

## Life-saving response to deal with saber-tooth tiger

- Blood is shunted away from gut, where it is not immediately needed for the purpose of digestion, to the large muscles of the arms and legs to provide more strength in combat, or greater speed in getting away from a scene of potential peril
- Clotting occurs more quickly to prevent blood loss from lacerations or internal hemorrhage

## Fight or Flight Response



# Short term stress

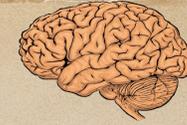
- Designed to counter a threat
- Second phase - PNS kicks in diffusing stress chemicals
- Helps person feel as though they controlled or conquered a situation

Brain is the first target for stress -  
regulates biological response to stress



# The Brain

## Limbic System



- Thalamus
  - Gathers information from internal and external environment
  - Sends information to the amygdala (fast) and somatosensory cortex (slow)
  - If the thalamus is activated the amygdala is also activated
- Hippocampus
  - Makes and stores declarative and explicit memories



# The Brain

## Amygdala



- Center of the fear process
  - “encodes” dangerous events
  - Labels experiences as significant
  - stores in lateral nucleus periaqueductal gray region
- Mediates conversion of emotion into physiology
- Plays a pivotal role in onset of anxiety
- Co-ordinates survival responses



# Amygdala



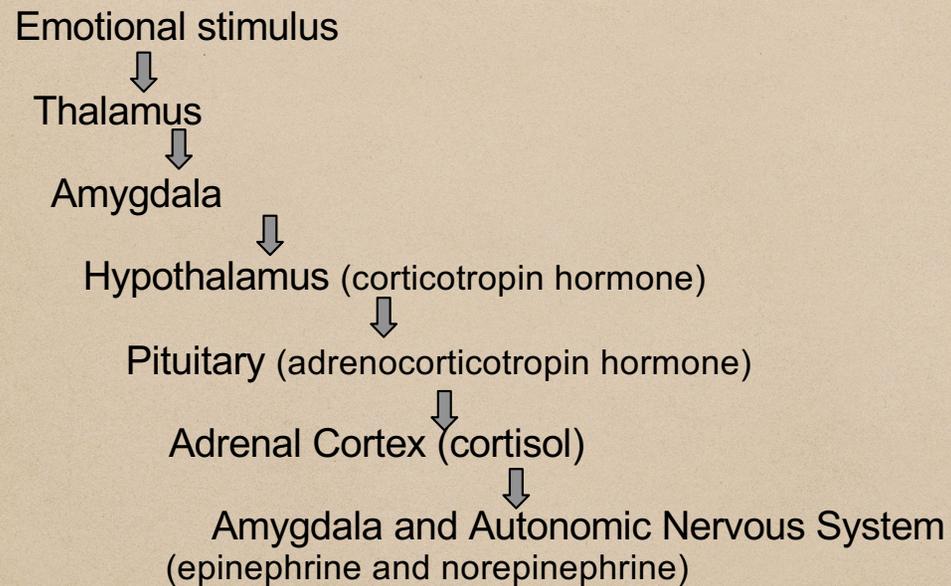
- Increased activation with fear, anxiety, and anger
- Initiates fight or flight response
- Doesn't distinguish between what is real and what is imagined - just sounds the alarm
  - links perception to emotion
- Linked to different structures in the brain
  - Fast pathways to cortex, slow return from cortex to amygdala

## When threat occurs, amygdala signals

- Prefrontal cortex ↑ Fear
- Parabrachial Nucleus - ↑ respiratory rate, ↑ shortness of breath, tightness or sense of smothering
- Locus Ceruleus - tremors, sweating, ↑ BP, ↑ heart rate
- Hypothalamus - pituitary - adrenals - ↑ cortisol

# Stress Pathways

(The Emotional Brain; Le Doux)



# Limbic System

- Amygdala can not distinguish between what is real and what is imagined
- Amygdala cannot tell time
- Limbic brain cannot reason in words

## Limbic System and Hypnosis

- Limbic system is imprinted with early life experiences of trauma
- Hypnosis allows us to intervene in those stress imprints
- If in hypnosis you can turn off central nucleus of amygdala, you can turn off fear

# Persistently elevated levels of cortisol

- Damage the amygdala making it difficult to turn off the flight - fight response
- Increases risk of somatic illness

# Chronic Stress

- Increases levels of stress hormones and pro inflammatory cells
- cytokines adversely affect mood and behavior
- Suppresses immune system
- Primes body to react to even minor sources of stress more strongly

# Years of Chronic Activation of Stress Response may result in

- Impaired Memory
- Weakened Immune system
- Increased BP
- Stomach ulcers
- Digestive Difficulties
- Skin Problems
- Stroke
- Sleep Disorders
- Depression
- Heart Disease

## Psychological Stress at the Cellular Level

- Increases cellular aging and decreases longevity
  - Higher oxidative needs
  - Decreases telomerase activity
  - Shorter telomere length
- Aged cells can no longer divide

# Stress' Higher Order

- “During the acute stress response brain regions do not fire in isolation, but are organized into functional networks of dynamically interacting regions, which underscores the need for a systems level neuroscience approach to stress.”

Oort, J.V. et al (2017). How the brain connects in response to acute stress:  
A review at the human brain systems level.  
Neuroscience and Biobehavioral Reviews 83: 281-297.

Hypnosis can change our biology

# Epigenetics

- epi (around) genetics (genes)
- The study of modifications to our genetic material that change the way genes are switched on or off, but which don't alter the underlying genes themselves
- The receptors on cell membranes interpret signals from environment and change the read-out of genes

Rossi's Psychobiology of Gene  
Expression  
ENCODE Project

- 21,000 genes - DNA molecule
- nearly 78% DNA molecule on/off switches & rheostats for 21,000 genes
- Switches up-regulate or down-regulate genes making inflammatory molecules and genes that turn stem cells into new brain cells

# Epigenetics

- Epigenetics looks at results of changes in the switch settings and how the switches change
- We inherit the sequence of our DNA, what changes is the pattern of DNA switches and the proteins the genes can make
- We can change our switches with
  - Biology of Hope or
  - Biology of Stress

## Ways that the Biology of Hope can change the DNA switches

- Novelty/ fascination
- Physical & Mental Exercise
- Numinous, enriching experiences
  - music, art, nature, prayer
- HYPNOSIS (Ernest Rossi)
  - 15 genes turn on within 1 hour of hypnosis

# Sense of Safety

- Only mammals can alter their ANS activity in response to safety
  - Prosodic Voice
  - Warm, emotionally expressive faces

# Sense of Safety

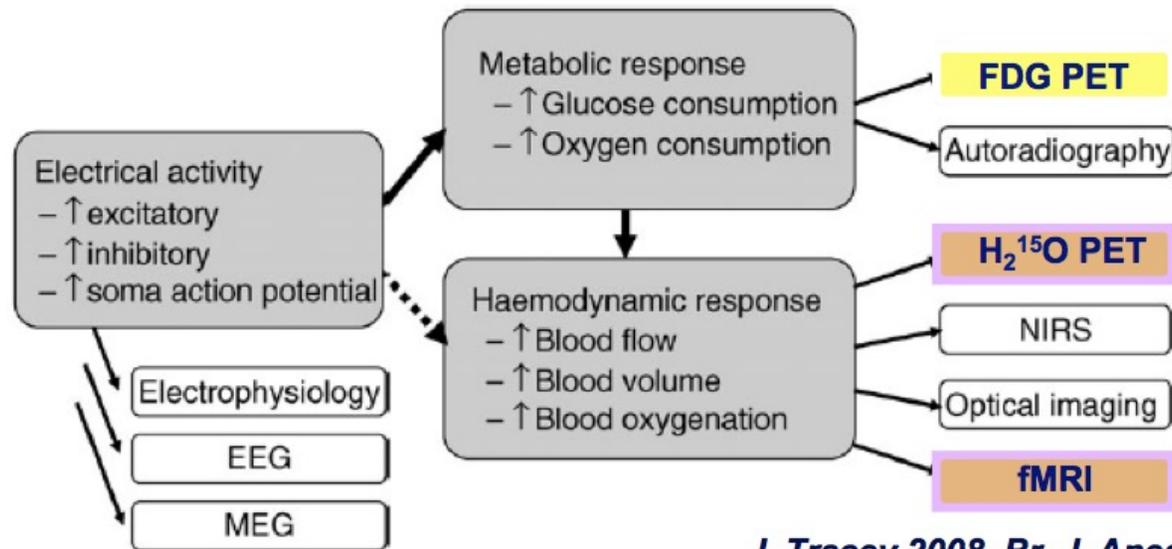
- The experience/felt sense/implicit memory of safety “retunes” the ANS to a state that promotes growth (not just a cognitive appreciation of growth)
- Increasing Heart Rate Variability contributes to this retuning

## Hypnosis has an unique signature in the brain

- Absorption increases
- Dissociation increases
- Critical thinking decreases
- External thoughts decrease
- Increase functional connectivity

Hypnosis is a modified state of  
consciousness which can now be  
measured

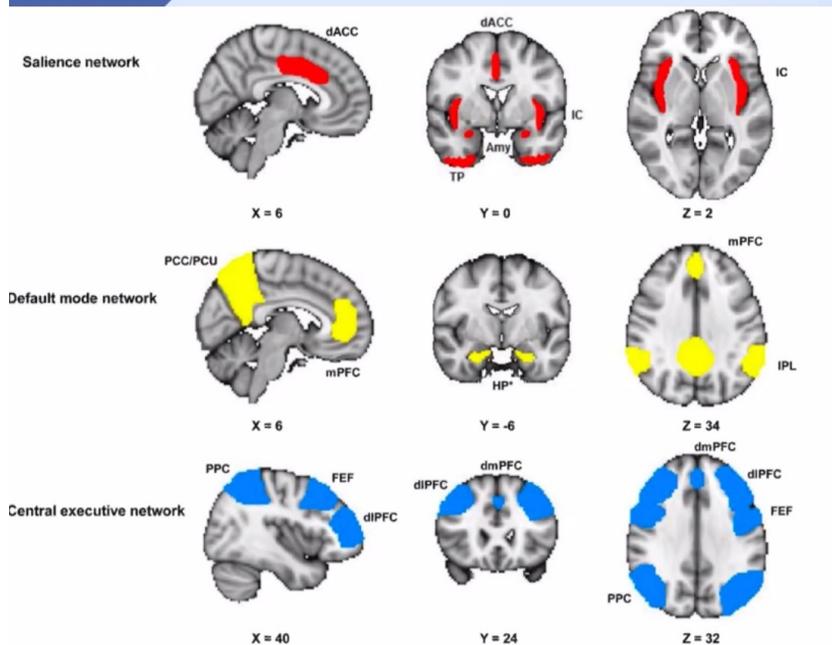
Ulrike Halsband



*I. Tracey 2008, Br. J. Anesth*

Functional neuroimaging and functional connectivity studies offer new opportunities to use hypnosis as probes into brain mechanisms and provide a mean of studying hypnosis itself.

# Brain Networks



## SALIENCE (SN)

> attention to internal and external information

- anterior Insula (IC)
- dorsal Anterior Cingulate Cortex. (ACC)
- Amygdala (Amy)
- Temporal poles (TP)

## DEFAULT MODE (DMN):

> ant: self referential and emotional processing

> post: consciousness and memory processing

- medial Prefrontal Cortex (PFC)
- Posterior Cingulate Cortex. (PCC)
- Precuneus & Hippocampus (Hip)
- inferior Parietal Lobes (IPL)

## CENTRAL EXECUTIVE (CEN)

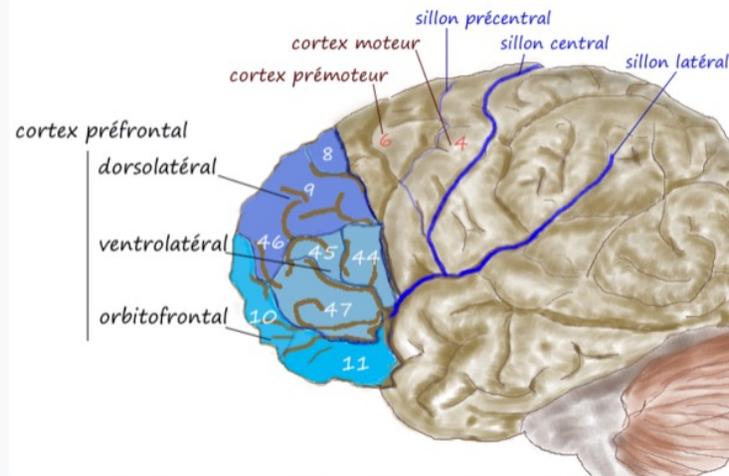
> Higher order cognitive functions =

> Goal directed behavior

- dorsal-lateral & medial Prefrontal Cortex (PFC)
- Posterior Parietal Cortex. (PPC)
- frontal eye fields (FEF)

Oort, J.V. et al (2017). Neurosc. Biobeh. Rev. 83: 281-297.

## Dorsolateral Prefrontal Cortex

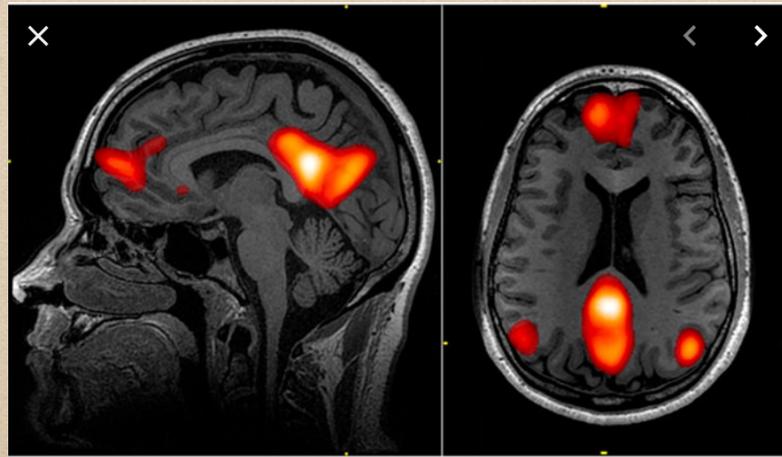


An illustration of brain's prefrontal region

## Executive Control Network

The dorsolateral prefrontal cortex is a part of the brain located on the frontal lobes in each of the brain's hemispheres.

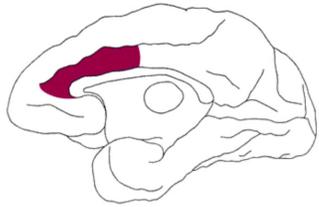
# Default Mode Network



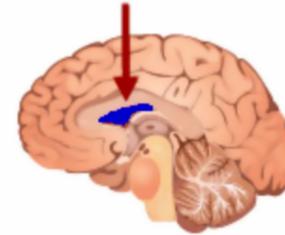
Active when the brain is at rest, not focused  
on the external environment

# Saliience Network

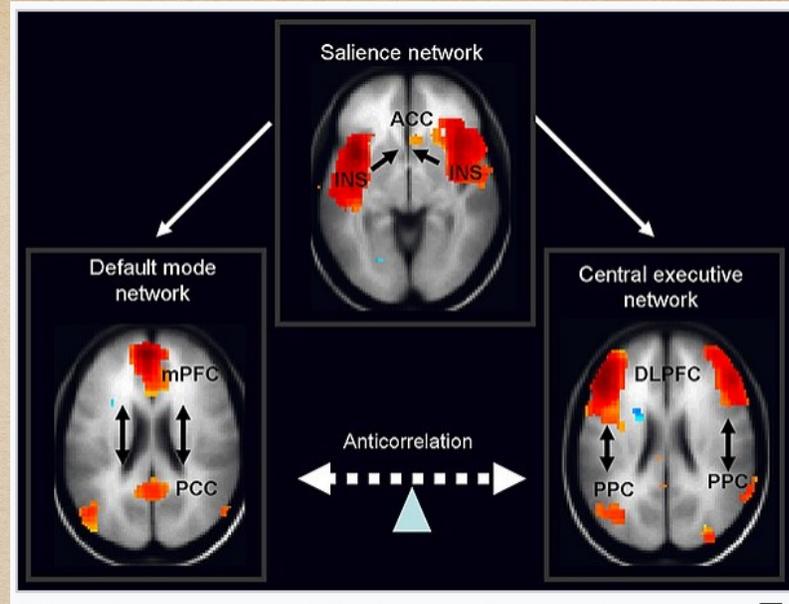
Anterior Cingulate Cortex



Insula



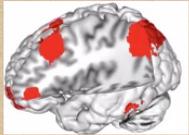
- Selects what stimuli deserve our attention and what we need to worry about
- Coordinates the brain's neural resources in response to these stimuli.



# Saliency Network

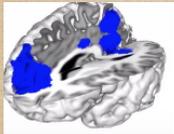
mediates between  
the DMN and the executive control network

# Three Key Brain Networks



- Executive Network

- cognitive processes and higher order executive functions that are necessary for the cognitive control of behavior



- Default Mode Network

- active when the brain is at rest

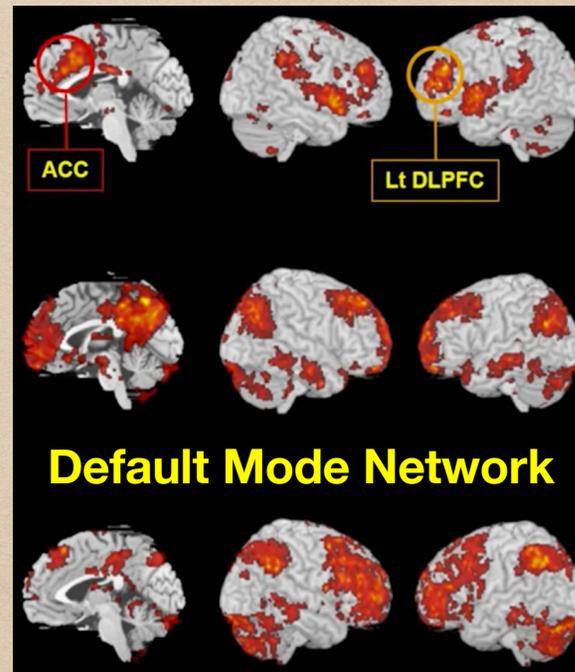


- Salience Network

- detects and filters salient stimuli; worry network
- mediates switching between the default mode network and central executive network.

The hypnotic state is associated with alterations in specific neurophysiological parameters of consciousness

### Saliency Network



### Default Mode Network

### Executive Control Network

Hallmarks of the  
Brain  
under Hypnosis

“Brain Activity and Functional  
Connectivity Associated with  
Hypnosis” by Heidi Jiang, Matthew  
P. White, Michael D. Greicius, Lynn  
C. Waelde, and David Spiegel in  
Cerebral Cortex, Volume 27, Issue 8,  
1 August 2017

# Hallmarks of the Brain under Hypnosis

- Scanned (fMRI) brains of 57 people (36 Highs and 21 Lows) under four different conditions —while resting, while recalling a memory and during two different hypnosis sessions.
- Distinct sections of the brain have altered activity and connectivity while someone is hypnotized
- Discovered three (3) hallmarks of the brain under hypnosis.

# Hallmarks of Brain in Hypnosis

- Decreased activity in dorsal anterior cingulate, part of the salience network
  - The salience network is responsible for switching between the default mode network and the central executive network
- Increase in connectivity between DLPFC and the insula, the brain-body connection
- Reduced connectivity between DLPFC and the default mode network, a disconnect or disassociation of actions from awareness of the actions

# Elicitation / Induction

- Enhanced mental absorption
  - Disengages default mode network
- Reduced introspection and generation of internal thoughts
  - Engages the dorsal attention network which includes the DLPFC

# What happens when DMN goes quiet or is disengaged?

- Ego-dissolution
  - permits a reconnection with others, nature, past self
- Defenses go down, freeing us from the destructive stories we tell ourselves
  - unworthy of love
  - need a drink to get through the day
- Break out of loop of recrimination and rumination

## What happens when DMN goes quiet or disengaged

- New connections can form which never existed before
- Brain is temporarily rewired which can have lasting effects

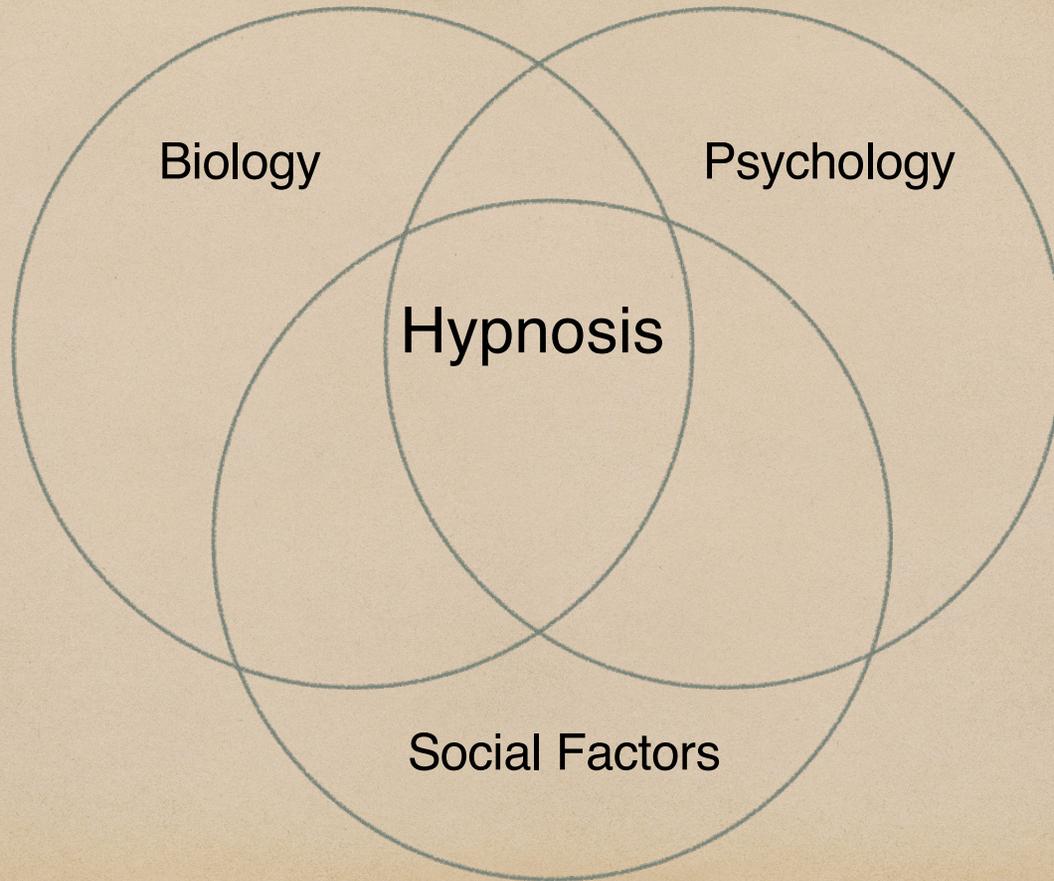
# Suggestions

- Suggestions produce highly specific changes in brain function by targeting corresponding brain processes
  - Perceptual suggestions change sensory and perceptual brain networks
  - Cognitive suggestions change brain networks related to cognitive processes
  - Ideomotor suggestions change brain networks involved in the planning, production, and monitoring of action

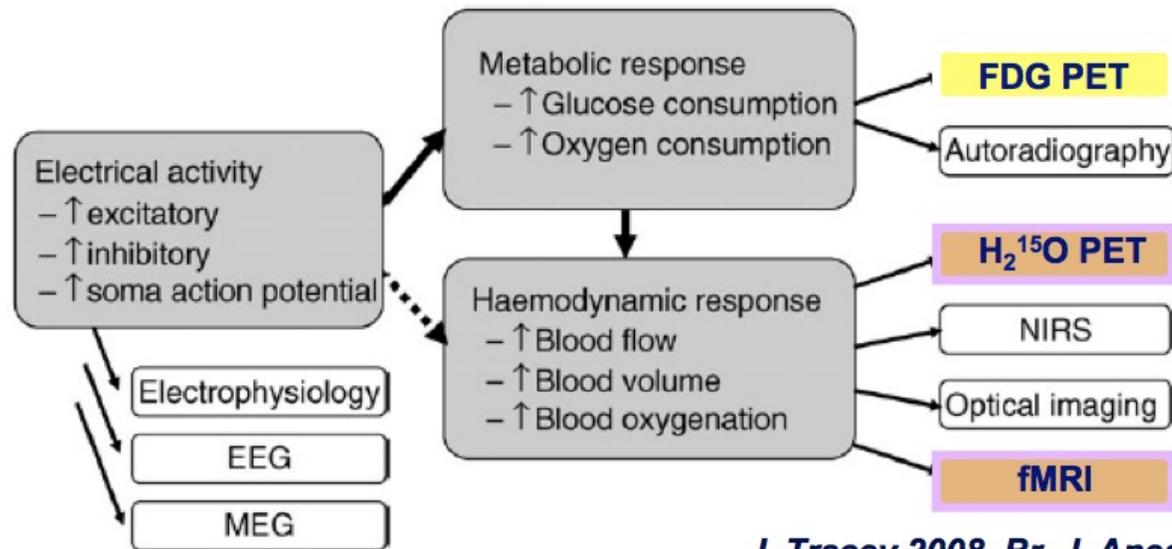
# Biopsychosocial model of hypnosis

- Hypothesizes the roles for and interactions of biological, psychological and social factors

# BIOPSYCHOSOCIAL MODEL



Biological factors



*I. Tracey 2008, Br. J. Anesth*

Functional neuroimaging and functional connectivity studies offer new opportunities to use hypnosis as probes into brain mechanisms and provide a means of studying hypnosis itself.

## Two of the brain areas affected by hypnosis

- Frontal cortices
  - integral part of the executive function network involved in planning, goal setting, selective attention and modulation (mostly inhibition) of other brain functions
- Mid cingulate and anterior cingulate cortices
  - areas of the limbic system involved in reward anticipation, error detection, attention, motivation, emotion and many other areas of human experience and behavior

Activity in those brain areas can be increased or decreased depending on the hypnotic suggestions given

# Hypnosis and Suggestion

- Changes in brain function have been demonstrated to be greater during hypnosis than when the same images or suggestions are given outside of hypnosis
- Increased brain response to analgesic hypnotic suggestion despite no subjective difference to nonhypnotic suggestion

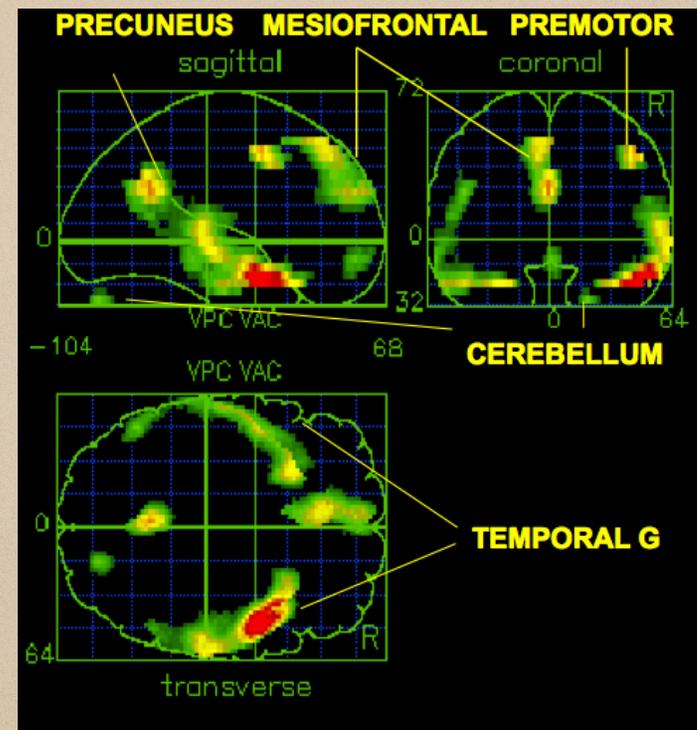
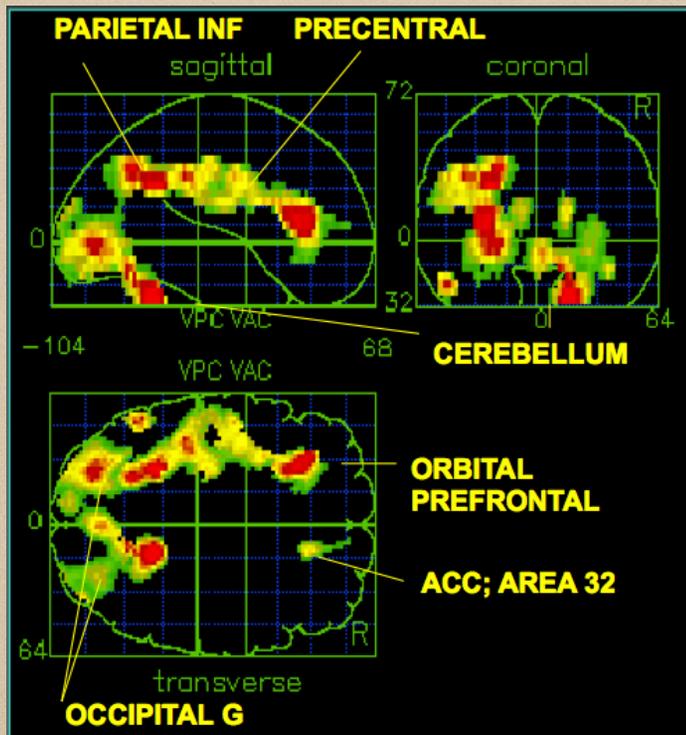
Crawford, et al (1993) Effects of hypnosis on regional blood flow during ischemic pain with and without suggested hypnotic analgesia. Internat J of Psychophys

Derbyshire, et al (2009) Fibromyalgia pain and its modulation by hypnotic and non-hypnotic suggestion. European J of Pain

# Distribution of regional cerebral blood flow during hypnosis compared with autobiographical Mental Imagery

Pierre Maquet, MD, PhD Steven Laureys, MD, PhD Mélanie Boly, MD, PhD Audrey Vanhaudenhuyse,  
PhD Athena Demertzi, PhD

# Hypnosis > Mental Imagery



(Biol. Psychiatry 1999; 45(3): 327-333)

$P < 0.05$  corrigé pour analyses multiples ( $Z > 3.09$ )

## Cerebral activation during hypnotically induced and imagined pain

S.W. Derbyshire et al, Neuroimage 2004,23:392-401

First direct experimental evidence in humans linking specific neural activity with the immediate generation of a pain experience

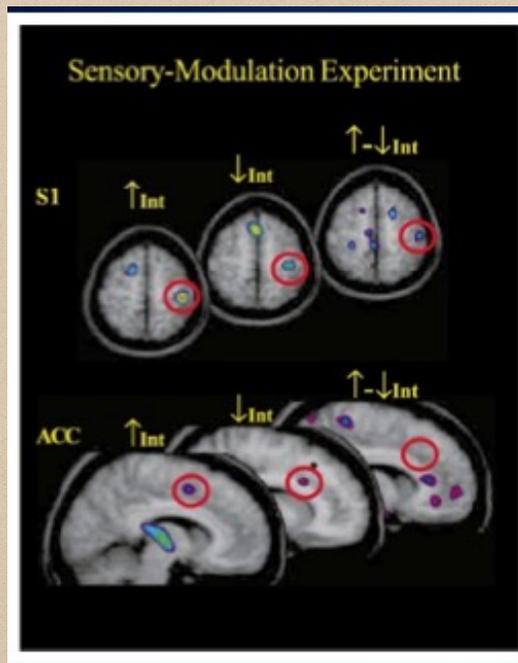
Identified brain areas directly involved in the generation of pain by using hypnotic suggestion to create an experience of pain in the absence of any noxious stimuli

# The Effect of Hypnotic Language on Brain Pathways Involved in Pain

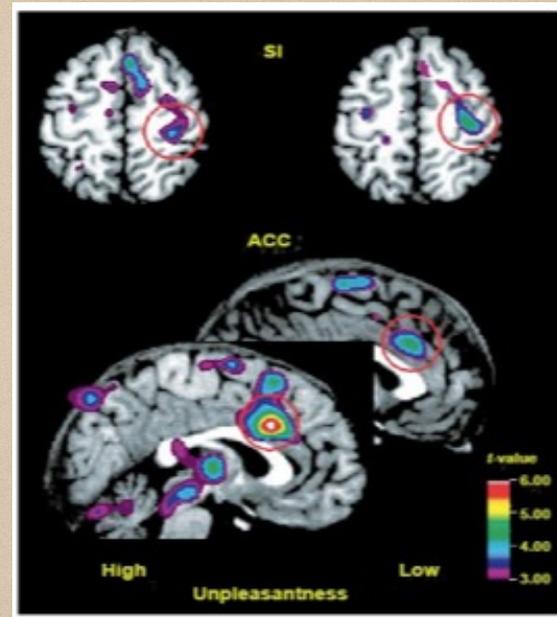
“A preponderance of evidence indicates that hypnotic analgesia can significantly and substantially reduce pain associated with both acute and chronic pain conditions.”

“One of the most important findings from this research is that the neurophysiological effects of hypnosis depends on the specific suggestions used.”

# Hypnotic Suggestions can target specific brain areas

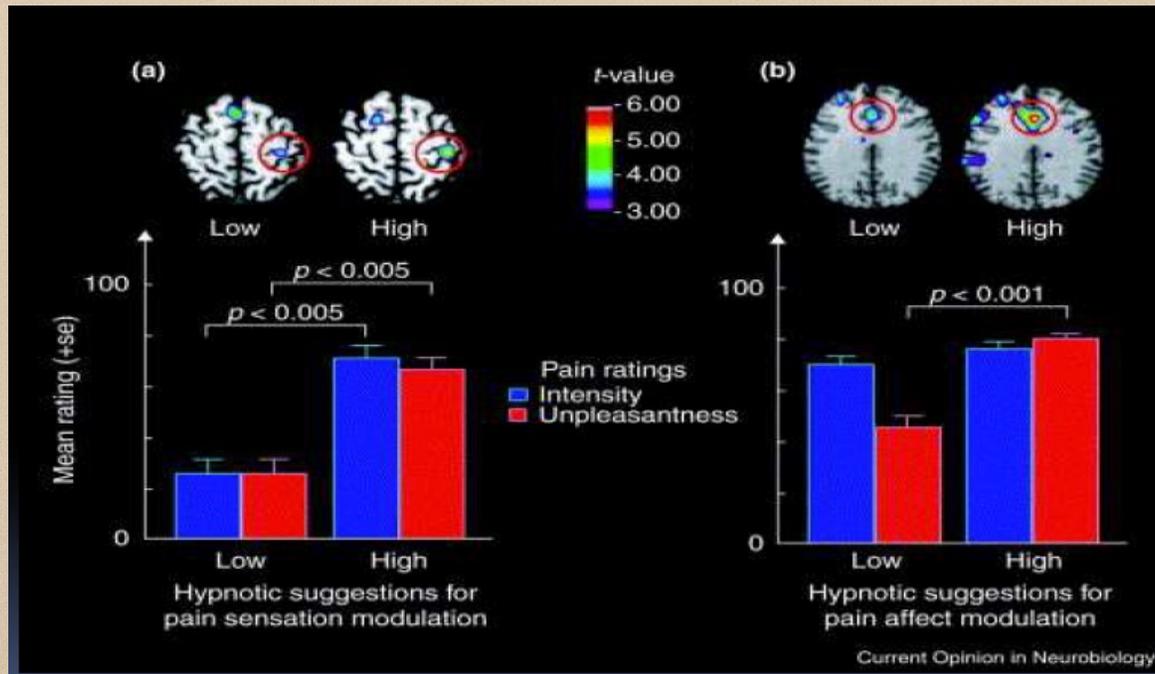


Hofbauer et al., 2001



Rainville et al., 1999

# Hypnosis and Suggestion High & Low Hypnotizables



Effects of hypnotic suggestions to modulate pain sensations vs. unpleasantness on pain related rCBF in normal subjects.

Rainville, et al. (1997) & Hofbauer et al. (2001)



Right Hemisphere

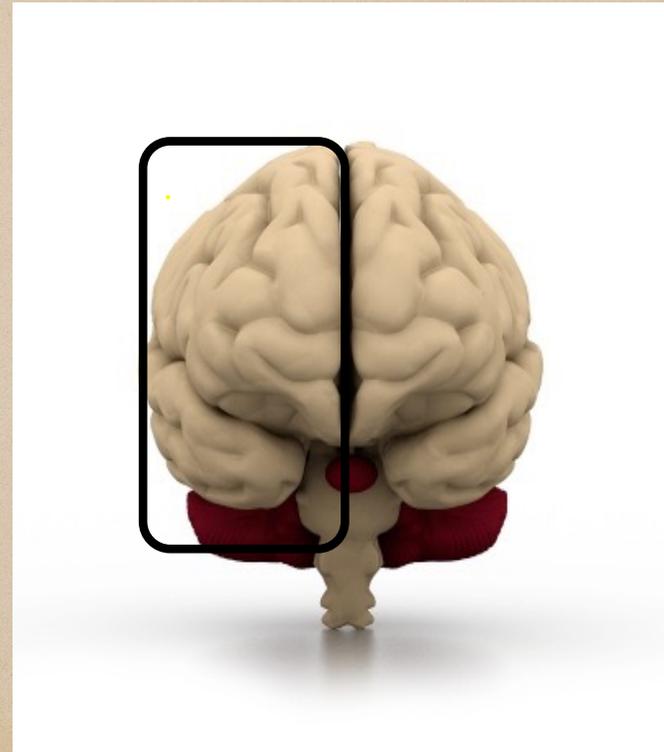
???????





# Right Hemisphere ??????

- Hypnosis associated with:
  - Creativity
  - Intuition
  - Non-analytic processing
  - (metaphors, stories, imagery)



# BUT.....

- Right vs. left lesions (strokes) no difference in hypnotizability (Kihlstrom et al., 2013)
- Hemisphere shifts sometimes (but not always) found, direction often right > left, but not always (Crawford et al., 1992, 1998; De Pascalis, 1999; Oakley & Halligan, 2010; Ray, 1997)
- And highs show more changes in asymmetry than lows; greater flexibility (Crawford, 1994)

So.....

- A model of hypnosis as (always) involving right hemisphere activity more than left not supported
- A model of greater neurophysiological flexibility (greater response in areas involved in the suggested activity) remains viable

Hypnosis is associated with hemispheric  
asymmetry

For Imagination and for Reason  
you need both hemispheres



Hypnosis associated with both increases & decreases in functional connectivity between brain areas

- Differs as a function of
  - general hypnotizability
  - content of the hypnotic suggestions
- High hypnotizable's show greater structural connectivity

# EEG

- EEG SIGNALS ARE DIVIDED INTO SPECIFIC FREQUENCY BANDWITHS
- EACH BANDWITH IS ASSOCIATED WITH A DIFFERENT STATE

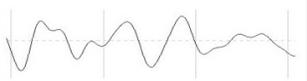
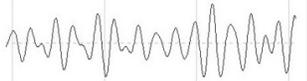
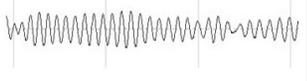
# Bandwith and state

Delta - Sleep

Theta - Drowsy/Focused

Alpha - Relaxed

Beta - Engaged

Frequency Band Name	Frequency Bandwidth	State Associated with Bandwidth	Example of Filtered Bandwidth
Raw EEG	0-45 Hz	Awake	
Delta	0.5-3.5 Hz	Deep Sleep	
Theta	4-7.5 Hz	Drowsy	
Alpha	8-12 Hz	Relaxed	
Beta	13-35 Hz	Engaged	

# Brain States: Theta

“Perhaps the most consistent finding is that theta power is ... strongly and positively related to hypnotic susceptibility”

(Crawford & Gruzelier, 1992)

“...the hypnosis condition itself is associated with the production of theta”

(Crawford & Gruzelier, 1992)

High hypnotizables spend more time in theta - important for memory and attention

# Brain States: Alpha and Beta

Alpha: Less consistency, but when effects are found, alpha tends to increase with hypnosis

(Oakley & Halligan, 2010).

Beta: Even less consistency, but some evidence for left hemisphere decreases with hypnosis

(Oakley & Halligan, 2010).

# What does theta do?

Important to learning and memory  
So that ... when theta is present:

- Easier to recreate experience
- The record and play functions work better

Buzsáki, G. (2006). *Rhythms of the brain*. Oxford ; New York: Oxford University Press.

Bastiaansen, M., & Hagoort, P. (2003). Event-induced theta responses as a window on the dynamics of memory. *Cortex*, 39(4-5), 967-992.

# Theta hypothesis

Theta facilitates access to neuronal networks

When theta is present, *stronger* connections happen  
*faster*

→ *Theta facilitates change*

# Theta

Theta waves are necessary to put something into memory and retrieve something from memory

## Hypnosis

Increase in  
theta  
2 waves

Deep  
reflection  
&  
introspection

## Meditation

Increase in alpha  
waves

Brain receptive to  
receive information  
from the universe

## Hypnosis

Rapport

Input: determined  
by suggestion

Concentration: increases

Memory: increases

Time: distortion,  
pro/regression

Stress: reduction

## Meditation

Independent

Focus deliberately on  
meta-attention, let  
everything pass by

Concentration: increases

Memory: inactive,  
focus on present

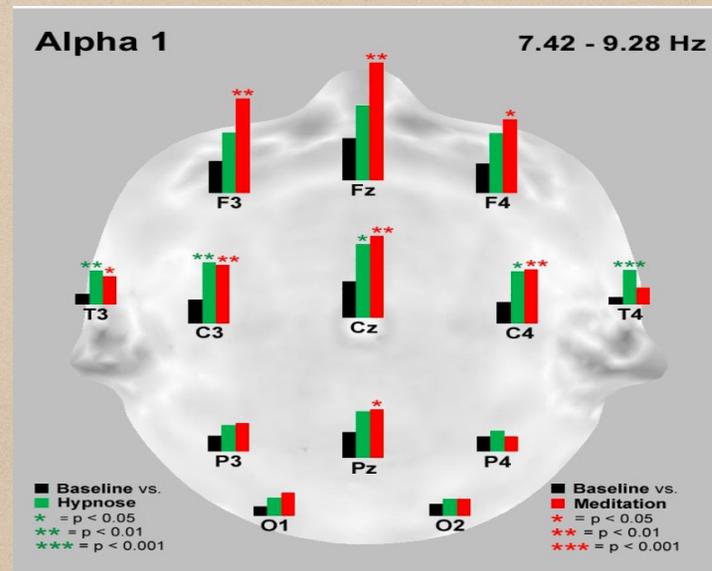
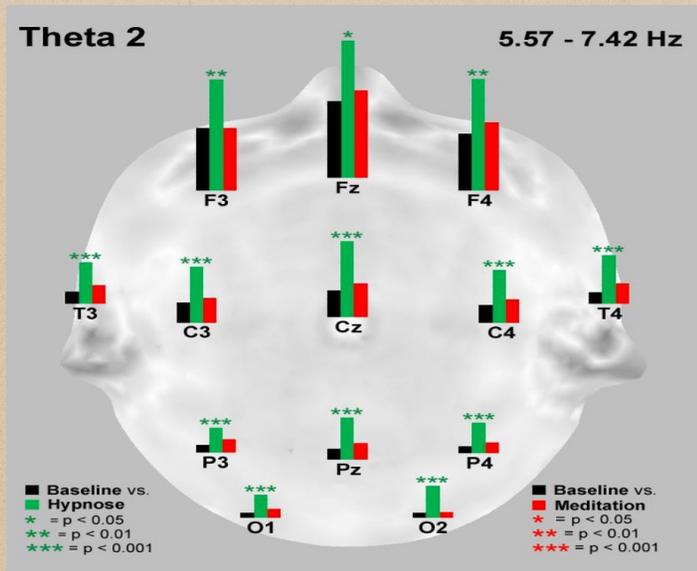
Time: focus on here  
and now

Stress: reduction

## EEG Results: Hypnosis vs Meditation

- Alpha Power 1
  - Hypnosis: increase most pronounced in central and temporal locations
  - Meditation: increase most pronounced in the frontal cortex
- Theta 2 band
  - significantly greater activity was observed only under hypnosis, in both hemispheres
- Conclusion: Brain plasticity changes in hypnosis can be differentiated from neurophysiological changes in meditation

# Hypnosis vs Meditation



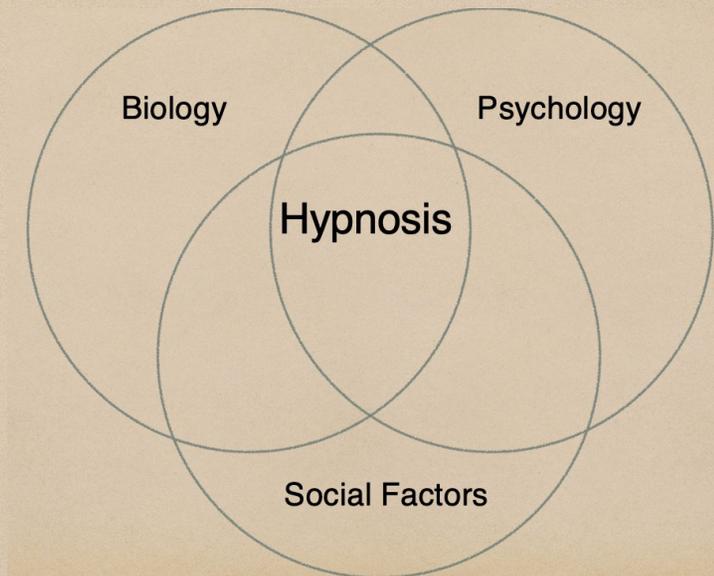
# Mindfulness

- Internal locus of control
- Acknowledges challenges that arise
- Apply attention to challenges without judgement in the present moment
- Enhanced awareness of automatic reactions to internal and external cues
- Enhances stress resilience

Psychological Correlates of  
Hypnosis

# Psychological Factors

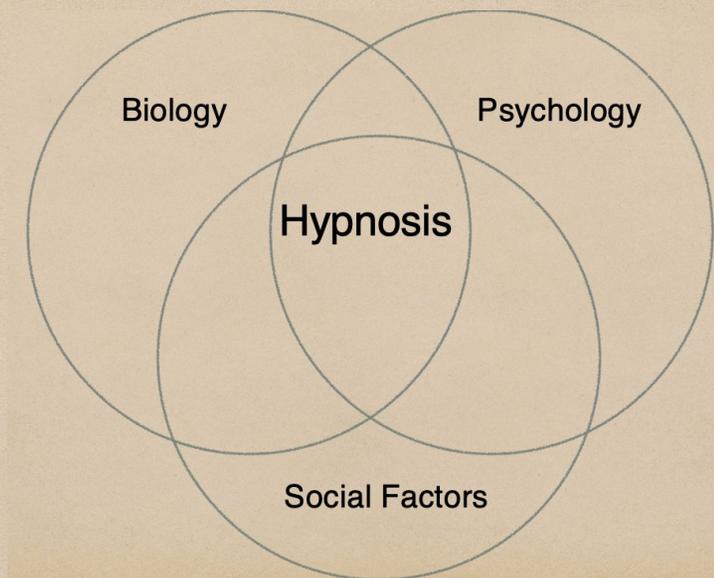
- Hypnotizability
- Expectancies
- Absorptive / imaginative ability
- Motivation
- Attitudes toward hypnosis



Social Factors

# Social Factors

- Rapport
  - therapeutic alliance, resonance, harmony
- Social context



There is an interaction of Biological, Psychological and Social, variables that produce the multifaceted experience of hypnosis

# Variables include

- individual's attitudes, beliefs and expectancies
- motivation to respond to suggestions
- interpretation of how to respond
- willingness and ability to imagine consistent with the suggestions
- ability to form response sets

## Therapeutic Hypnosis occurs when -

“the limitations of one’s usual consciousness sets and belief systems are temporarily altered so that one can be receptive to an experience of other patterns of association and modes of mental functioning . . . that are usually experienced as involuntary by the patient.”

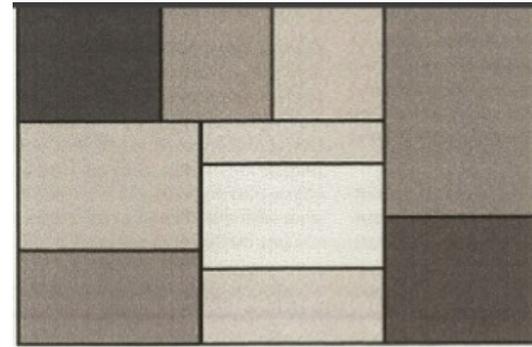
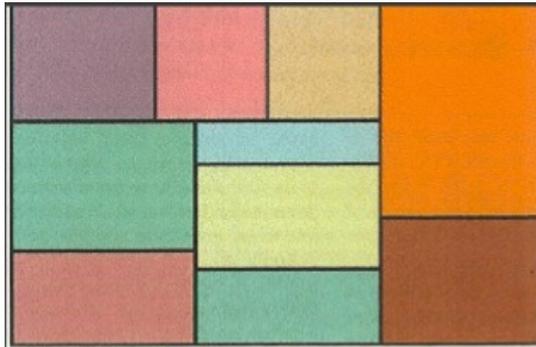
Erickson, Rossi & Rossi, 1976

“At least for highly suggestible people, words framed as part of a carefully crafted suggestion can change focal brain activity in a way no drug we have can do.”

Amir Raz - Stroop Effect

## Hypnotic visual illusion alters colour processing in the brain

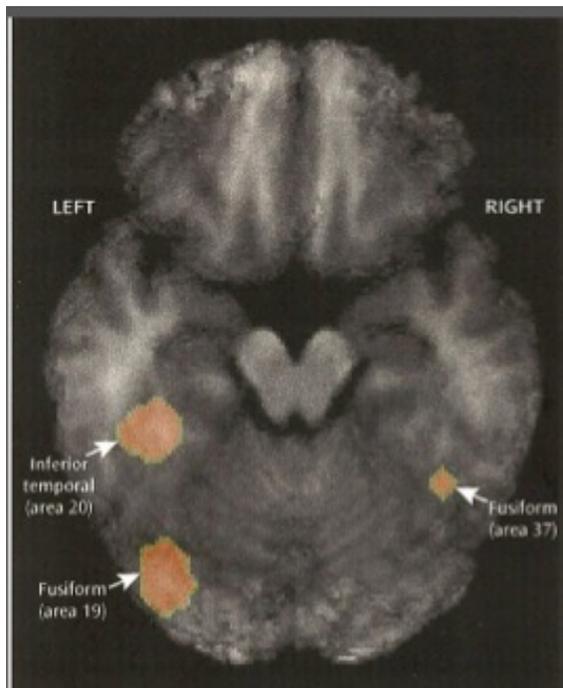
S.M. Kosslyn et al, *Am. J. Psychiatry* 2000, 157:1279-1284



Subjects were asked to see a color pattern in color, a similar grey-scale pattern in color, and color pattern as grey-scale during PET scanning

## Hypnotic visual illusion alters colour processing in the brain

S.M. Kosslyn et al, *Am. J. Psychiatry* 2000, 157:1279-1284



Color is processed by a circuit:  
inferior temporal (area 20)  
fusiform area (19-37)

Under hypnosis (in the left hemisphere):  
color areas were activated when subjects  
were asked to perceive color, whether or  
not they were actually shown the color  
image or the grey stimuli

Decrease activation when subjects were  
told to see grey scale when they actually  
were shown color

The greatest discovery of my generation is that human beings by changing the inner attitudes of their minds, can change the outer aspects of their lives.

William James

“We strive to achieve iatrogenic health with words  
that heal”

*Milton Erickson*

“Words change Physiology”

Bloom, ISH, 2004

“It is not simply mind over matter,  
but it is clear that  
mind matters”

*David Spiegel*  
*JAMA*  
*1999*

# Questions

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# Contact Information

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