Near-Death Experiences and the Neural Correlates of Consciousness

Video: youtu.be/nYgiEUXNI9s

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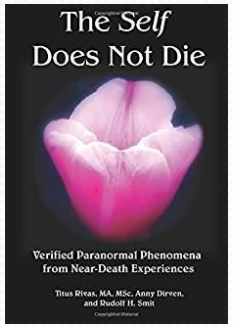
NDE Phenomenology Implies Separation of the Mind or Psyche

- **Sense of separation from the physical body – absence of pain and prior disabilities**
- **Lucid thought processes, hyperreal perceptions, "instant" response to volition**
- **Subtle interactions with physical processes: light, sound, solid objects**

- Mays, R. G., & Mays, S. B. (2008). The phenomenology of the self-conscious mind. *Journal of Near-Death Studies*, *27*(1), 5–45.
- Mays, R. G., & Mays, S. B. (2011). A theory of mind and brain that solves the 'hard problem' of consciousness. 2011 IANDS conference, Durham, NC.
- Mays, R. G., & Mays, S. B. (2015). Explaining Near-Death Experiences: Physical or Non-physical Causation? *Journal of Near-Death Studies*, *33*(3), 125-149.

NDE Phenomenology Implies Separation of the Mind or Psyche…

- **Verified, accurate perceptions: "apparently nonphysical veridical perceptions" (AVPs)**
- **Accurate recall of existing memories, formation of new memories of the NDE**
- **Access to all prior semantic knowledge: word meanings, world knowledge, etc.**
- **Separate mind-entity is objectively real (several verified NDE cases)**



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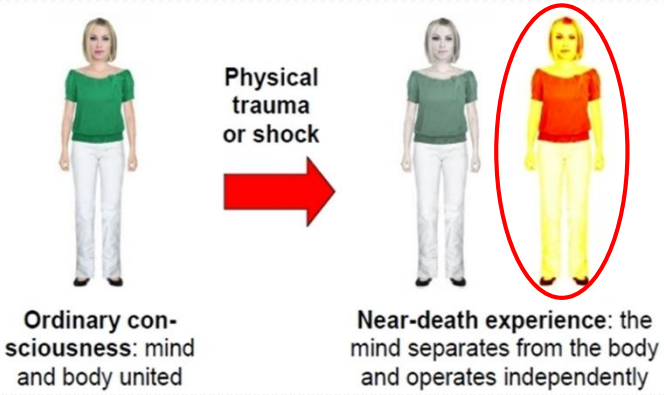
Implied Characteristics of the Separate Mind-Entity



- **The mind-entity is separate from the physical body**
  - **The *seat of consciousness* of the person**
  - **All mental functions & capacities are <u>in the mind</u>**
- **<u>Out-of-body state</u>: the mind operates independently of the brain and body**
  - **Hyperreal perceptions, vivid & indelible memory formation, instant response to volition**
  - **Interacts <u>directly,</u> energetically with light, sound, physical matter – to produce awareness**
- **<u>In-body state</u>: the mind is united and coextensive with brain and body**
  - **Interacts <u>through</u> neural activity in the brain – to produce awareness <u>in the mind</u>**
  - **Consciousness in the body is diminished from the hyperreal level in NDEs**

An Experience of Visual Perception

- A short video with pairs of images and sentences
- Each visual stimulus is preceded by a white "+" for 1 second: focus your attention!
  - Each stimulus is flashed very quickly, about 50 ms
  - It's important to pay attention
  - Due to technical limitations, some images may not show
- First we present three pairs of images
  - Pause — "+" — image 1 — pause — "+" — image 2
  - Repeat
- Then we present two simple sentences: sequence of words, one per second
  - Pause — "+" — word 1 — word 2 — word 3 — word 4
  - Repeat for second sentence

An Experience of Visual Perception…

Experience of Visual Perception: Observations

- **The two sentences: Could you read the words? Anything unusual?**
- **The pairs of images: Did you see each image? Did you recognize what it was?**
  - **Tools**
  - **Faces**
  - **Animals**

Experience of Visual Perception: Two steps to recognition

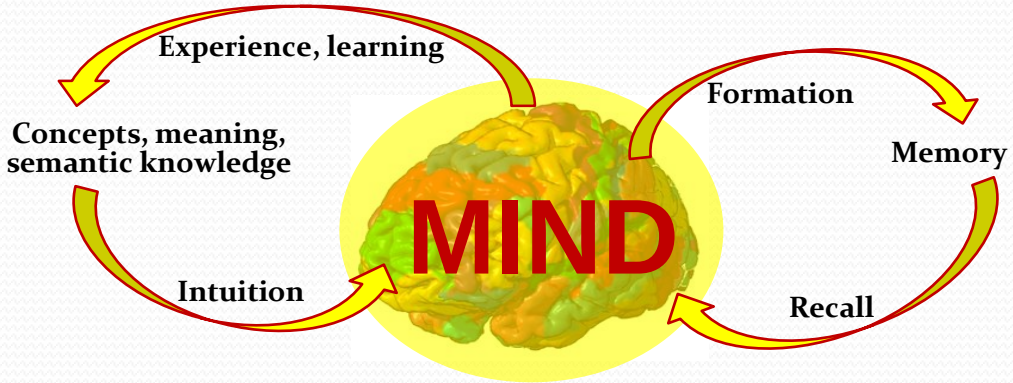
Experience of Visual Perception: Semantic content

- **Where do the *concepts* come from so that we can "recognize" an object, a face, a word? Even after only 50 ms—or less—of visual stimulus? Where are concepts "stored"?**
  - **Semantic knowledge – word meanings, object recognition, etc.**
  - **World knowledge – facts about the world**
  - **Experiential knowledge – mental pictures from experience**
  - **Episodic memory – memory of specific events in one's life**
- **How can we so easily "parse" or segment images into recognized objects, usually "instantly"?**
- **How do we integrate words or images into the context of what went before?**
  - **What if we detect a semantic incongruity, like "The peanut is in love"?**

We submit: the mind-entity hypothesis does a better job explaining these phenomena than current physicalist neuroscience

Implied Operation of the Mind with the Brain

Functional areas of the cortex

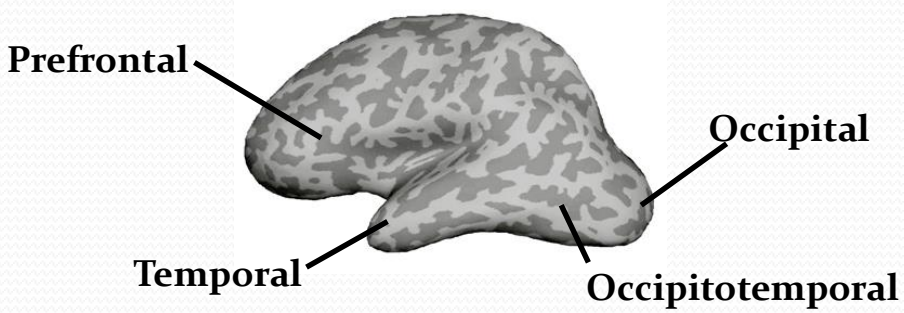


The mind is an energetic entity that interfaces with the brain

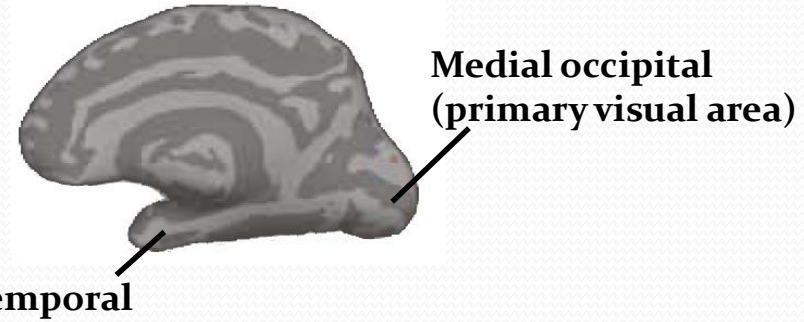
- **Concepts, meaning, semantic knowledge and memory reside *in the mind***
- **Perceptions begin with sensory brain processes ("exogenous") but the conceptual, semantic content comes from the mind through *intuition***
- **Thoughts, feelings, urges, volitional processes begin in the mind ("endogenous") and activate neural processes so they come to awareness**
- **Memories are formed and reside in the mind, not in the brain**
  - **Episodic memories (life events): formed in the mind through neural processes in the hippocampus**
  - **Semantic knowledge is formed in the mind through experience and recalled through intuition**

Brain Structure, Dynamics and Imaging

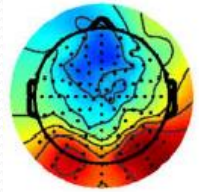
Left Hemisphere – outside lateral view



Right Hemisphere – inside medial view



- Electroencephalography (EEG) measures <u>electrical voltage</u> fluctuations at the scalp (+ and – volts)
  - Fluctuations imply neural activity in different brain regions – identified with different cognitive functions – e.g., perception, recognition
  - Advantages: precise measurement of amplitude and timing of brain events
  - Disadvantage: poor spatial resolution of brain regions



- Magnetoencephalography (MEG) measures <u>magnetic</u> fluctuations at the scalp (activation levels)
  - Fluctuations imply neural activity which are identified with cognitive functions
  - Advantages: good spatial resolution of brain regions and timing of brain events
  - Disadvantage: not all electrical activity is detected (detected chiefly in brain sulci)

Brain Dynamics: Electroencephalography (EEG)

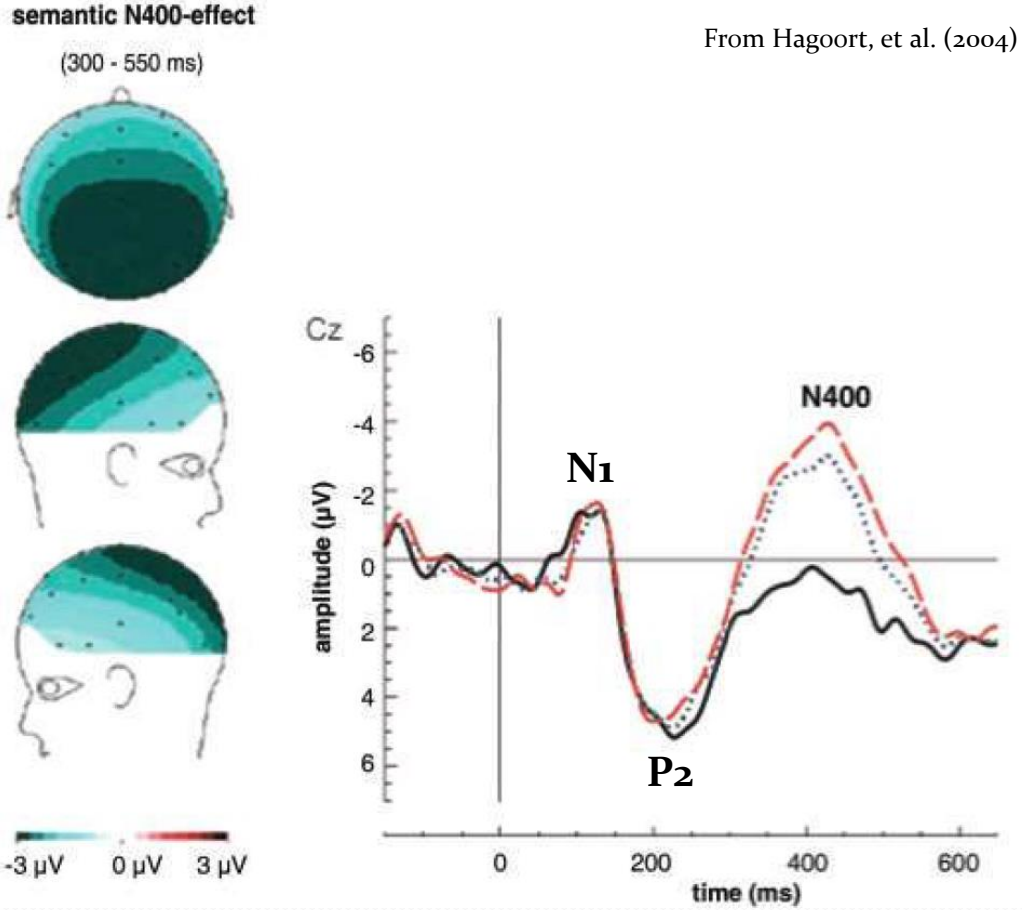
EEG example: an <u>incongruent</u> word in a sentence evokes a strong minus voltage at the top of the scalp.

Our interpretation:

- **At 115 ms: minus voltage is associated with detecting the word percept (form of the word)**
- **At 200 ms: plus voltage is associated with detecting the meaning of the word (concept)**
- **At 400 ms: strong minus voltage is associated with awareness of how <u>congruent</u> or <u>incongruent</u> the word is in context**
  - **Note: the large N400 <u>disappears</u> when a <u>congruous</u> context has been set, example: "The peanut was in love."**

Perception and comprehension appear to proceed in three distinct stages

From Hagoort, et al. (2004)



The Dutch trains are <u>yellow</u> and very crowded.
The Dutch trains are <u>white</u> and very crowded. (elevated N400)
The Dutch trains are <u>sour</u> and very crowded. (elevated N400)

- Hagoort, P., Hald, L., Bastiaansen, M., & Petersson, K. M. (2004). Integration of word meaning and world knowledge in language comprehension. *science*, *304*(5669), 438-441.
- Nieuwland, M. S., & Van Berkum, J. J. (2006). When peanuts fall in love: N400 evidence for the power of discourse. *Journal of cognitive neuroscience*, *18*(7), 1098-1111.

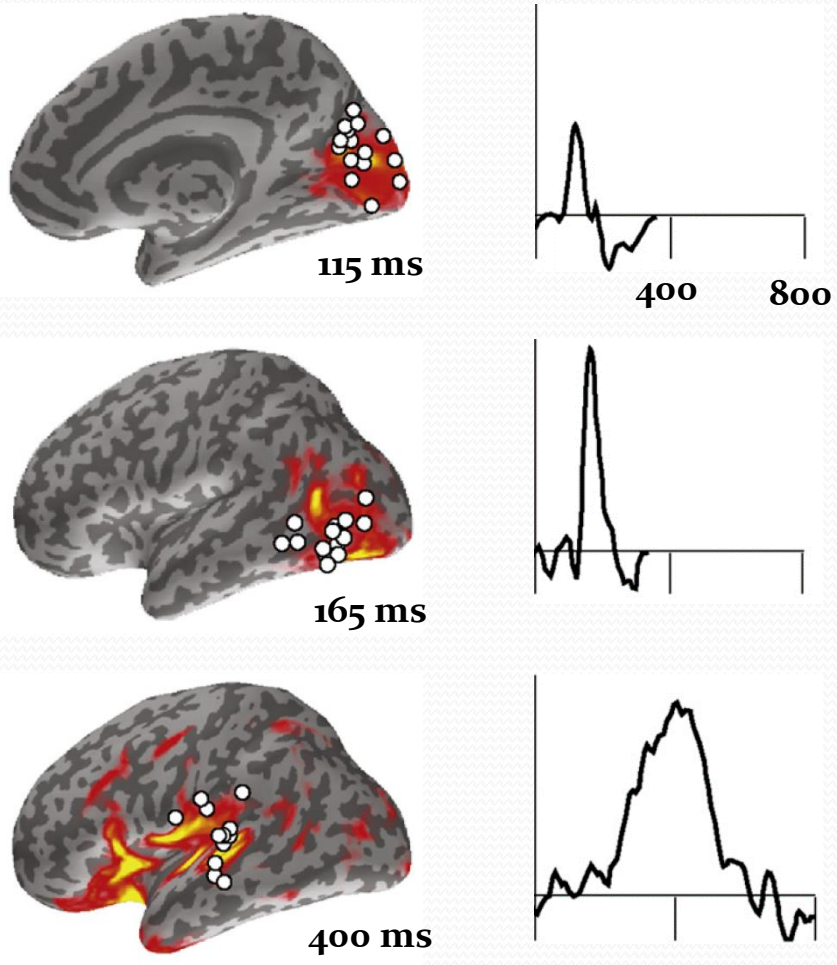
Brain Dynamics: Magnetoencephalography (MEG)

MEG example: reading a word – a novel word producing a large N400

Our interpretation:

- **At 115 ms: activation in medial occipital area is associated with detecting the word percept (form of the word)**
- **At 165 ms: activation in occiptotemporal area is associated with detecting the meaning of the word (concept)**
- **At 400 ms: activation in superior temporal and prefrontal areas is associated with awareness of how <u>novel</u> the word is from prior experience**

Perception and comprehension appear to proceed in three distinct regions of the brain

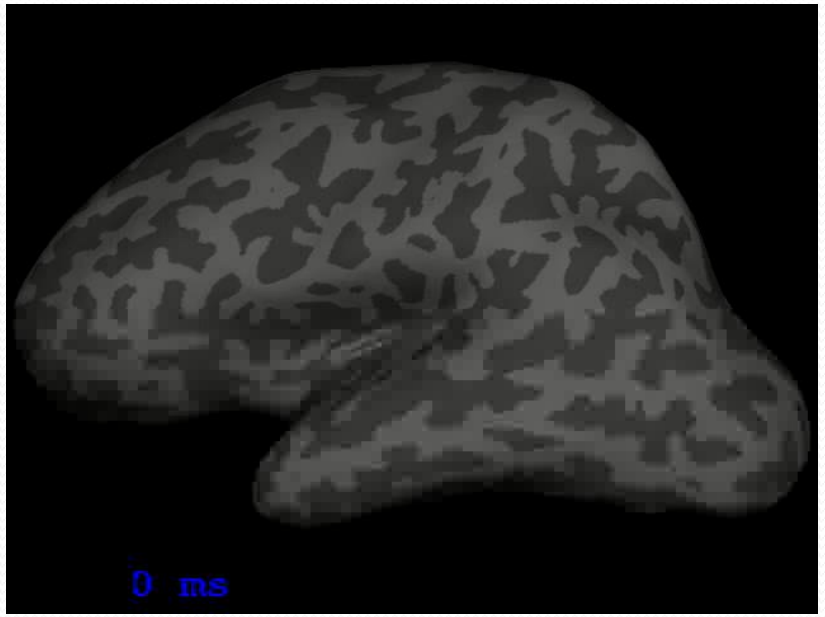


Hari, R., & Salmelin, R. (2012). Magnetoencephalography: from SQUIDs to neuroscience: Neuroimage 20th anniversary special edition. *Neuroimage, 61*(2), 386-396.

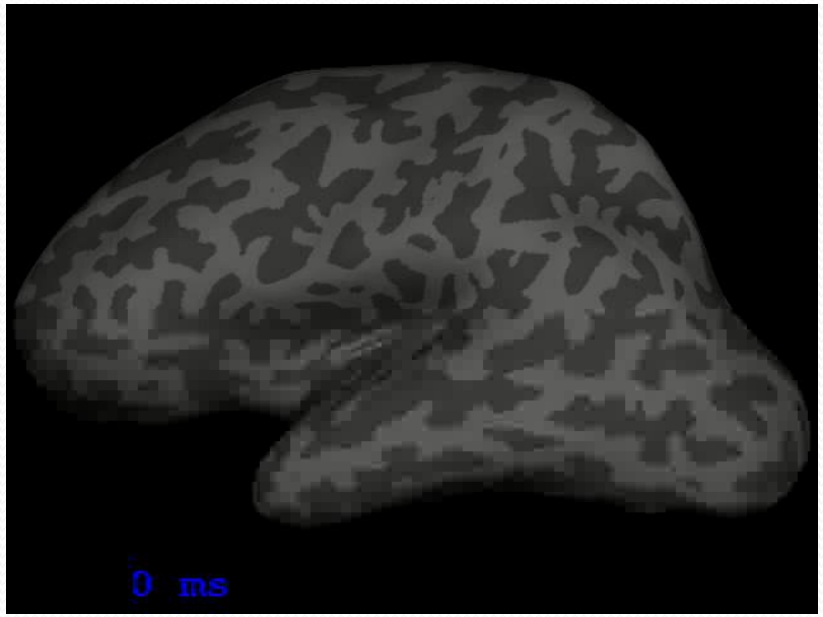
Brain Dynamics: Magnetoencephalography (MEG)…

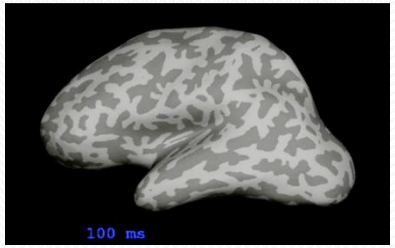
The dynamic brain view of reading a single word

Real time: about 400 ms

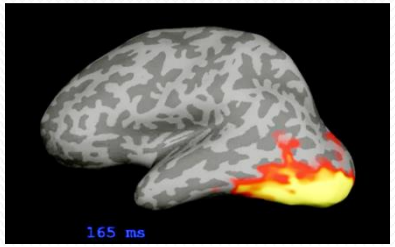


Slowed 32x

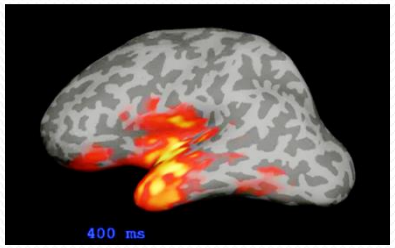




100 ms



165 ms



400 ms

Notice the <u>pauses</u> while the brain activity moves to a different area

Marinkovic, K., Dhond, R. P., Dale, A. M., Glessner, M., Carr, V., & Halgren, E. (2003). Spatiotemporal dynamics of modality-specific and supramodal word processing. *Neuron*, *38*(3), 487-497.

How long does it take to become aware?

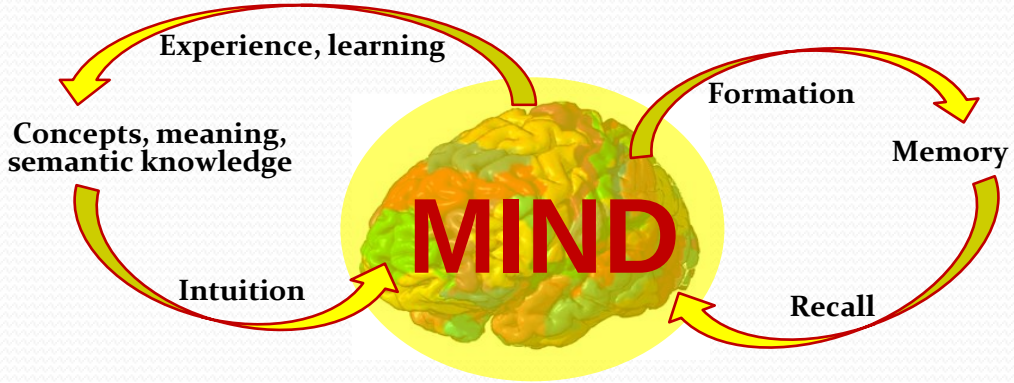
Benjamin Libet
(1916-2007)

- It takes time for neural activation to build up to conscious awareness
  - Awareness requires a stimulus of (1) minimum "liminal" intensity and (2) minimum duration of neural activity
  - Otherwise the stimulus remains unconscious (a "subliminal" stimulation)
  - If the stimulus is above "liminal" intensity, one becomes aware of it only after the 300 to 500 ms of neural activity
  - Libet's "time-on" principle
- Libet distinguished between detection and conscious awareness
  - Even without conscious awareness, subliminal stimulations are detected and have an effect (called "priming")
- The delay of awareness applies generally to all sensation and also to *endogenous* thoughts, volition, imaginations
- In our view, the *primary purpose* of neural activations is to bring mental content to conscious awareness.
  - The mind is engaged throughout this process—from detection to awareness

- Libet, B. (2004). *Mind time: the temporal factor in consciousness*. Cambridge, MA: Harvard University Press..

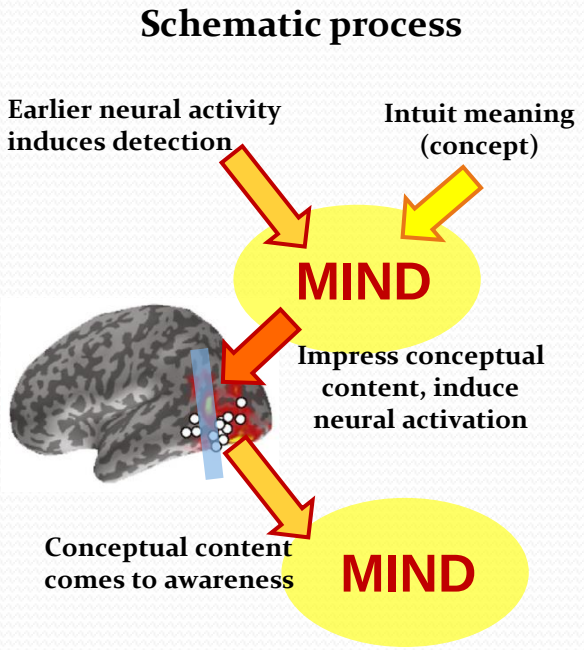
Mind-brain functional interactions

- **The invisible, non-material mind-entity is intimately united with the brain**
- **From NDE phenomena and Libet's work, the mind operates under the following constraints:**
  - **All conceptual content resides in the mind**
  - **The mind requires neural activation to become aware of its own mental content**
  - **Therefore, the mind must first *impress* its conceptual content on the appropriate brain regions**
  - **The neural activation from those regions acts as a *mirror* bringing the mind's conceptual content to consciousness**



Neural activity acts as a mirror for the mind

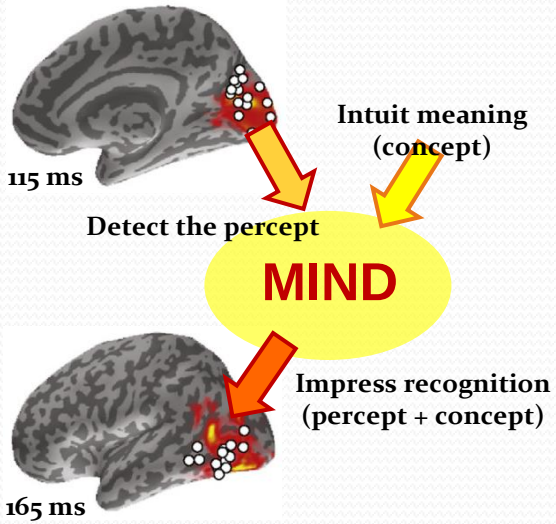
- **Functional interactions between the mind and brain: a schematic view**
  - **Earlier neural activity induces some content in the mind (top orange arrow)**
  - **The mind adds *conceptual* content (yellow arrow)**
  - **The mind *impresses* this combined content on the appropriate brain regions and induces neural activation in those regions (red arrow)**
  - **The neural activity *mirrors* the content and induces *awareness* of the mental content in the mind (bottom orange arrow)**



Stages in the mind-brain process of perception - 1

- **<u>Stage 1</u>: With the activation of <u>primary sensory</u> neurons, the mind detects the *percept*, the <u>raw</u>, <u>uninterpreted</u> sensory content – the letters w-h-i-t-e**
  - **The *conceptual content* of the percept (the meaning of "white") comes to the mind through *intuition*. The *perception* (percept + concept) is *impressed* on the subsequent neural structures**

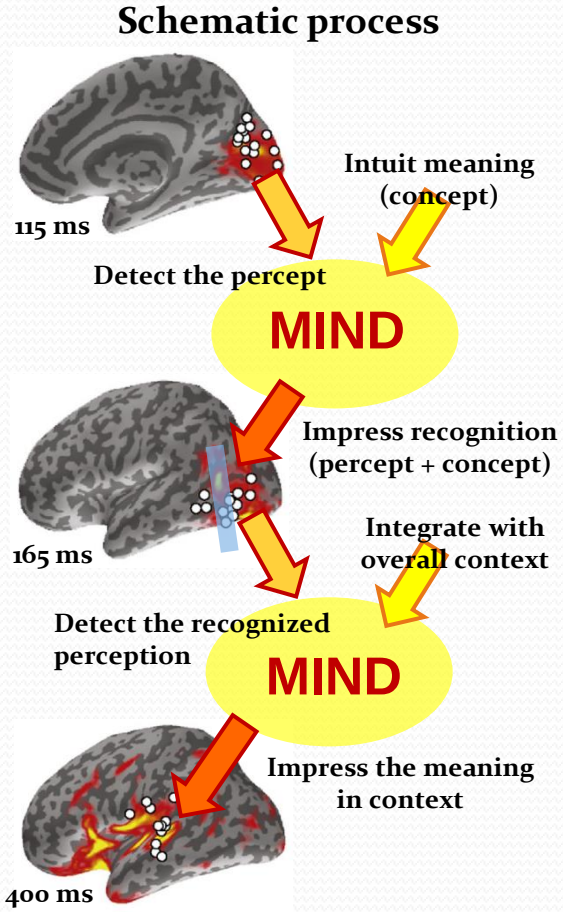
Schematic process



Stages in the mind-brain process of perception - 2

- **Stage 1: With the activation of primary sensory neurons, the mind detects the *percept*, the raw, uninterpreted sensory content – the letters w-h-i-t-e**
  - **The *conceptual content* of the percept (the meaning of "white") comes to the mind through *intuition*. The perception (percept + concept) is *impressed* on the subsequent neural structures**

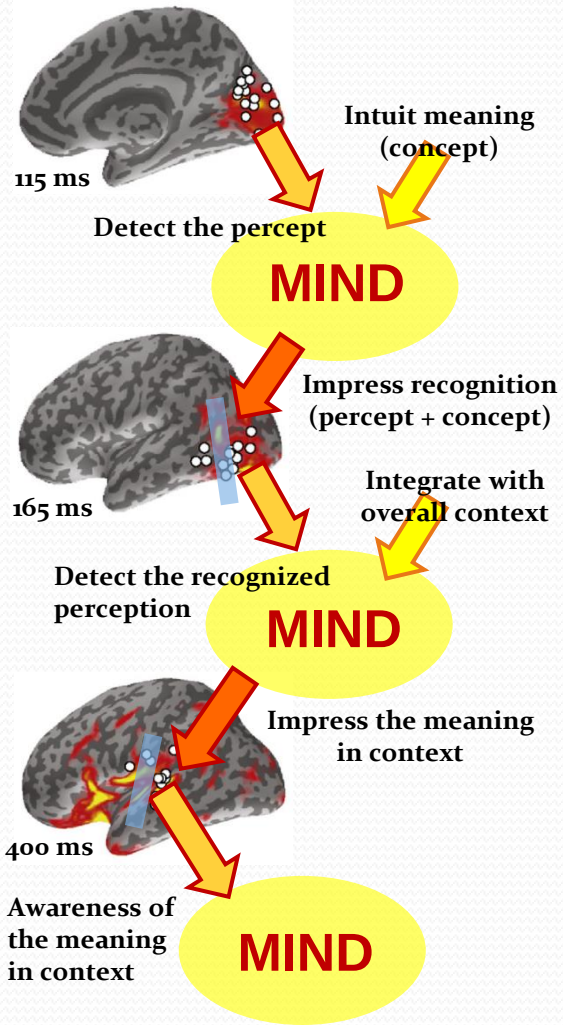
- **Stage 2: The activation of the second brain region mirrors the new mental content, and the mind detects the *perception* – the meaning of "white"**
  - **The *integration* of perception in the current context ("Dutch trains") is developed in the mind from world knowledge through *mental activity,* and is *impressed* on subsequent neural structures**
  - **The level of neural activation reflects the "fit" of the perception within the context (the N400): White is an incongruous color for Dutch trains**



Stages in the mind-brain process of perception - 3

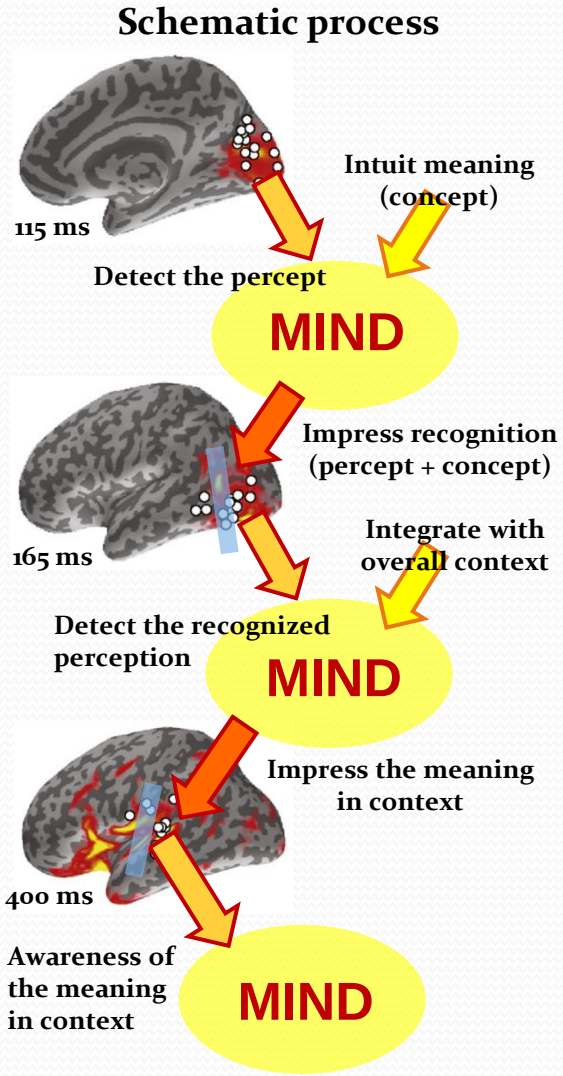
- **Stage 1: With the activation of primary sensory neurons, the mind detects the *percept*, the raw, uninterpreted sensory content – the letters w-h-i-t-e**
  - **The *conceptual content* of the percept (the meaning of "white") comes to the mind through *intuition*. The perception (percept + concept) is *impressed* on the subsequent neural structures**
- **Stage 2: The activation of the second brain region mirrors the new mental content, and the mind detects the *perception* – the meaning of "white"**
  - **The *integration* of perception in the current context ("Dutch trains") is developed in the mind from world knowledge through *mental activity,* and is *impressed* on subsequent neural structures**
  - **The level of neural activation reflects the "fit" of the perception within the context (the N400): White is an incongruous color for Dutch trains**
- **Stage 3: The activation of the third region mirrors the new mental content**
  - **The mind comes to *conscious awareness* of the incongruous word within the current context. Dutch trains are *not* white.**

Schematic process



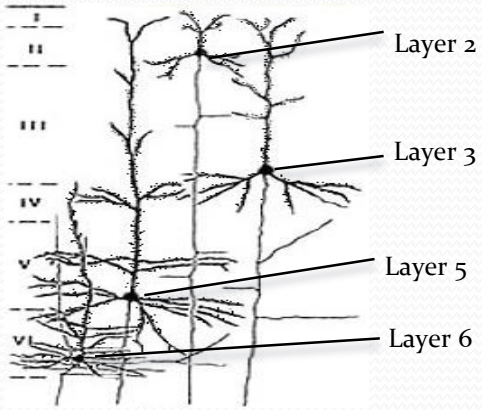
Interplay of bottom-up brain and top-down mind processes

- There is an interplay between alternating bottom-up processes (the orange arrows) and top-down processes (yellow and red arrows)
- Different brain regions are specialized to induce different mental content in the mind
  - Object recognition areas, face recognition areas, language comprehension areas, working memory, etc.
  - In the pause <u>after</u> <u>Stage 1</u>, the mind directs which region is to be activated, based on the recognized content
  - The mind is engaged *throughout* the process of "coming to awareness" but awareness does not occur until Stage 3.
- The result of the 3 stages in the mind are: (1) detect the raw percept, (2) detect the recognized meaning, and (3) awareness of the meaning in context.



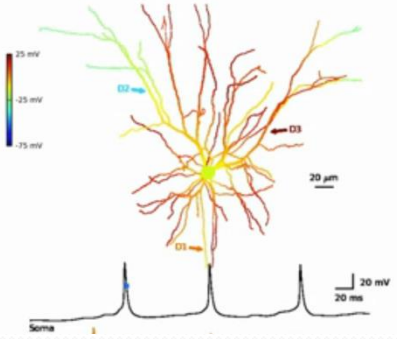
Mind-brain physical interactions

- **The interface between the mind and the brain**
  - **The neural activations must work energetically to induce detection and awareness in the mind (*brain-to-mind* interface – the orange arrows)**
  - **The mind must work energetically with neurons to induce neural action potentials (*mind-to-brain* interface – the red arrows)**
  - **We propose that *both* interfaces are in the apical dendrites of pyramidal neurons at the <u>surface</u> of the cortex: (1) via backward propagation of action potentials and (2) via opening of ion channels in the dendritic spines**



Apical dendrites in layers 2-3 and 5 pyramidal cells

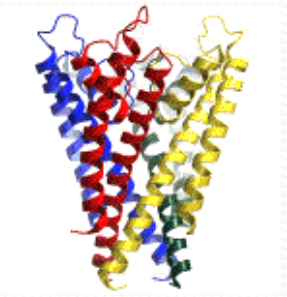
Brain-to-mind interface



Action potential propagates back through dendritic arbor

Mind-to-brain interface

Dendritic spines in vivo



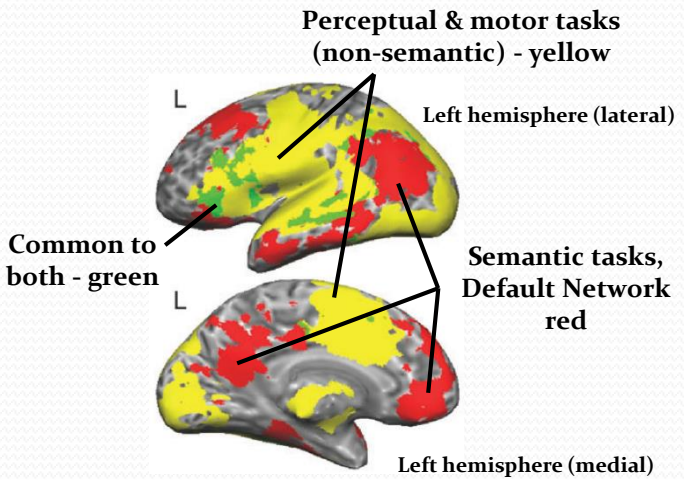
Molecular structure of a neural ion channel

- Smith, S. L., Smith, I. T., Branco, T., & Häusser, M. (2013). Dendritic spikes enhance stimulus selectivity in cortical neurons *in vivo*. *Nature,* **503**:115-120..
- Yang, G., Pan, F., & Gan, W. B. (2009). Stably maintained dendritic spines are associated with lifelong memories. *Nature*, *462*(7275), 920-924.

Mind-entity model is applicable to *all* conscious experience

There are two largely distinct, complementary brain networks

- **An <u>externally</u> directed *perceptual* system involving external sensory and motor processes with minimal semantic content (yellow areas)**
- **An <u>internally</u> directed *conceptual* system used in semantic tasks—the "default network" (red areas)**
- **<u>Both</u> networks are involved in perception**
- **The *default network* is active when we are engaged in inward or endogenous mental activity. Examples: "lost in thought," daydreaming, solving a problem, planning the shopping list, etc.**



- Binder, J. R., Desai, R. H., Graves, W. W., & Conant, L. L. (2010). Where is the semantic system? A critical review and meta-analysis of 120 functional neuroimaging studies. *Cerebral Cortex*, *19*(12), 2767-2796.
- Binder, J. R., Medler, D. A., Desai, R., Conant, L. L., & Liebenthal, E. (2005). Some neurophysiological constraints on models of word naming. *Neuroimage*, *27*(3), 677-693.
- Buckner, R. L., Andrews-Hanna, J. R., & Schacter, D. L. (2008). The brain's default network: Anatomy, function, and relevance to disease. *Annals of the New York Academy of Sciences*, *1124*(1), 1-38.

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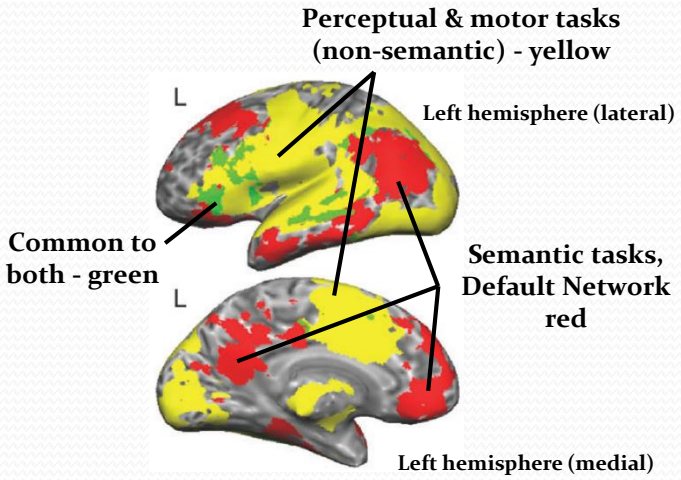

In this model, the mind is engaged in <u>both</u> networks, throughout the cortex:

- **<u>External</u> sensory and motor processes: the mind brings perceptions to consciousness across all sensory modalities, coordinates motor interactions with external environment**
- **<u>Internal</u> sources of information: the mind brings semantic knowledge, simulations, imaginations, future plans, episodic memories, etc. to consciousness**

- Binder, J. R., Desai, R. H., Graves, W. W., & Conant, L. L. (2010). Where is the semantic system? A critical review and meta-analysis of 120 functional neuroimaging studies. *Cerebral Cortex*, *19*(12), 2767-2796.
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Radical departure from current neuroscience

Current neuroscience	Mind-entity model
Neural activations are calculations on neural representations of mental content	Neural activations enable detection and awareness of mental content; there are no neural "representations"
Semantic & world knowledge are globally encoded as neural representations in the brain	Semantic & world knowledge are globally accessible in the mind
The higher frequencies of neural activations represent conscious mental functions	The natural frequency of mind-brain interaction is in the theta range (5–7 Hz). Higher frequencies likely implement neural mechanisms under the mind's volitional control
Episodic memories are encoded in the hippocampus as long-term potentiations of neural connections.	Episodic memories are formed in the mind. LTPs indicate common pathways in memory formation and recall.

- Mays, R. G., & Mays, S. B. (2015). Explaining Near-Death Experiences: Physical or Non-physical Causation? *Journal of Near-Death Studies*, 33(3), 125-149.
- Mays, R. G., & Mays, S. B. (submitted). Near-Death Experiences: Critiquing the physicalist interpretation.

Greater explanatory power

The mind-entity model has greater explanatory power for:

- **All aspects of NDEs – phenomenology, especially veridical perceptions and NDE memories**
- **General *enigmas* of consciousness—like the "hard" problem, the "binding" problem**
- **Numerous neurological phenomena, anomalies and disorders**
  - **Rapid visual categorization (speed of sight)**
  - **Readiness potential**
  - **Split brain phenomena**
  - **Change blindness, inattention blindness**
  - **Libet's antedating paradox**
  - **Libet's free will paradox**
  - **Disorders: Alzheimer's (including terminal lucidity), autism, schizophrenia, persistent vegetative state, and so on**

- Mays, R. G., & Mays, S. B. (2015). Explaining Near-Death Experiences: Physical or Non-physical Causation? *Journal of Near-Death Studies*, 33(3), 125-149.
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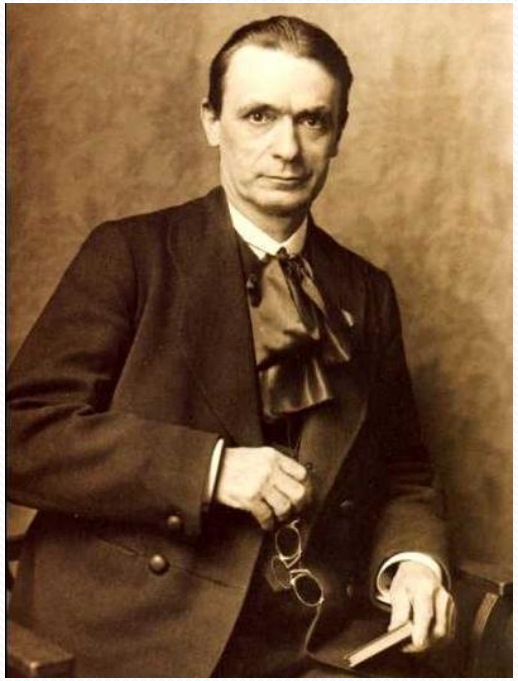
The Mind's Activity in Perception

Philosopher and spiritual scientist Rudolf Steiner

- **Major philosophical work, *The Philosophy of Freedom***
- **Based on his introspection and insights into the nature of thinking and perception.**
- **His insights into mental processes bear a striking similarity to recent observations in neuroscience, such as in rapid visual categorization, face recognition and language comprehension**



Rudolf Steiner (1861–1925)

Due to our unusual mental organization, the perceiver receives two aspects of reality:

- **One from perceiving through the physical senses**
- **And one from *thinking* through *intuition***

- Steiner, R. (1894/1964). *The Philosophy of Freedom: The basis for a modern world conception.* London, UK: Rudolf Steiner Press.

The Twofold Nature of Perception

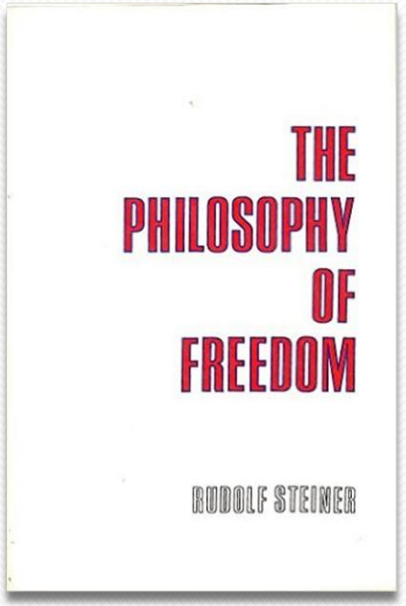
"It is due to our mental organization that the outer world is given to us, at first without its corresponding concepts."

"Intuition adds that part of the reality—the concept—which is lacking in the percept."

"From every real thing the relevant elements come to us from two sides, from perceiving and from thinking."

"The moment a perception rises up on the horizon of my observation, thinking also becomes active through me. An entity within my system of thoughts, a particular intuition, a concept, joins itself to the perception."

"The act of knowing or cognition is the synthesis of percept and concept."



- Steiner, R. (1894/1964). *The Philosophy of Freedom: The basis for a modern world conception.* London, UK: Rudolf Steiner Press.

The Pauses Between Neural Activations

- **Steiner acknowledged the necessity of a brain for embodied consciousness.**

> **For this life, man needs the physical brain as an instrument of consciousness: without it, man cannot be conscious.** (Steiner, 1906)

- **At the same time, the mind needs to <u>repress</u> brain activity so that the conceptual content can be given:**

> **The essence which is active in thinking has a two-fold function: first, thinking activity represses the activity of the human organization; secondly, it replaces that activity with its own activity. The repression of the physical organization prepares the way for thinking to manifest.** (Steiner, 1894, ch. 9)

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- **We propose that this process of <u>repression</u> occurs in the <u>pauses</u> between stages of neural activations.**
- **The insertion of a combined perceptual and conceptual content is followed immediately by neural activation in a different region, that then brings the combined mental content to detection or awareness.**

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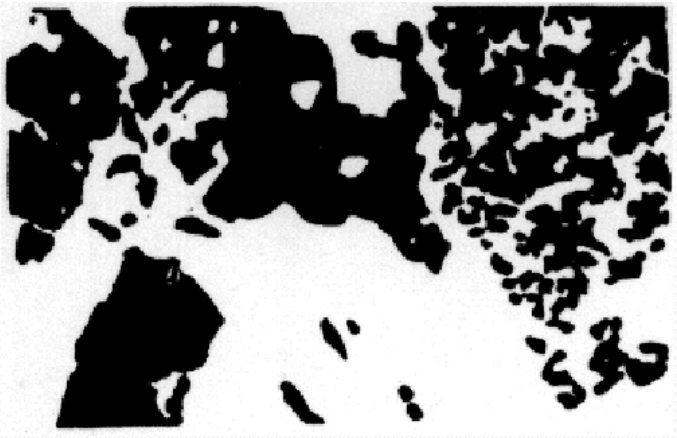
Polarity of Observation and Thinking: an example

One's thinking activity can be seen when the concept of the image is not obvious to us, for example in this hidden image.



- **If the image appears meaningless, it is because the mind has not "parsed" it into meaningful segments.**
- **Until one's thinking can bring the *unifying concept* through *intuition*, the image remains unsegmented, unintelligible.**
- **Once the concept dawns on one, the concept instantly organizes the image.**

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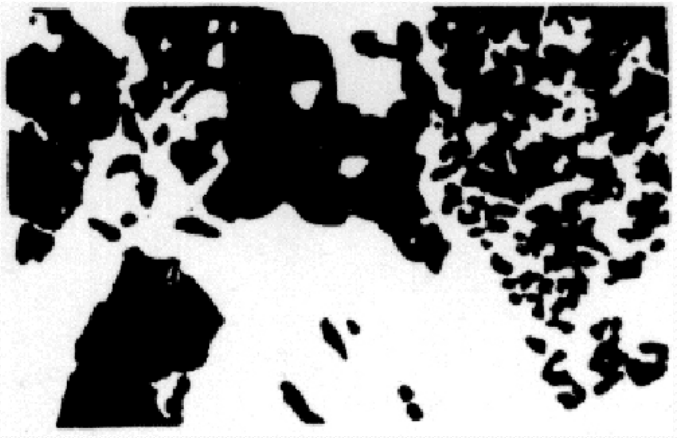

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> **An occurrence or object that is merely observed does not of itself reveal anything about its connection with other occurrences or objects. This connection becomes visible only when observation joins itself with thinking.** (Steiner, 1894, ch. 3)
>
> **[Without thinking] the world is a multiplicity of objects of equal value… Objects remain unintelligible to us until we have within ourselves the corresponding intuition which adds that part of the reality which is lacking in the percept… [Without] the intuitions corresponding to the things, the full reality remains inaccessible.** (ch. 5)

- **Sense perception is physiological—thinking is *spiritual activity***

The Greater Implications of NDE Phenomena

- **The mind-entity hypothesis holds that the *essence* of the human being is an autonomous, non-material mind or psyche**
  - **Seat of the person's consciousness**
  - **Interfaces and is active within the physical body and brain**
  - ***Thinking activity is a spiritual activity***
  - **Science *can* bridge to spirituality**

- **Yet questions persist:**
  - **What is the purpose of life on earth?**
  - **Why are there sickness, pain, suffering, old age and death?**

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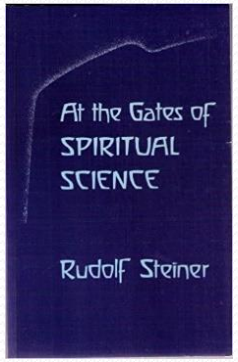
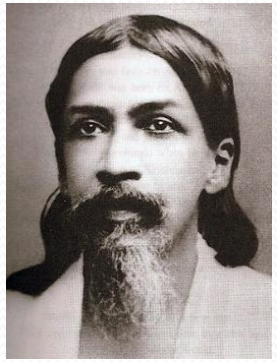
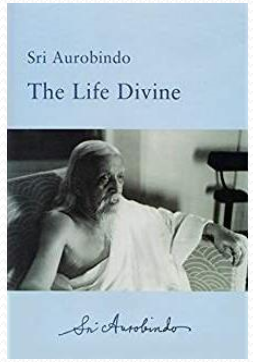
- **From their experience, NDErs hold that:**
  - **The human being is an eternal spiritual being**
  - **The ultimate purpose of life is to learn to Love**
  - **Every person is born with a specific life purpose and direction**

The Worldview of Western and Eastern Esotericism



Rudolf Steiner (1861–1925)



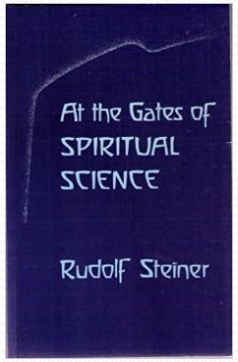


Sri Aurobindo (1872–1950)

- **The evolution of consciousness**
  - **By means of the intellect, human beings will regain the spirit**
  - **The evolution of consciousness in Matter is the keynote of earthly existence**
- **The evolution of the individual spiritual Self**
  - **The Self is universal but free in the universe**
  - **The Self is individual but not limited by separative individuality**
  - **The actualized, individualized Ego consciousness reestablishes interconnection with the spiritual Hierarchies**

- Steiner, R. (1906/1986). *At the Gates of Spiritual Science.* London, UK: Rudolf Steiner Press.
- Aurobindo, S. (2013). *The Life Divine.* Pondicherry, India: Sri Aurobindo Ashram Press.

The Worldview of Western and Eastern Esotericism…



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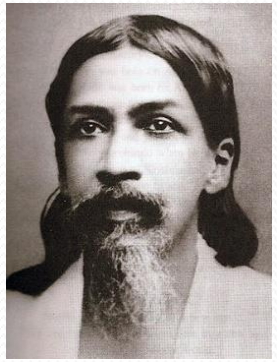

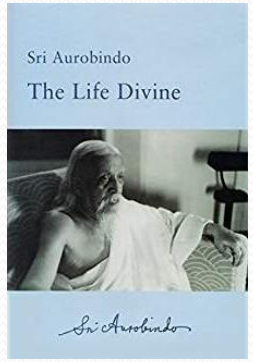

Sri Aurobindo (1872–1950)

- **The transformation and spiritualization of the Earth**
  - **A Kingdom of God, not only within us but in the world, in a collective human life**
  - **Human beings will transform all the beings of Nature and the entire substance of the Earth**

- **Freely chosen Love, new for the Universe, unravels the riddle of Good and Evil and existential questions of the meaning of life**

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