Your Brain on Story: AIMED, Santa Fe, NM August 4, 2011

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What are we doing when our brain is in idle mode?

(Eyes open or closed, awake, thinking of nothing in particular).

We are recalling vignettes (short stories) from our lives, running simulations (what if … scenarios for past, present, and future), and planning future behavior.

What are we doing when our brain is in idle mode:

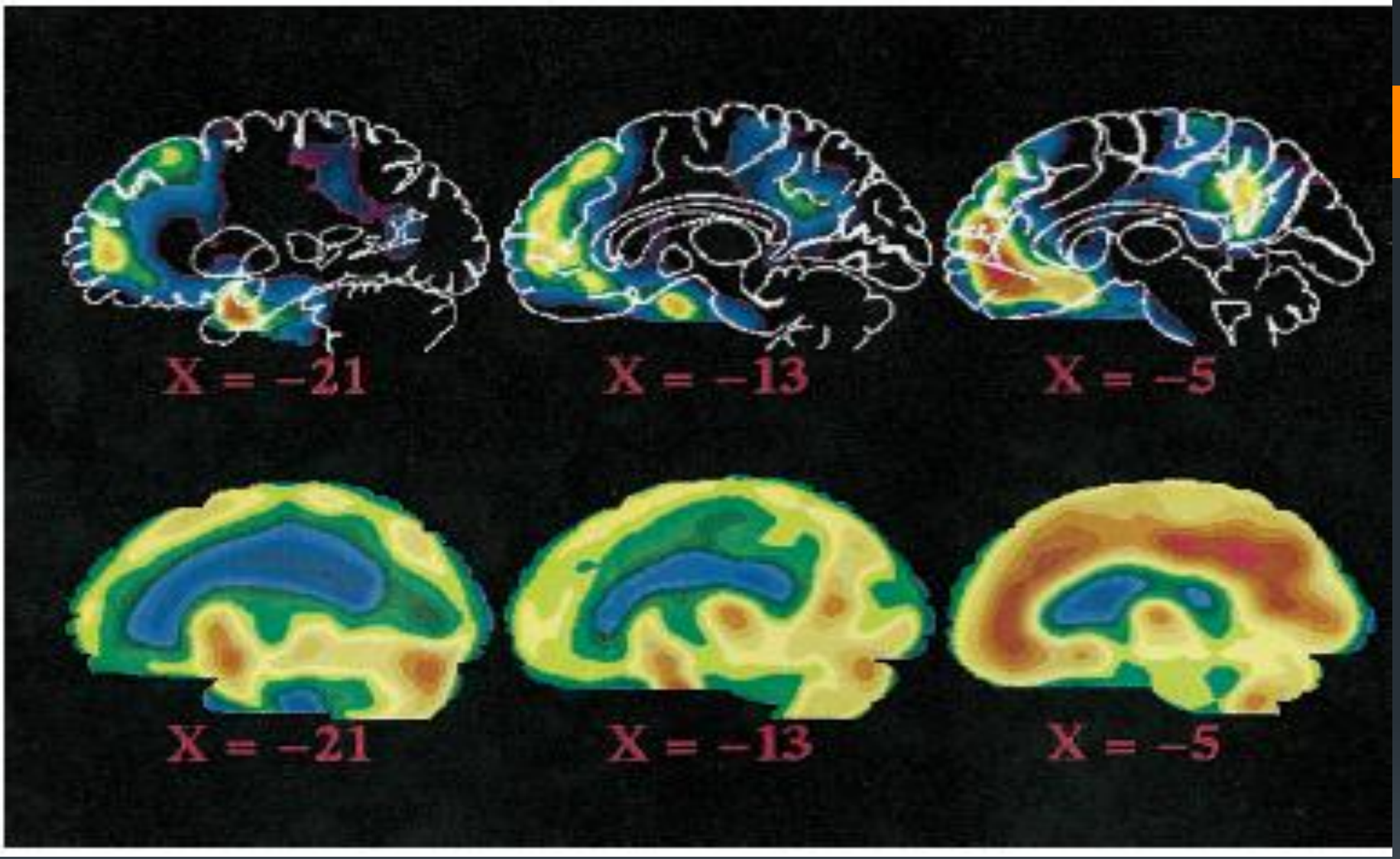
For example:

On the way home, remembering the argument about garbage this morning, planning the apology and running simulations about the effect it will have (consistent with the long range goal of the relationship)

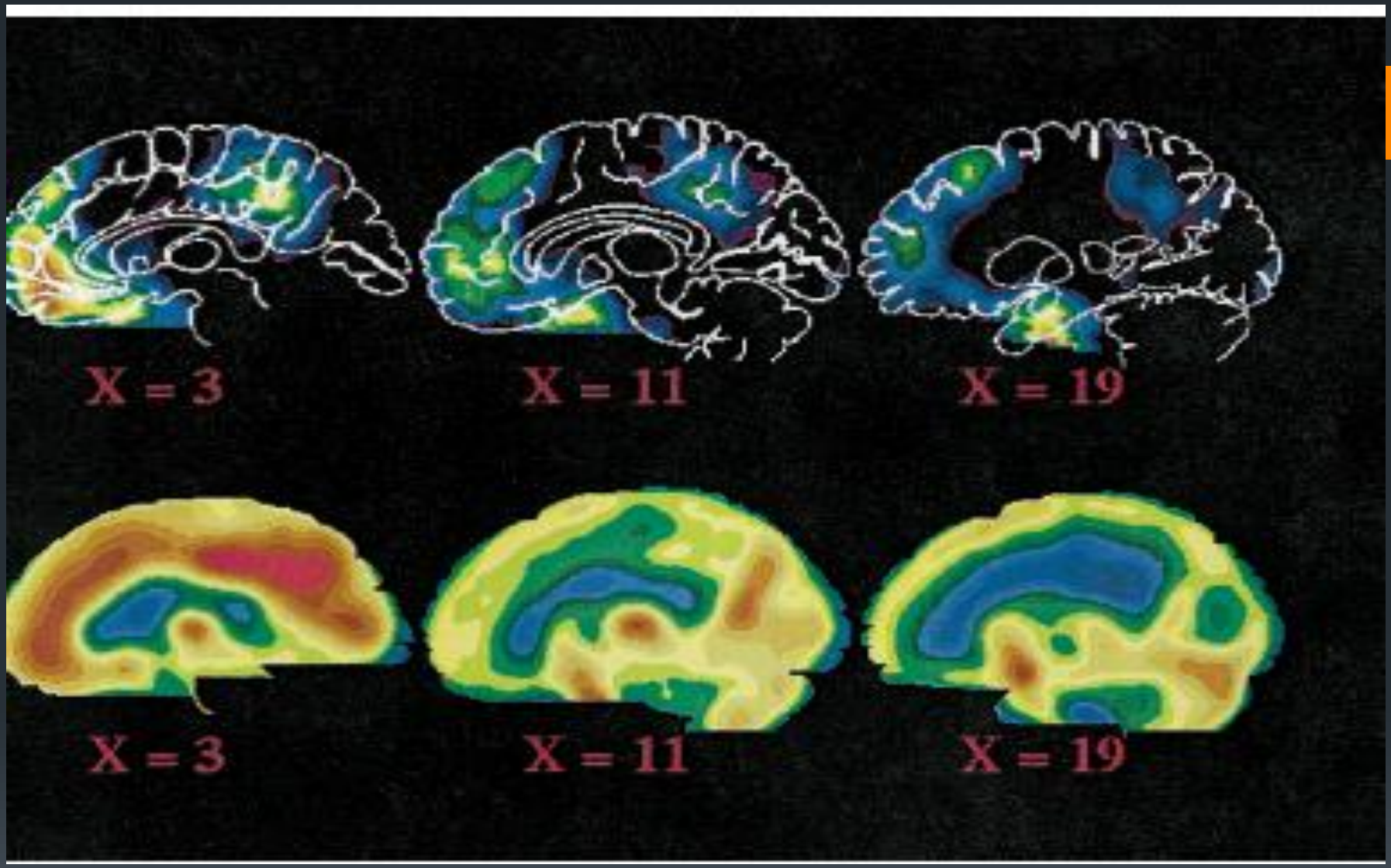
Uniqueness of Narratives:

This turns out to be the default mode of the brain, the mode that burns the least glucose and uses the least oxygen.

Raichle, et al., 1999



Top row is a task demanding attention while lower row is idle mode (default).



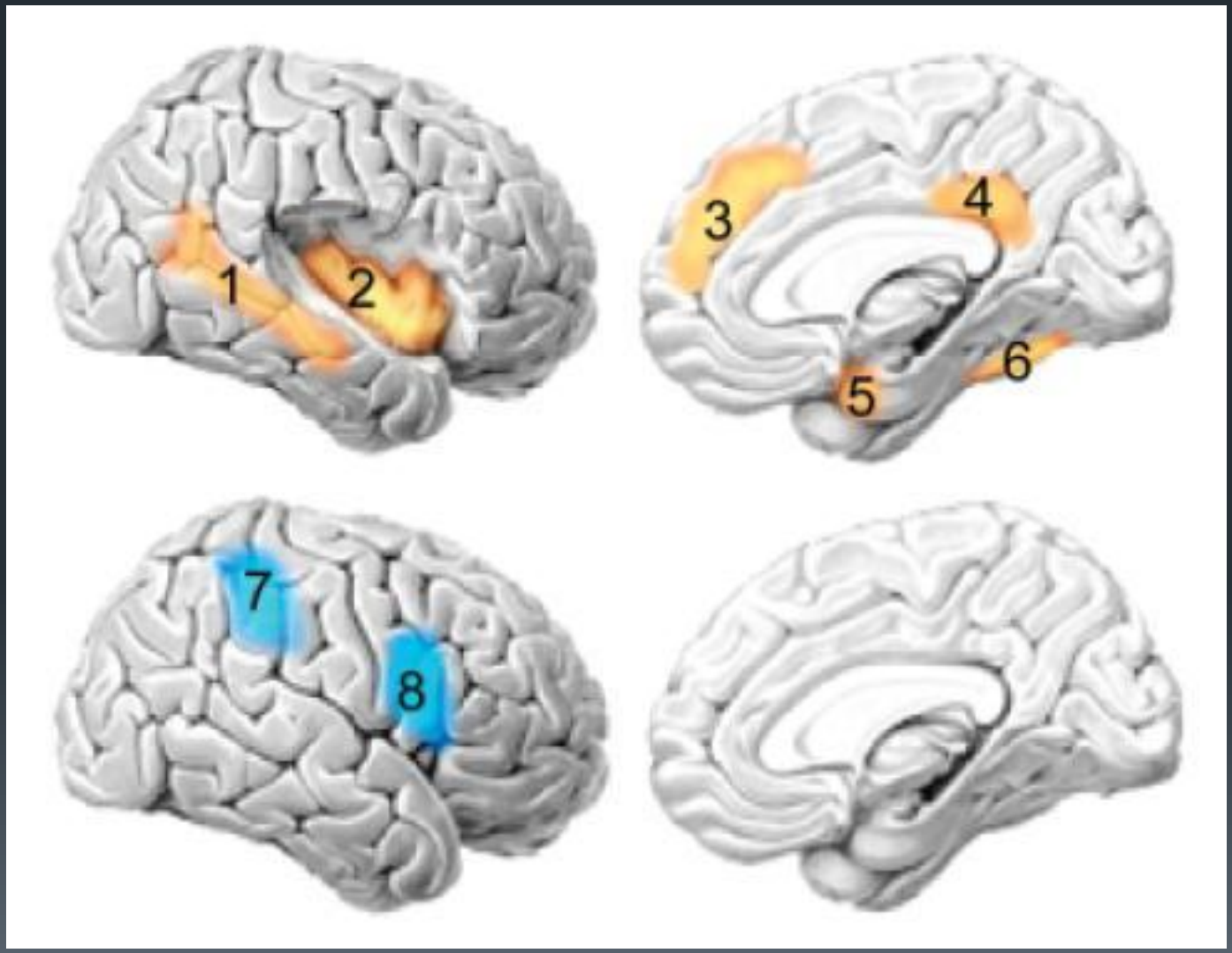
Top row is a task demanding attention while lower row is idle mode (default).

Areas of the brain involved in default mode:

1. Midline areas within the precuneus (parietal lobe)
2. Midline areas within the posterior cingulate cortex (parietal lobe).
3. Areas within the medial prefrontal cortex (MPFC) (frontal lobe).

Activity in these regions indicates spontaneous self-generated mental activity, i.e., streams of thoughts, episodic memories, review of vignettes, and social simulations.

Posterior cingulate cortex:



Superior temporal sulcus (1)

Insula (2)

Medial prefrontal cortex (3)

Posterior cingulate cortex (4)

Amygdala (5)

Posterior Cingulate Cortex (PCC) and adjacent precuneus:

Continuously gathers information about the world around us and within us and alerts us when something novel or interesting is happening so we can pay attention.

It makes sure that we can jump up and run from a tiger if one shows up while we're daydreaming!

Posterior Cingulate Cortex (PCC) and adjacent precuneus:

If your medial prefrontal cortex isn’t working quite right, you might find yourself jumping up and running (actually) from imaginary tigers.

Story Comprehension:

Robertson (2000) showed that narrative processing increases in right hemisphere activation in:

1) the precuneus,

2) cuneus,

3) posterior cingulate,

4) parietotemporooccipital regions (bilaterally), 5) the frontal poles, and

6) a stretch of cortex

extending along the right superior temporal sulcus to the right temporal pole.

Story Comprehension:

These same areas are activated during processing of picture stories in which a succession of pictures is presented such that a simple narrative like those used in the reading task is constructed.

This suggests that these regions represent more general processes involved in story comprehension.

Gernsbacher, et al.

Story Comprehension:

When St. George et al. (1999) asked participants to read both titled and untitled stories nearly identical areas of activation were found.

Right hemisphere activation was stronger when the stories were untitled.

More effort is expended to create a coherent episode out of untitled stories relative to titled stories.

Story Comprehension:

Story processing involves extensive right hemisphere regions, in keeping with other roles of the right hemisphere in language processing:

1) processing prosody,

2) comprehending irony and metaphor, and

3) processing particularly abstract and/or difficult words or sentences.

Story Comprehension:

Fletcher et al. (1995) asked participants to read three types of texts: theory-of-mind stories, physical stories (which are about physical events and do not require reasoning about the mental processes of the characters in the story), and collections of unrelated sentences.

When you need to feel what it's like to be in the character's shoes, the posterior cingulate cortex calls upon both right and left temporal poles as well as the left superior-temporal gyrus, which also helps you understand other people's desires and beliefs (theory of mind).

Posterior Cingulate Cortex:

Mediates the experience of imaging yourself as a fictional character, which involves imagery and memory processes that are emotional in nature.

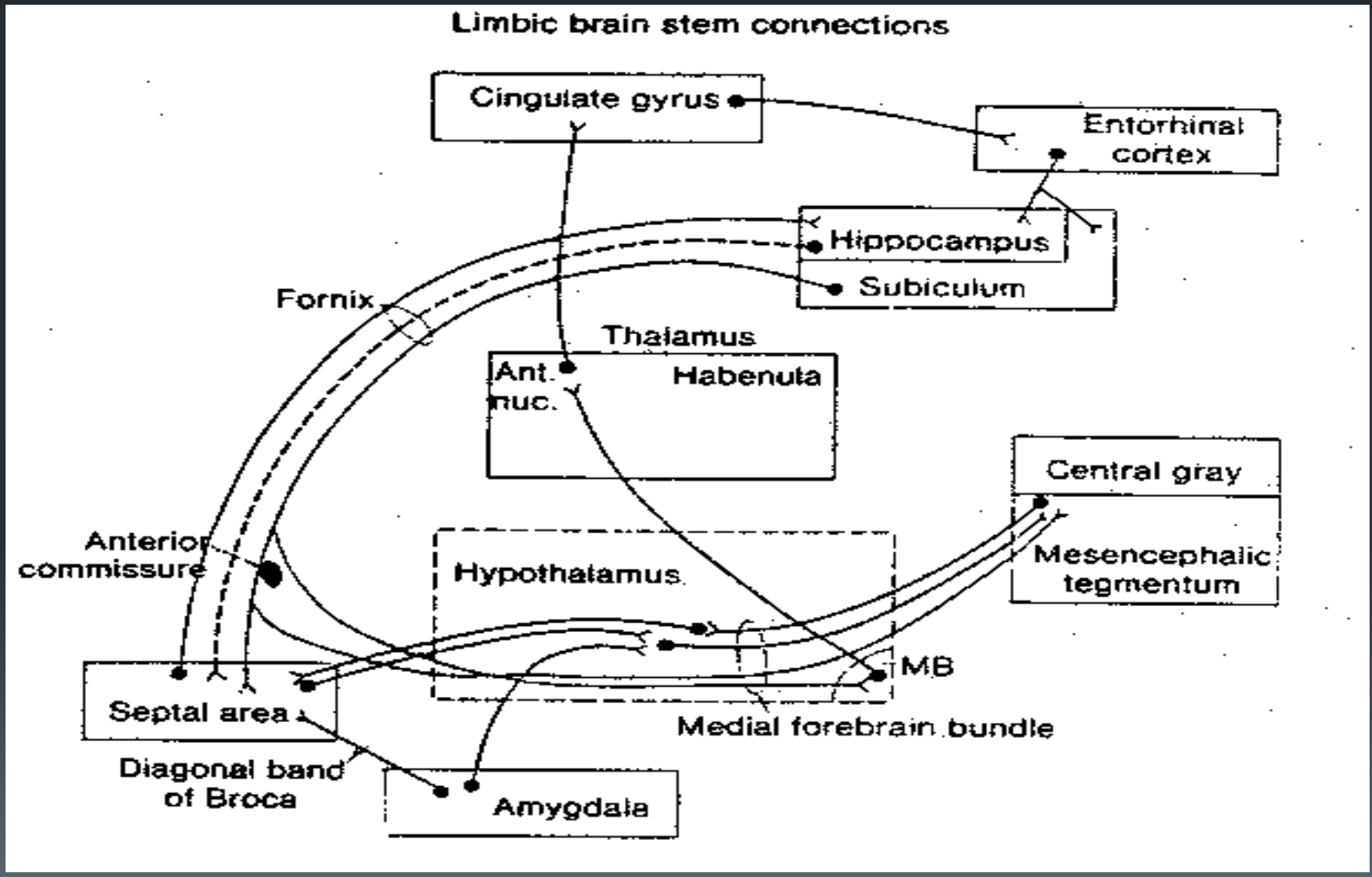
Posterior Cingulate Cortex:

Further Role in narratives:

Helps to retrieve elaborative information such as personal experience, in order to enrich comprehension or add realism to a story.

Contributes visuospatial imagery and modulates memory as a function of emotions elicited by stories.

Posterior cingulate cortex connections:



Medial Prefrontal Cortex:

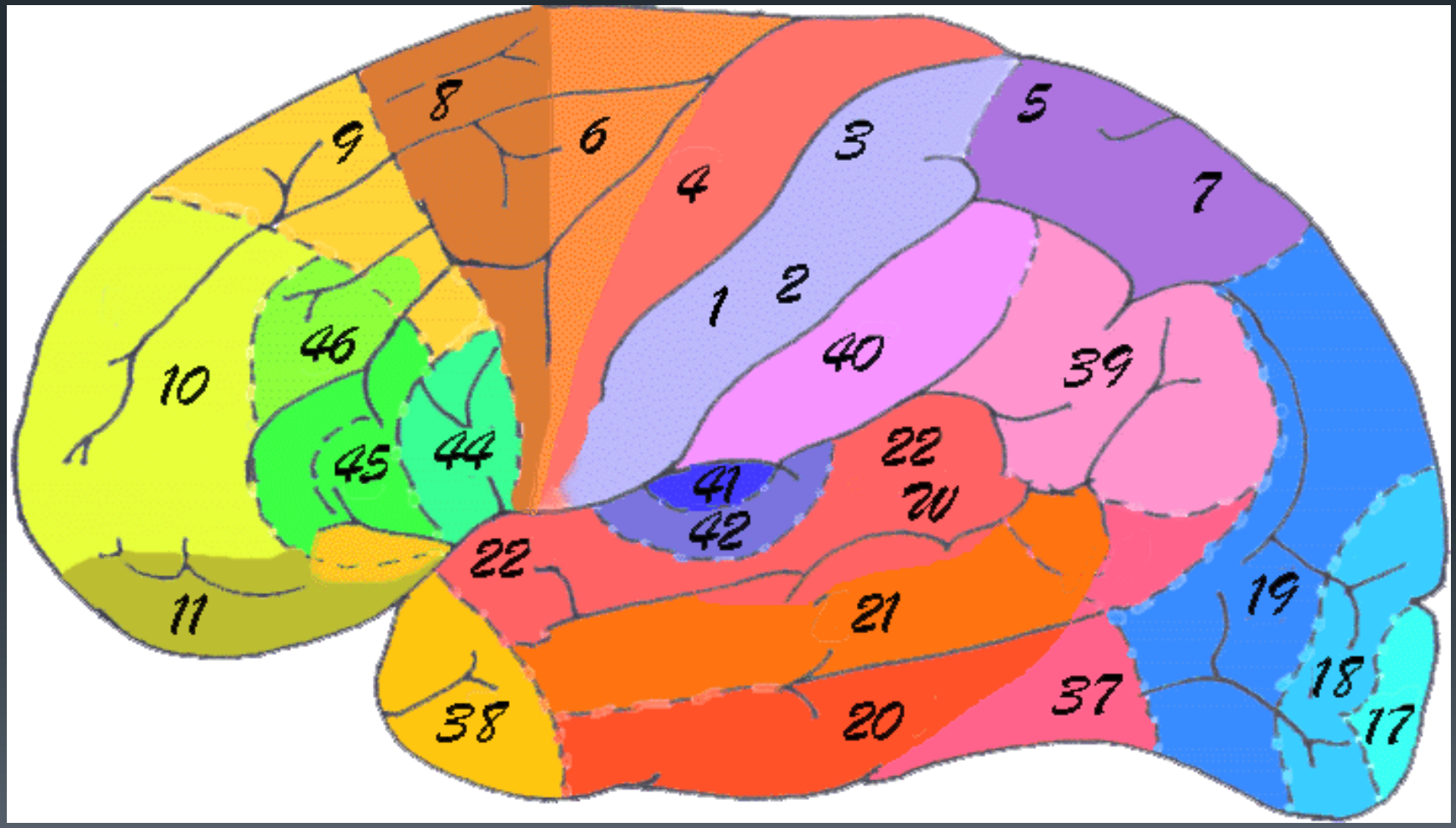
Helps integrate emotion and thought to make a complete story.

Respond to stimuli based on their reward and non-reward associations, meaning that we'll respond best to the stories that give us the most pleasure.

Composed of Brodmann's areas 44-46 and heavily interconnected with amygdala, ventral striatum, hypothalamus, midbrain periaqueductal gray region, and brainstem autonomic nuclei

Potential Brain Areas Predicted by Cognitive Models:

Brodmann's Areas



Medial Prefrontal Cortex:

Determines the meaning and relevance of the story being heard (and imagined sensory information like the hot breath of the fire breathing dragon as you rescue the princess) (in conjunction with the precuneus and posterior cingulate cortex).

Is this a story that's potentially important and useful to you or can you ignore it?

The Medial Prefrontal Cortex monitors the autonomic nuclei to determine how the body is reacting to the story (blood pressure, heart rate, sweating, etc.)

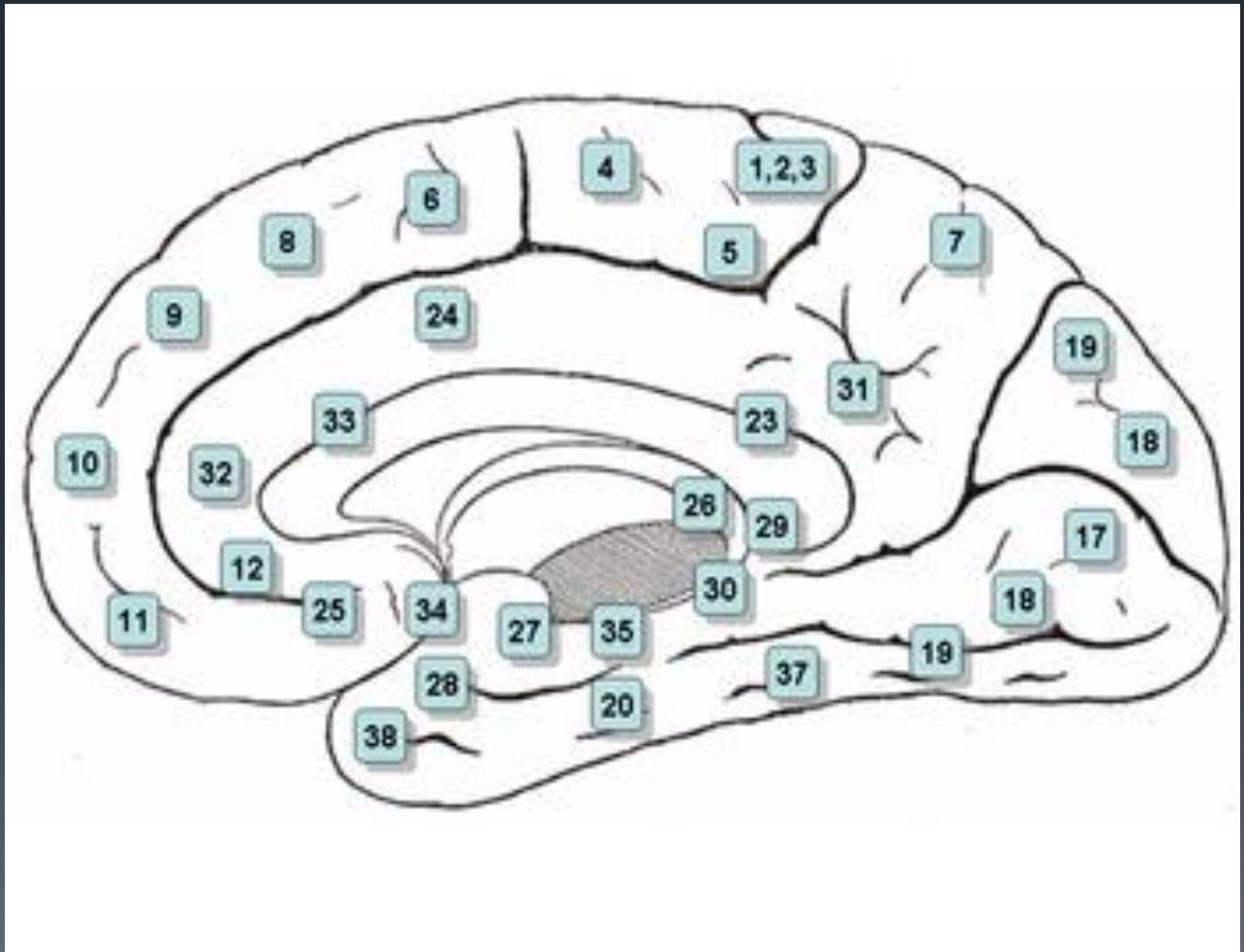
Prefrontal cortex:

Using working memory processes in the medial and lateral prefrontal cortex, we select and sequence information that we are hearing or creating, in order to create a representation of what is being described, or a representation of a story we are about to tell.

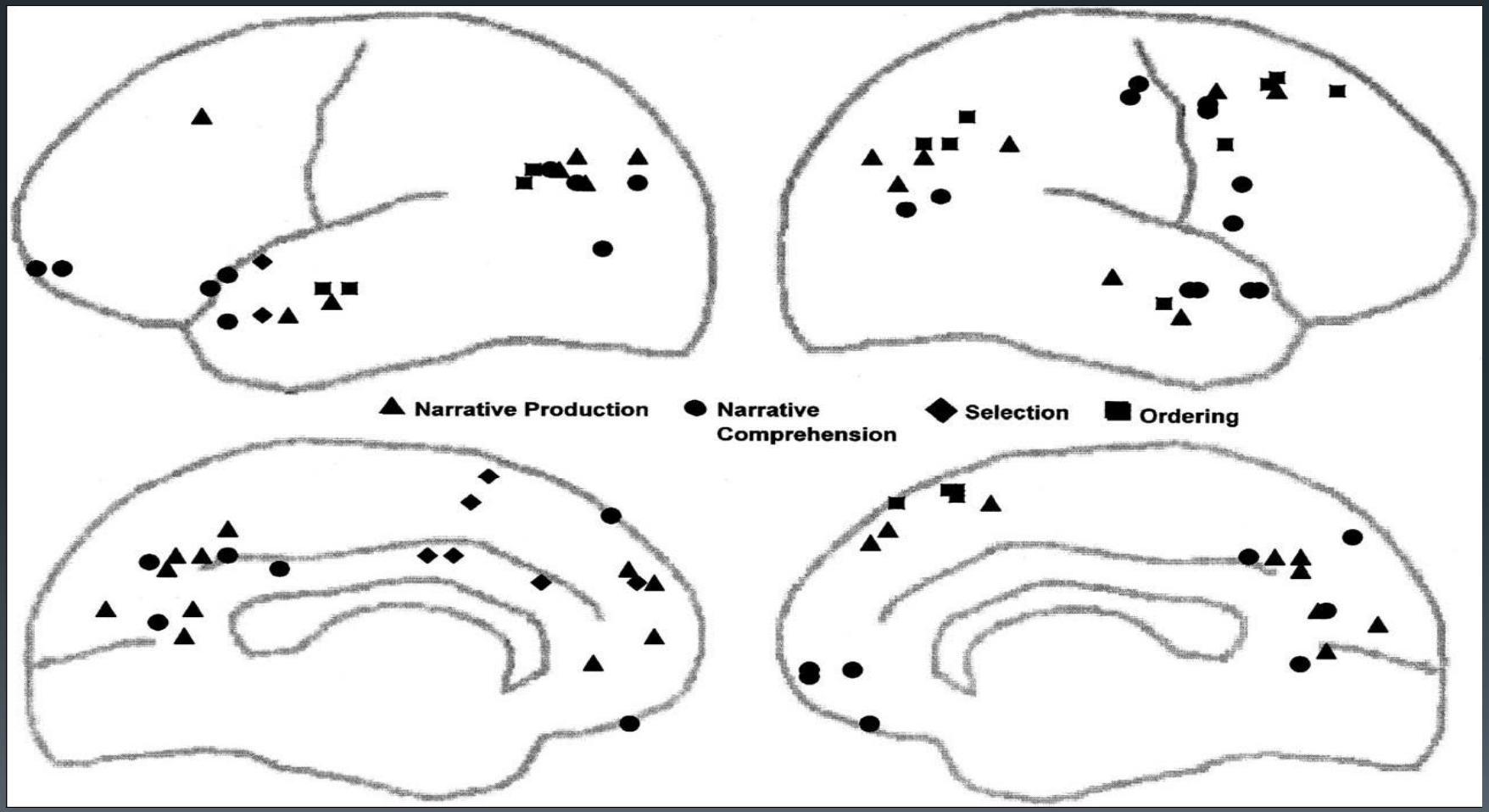
(This could be achieved in concert with areas that may modulate attentional focus in the narrative (either comprehended or produced), through the selection processes of the orbitofrontal cortex and anterior cingulate for example.)

Potential Brain Areas Predicted by Cognitive Models:

Brodmann's Areas



Reported peak activations for studies of narrative comprehension, narrative production, selection and ordering:



Meditation:

A state of intense concentration or heightened awareness differing from daydream-like resting [6].

The task of meditation is characterized by two general cognitive conditions:

(a) the disregard of distracting events and memories that interfere with the task and thus create conflict, and (b) the absence of mind wandering.

Holzel, et al., 2007

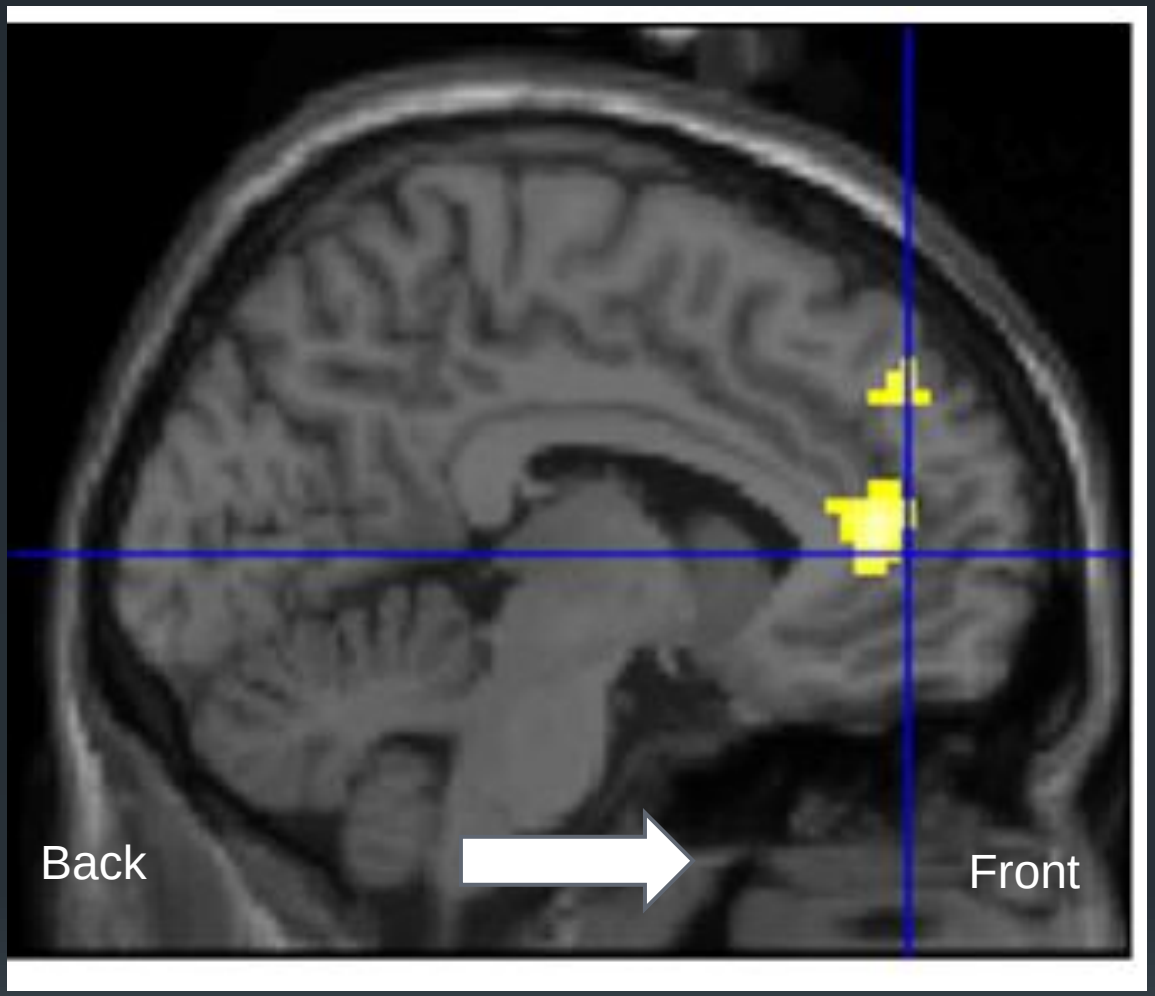
Meditation:

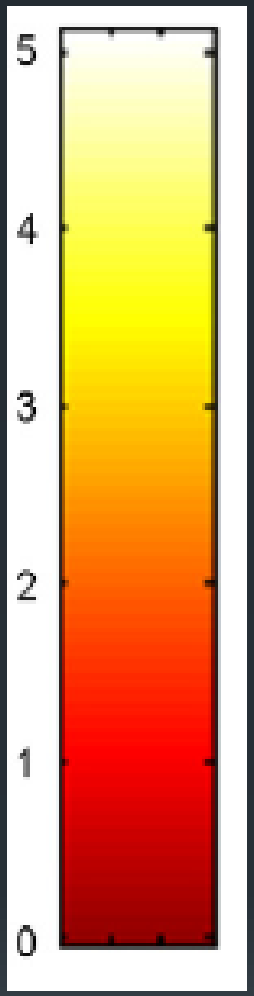
Volitional, self-guided types of meditation usually activates the prefrontal cortex and the anterior cingulate cortex (ACC).

The ACC detects conflicts emerging from incompatible streams of information processing.

During meditation, distracting external events as well as memories (internal stories) interfere with full concentration and ACC activation the default brain systems and the sensory cortex to “chill”.

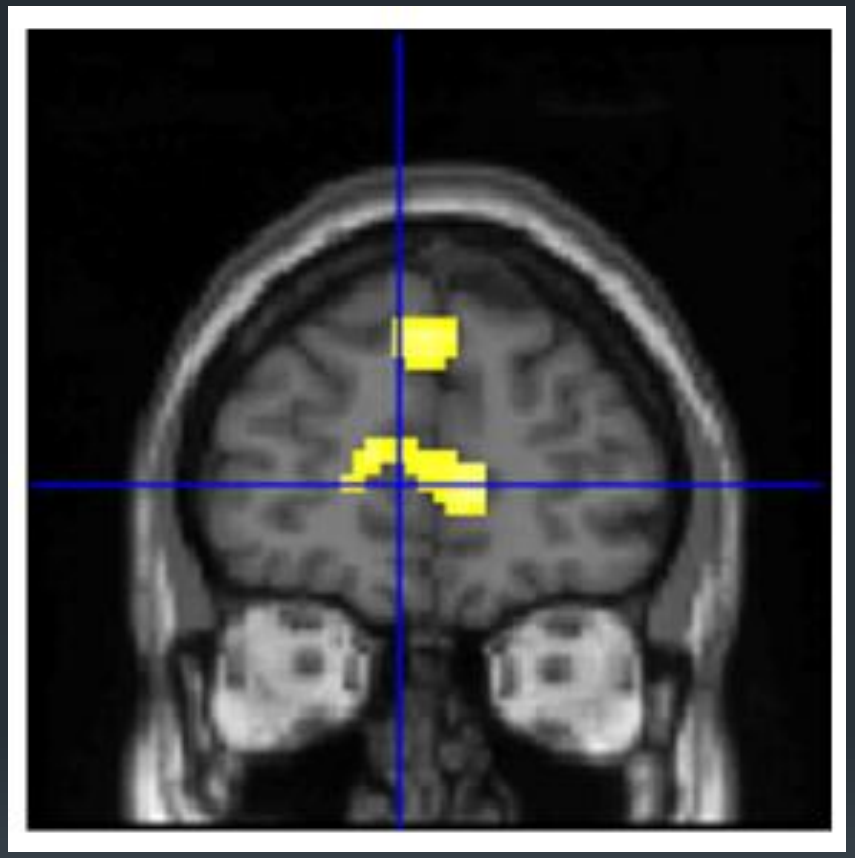
Holzel, et al., 2007

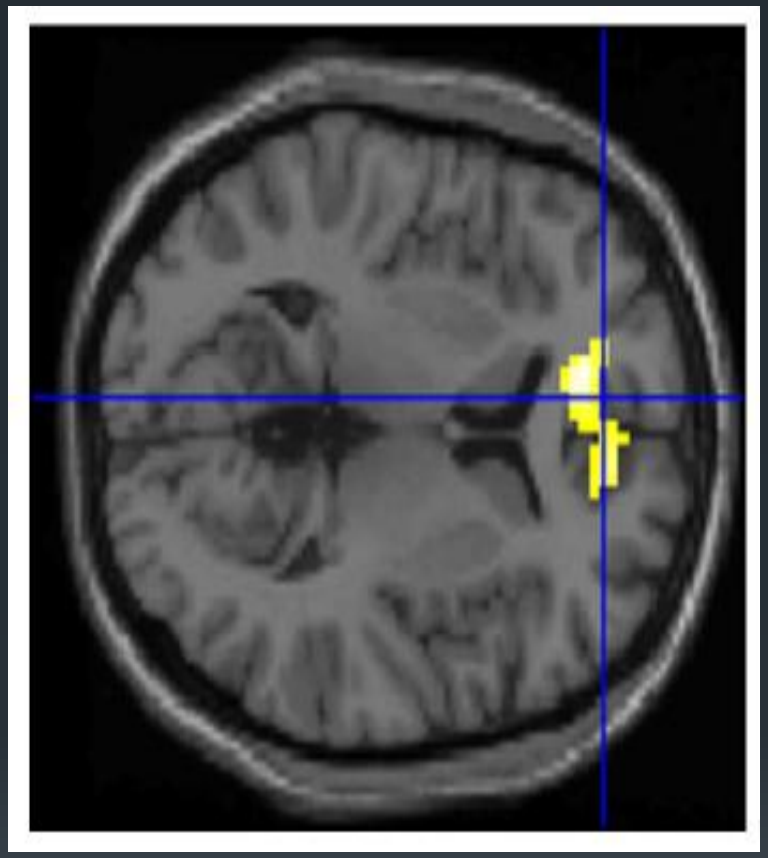




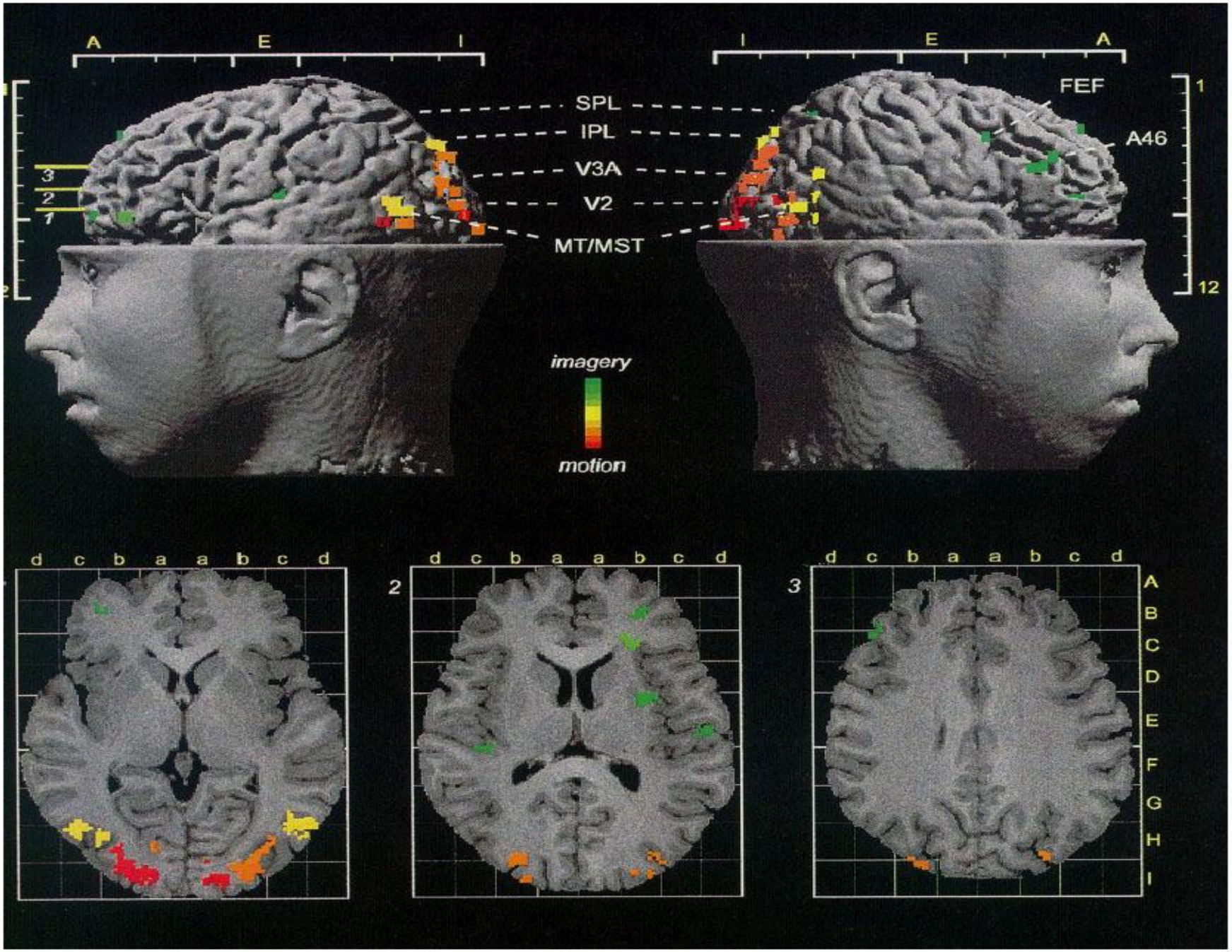
Stronger activation of the rostral anterior cingulate gyrus (lower) and the medial Prefrontal cortex during meditation.

Holzel, et al., 2007





Further views of the anterior cingulate cortex and dorsomedial prefrontal cortex (suggests emotional processing is occurring..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Functional magnetic resonance imaging (fMRI) study:

Areas that responded to real motion but not while motion was being imagined are shown in red.

Areas that were active during motion imagery but not to real motion are shown in green.

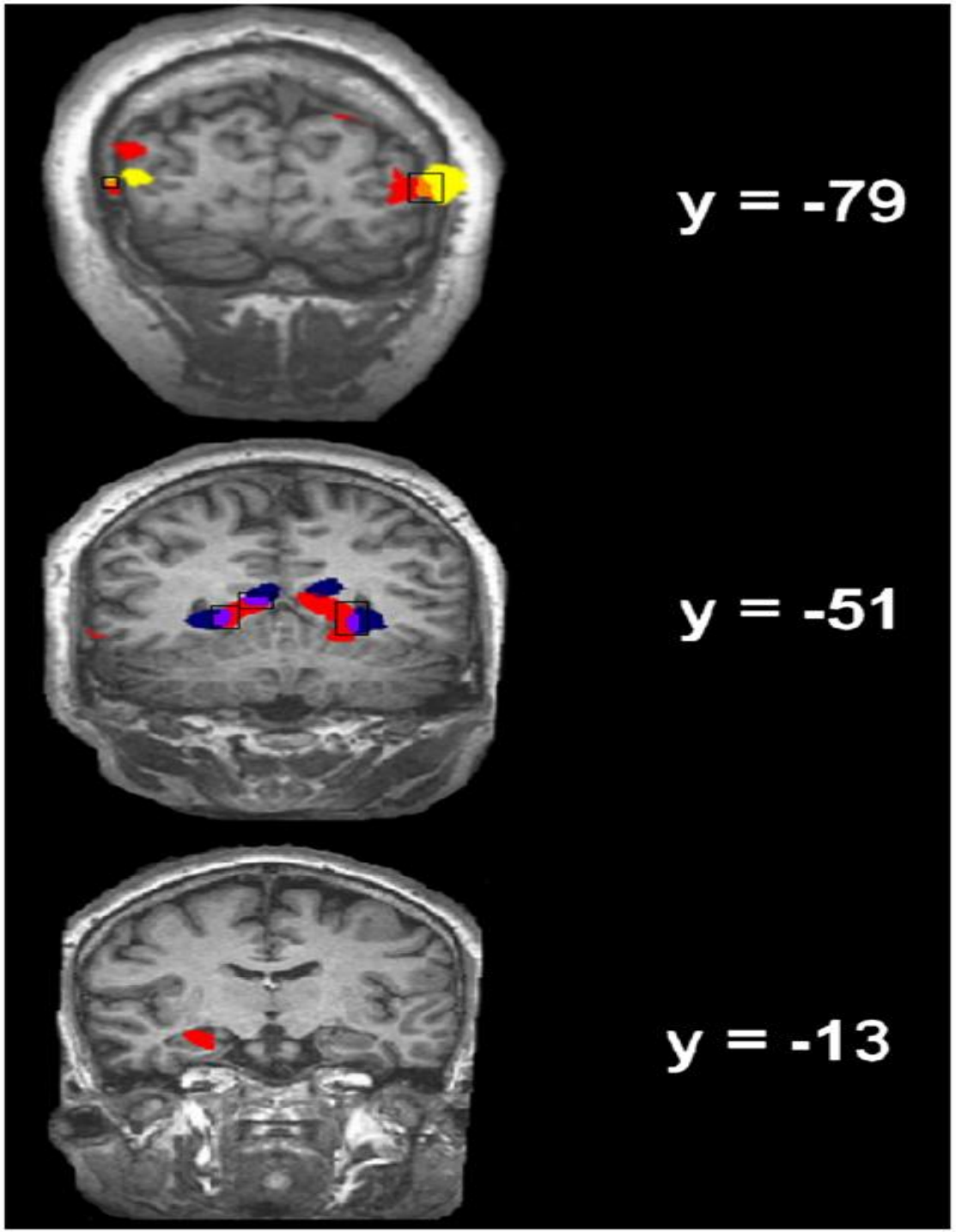
Areas that were active in both conditions appear as orange & yellow (Thompson & Kosslyn, 2000).

Visualizing movement

Coronal slices showing activity during hallucinations and localizer scans.

The images show the overlay maps (from top to bottom) at the level of the EBA (bilateral inferior temporal and middle occipital gyrus: y=−79), at the level of the PPA (parahippocampal gyrus: y=−51) and at the level of the hippocampus (y=−13).

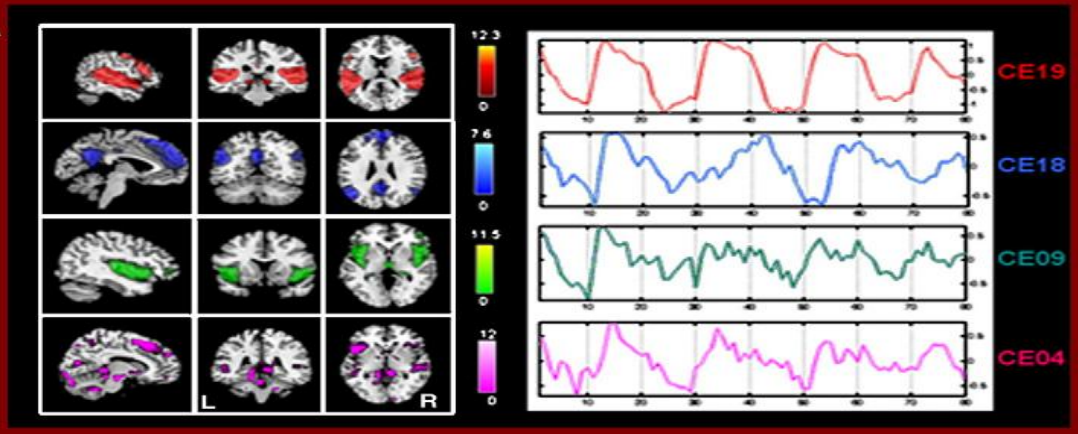
Visual hallucinations


y = -79
y = -51
y = -13

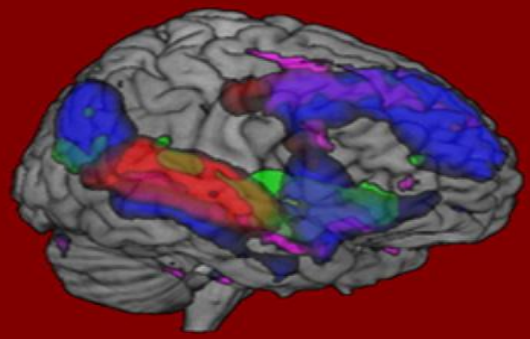
Color code: red=hallucinations; yellow=body localizer, blue=scene localizer; overlap hallucinations – body localizer=orange (marked with a black square in top image), violet=overlap hallucinations – scene localizer (marked with a black square in middle image). The left side of the images shows the right side of the brain.

Visual halluciantions

A



Controls N = 31



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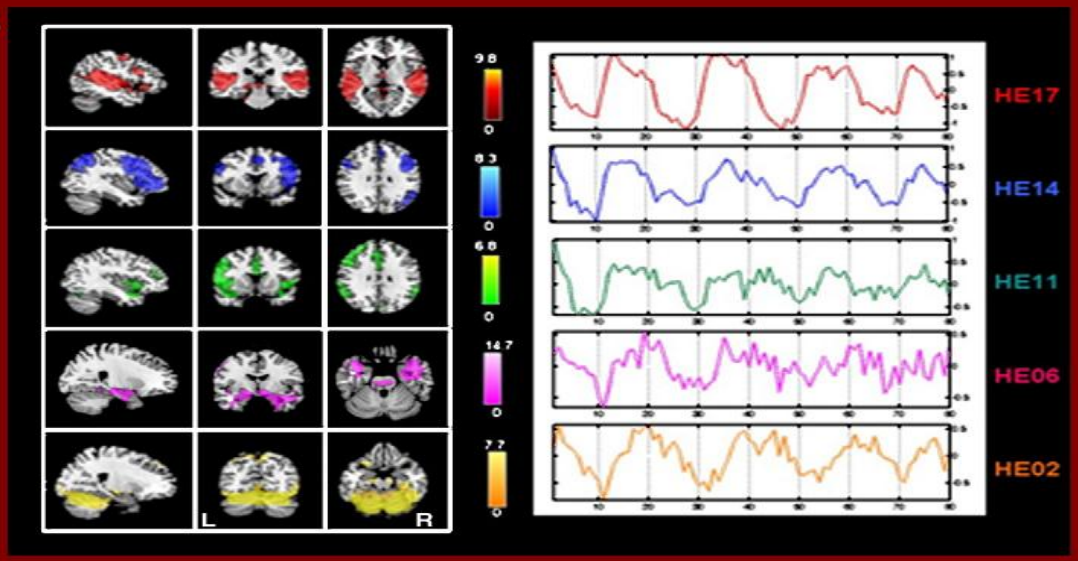
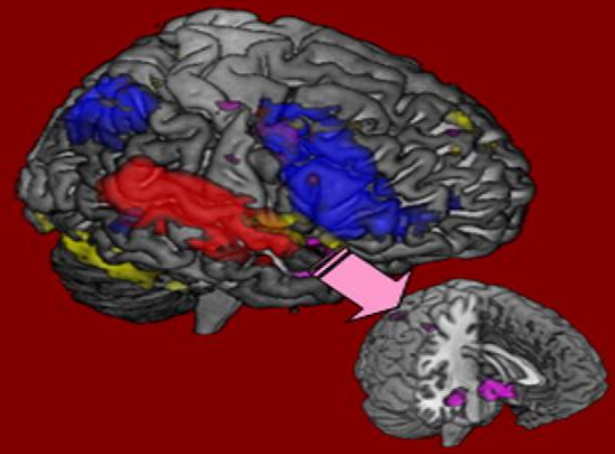


Schizophrenic with Hallucination
N = 27



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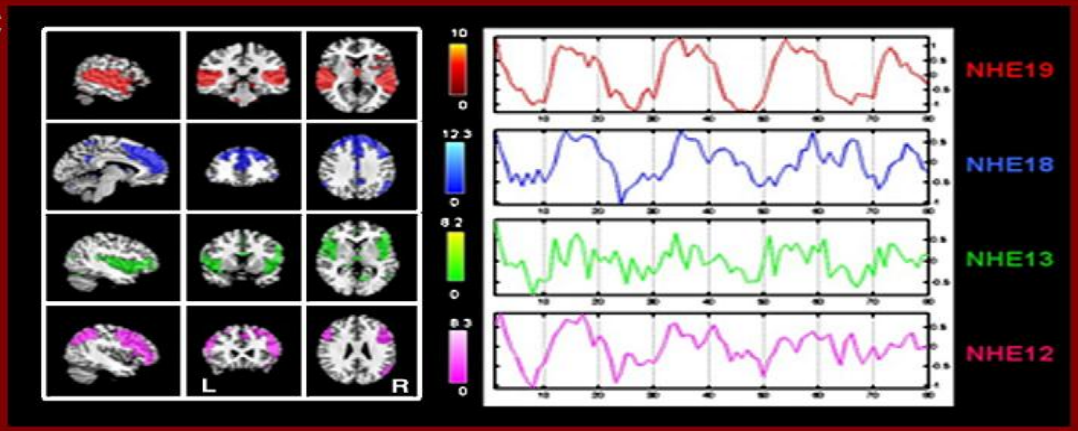
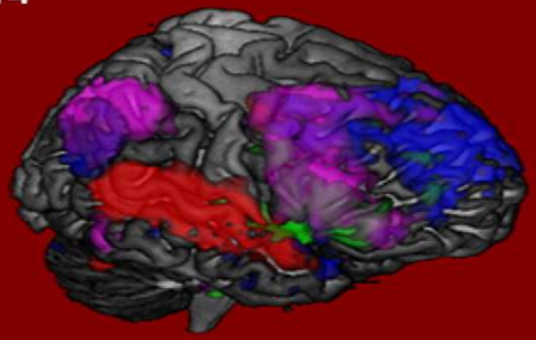


Schizophrenic without Hallucination
N = 14



Story, or narrative, is present in every age, every place, every society;

Story begins with the very history of mankind and nowhere is there a people without narrative.

All classes, all human groups, have their narratives, enjoyment of which is very often shared by men with different, even opposing, cultural backgrounds.

Roland Barthes

Defining Narrative:

A description of a series of actions and events happening to characters that unfold over time, according to causal principles.

(Graesser, Hauft-Smith, Cohen, and Pyles, 1980).

Defining Narrative

“A narrative is never made up of anything other than functions: in differing degrees, everything in it signifies.”

(Roland Barthes, 1982: 261).

Defining Narrative:

A story holds meaning and purpose, a point, a message, values, important instructions, and/or definitions.

(Graesser, Hauft-Smith, Cohen, and Pyles, 1980).

Defining Narrative

- Coherence
- Eiminating superfluous or tangential information.
- Logic (if *x* then *y),*
- Causal *(because x then y),*
- Temporal priority (first *x then y).*

*(Barthes, 1982; Dixon,*1996).

Defining Narrative

Basic elements of a story:

- Setting
- Agent (the hero)
- Goal (e.g., “to get the girl”)
- Obstacles (e.g. the presence of a rival)
- Facilitators (a sudden boost in status)
- Events (plot)
- Other characters (villains and helpers).

(Oatley, 1992; Peterson, 1999).

Defining Narrative

- The significance of an element in a narrative is determined by the goals and intentions of the story's characters.

Uniqueness of Narratives

Character:

- Intentional, autonomous agent who holds unique goals, and who acts and emotes in ways congruent with these goals.

Defining Narrative

- Ordinary interaction directs our attention to the assessment of the immediate goals of those with whom we interact (Yantis, 1996).

Defining Narrative

Narrative comprehension:

Requires the inference of intentions and goals through interpretation of the objects and episodes selected by the author.

Narrative Neuropsychology

Story evolved as the most efficient way for the brain to store and recall the massive amounts of information we must juggle to negotiate our being in the world.

Narrative Neuropsychology

Which has more information and is easier to remember?

Little Red Riding Hood, or

Your Credit Card Number?

Stories Provide us with a way to:

1) make our world more predictable,
2) to make some things seem more certain,
3) and to reduce the number of possible choices.

Narrative Neuropsychology

Stories help us to keep track of what is salient about an experience.

Narrative Neuropsychology

We form our sense of self as a story we tell about who we and others think we are.

Gergen & Gergen, 1988; Habermas & Bluck, 2000).

Narrative Neuropsychology

Reasoning proceeds by creating a story (theory) and testing its plausibility.

Narrative Neuropsychology

Future-oriented and distinctly non-traumatic personal narratives are associated with advantages for improved health. (King, 2001).

Narrative Neuropsychology

More coherent and organized accounts of past traumas are associated with greater healing potential
(Pennebaker & Graybeal, 2001; Pennebaker & Seagal, 1999; Smyth, 1998).

Narrative Neuropsychology

Creating a coherent story of a traumatic event and incorporating it into one's self-representation is fundamental for the successful treatment of post-traumatic stress disorder .

(Brewin, Dalgleish, & Joseph, 1996; Herman, 1992; van der Kolk & Fisler, 1995).

Narrative Neuropsychology

Jurors arrive at courtroom verdicts based upon the creation and coherence-testing of multiple different stories constructed to account for the presented evidence

(Pennington & Hastie, 1986, 1992).

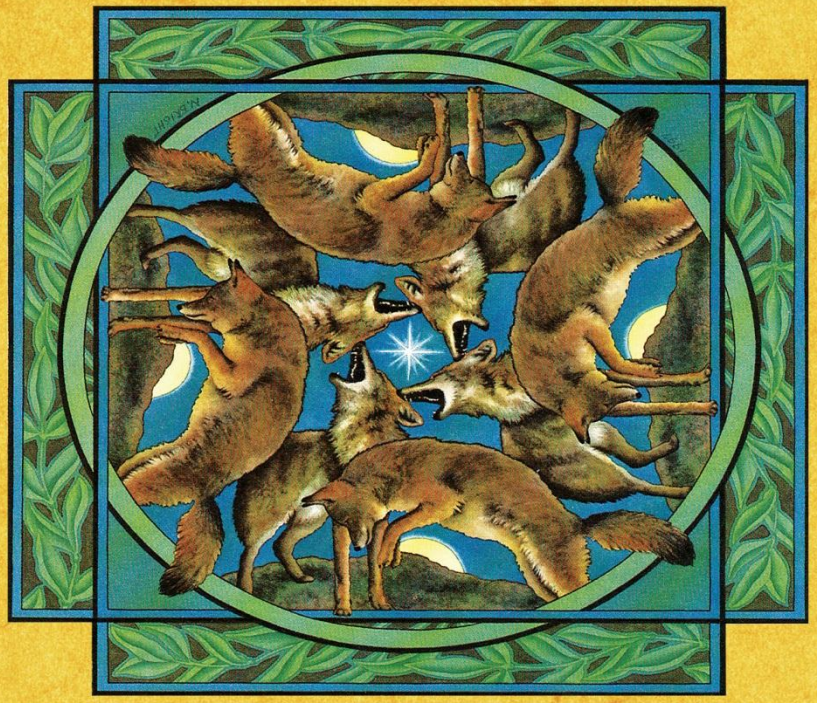
Uniqueness of Narratives

Only through stories can we create and share imagined worlds which mirror our own realm of sensory experience.

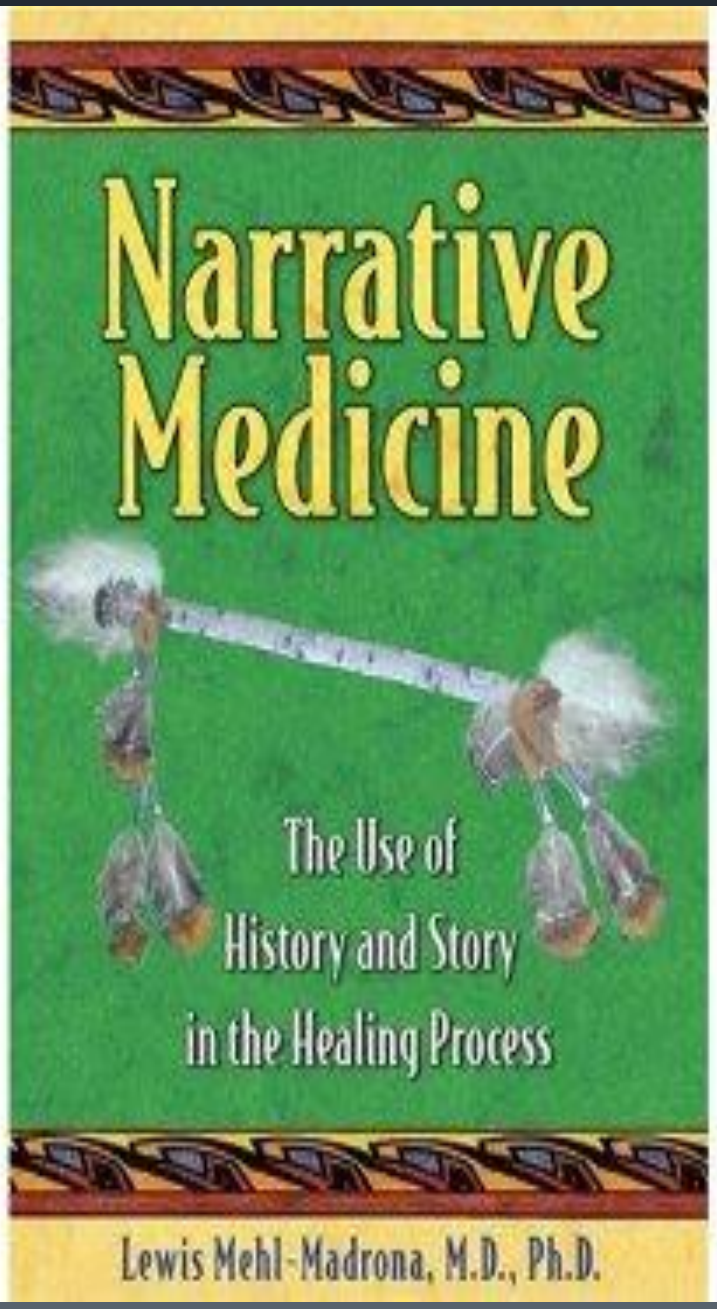
(Bruner, 1986; Gerrig, 1993; Graesser, Mills, & Zwaan, 1997; Oatley, 1999).

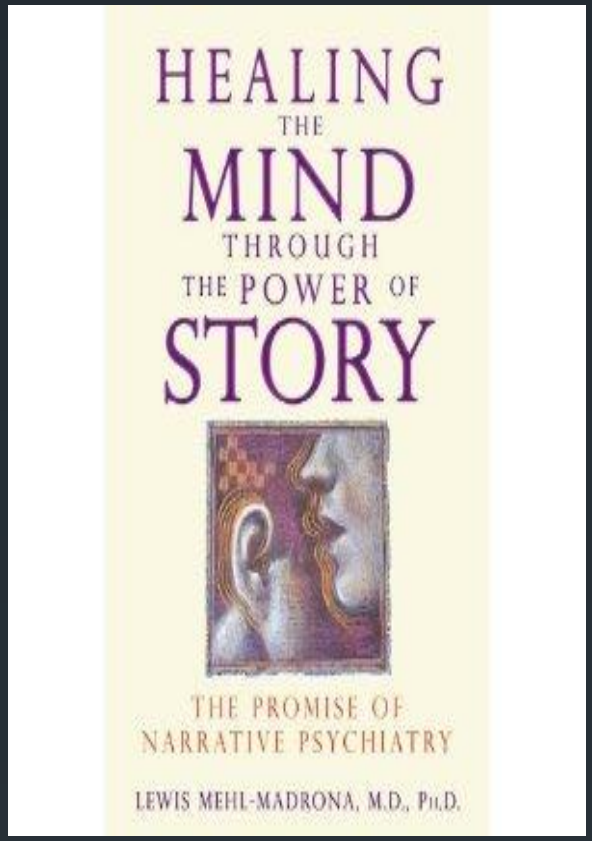
COYOTE WISDOM

The Power of Story in Healing



Lewis Mehl-Madrona, M.D., Ph.D.
author of *Coyote Medicine*


Narrative Medicine
The Use of History and Story in the Healing Process
Lewis Mehl-Madrona, M.D., Ph.D.



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