

User interfaces

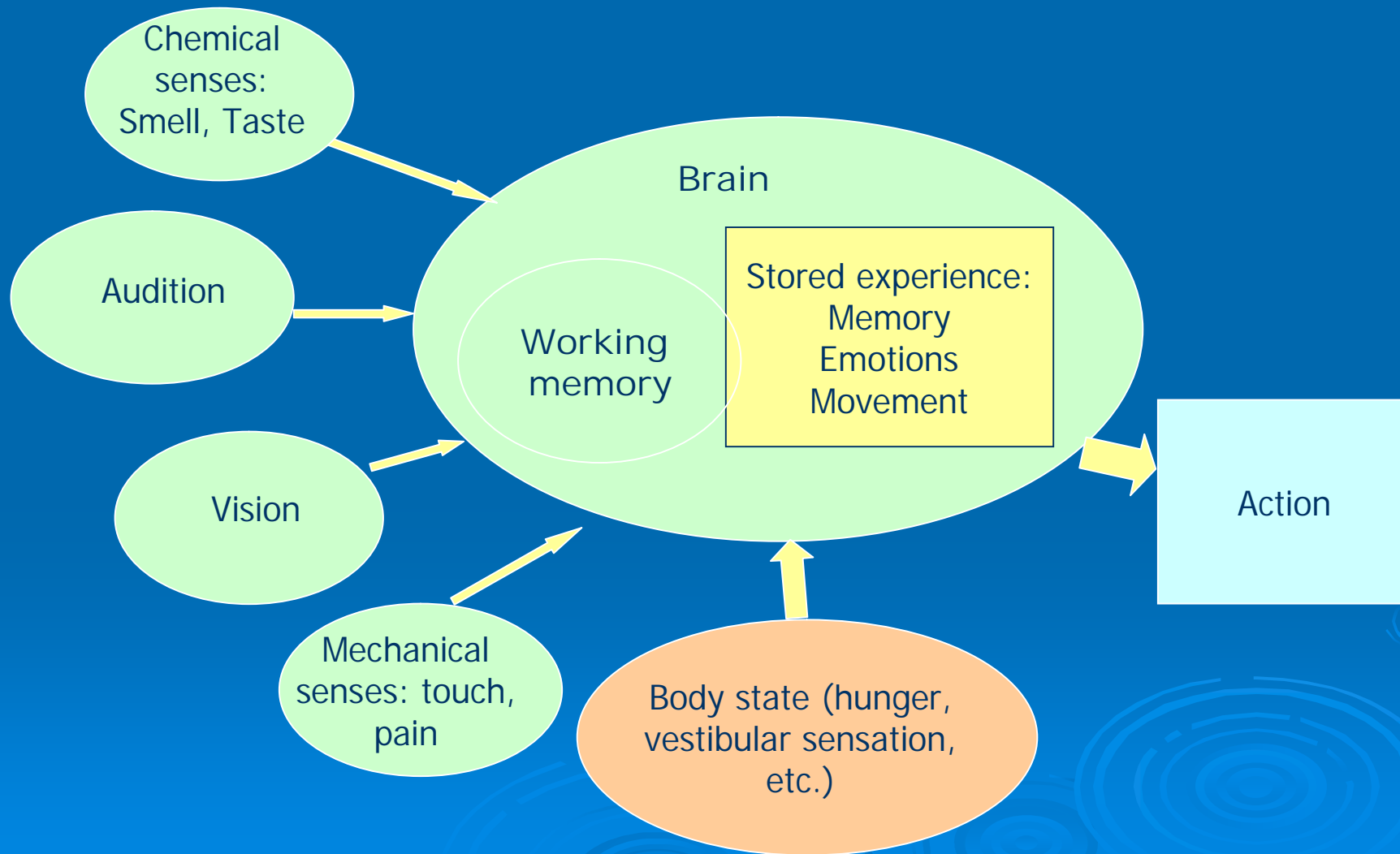
Brain and memory

2009

Jaana Holvikivi



Modalities: perception



Development of brain

- ∅ The process of neurogenesis populates the brain until the maximum number of neurons has been reached at age 2,
- ∅ then programmed cell death cuts the growing brain down to size.
- ∅ Learning creates new synaptic connections between neurons.
- ∅ During adolescence the brain goes through a process of synaptic pruning.
- ∅ Brain plasticity decreases in time, the localization of functions stays fixed in adults.

Spatial intelligence

- ∅ about half of brain cells (neurons) are specialized in motor control, movement
- ∅ about $\frac{1}{4}$ of neurons are involved in perception
- ∅ therefore, walking in nature (varied and demanding terrain) develops brain more than almost any other activity
- ∅ exercise: produces endorphins that make you feel good & helps in production of new neurons

Auditory and visual input

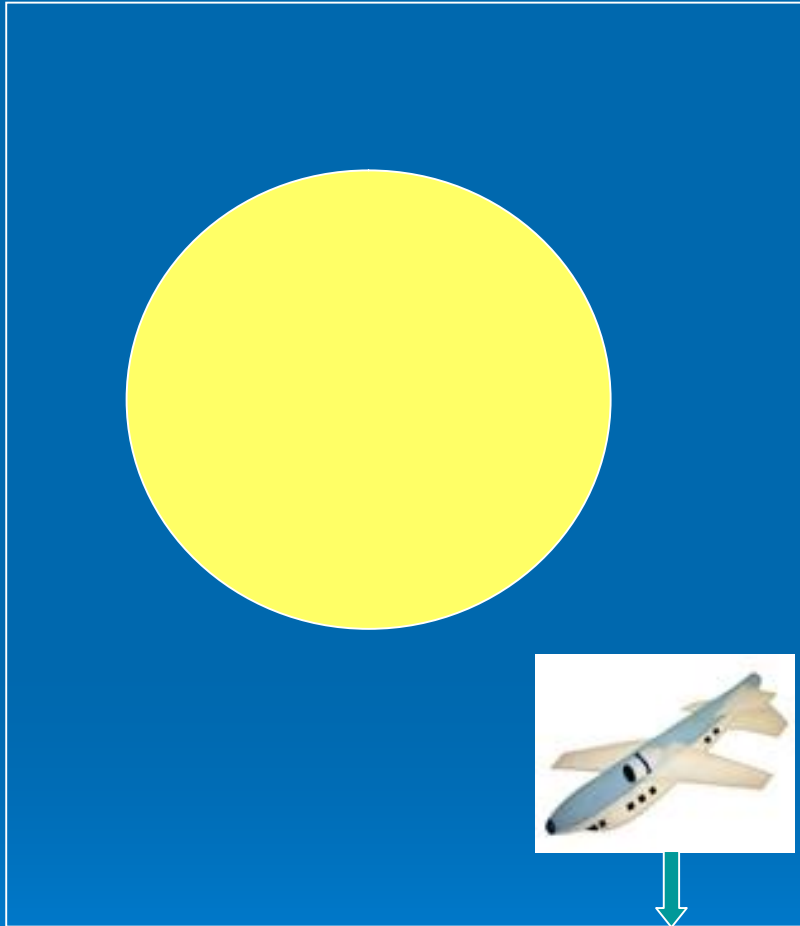
- ∅ Yakking drivers are four times more likely to crash their cars. Using a hands-free headset instead of handheld phone made no difference at all.
- ∅ The brain can be intensely aware of what is coming through either the eyes or the ears but not both at the same time.
(Certain brain regions were activated when subjects consciously chose to see; these were muted when they chose to hear.)



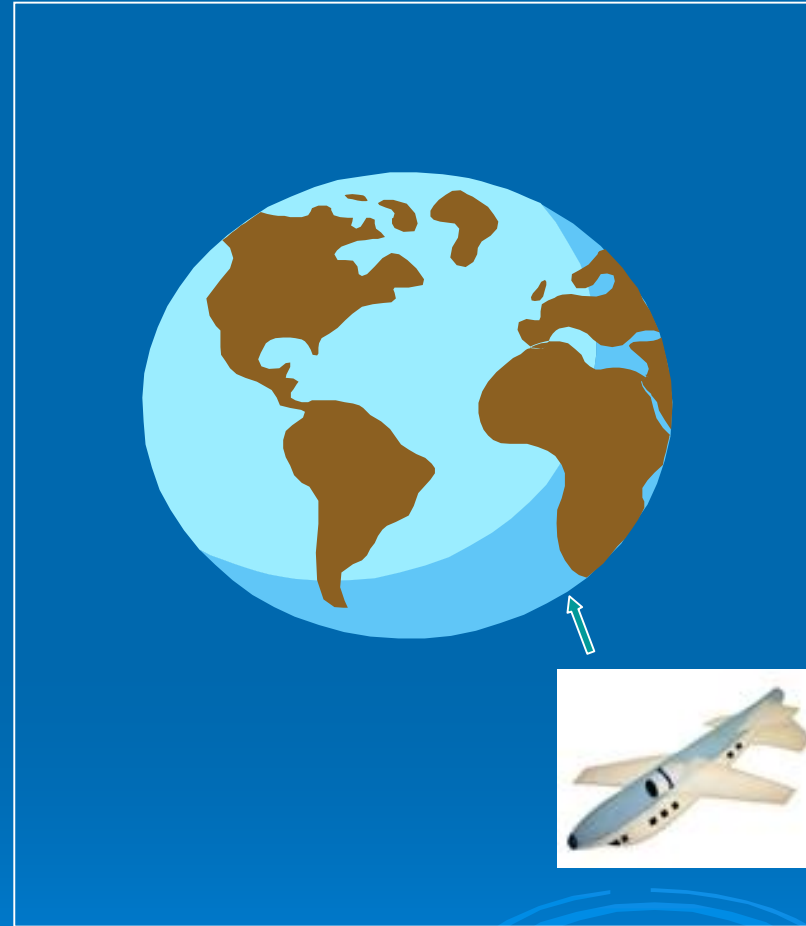
Auditory and visual input

- ∅ The use of sound during visual training can enhance later performance on a purely visual task, a finding that demonstrates just how much multisensory interaction occurs in brain areas that before now were thought to be dedicated solely to vision.
- ∅ Multisensory interactions can be exploited to yield more efficient learning of sensory information
- ∅ People can focus on more than three items at a time
 - | if those items share a common color like players in a football team. They perceive separate individuals as a single set. Color seems to be the easiest sorting tool.

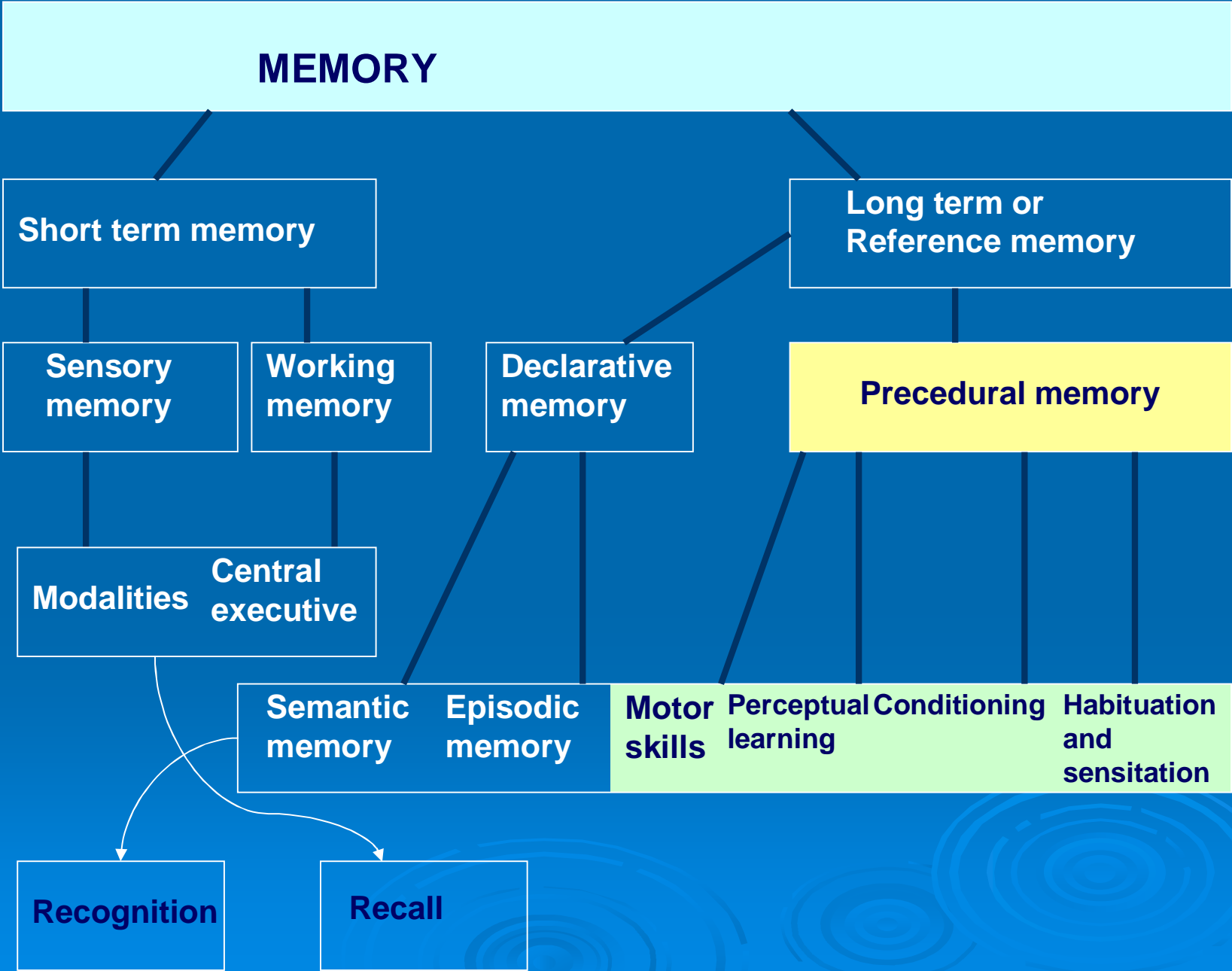
Which way does the airplane fall?



Mental framework 1



Mental framework 2



MEMORY

Short term memory

Long term or Reference memory

Sensory memory

Working memory

Declarative memory

Precedural memory

Modalities

Central executive

Semantic memory

Episodic memory

Motor skills

Perceptual learning

Conditioning

Habituation and sensation

Recognition

Recall

Improving memorizing

- ∅ Timing of activities is decisive when storing information to the memory.
- ∅ In an experiment, where fruit flies were trained to avoid a particular odor, it was found that massed training, giving the flies the same number of training experiences in rapid succession, did not produce an enduring memory;
- ∅ spaced training, with session intervals of 15 minutes, did produce.
- ∅ Distributed practice works better than massed practice.
- ∅ Spreading out your study is better than cramming.
- ∅ There is a specific time interval, about six to eight hours after training, when the neural activity is particularly strong, and lasting memories are formed.

Improving memorizing

- ∅ Memory consolidation takes place while we sleep, and it takes up to a few weeks of repeated rehearsal for the molecular reactions controlling gene and protein synthesis to record long-term memories.
- ∅ If the interval between rehearsal sessions is too long, the short-term memory will have weakened too much to benefit from repetition.
- ∅ Also, having a break and relaxing after intensive working often releases creativity and yields a solution to the problem under consideration.

Benefits of sleep

- ∅ stores memories
- ∅ helps to attain high level of concentration
- ∅ reduces stress
- ∅ combats obesity

Memorizing



- Ø Rats learn to navigate new spaces by replaying memories in reverse order:
- Ø After exploring an environment such as a maze, rats typically pause to eat, groom or rub their whiskers. Electrodes in rat's hippocampus monitored so-called place neurons, which fire in specific sequence as a rat navigates a path. When various rats paused on completion of a run, the place neurons fired in reverse order from the firing that had occurred during navigation. This reverse replay occurred more frequently after walking through new mazes than familiar ones, implying that the technique plays a role in learning.

Cognition and emotion

- ∅ Happiness and positive mood increases flexibility in problem solving.
- ∅ Affect, cognition, and motivation influence one another.
- ∅ Meaningful and emotional information is retained better in memory than purely factual information.
 - | It does not necessarily indicate, however, that the memories would be accurate in relation to factual events, especially if they are connected to strong feelings.
 - | Memories do change.

Cognition and emotion

- ∅ Stress weakens attention and working memory.
 - | It rises levels of noradrenalin, dopamine, and cortisol in the brain, and induce neuron destruction in hippocampus. The production of new neurons in hippocampus is also reduced under stress.
- ∅ Laughing has numerous benefits for health as well as learning.
 - | Laughing reduces stress because the level of cortisol is reduced and levels of epinephrine decrease.
 - | Laughing improves memory: Students who watched an episode of "Friends" after studying for an exam, got 20% better grades than the control group that did not have fun.

Music in brain

- ∅ Brain imaging studies: when people listen to music, the neural activation proceeds from the auditory system to regions related to planning, expectation and language as well as arousal, pleasure, mood and rhythmic movement.
- ∅ Music engages nearly every area of the brain.
- ∅ Music promotes cognitive development.
- ∅ Music reaches deep into the brain's most primitive structures, including the "reptilian brain" tied to motivation, reward and emotion.
- ∅ Music elevates dopamine levels.

Lying

- ∅ Pathological lying:
liars' brains had 22 % more white matter in the prefrontal regions that govern decision making and judgment. The excessive white matter creates an abundance of connections among otherwise contradictory, compartmentalized data.
- ∅ MRI scans of people lying in real time also point to excessive activation in the prefrontal lobes.

Expatriate creativity

- ∅ a study in 2009 in France/ US
- ∅ people who had lived abroad more consistently showed innovation and creativity
 - | in negotiations,
 - | in the use of ordinary items,
 - | in drawings.
 - | http://50.insead.edu/press_releases/insead-research-shows-going-abroad-linked-creativity

