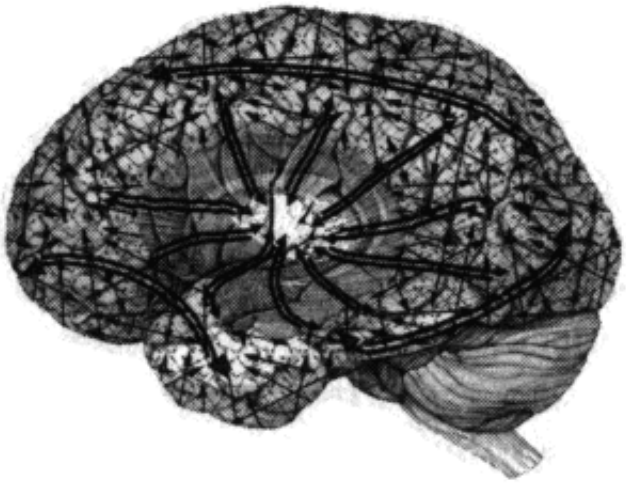
HOW THE BRAIN WORKS

"Three Topographical Arrangements" Model of Mind

Edelman & Tononi (2000) argue that the synaptic connections between different brain regions, including neural maps, consist of three broad neuroanatomical arrangements:



1. The thalamo-cortical system

A dense meshwork of "re-entrant" connectivity (reciprocal connections) between the thalamus & the cortex & between cortico-cortical fibres.

They have evolved to allow integration of different brain areas (neuronal maps).

Fig 1 (from Edelman & Tononi, 2000)

The brain specimen seen on left demonstrates the corona radiata, massive numbers of nerve tracts connecting the thalamus (central dissected area) & the cortex (peripheral areas).

All known connections between thalamus and cerebral cortex are reciprocal, two-way radiations (thalamocortical and corticothalamic), and they contribute conspicuously to the formation of the internal capsule and corona radiata.

Fig 2 (from Virtual Hospital)

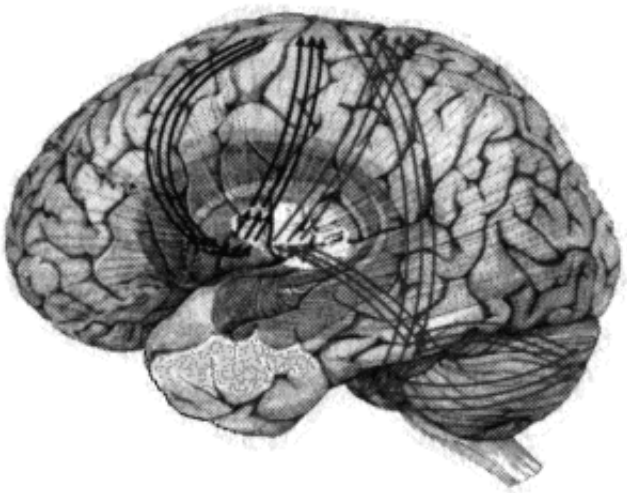


Fig 3 (from Edelman & Tononi, 2000)

2. The cortical "appendages"

Long, polysynaptic loops arranged in parallel extending from cortex to basal ganglia, hippocampus & cerebellum, then returning to the cortex

The basal ganglia are involved with emotional & motor processing. The hippocampus is involved with memory storage. The cerebellum is involved with cognitive & motor coordination.

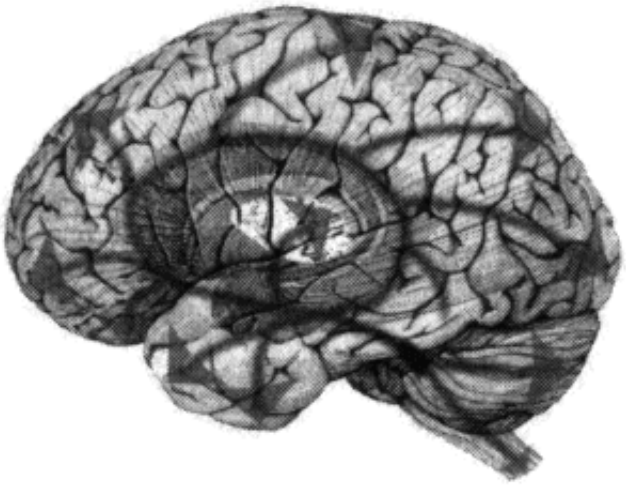


Fig 4 (from Edelman & Tononi, 2000)

3. The "value" systems

A "hairnet" of neural circuits extending from the brain's brainstem and diffusely projecting all over the brain.

They include the noradrenergic, cholinergic, serotonergic, histaminergic & dopaminergic nuclei and their branching fibres.

Each of these systems modulate synaptic function, with only a few thousand neurons giving rise to vast meshwork of axons blanketing the entire cortex and the cortical "appendages", potentially influencing transmission at billions of synapses over all levels of the CNS.

The circuits may have evolved to continually signal information about the ongoing behavioural state of the organism (e.g. sleep, waking, exploration, grooming) & the sudden occurrence of events that are salient for the entire organism (e.g. novel stimuli, painful stimuli, rewards). They are perfectly poised to signal the occurrence of important events to the organism.

They can alter the probability of strengthening or weakening of synapses will occur to neural activity. These systems provide "constraints", providing a basis for the development & refinement of brain-based categorisation & action within a species.

They are thus like the "gears" of the brain engine. Unlike mechanical gears, however, which would leaded to a narrow repertoire of stereotyped responses, value systems are almost certainly *modifiable*. Edelman & Tononi speculate that the various value systems may work together to affect brain action by interacting in combination (Edelman & Tononi, 2000).

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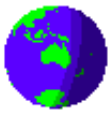

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