

# Models of consciousness and clinical implications

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In animal life computations are needed: nature has evolved

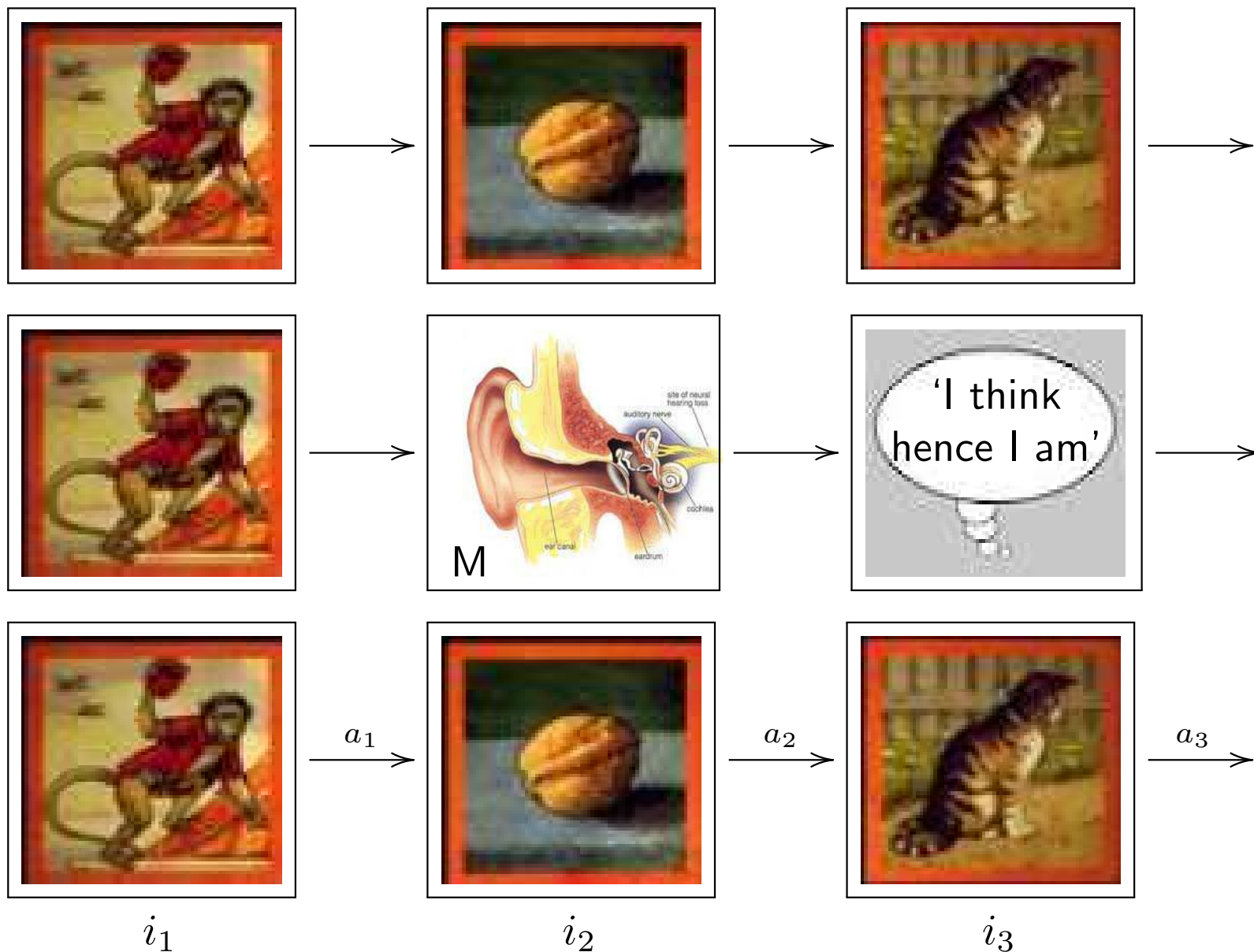


an electro-chemical computational model

neural net                      synapse

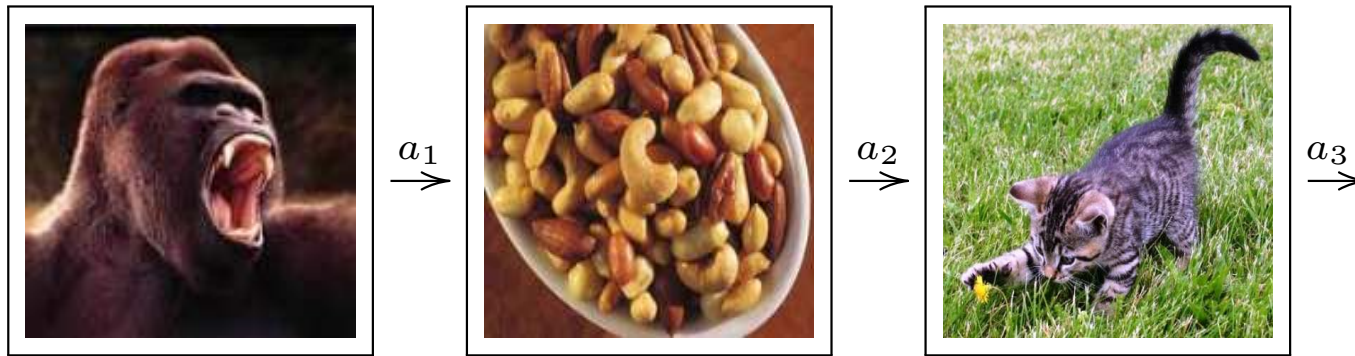
These are programmed by trial and error  
are trained through evolution via **genes**  
run in parallel and are remarkably efficient

Lehmann mental atoms



$i$ : input,  $a$ : action

Too much restricted (stimulus-response of behaviourism)  
in this way the same input results in the same action



$(i_1, s_1)$  fear

$(i_2, s_2)$  greed

$(i_3, s_3)$  joy

Now the transitions can be subject to theory

States exist mathematically (cf kinetic theory of gasses:  $s \in \mathbb{R}^{6 \cdot 10^{23}}$ )

We can't fully determine states, but can *reason* about them

States more than input determine what happens

States determine whether we are e.g. creative, destructive, or hesitant

in short: states determine us, but we cannot directly determine our states!

In mathematics and cybernetics the notion of state is simple, essential and effective

Proposal: also in the study of the mind/brain we need an abstract notion of state

The notion of state includes notions like mood, motivation, intention, ...

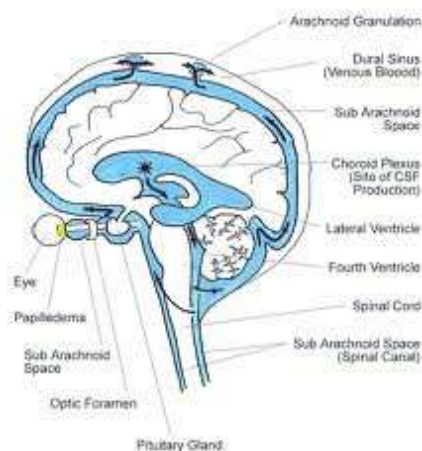
A state has three aspects

state  $\left\{ \begin{array}{l} 1 \text{ phenomenological} \\ 2 \text{ behavioural} \\ 3 \text{ neurophysiological} \end{array} \right.$

Possible implementations of states (aspect 3):

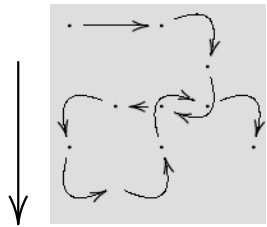
- collaboration between frontal lobe & amygdala Salzman-Fusi [2010]
- volume transmission through the cerebrospinal-fluid Veening-Barendregt [2010]

ventricle system



- acquired associations
- ... (how is mindfulness implemented?)

Dynamical system: Every point  $.$  stands for a triple  $(i, s, a)$



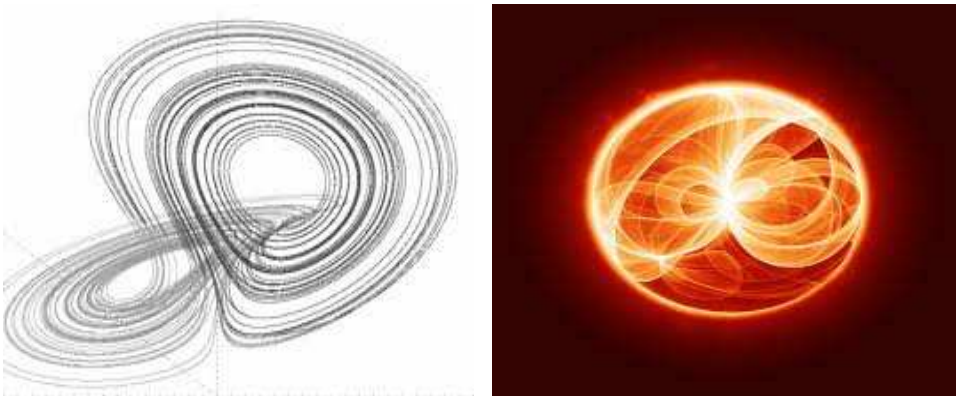
the unlimited input and action possibilities make the stream quite varied (almost always somewhere else)

Nevertheless there are strange attractors

We may walk in (vicious) circles and get stuck

input dependent (agoraphobia)

or input independent (depression)



Insects orient themselves on the sun/moon; but also on a candle

Mental balance

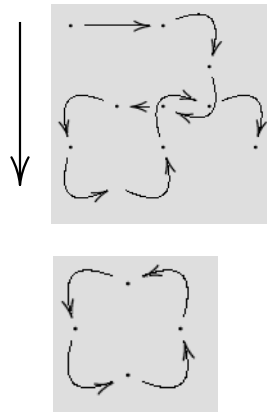
aversion, desire

mindfulness

Fundamental **instability** of mind → existential fear or ‘attachment’

**Craving** for symptomatic stabilization (with **side-effects!**)

Decreasing frequency of **addictive states** by



dynamical system view

- sensory restriction
- mental restriction: attention on present input using mindfulness taking distance from  $(i, s, a)$
- insight in our vicious circles: deautomatization

- Rosenkrantz [2003] • improved immune system
- Jha [2007] • better handling of disturbances  
>>>>> versus <<><< (is middle one going L or R?)
- Pagnoni [2008] • decreased attachment to words
- MacLean [2009] • keeping up discriminability  
  
|  
versus  
|
- Jha [2009] • keeping up memory under stress
- vd Hurk [2010] • less startle (more equanimity)
- van Vught [2011] • increased memory for subtle visual details
- Jacobs [2011] • less ageing



- Lutz [2004] • considerably increased  $\gamma$ -rhythm correlating with declared serenity
- Lazar [2005] • increased cortical thickness (insula)  
decreased decline of thickness over lifetime
- Brewer [2011]  
Killingsworth [2010] • less activity in *default mode network* ('self')  
so more happiness (self-reported)
- Choi [2011] • happier look (rated by outsiders)
- Poulin [2013] • more altruism, correlating with  
increased stress immunity and density gray matter

- Teasdale [2000] ● Half relapse rate into depression in patients in remission
- Schoenberg [2011] ● In ADHD patients decreased error-related negativity
- van Aalderen [2012] ● Also improvement on currently depressed patients
- van Ravesteijn [...] ● Decrease of stress by unexplained symptoms

Tendency toward psychosis seen as contra-indication

Clinical	Meditation
Loss of self	<i>There is seeing but no seer</i> <i>There is doing but no doer</i>
stroboscope view	constant flux
confusion	<i>Cannot say that there is an "I"</i> <i>Cannot say that there is no "I"</i>

The "I" is not a thing but a process

Meditation in a friendly safe environment

aims at the change of view

Can elements from meditation be used to improve schyzophrenic conditions?

Care should be taken for traumatic associations from the past