Two types of mathematical formalism for two types of systems

component dominant dynamics

Jakob Bernouiili (1654-1704): [The application of the Law of large numbers in chance theory] *to predict the weather next month or year, predicting the winner of a game which depends partly on psychological and or physical factors or to the investigation of matters which depend on hidden causes, which can interact in a multitude of ways is* ***completely futile!****"* Vervaet (2004)

A system is ***ergodic*** *iff:*

The averaged behaviour of an observed variable in a substantial ensemble of individuals (space-average) is expected to be equivalent to the average behaviour of an individual observed over a substantial amount of time (time average)

f.i. Throw 100 dice at once, and then throw 1 die 100 times in a row… The expected value will be similar for both measurements

interaction dominant dynamics

Deterministic chaos (Lorenz, 1972)
(complexity, nonlinear dynamics, predictability)

Takens' Theorem (1981)
(phase space reconstruction)

Systems far from thermodynamic equilibrium
(Prigogine, & Stengers, 1984)

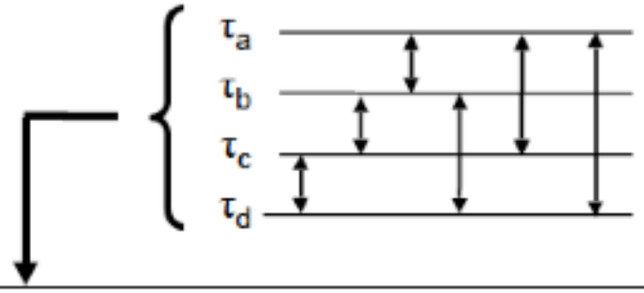
SOC / $\frac{1}{f^{\alpha}}$ **noise** (Bak, 1987)

(self-organized criticality, interdependent measurements)

Fractal geometry (Mandelbrot, 1988)
(self-similarity, scale free behaviour, infinite variance)

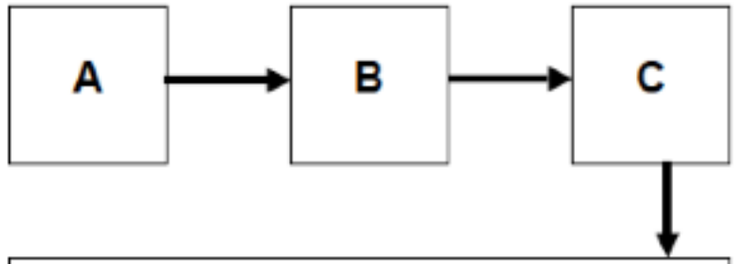
Aczel's Anti-Foundation Axiom (1988)
(hyperset theory, circular causality, complexity analysis)

Interaction dominant dynamics



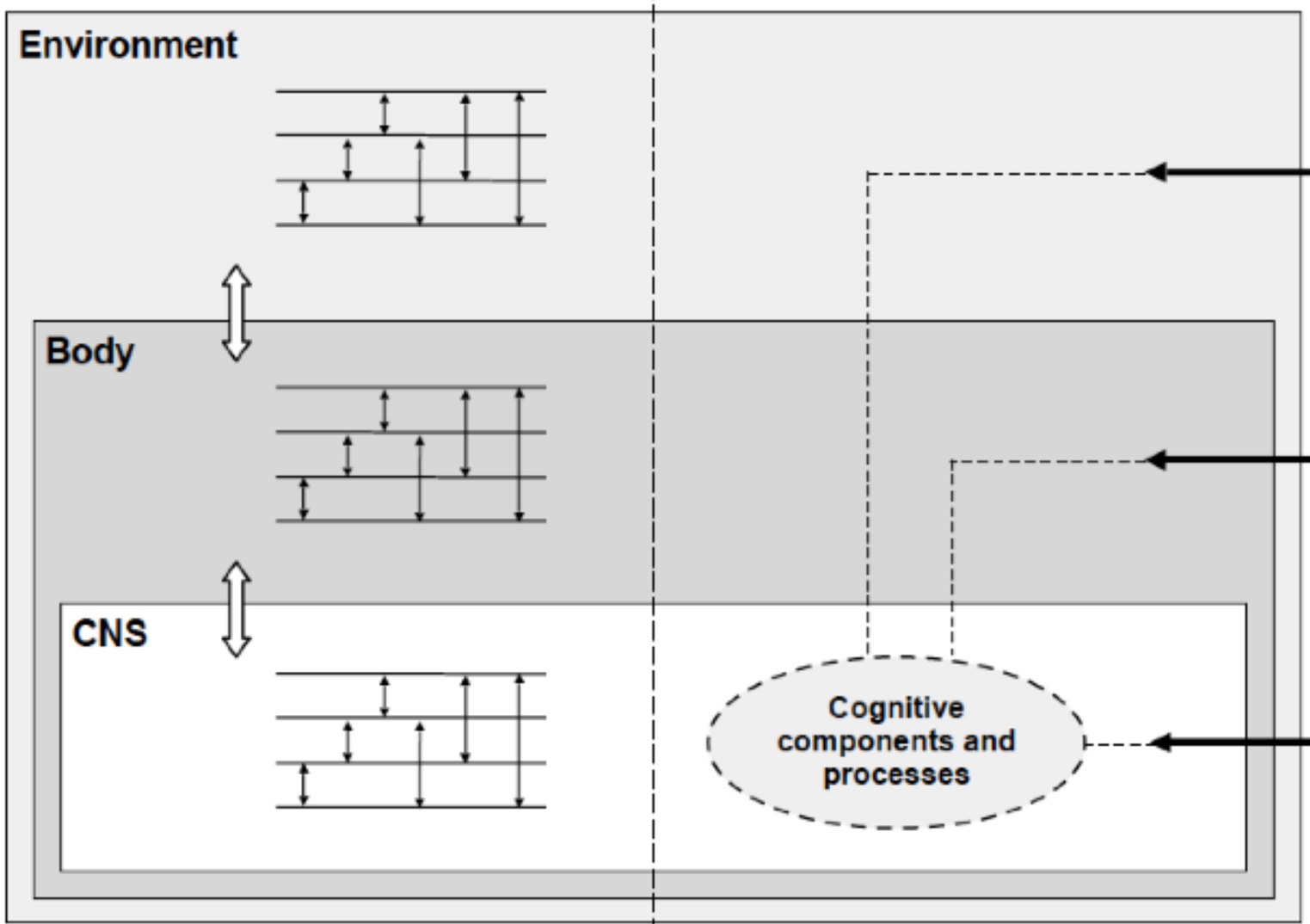
Behavior emerges from interaction between many processes on different timescales in body and environment

Component dominant dynamics



Behavior is the result of a linear arrangement of a virtual architecture of cognitive components and processes

Place of measurement of efficient causes



Environmental factors, Performance and perception measures, Social interactions, ...

Genetic, immunological, endocrine systems. Biophysical composition, physiology, Organic chemistry, ...

Structure and function of the cortex, cerebellum, brainstem, neural pathways. Neurochemistry, ...