

# **MEMORY EVOLUTIVE SYSTEMS (MES):** **an integrative dynamic multi-level approach to** **individual and collective cognition**

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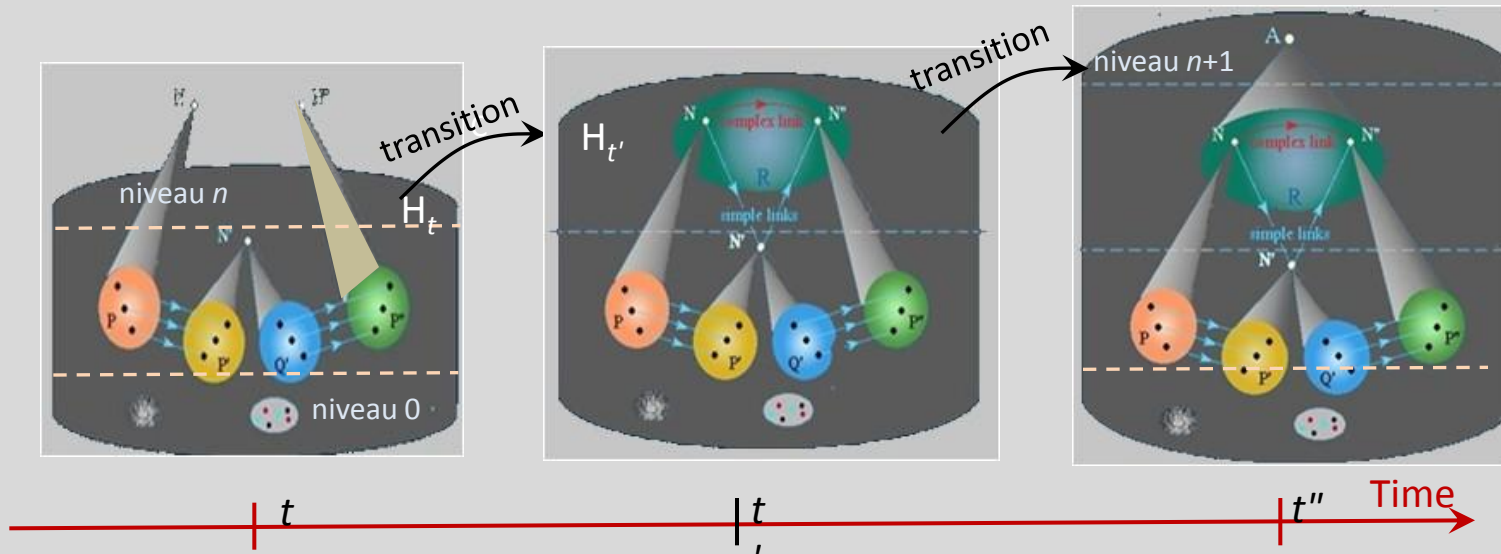
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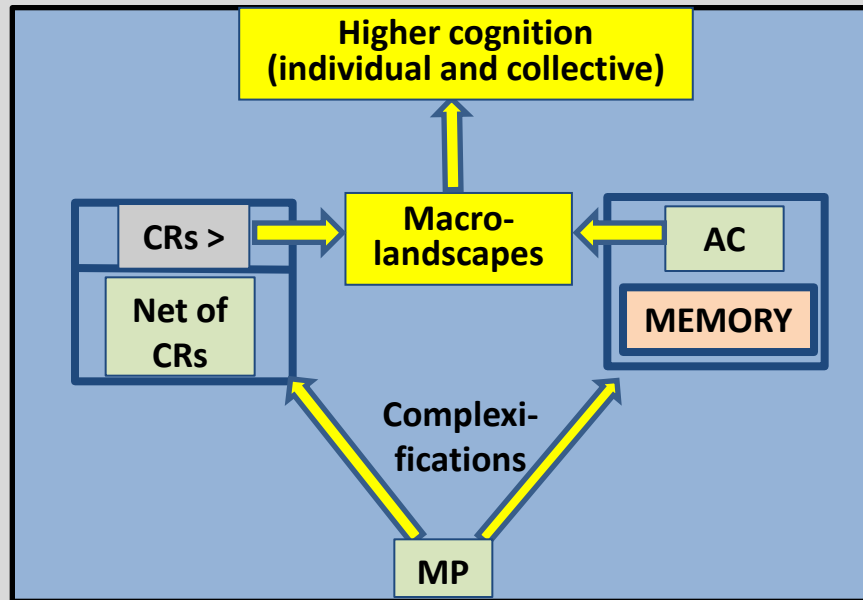
- Problems raised by cognitive systems: multi-level integration; formation of global dynamics merging the local dynamics of heterogeneous agents; emergence of flexible higher cognitive processes.
- MES (Ehresmann et Vanbremeersch (1991, 2007) propose an internal relational approach to these problems for multi-scale complex systems. They are based on a 'dynamic' category theory.

## MES: THE BECOMING AT WORK



- A MES is a multi-level evolutionary system  $\mathbf{H}$ . Its configuration at  $t$  is represented by a **hierarchical category**  $H_t$  where an object  $N'$  aggregates (= is the colimit of) at least one pattern  $P'$  of interacting lower level objects.
- The **transition** from  $t$  to  $t'$  depends on changes of the types: addition or suppression of components, aggregation of some patterns  $P$ . It is generated by *complexification* processes (explicitly constructed).
- A MES has some flexibility thanks to the **Multiplicity Principle** (MP): there are **multi-faceted** components  $N$  aggregating non isomorphic lower levels patterns between which they can switch. MP allows the development of a robust and flexible *memory* uniting the individual and collective knowledge.

## DYNAMICS ALLOWING FOR HIGHER COGNITION

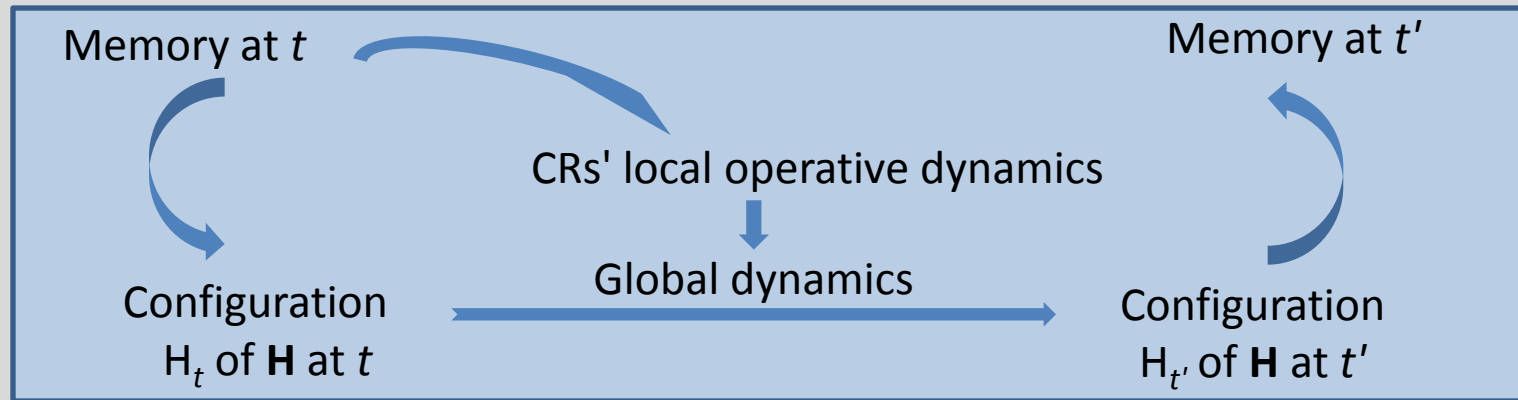


A MES is self-organized by a net of internal agents, the *co-regulators* (CRs). Each CR has its own rhythm and logic. At each step it forms its landscape in which it develops a local operative dynamic with the help of the memory. The global dynamic results from an 'interplay' among the (possibly conflicting) operations of the CRs.

**EMERGENCE THEOREM.** *MP gives flexibility to the interplay among CRs and allows the emergence over time of components of increasing orders.*

- MP leads to the development of a strongly connected higher order subsystem of the memory, the **Archetypal Core**. This AC generates the formation of *macro-landscapes* in which higher 'intentional' (human or not) co-regulators can cooperate for developing higher order individual and collective processes, e.g. (collective) intelligence, innovation, anticipation and creativity.

## CONCLUSIONS AND FUTURE DEVELOPMENTS



- **Theorizing beyond problem-solving:** MES conceptualizes individual and collective higher cognition beyond the “perception-action loop” to include, e.g., experience, emotions or non-conscious processes.
- **Integrating multidisciplinary studies:** MES have been developed in the fields of neuroscience (‘MENS’), biology (with P. Simeonov), creativity (with IRCAM), and innovative design and prospective (with M. Béjean).
- **Creating synergies for innovative engineering:** MES’s potential for stimulating innovative engineering is being explored (e.g. with CNES in space complex systems). *New partners are needed to go further.*