

Anticipatory Systems(Prolegomena)

by Rosen, R. 2012

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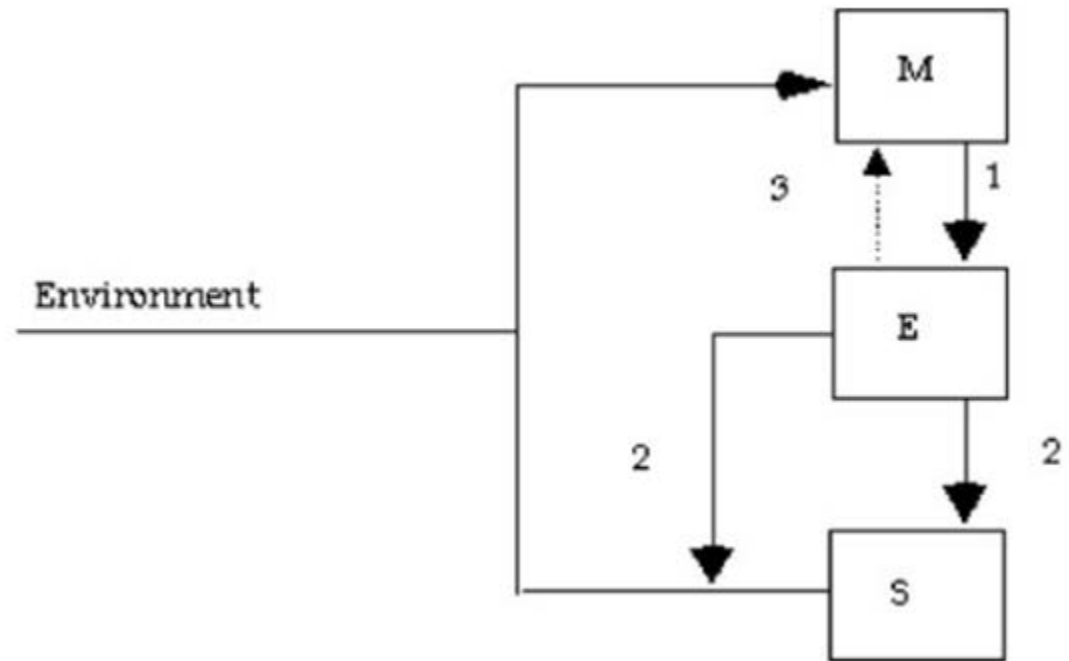
Beyond Reductionism

- The measurement aspect, the anticipation aspect (influenced by the experience of measurement), and the overarching understanding of the living(as open, learning, on faster time scale, etc.) are tightly connected
 - (e.g.) Stone falling versus. Cat falling

Beyond Reductionism

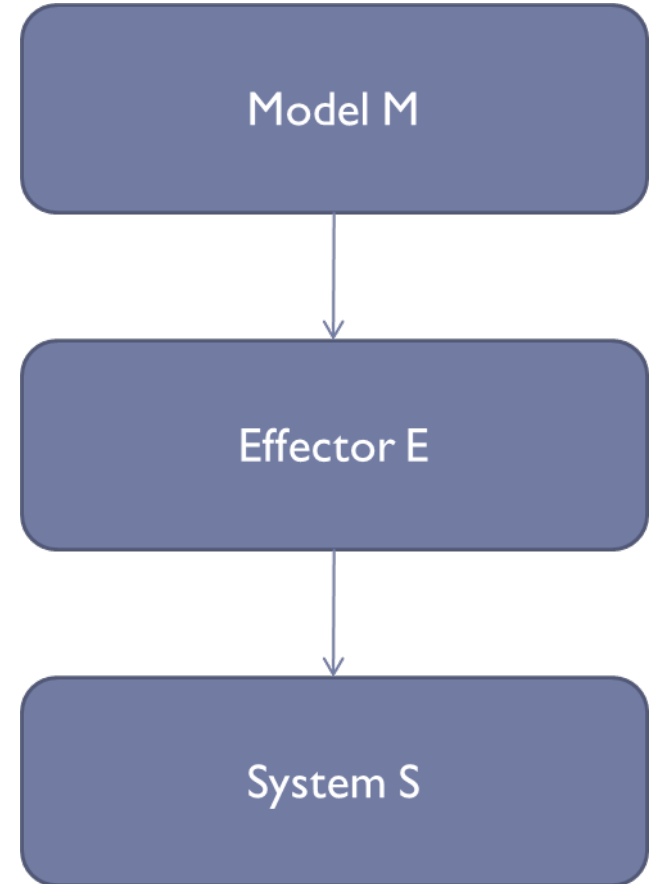
■ A model of Anticipation

Fig. 2 Rosen's model of anticipation



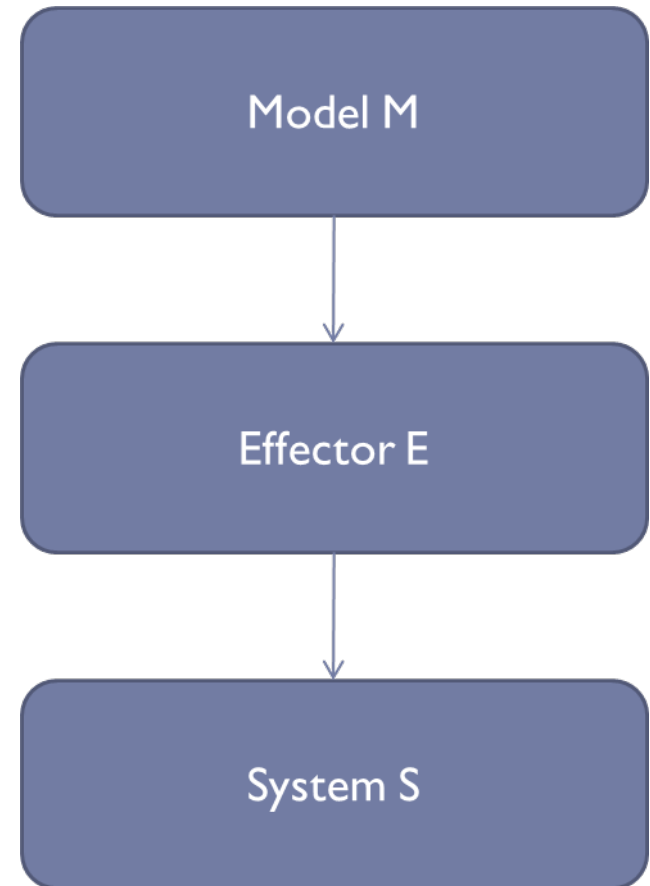
A model of Anticipation

- The system S may be an individual organism, an ecosystem, a social or economic system.
- A second system, called a model M of S , is then associated with M .
- The only preliminary condition that must be assumed is that the dynamic evolution of M proceeds faster than the dynamic evolution of S .



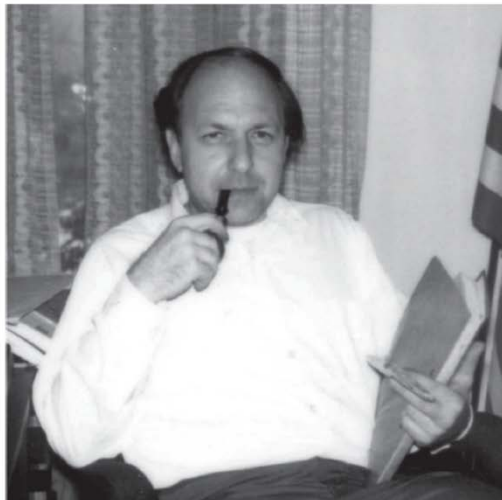
A model of Anticipation

- The real novelty arises when we assume that M and S can **interact with each other**
- From S to M = updating or an improving of M (skipped)
- From M to S
 - In order for M to affect S, M must be equipped with a set of effectors E
 - which allow M to operate on S in such a way as to change the dynamics of S



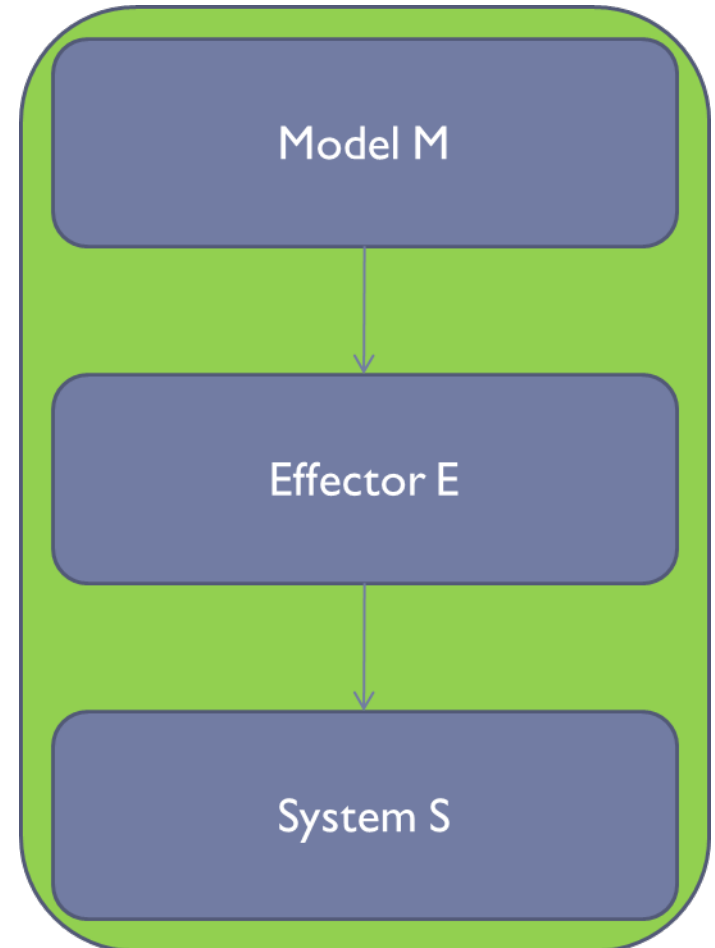
A model of Anticipation

- Consider **S+M+E** as parts of one single system
- This is an anticipatory system in which modelled future behaviours determine present states of S



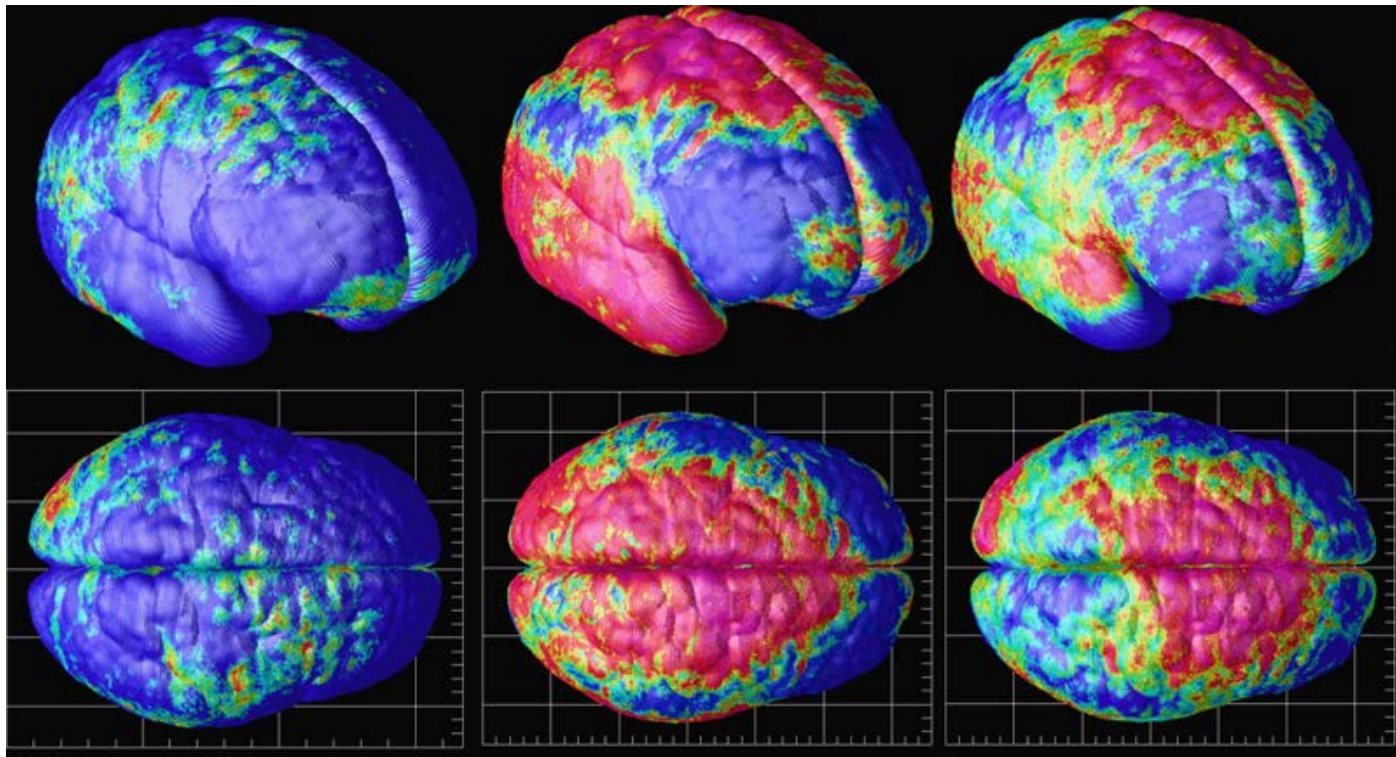
Robert Rosen (1934-1998)

“An anticipatory system is a natural system that contains an internal predictive model of itself and of its environment, which allows it to change state at an instant in accord with the model's predictions pertaining to a later instant”



Computation and Anticipatory Processes

- Re-resentations of world are always incomplete; it processed in an algorithm driven computation or in some non-algorithmic computational process



Computation and Anticipatory Processes

- Re-presentation of things is subject to processing and understanding, not things themselves
- Re-presentations are renewed presentations from the dynamics in which they are involved
- Re-presentations can be of various degrees of ambiguity-from very low(indexical signs) to very high(symbols)
 - Lightning versus. Black cat

Computation and Anticipatory Processes

- Machines operate also on representations
- But, if we expect a certain output, we have to provide representations that are unambiguous
 - Visualization of a process
 - Processing of a matrix
- The living operates, most often effectively, with representations regardless of their ambiguity.

Computation and Anticipatory Processes

- Rosen ascertained that the living is **not representable through a computational process**
- The living is not reducible to a deterministic machine, no matter how sophisticated such a machine might be.

Computation and Anticipatory Processes

- In general, to represent life is to represent something that is in process, changing all the time
- we can model/represent every oil spill that has already occurred, but not anticipate accurately the one that will happen next
 - We can similarly model every terrorist attack, and every financial crisis, etc.
- we cannot build a machine some cases
 - Extreme events, disease, art creation, Shakespeare's writing, etc.

Law of Nature vs. Expressiveness. Generality vs. Singularity

- What is the nature of the relation between two systems that allows us to assert that one of them is a model for the other?

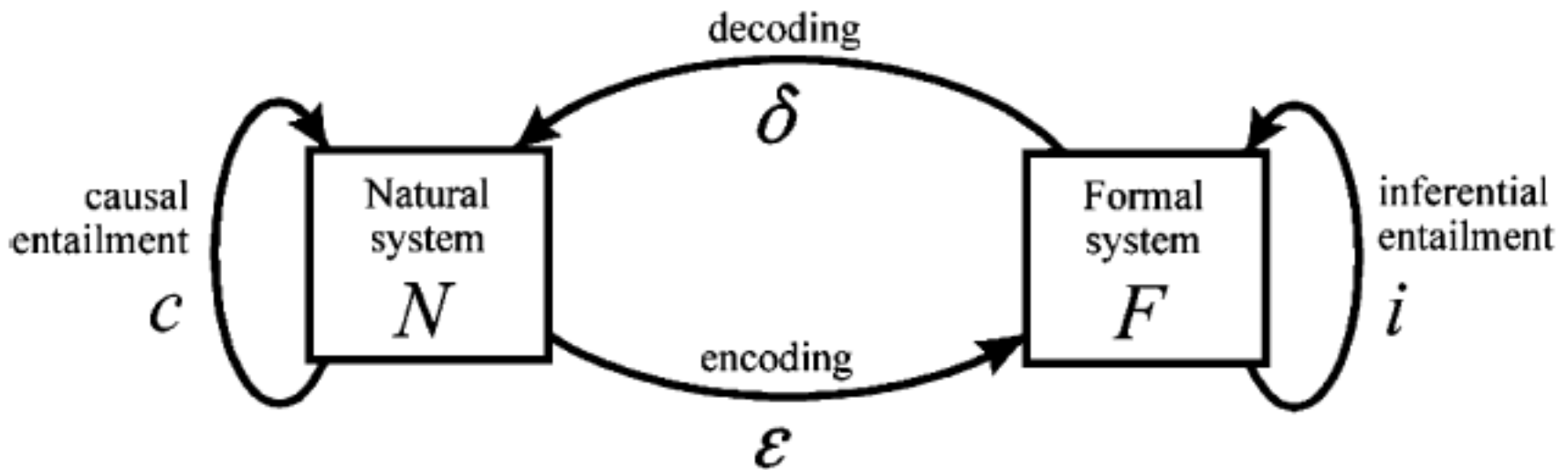
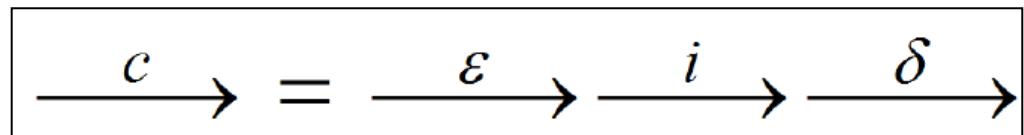


Fig. 5 Revised modeling relation

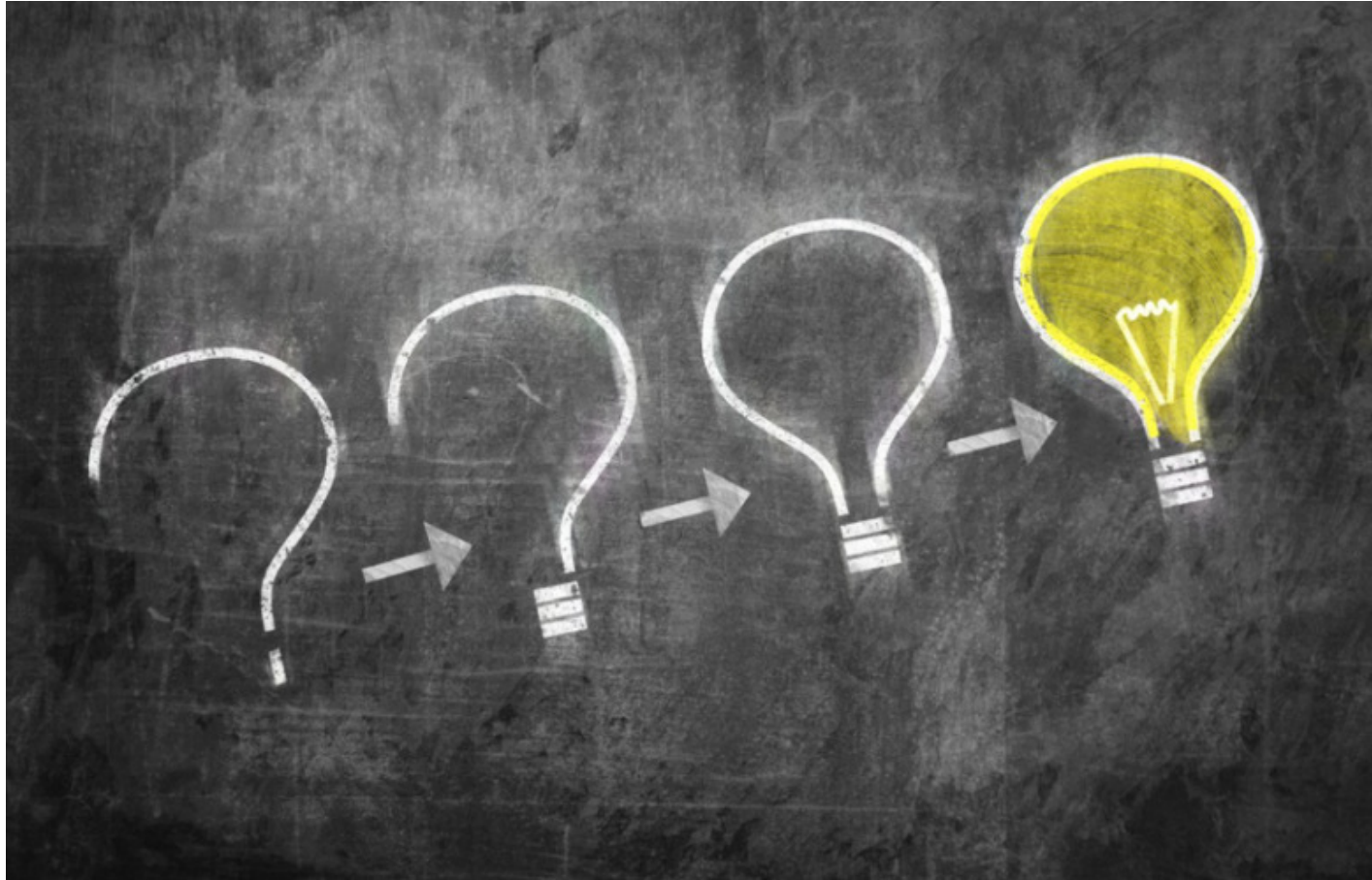


Law of Nature vs. Expressiveness. Generality vs. Singularity

We seek to encode natural systems into formal ones [such that] the inferences or theorems we can elicit within such formal systems become predictions about the natural systems we have encoded into them (p. 74 of the original edition).

- “The point of view I have taken over the past 25 years is that the way we look at systems is no different than the way we look at each other . . . dynamic interactions between the (systems) are cognate to our own observing process.”

Any questions?



(Credits) A. H. Louie, Robert Rosen's anticipatory systems, 2010
<https://www.researchgate.net/publication/228091658>
, Roberto Poli, Evolution and Anticipation

Appendix.

Introduction



Robert Rosen (1934-1998)

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