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*The impact of the paradigm of complexity on the foundational frameworks of biology and cognitive science*

For centuries biological and cognitive systems have been studied by analytic decomposition, trying to determine how their parts are arranged so as to generate an observed behavior, in a similar way as the parts in human-made machines are suitably arranged to perform an externally fixed goal. Modern biological and cognitive thinking, however, has stressed a new more synthetic-holistic view, where the concept of network has provided the most fruitful metaphor for non-decomposable models.

However, these holistic models cannot explain biological and cognitive systems because their highly organized complexity requires functional, selective controls, creating dynamically decoupled subsystems that can modify the parameters of other subsystem parts. In this way, the higher-level subsystem creates a set of functional constraints on the lower-level dynamics and the controlled level plays a fundamental role in the constitution and maintenance of the controller level (and therefore, of the whole system). Therefore, biological and cognitive systems convey specific forms of complexity that produce holistic-emergent patterns, which in turn can act as new selective functional constraints. These emergent functional constraints can be described as mechanisms because they act as distinguishable parts (or collections of parts) related to particular tasks (e.g., catalytic regulation) performed in the system. So both aspects are, thus, complementary: the holism of the global network of processes and the local control devices/actions that are required for the system to increase in complexity. Moreover, the newly created and functionally diverse constraints may give rise (once a certain degree of variety is reached) to new self-organizing holistic processes, which, in turn, may be functionally re-organized. In this way, an increase in organizational complexity can take the paradoxical form of an apparent “simplification” of the underlying complicatedness giving rise to levels of organization in which a mechanistic de-compositional strategy might be locally applicable.