Autopoiesis = Cognition = Life?

A Discussion on Life And Mind

27 January 2010

Why I'm Interested

- Attempting to situate my own work on concepts in an enactive perspective.
- Want to say things about concepts that are at least biologically plausible.
- Sympathetic to defining life in this way.
- Sympathetic in particular to the idea that minimal cognition is co-extensive with life.

Enaction

Autopoiesis

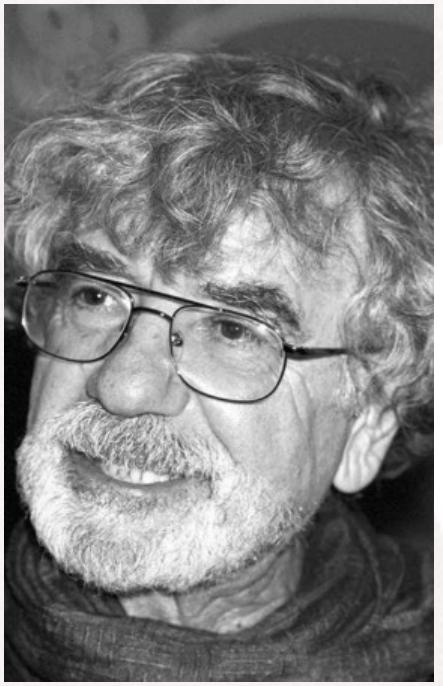
Boundary

Operational Closure

Life

Cognition

Representations/Representationalism



Enaction

- Understanding cognition, at least in the first instance, as a *skillful activity*, and in any case as a lived, dynamic process and not a static entity.
- **Typically perceiving continuities as underlying that which appears individuable and discrete, most notably the continuity between agent and environment.**
- Taking an agent/environment, internal/external distinction to be both conceptually necessary and, at the same time, meaningful only with respect to an observer (and not to the organism itself independently of some observer);
- **Giving a foundational role to phenomenology and emphasizing the essential contribution to be made by first-person methods.**

Autopoiesis (Bitbol-Luisi)

- "...Life is a cyclic process that produces the components that in turn self-organize in the process itself, and all within a boundary of its own making." (p. 99)

- **Autopoietic Unit:** "a system that is capable of self-maintenance owing to a process of components self-generation from within." (p. 99)

- **Three criteria (p. 100):**
  - "That the system builds its own boundaries."
  - " That this construction is due to reaction(s) (activity) taking place within the system."
  - "That it is performed through reactions determined by the system itself."

Autopoiesis (Luisi)

- “Autopoiesis deals with the question 'what is life?' and attempts to define, beyond the diversity of all living organisms, a common denominator that allows for the discrimination of the living from the non-living.” (p. 49)

- “The autopoietic analysis of the living is based on cellular life, the main argument for this being simply that there are no other forms of life on Earth.” (p. 50)

- “It must be said at this point that in its original form, autopoiesis was limited to cellular life. Varela, for example, was for a long time opposed to generalizing it.” (p. 52)

Boundary (Luisi)

- “The notion of boundary is, in fact, central in the theory of autopoiesis. Inside the boundary of a cell, many reactions and, correspondingly, many chemical transformations occur. However, despite all these chemical processes, the cell always remain itself, it maintains its own identity.” (p. 50)
- “The components organize themselves (auto-organization) in a bounded system that produces the components that in turn produce the system, and so on.” (p. 51)
- “The most general property of an autopoietic system is the capability of generating its own components via a network process that is internal to the boundary. The boundary of the system must be “of its own making”, i.e., also a product of the process of component production.” (p. 51)

Operational Closure (Luisi)

- “Operational closure must not be viewed as a lack of contact with the environment–we will see in a moment that in the autopoietic perspective such contact is, in fact, central.” (p. 52)
- “Let us consider now the interaction between the autopoietic unit and its environment. As already pointed out, the living cell must be seen as an open system that receives energy and nutrients from the environment. We have here, then, an interesting contradiction between the biological autonomy and at the same time the dependence on the external medium. In fact, the living must operate within this contradiction.” (p. 54)
- “Let us repeat the central point about this interaction: the environment has its own structural dynamics and, although independent of the organism, it does not prescribe or determine the changes in it. It induces a reaction in the organism, but the accepted changes are determined by the internal structure of the organism itself. It is the structure of the living system and its previous history of perturbations that determines what reactions the new perturbation will induce.” (p. 54)

Social Autopoiesis (Luisi)

- "The main feature of autopoiesis is the self-maintenance due to a process of self-generation from within. Although this concept came from the analysis of a living cell, it can be metaphorically applied to social systems. Consider, for example, a political party, or a family, whereby the rules that define a party or a family can be seen as a kind of boundary formed by the (social) structure itself." (p. 57)

- Varela, initially at least, very sceptical.

- Implies different levels or orders of autopoiesis:
    - First-order: single cell.
    - Second-order: multi-cellular organism.
    - Higher-order: social "organism".

Cognition (Bitbol-Luisi)

- "[Maturana and Varela] claimed that there is no life without cognition, and that it is the co-emergence of the autopoietic unit and its cognitive activity that gives rise to the process of life...." (p. 100)

- "The first general problem is to provide a definition of cognition that is both comprehensive enough to avoid mere identification with human brain's functioning, and specific enough not to encompass any self-catalytic chemical process whatsoever." (p. 101)

- "Maturana and Varela's theory of cognition is certainly the most radical attempt in this direction. In this theory, the relevant concept is not information provided by the external world, but local environmental conditions for maintaining an *operationally closed, autopoietic unit.* The invariants of this type of unit are said not to represent any feature of the world, but rather to identify with steady aspects of its *own* internal dynamical organization." (p. 101)

Life? (Luisi)

• “Life itself can be seen as an emergent property, something that the single, nonliving components do not display, and that occurs only at •the level of the organized, distributed ensemble.” (p. 52)

• “From all the above it is apparent that autopoiesis belongs epistemologically to systems theory, according to which it is the organization of the components that characterizes the quality of the system. Thus, the life of a cell is a global property, and cannot be ascribed to any single component.” (p. 53)

• “This is another important point in the autopoietic world: that the environment brings to life the organism and the organism creates the environment with its own perceptory sensorium. To express this process of mutual calling into existence, Varela and Maturana (1998) and later mostly Varela (1989, 2000) use the word 'enaction'.” (p. 55)

• Life is ***not*** DNA, and life is ***not*** reproduction.

Cognition (Bitbol-Luisi)

- “In other terms: cognition is definitely *not* tantamount to a passive reproduction of some external reality. It is instead mostly governed by the activity of the cognitive system itself.” (p. 101)
- “The system and the environment make one another: cognition according to Maturana and Varela is a process of co-emergence.” (p. 101)
- Idea of co-emergence one of the key ideas in my thesis (Chapter 7) wrt the co-emergence of concepts and experience.
- Comparison with Piaget's theories: “One difference between Varela’s and Piaget’s theories of cognition, however, is that Piaget essentially started from complex human cognition as a model for biologically more elementary forms of cognition, whereas Varela proceeded the other way round. Also, since Piaget deals essentially with perceptual inputs and motor outputs, his conception involves the latent presupposition that cognition mostly deals with *novel* features of the environment.” (p. 103)

Representationalism and Anti-Representationalism

- Autopoiesis/enactivism often seen as strongly against representations of *any* kind.

- "Should we then accept that the invariants of an operationally closed unit are indeed equivalent to *representations*, if we make clear that what they 'represent' are *features of the environment that are salient relative to them*, thereby carefully avoiding the slippery notion of an 'external independent world'?" (p. 101)

Levels of Cognition

- **Two aspects to metabolism/cognition: one more passive, one more active.**
- "Piaget calls this first step of cognition the process of assimilation: incorporation of objects of the environment to the subject's pre-existing schemes of motor activity." (p. 103)
- "In other terms, assimilation is a process by which the unit temporarily changes its detailed structure according to the incorporated elements without changing its global organization." (p. 103)
- "This step two corresponds to what was called *accommodation* by Piaget, in the context of human cognition: drastic reorganization of the subject's scheme of motor activity in order to assimilate new objects. For a bacterium or any other cell, however, we would rather call it *adaptation*. In this process, the unit transforms itself *permanently* and thereby becomes able to more efficiently assimilate the former disturbances and to remain viable even when confronted with higher concentrations of disturbing substances of the same type." (p. 103)

Levels of Cognition

- " Stage three of cognition relies on highly complex types of accommodative changes resulting in *representation-like* types of behaviour (namely types of behaviour that evoke the use of a representation from the standpoint of an external observer, but that do not necessarily involve the possession by the unit of actual 'pictures' of its environment." (p. 105)

- "Stage four of cognition may finally involve several social aspects which transform it into genuine *knowledge*, either ascribing properties to intersubjective invariants (called 'objects') by means of *language*, or formulating mathematical counterparts to the reversible schemes of activity in which disturbances are embedded, in order to get intersubjectively shared *predictive rules."* (p. 105)

- "In considering, as in the present paper, minimal life at its edge, the upper levels of cognition (stages three and four) are clearly irrelevant." (p. 105)

Conclusions

• “By means of this model, we are able to visualize the minimal metabolic unit that also corresponds to the minimal level of cognition. This visualization is pragmatically important, in so far as it may suggest to the experimentalist some minimalist cell that can be fabricated in the laboratory.” (B-L p. 104)

• “According to Bourgine and Stewart’s is final tentative thesis, ‘A system that is both autopoietic and cognitive (. . .) is a living system’.
•However, our own corresponding tentative thesis should be ‘A system that is minimally cognitive and, therefore, autopoietic, is a living system’.” (B-L p. 106)

• “The acceptance of the notion of cognition [as co-extant with life] is important from another viewpoint, in that it permits us to construct a bridge between biology and cognitive sciences. I maintain that autopoiesis is the only available simple theory that is capable of providing a unitary view of the living, from the molecular level to the realm of human perception.” (L p. 58)