

Deleuze and Biology

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Lecture 2

Contemporary Issues and Positions

- Issues:
 - Genetic reductionism
 - Unit of selection; Adaptation; Niche-construction
- Positions
 - Ultra-Darwinism and evo-devo
 - Autopoiesis / enaction
 - Process structuralism
 - Serial endosymbiosis
 - Devo-evo
 - Developmental systems theory (DST)

Issues

- Physiology and Development
 - Genetic determinism and reductionism
 - Genetic reductionism in physiology: structure dictates function
 - Genetic reductionism in development: the genetic program
- Heredity and Evolution
 - Unit of selection
 - Adaptation
 - Niche-construction and "co-evolution"

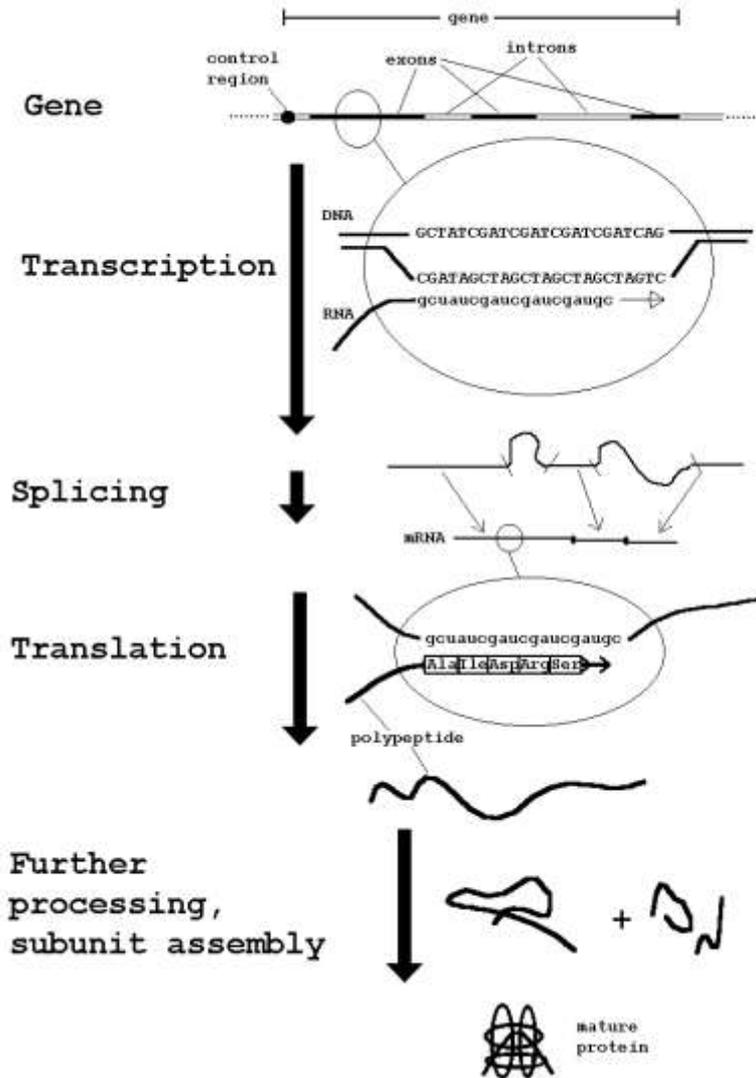
Genetic determinism and reductionism

- Determinism (an ontological thesis)
 - Absolute: genes determine traits / development
 - Interactionism
 - Two sorts of developmental resources
 - Genes are locus of control
- Reductionism (an epistemological issue)
 - Philosophical: translation of discourses
 - Biological: isolation of genetic factors

Protein synthesis (revised)

- DNA in nucleus is *separated* (two strands pull apart).
- *Transcription*: copying a strand of DNA into mRNA
- The *primary mRNA transcript* is transported out of nucleus
- Editing and splicing
 - The introns are cut out
 - The exons are spliced together
- The *mature tRNA transcript* binds to mRNA on the ribosome
- *Translation*: The tRNA adds an amino acid to protein chain
- Completed protein chain *drops off* ribosome

Protein synthesis



Consequences of revised view of protein synthesis

- Locus of control moves from genes to distributed system of genes + cell conditions
- Separation of hereditary and functional genes
 - Hereditary genes = string of DNA
 - Functional genes = mature mRNA transcripts
- Flexible regulation of protein function
 - “allostery”
 - Depends on cell conditions

Revision of the logic of structure determines function

- FROM
 - One gene = one protein = one function
- TO
 - one DNA string (hereditary gene)
 - many functional genes (mature mRNA transcripts)
 - many proteins
 - many functions

Genetic reductionism in development: the “genetic program”

- Genetic vs epigenetic factors
- Epigenetic factors
 - Intranuclear : chromatin
 - Cytoplasmic: gradients
 - “Cellular information”
 - Extra-somatic
- A distributed developmental system
- Instead of “regulatory gene networks” with cell as data
- We can see DNA as data for cellular program

Issues in hereditary and evolution

- UNIT OF SELECTION
- Gene selectionism: replicators and interactors
- Criticisms of gene selectionism
- No simple path of gene expression to traits
 - Phenotypes are screened in NS
 - But genes are the unit of selection
- Can't shift the target
 - Functional gene has no stable molecular base
 - Hereditary gene has no reliable path to trait

- Group selection
- Emergence: are groups individuals?
- Debates about altruism
 - Kin selection
 - Inclusive fitness
 - Reciprocal altruism

Other issues

- Adaptation
 - Gould and Lewontin's "Spandrels"
- Niche-construction and "co-evolution"

Contemporary positions

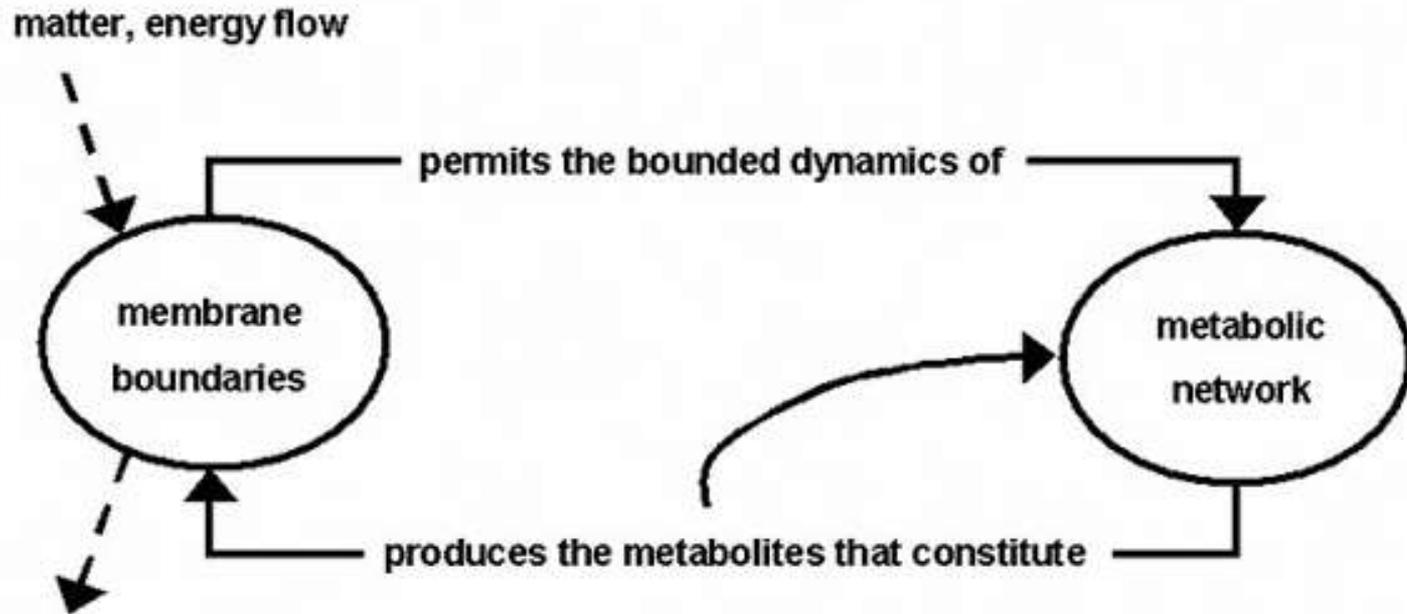
- Standard positions
- Ultra-Darwinism
 - Dawkins
 - Dennett
 - EO Wilson (Sociobiology)
 - genes for behaviors
 - Pinker (Evolutionary Psychology)
 - genes for psychological modules
- Evo-devo

Critical / heterodox positions

- Autopoiesis / enaction
- Process structuralism
- Serial endosymbiosis
- Devo-evo
- Developmental systems theory (DST)

Autopoiesis

the minimal / cellular logic of life:
viability constraints



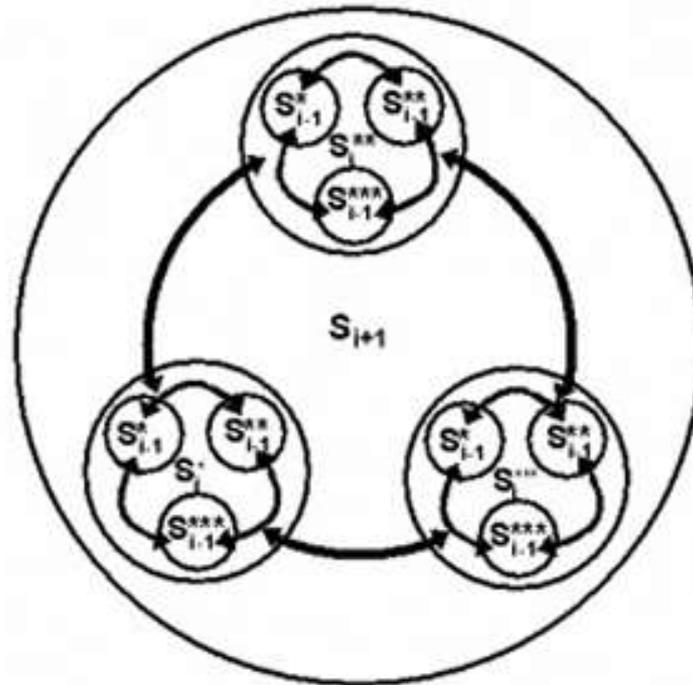
Cellular autopoiesis

<http://www.scielo.cl/fbpe/img/bres/v36n1/fig06.gif>

Rudrauf et al., From autopoiesis to neurophenomenology: Francisco Varela's exploration of the biophysics of being, Biol. Res. v.36 n.1 Santiago 2003

Autonomous systems

hierarchy of levels maintaining organizational closure



The organism is thought of as an organizational closure of interacting sub-systems.

http://www.scielo.cl/scielo.php?pid=S0716-97602003000100005&script=sci_arttext

Rudrauf et al., From autopoiesis to neurophenomenology: Francisco Varela's exploration of the biophysics of being, Biol. Res. v.36 n.1 Santiago 2003

Operational closure of bio-cognitive systems

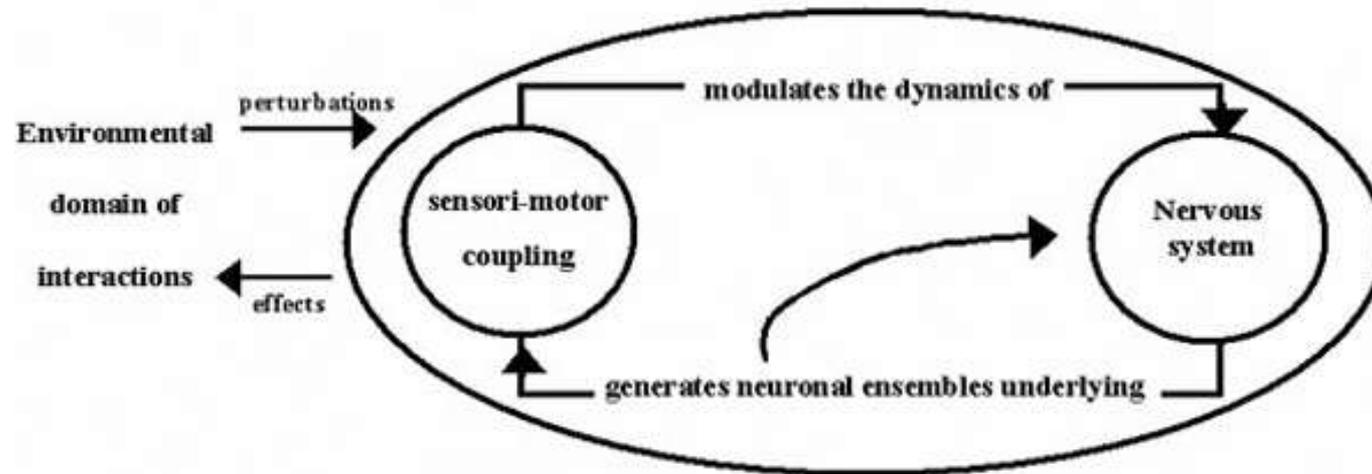


FIGURE 4 - The operational closure of the embodied system. Three levels: (i) CNS as a closed dynamical system; (ii) sensory-motor mutual definition of state of brain and of body; (iii) ongoing coupling between the autonomous system and its surroundings.

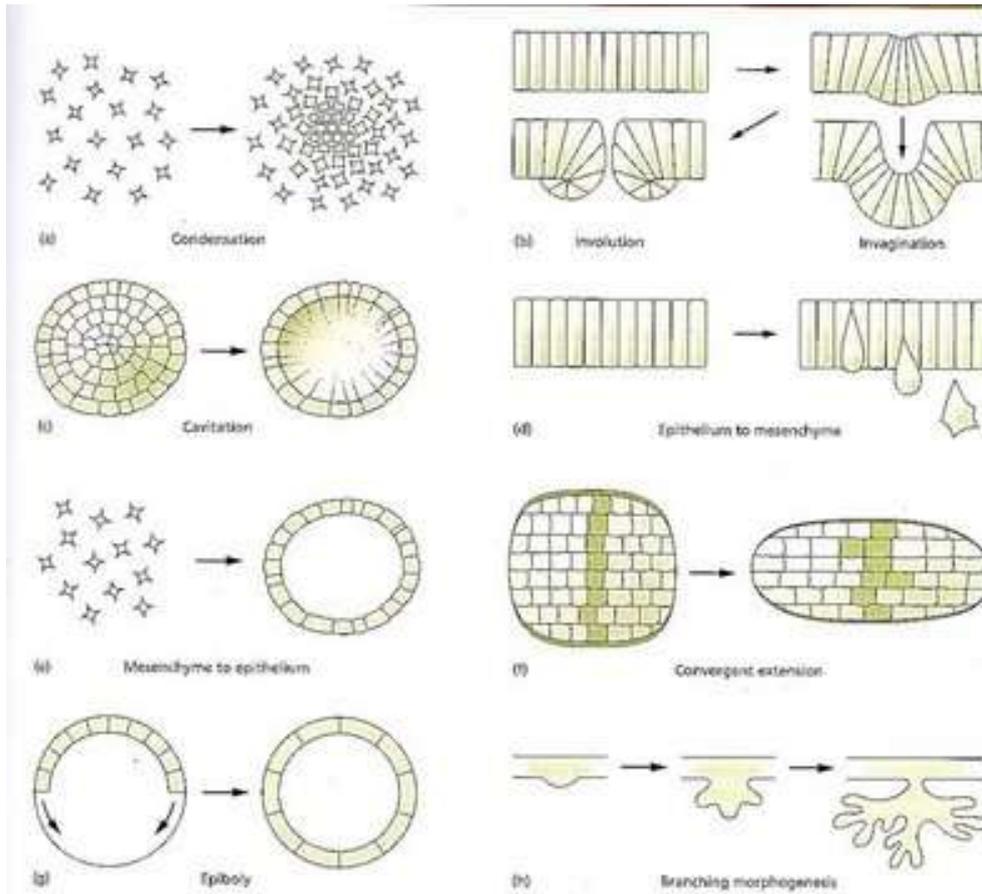
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Rudrauf et al., From autopoiesis to neurophenomenology: Francisco Varela's exploration of the biophysics of being, Biol. Res. v.36 n.1 Santiago 2003

Process structuralism

- Self-organizing processes in “morphogenesis”
 - Physical
 - Biological
 - Genetic networks
 - Cell differentiation
- Constraint on NS
 - Structured evolutionary search space

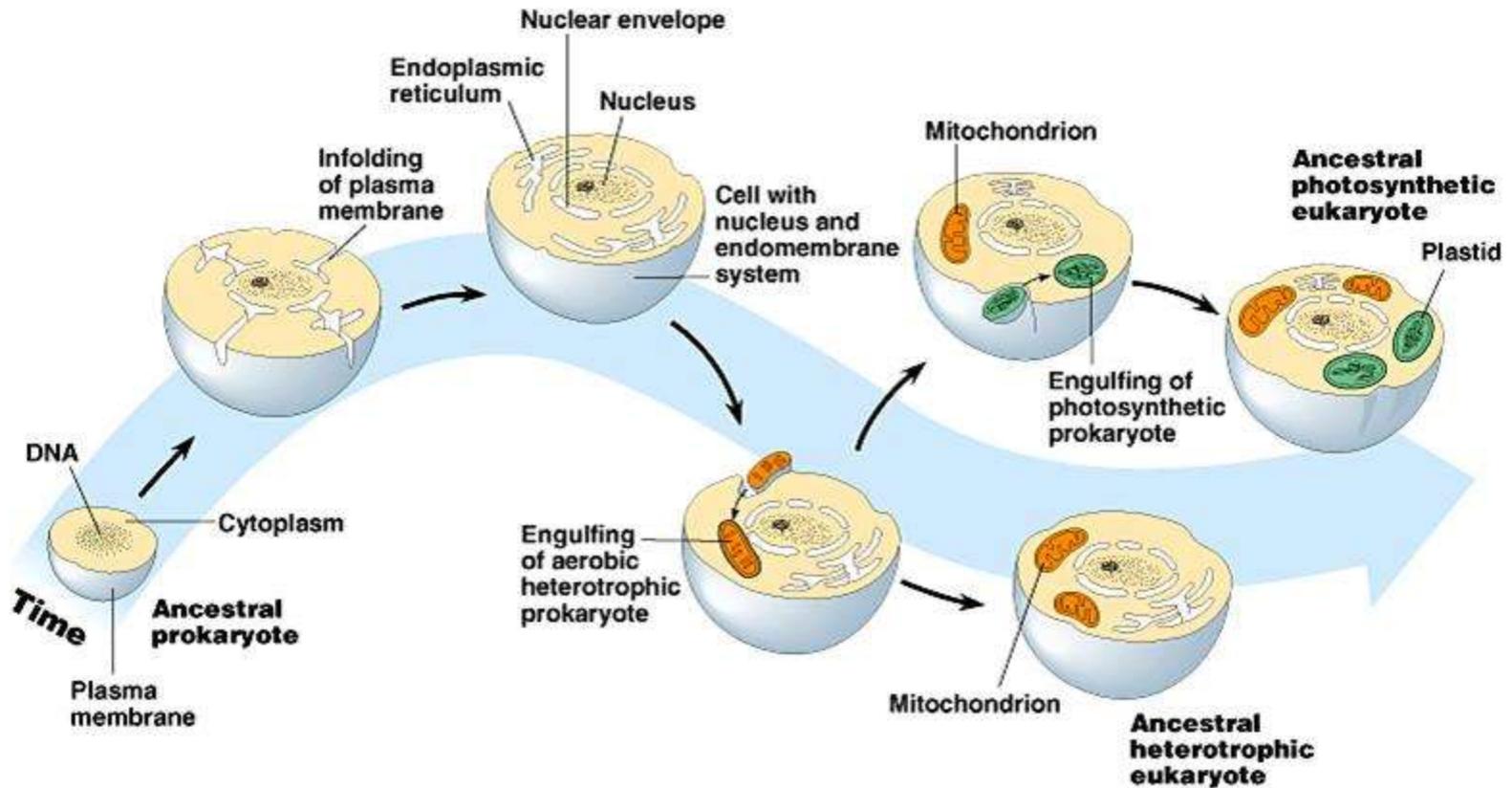
Modes of morphogenesis



<http://www.scholarpedia.org/article/Morphogenesis>

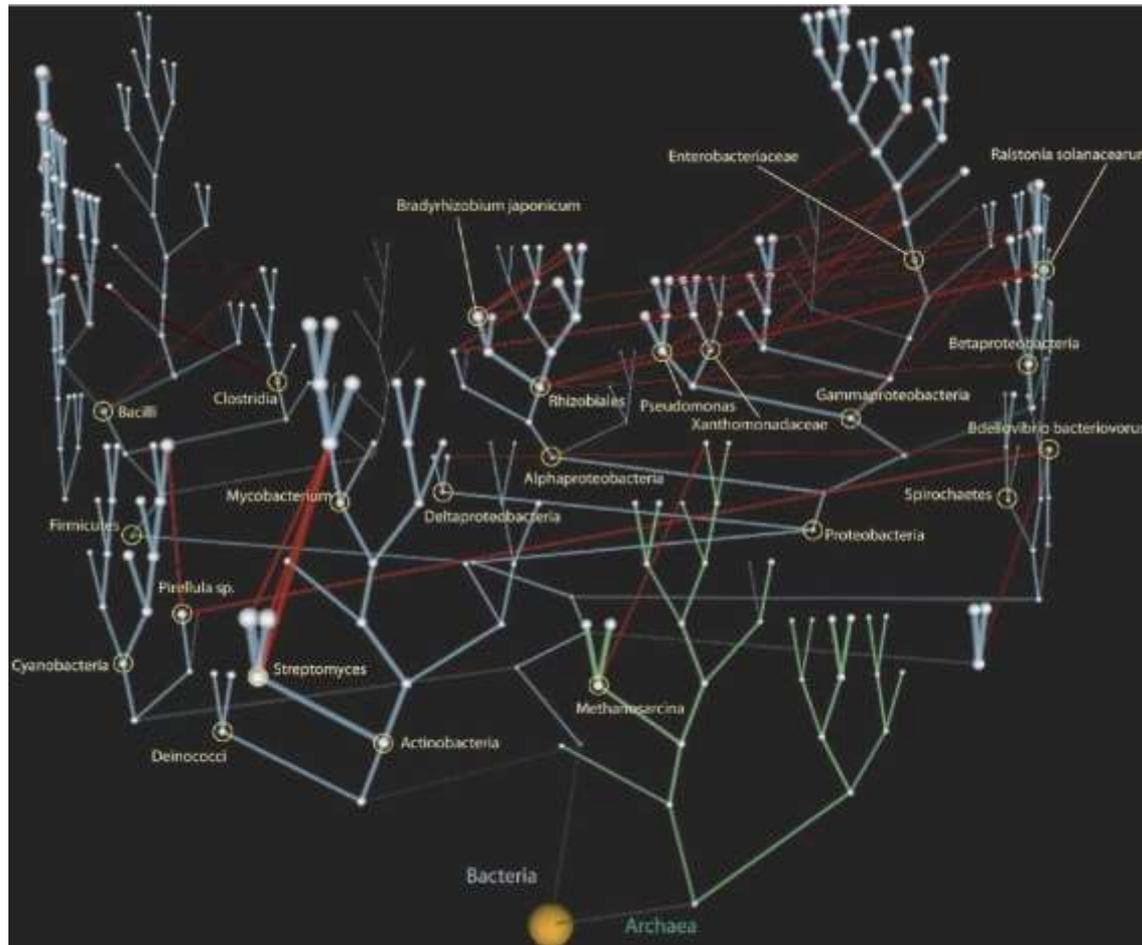
Figure 3: Some basic modes of morphogenetic movement.
(From Slack (2005), permission being sought)

Serial endosymbiosis aka “creative involution”



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Tree of life tangled in vines aka “transversal communication”



Devo-evo

- West-Eberhard, *Developmental Plasticity and Evolution* (Oxford, 2003)
- Genetic accommodation
- Developmental plasticity leads to new phenotype
 - Either mutation or environmental induction
 - Not Lamarckian: unexpressed genetic variation
- Phenotypic adaptation: “two-legged goat” effect
- New selection pressures
- New regulatory gene networks

Consequences of W-E's thesis

- Environmental induction a major source of evolutionary change
 - Genes are followers, not leaders
- Evolutionary novelties from reorganization of pre-existing phenotypes via environment
- Phenotypic adaptive plasticity leads to genetic accommodation

DST

- Parity principle: DNA only one of many developmental resources
 - Critique of pre-existing genetic “information”
 - “ontogeny of information”
- The “life cycle” as evolutionary unit
- Emphasis on niche-construction
 - Extra-somatic components of epigenetic inheritance
 - Behavioral and symbolic inheritance / evolution
 - “Scaffolding”
 - Opening to politics: “populations of subjects”
 - Questioning culture as repository of problem-solving tools

Consequences of DST

- FROM “regulatory gene networks”
- TO multi-level, interlocking, distributed system for gene expression
- OR, better, multi-level, interlocking, distributed system for protein synthesis
- OR, even better, multi-level, interlocking, distributed system for cell / organ / system / organism / life cycle development & function

Eco-devo-evo

- Synthesis of West-Eberhard and DST
- Provides for multi-level, interlocking, distributed system for cell / organ / system / organism / life cycle development & function in an evolutionary perspective
- IOW, the big picture: repetition and difference on all the spatial-organization and temporal-processual scales of life