

# Emergence

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# Superorganism

- It's true technology is weaving humans into electronic webs that resemble big brains — corporations, online hobby groups, far-flung N.G.O.s
- **It's not outlandish to talk about us being, increasingly, neurons in a giant superorganism**
- Certainly an observer from outer space, watching the emergence of the Internet, could be excused for looking at us that way

# Evolving Planetary Brain

Could it be the point of evolution has been to create these social brains, and maybe even to weave them into a giant, loosely organized planetary brain?

# One Big Brain?

- The new technologies, though derided by some skeptics for eroding the simple social bonds of yesteryear, are creating new social bonds
- **We're not just being lured away from kin and next-door neighbors by machines**
- We're being lured away by other people — people on Facebook, people in our inbox, people who make slides about giant superorganisms

# One Big Brain?

- Technology is letting people link up with more and more people who share a vocational or avocational interest
- **At this level, the social level, new efficiencies reside**
- The incoherence of the individual mind hopefully lends coherence to group minds

# One Big Brain?

- The fragmenting at the individual level translates, however ironically, into broader and more intricate cohesion at the social level — cohesion of an increasingly organic sort
- We've been building bigger social brains for some time

# One Big Brain?

- Could it be that the point of evolution —both the biological one that created an intelligent species, and the technological one that the intelligent species is bound to unleash— has been to create these social brains?
- Maybe even to weave them into a giant, loosely organized planetary brain?

# Evolution and Emergence - 1

- Biological evolution is characterized by a collection of highly convoluted processes that produce a remarkably complex kind of combinatorial novelty
- A general term often used to describe this large class of spontaneous, and only weakly predictable, order-generating processes is “emergence”

# Evolution and Emergence - 2

- The term “emergence” has become a kind of signal for research paradigms sensitive to systemic factors
- There is a growing awareness among biologists, physicists, and computation scientists studying diverse kinds of complex phenomena that many of these share a curious general feature in common

# Evolution and Emergence - 3

- Complex dynamical ensembles can spontaneously assume ordered patterns of behaviour that are not prefigured in the properties of their component elements or in their interaction patterns
- There is a kind of unpredictability in self-organizational phenomena best called “evolutionary”, with quite diverse and varying levels of complexity

# Evolution and Emergence - 4

- In cases of complex organisms able to permanently alter their environment,
- or in cases where higher-order evolutionary phenomena contribute with influences to biological evolution –like language and culture,
- it becomes difficult to distinguish, with the arisal of emergence, where evolution leaves off and self-organization begins

# What emerges?

- The answer is not some “thing” but rather something like a form, or pattern, or function
- The concept of emergence applies to phenomena in which relational properties dominate over constituent properties in determining aggregate features
- It is with respect to *configurations* and *topologies*, not specific properties of constituents, that we trace processes of emergence

# Functionalism

- By analogy with computing machines, cognitive scientists have argued that the “functional” properties that define a given cognitive operation are like the logical architecture of a computer program
- Philosophically, this general form of argument is known as *functionalism*, and it is quite relevant for viewing *emergence*

# Topology- 1

- Topology is global or ensemble relationship. So it may also include whole-to-part influences characteristic of emergent phenomena
- One can understand emergent phenomena as variant forms of what might be called *topological reinforcement or amplification in pattern formation*

# Topology- 2

- We are justified in calling something “emergent” if it is the result of a recurrent amplification of configuration or topology
- This recurrent architecture is itself a topological concept. In a sense, emergence is a topological transformation of topologies
- A degree of “circling back” is inevitable in the world, because of finiteness and aggregation

# Historical Contingency

- Certain highly organized systems have an “ampliative” character, reflected in their critical dependency on historical contingency and complex unique individual structure
- *Feed-forward* circles of cause and effect, linking reciprocally reinforcing effects at different levels of scale, are a defining feature of second-order emergence

# Second-Order Emergence

- Second-order emergence supervenes when first-order emergent properties become self-modifying, resulting in the emergence of *new* emergent phenomena
- There is now a whole new class of contingencies that can accumulate and amplify along the gradient of scale of lineages, defined with respect to continuity of seeding, across generation-time

# Third-Order Emergence - 1

- Third-order emergence inevitably exhibits a developmental and/or evolutionary character
- There is both amplification of global influences on parts, but also redundant “sampling” of these influences
- Plus their redundant re-introduction –across time– into distinct realizations of a second-order system type

# Third-Order Emergence - 2

There occurs self-referential self-organization:

- Because of “remembered” traces of prior “self” states, systems can develop with respect to this prior “self”, rather than just with reference to the immediate prior state of the whole –as in Markov systems
- Cognitive processes require introducing concepts of representation, adaptation, information and function, to capture the logic of their most salient phenomena

# Evolutionary Emergence

- Evolutionary emergent systems can further interact to form complex multi-layer systems
- This does not imply 4th-order systems because 3rd-order ones already include new forms of emergence
- So, organisms with representational processes introduced with the evolution of brains, symbolic communication and societal organization are encompassed

# Baldwin Effects

- However, the “niche construction” and other Baldwinian-like effects are more complex
- In these cases, the effects of an organism’s adaptive responses do feed-forward to affect what gets exposed to, or hidden from, the efforts of selection
- A dynamic can develop to become a bias on the future range of naturally selected, adaptive capabilities

# Language

- Take the evolution of symbolic communication in hominids
- This evolutionary transition marks the emergence of a new, partially decoupled, evolutionary 3<sup>rd</sup> order dynamic
- Linguistic and cultural evolution influence brain-evolution and human consciousness themselves – the tail that wagged the dog

# Conclusion

- The many levels of embedded evolutionary emergence processes characteristic of brains are what enable them, rapidly and selectively, to amplify such a vast range of forms of activity.
- The experience of a sentient agent is that of being the locus of something incessantly and spontaneously emerging

References: Terrance Deacon's chapters, in "Evolution and Learning: The Baldwin effect reconsidered", R. Weber & D. Depew (eds.), MIT Press 2003. Robert Wright's column: <http://opinionator.blogs.nytimes.com/2010/07/06/the-web-we-weave/>

**Thank you!**

**Questions?**