

Complexity Theory and Purposiveness

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*Context Changes Everything: How Constraints Create
Coherence* (MIT Press, 2023)

*Dynamics in Action: Intentional Behavior as a Complex
System* (MIT Press 1999)

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WHAT IS THE DIFFERENCE BETWEEN A WINK AND A BLINK?

Winks are ***actions*** because they are
intentional and purposive

Blinks are ***mere behavior*** because
they are ***unintentional and reactive***

ARISTOTLE ON CAUSE

- Four Causes
 - Formal: What makes that thing that kind of thing
 - Final: Object's goal/purpose
 - Material: The stuff the thing is made of
 - Efficient: The external force that brings the thing into being
- But: Causes must be external to their effects; i.e.,
Nothing Causes Itself (Metaphysics VIII)

ARISTOTLE ON ACTIONS

- Analysis of “Lion pursues a gazelle”
 - As perceived by lion, gazelle functions as *final cause* by
 - Eliciting lion’s *orexis* (desire), which in turn
 - *Efficiently causes* (activates)
 - Lion’s bodily motion
 - » And that’s how the lion pursues the gazelle!
- “**NOTHING MOVES ITSELF**” upheld!

ARISTOTLE ON EXPLANATION

- *Two Forms of Explanation*

- *Episteme*: Deductive

- Suitable for science because science deals in universals.

- *Phronesis*: Narrative

- Necessary for human affairs (medicine, ethics, and law) because human affairs are temporally- and contextually-embedded.

MODERN VIEW OF CAUSE and EXPLANATION

- **Only one legitimate form of Cause**
 - *Efficient Cause*
 - Billiard-ball, push-pull cause of one thing exerting force on another
- **Only one legitimate form of Explanation**
 - *Deduction*
 - Hypothetico-deductive model of explanation
 - Enables prediction!

MODERN VIEW OF PARTS AND WHOLE

Wholes reducible to aggregates

**Relational properties are
“secondary”**

Arrow of time is lost

PHILOSOPHY OF ACTION

Cartesian Dualism: Separate and distinct event, a non-physical intention, activates body *as efficient cause*

- **Objection:** How can *nonphysical* entity serve as efficient cause of a *physical* entity without violating causal closure
- Ongoing, standing causes are not instantaneous events as efficient causes are

PHILOSOPHY OF ACTION

- **Materialism:** One neurophysiological process activates a second.... which finally activates the muscles.
- **Objections:**
 - Neurological research does not show one neuron or set of neurons “pushing” others into action.
 - How can neurophysiological processes efficiently cause *meaningful* behavior?

***MAIN PROBLEM OF CONTEMPORARY
ACTION THEORY:***

**How can neurological processes embody a
(bottom-up) meaningful intention –
(meaning!) -- which then loops back
(top-down) and causes meaningful behavior
-- a wink, not a blink?**

IT CAN'T!

**Nothing can cause itself!
Disavowal of circular causality
goes back as far as
Aristotle Metaphysics VIII**

MAIN PROBLEM OF CONTEMPORARY ACTION THEORY

***No modern scientific
understanding of cause can
account for intentional causality***

Kant recognized this

Critique of Judgment

**Tree produces the leaves and is in
turn produced by the leaves**

constitutes a

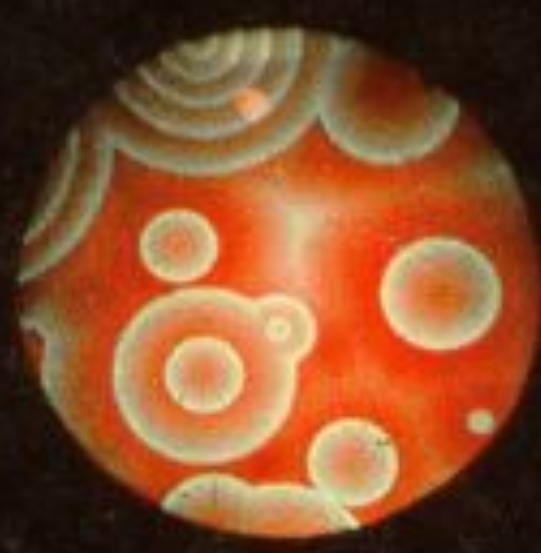
“Kind of causality unknown to us”

See Juarrero-Roque 1985

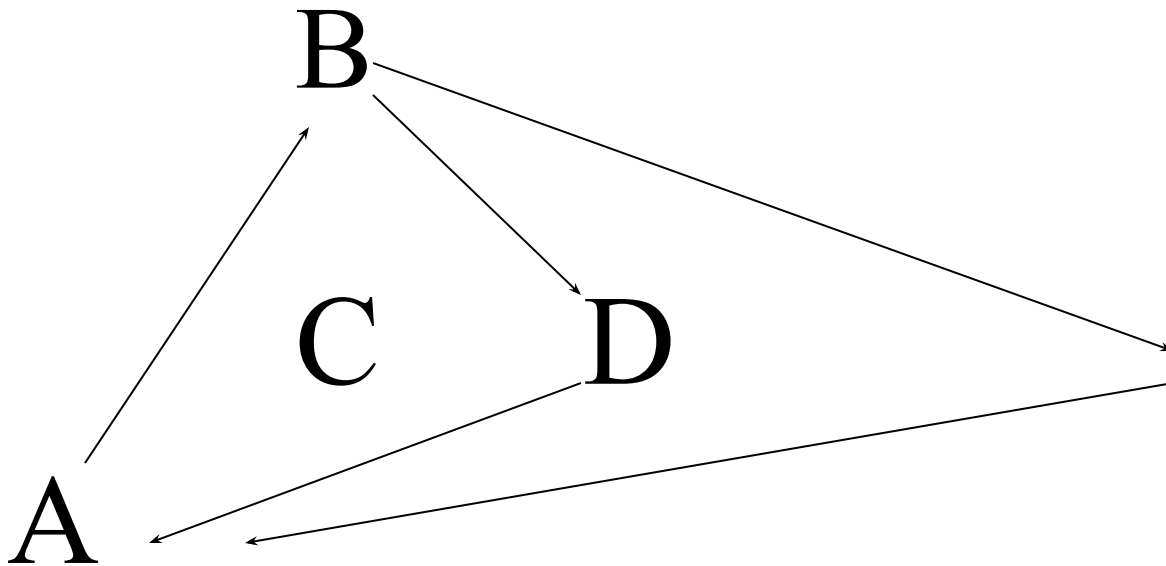
**COMPLEX DYNAMICAL SYSTEMS
THEORY ALLOWS US TO
RECONCEPTUALIZE
MEREOLGICAL
(PART-WHOLE/WHOLE-PART) CAUSAL
RELATIONSHIPS**

BELOUSOV-ZHABOTINSKY REACTION

- $A \rightarrow X$
 - $B + X \rightarrow Y + Q$
 - $X \rightarrow P$
 - $Y + 2X \rightarrow 3X$
- Fourth step is *autocatalytic*,
 - Closure of positive feedback drives system farther and farther from equilibrium
 - At instability threshold a bifurcation occurs which drives the reaction to a new mode of organization.



Autocatalysis



Function supported by autocatalysis is often multiply realizable: Same function can be carried out via different pathways

INTERLEVEL CAUSALITY

True Self-Cause

- *Bottom-Up:*

- Individual, previously independent parts suddenly *self-organize* into complex dynamical wholes;
- Complex dynamical systems are *qualitatively* different –they exhibit irreducible, *emergent* properties;
- But complex dynamical systems are *not other than* components that make them up.

- *Top-Down:*

- Global, dynamical “structures of process” actively influence their components – but not *qua* “other”;
- Selection criteria is determined at the emergent and systemic level
- *Whole causes itself to change*

***A NEW THEORY OF
INTERLEVEL CAUSALITY***

**AS THE OPERATION OF
CONSTRAINTS**

TWO TYPES OF CONSTRAINTS

- **Context-independent constraints:**
 - Take the system **far from equiprobability**
 - Ex: gradients, polarity, charge, boundary conditions
 - Ex: distribution of letters in an alphabet
 - more a's and e's than x's and q's
- **Context-dependent constraints:**
 - Take the system **far from independence**
 - Ex: given that q appears, u more likely
 - Ex: catalysts, feedback,

A RECONCEPTUALIZATION OF INTERLEVEL CAUSALITY

- **Catalysis and feedback function as first –order context-dependent constraints by making behavior of parts depend on what went before and what is occurring around them.**
 - **Context-dependent constraints embed system in time and space by making components interdependent**
 - **Bottom-up, context-dependent constraints are enabling constraints – they make complex systems possible;**
 - **Complex systems exhibit emergent properties qualitatively different from their components.**

BOTTOM-UP CAUSALITY

- **First-order, context-dependent constraints create “systems,” “organisms,” “communities”**
- **These are qualitatively NOT aggregates**
 - **Thereby expanding the phase space: (whole can do more than the parts) Ex: lasers**
 - **These dynamical, self-organized systems can be described as “mathematical attractors”**

STRONG EMERGENCE
IS **THE**
ESTABLISHMENT &
CLOSURE OF A
CONSTRAINT REGIME, a set
of interlocking
interdependencies that ensure
the system hangs together as a
coherent unit

CONSTRAINT REGIMES

- As Constitutive constraints, they

TOP-DOWN CAUSALITY

Acting as **governing constraints**, a constraint regime implements **second-order, context-dependent constraints top-down** (from emergent relational whole to parts)

They do so by altering the components' degrees of freedom;

As a result, individual behavior of parts is suddenly constrained by a) context and b) history of the attractor in which they are embedded.

A DYNAMICAL SYSTEMS THEORY OF INTENTIONS

- As a result of closure of context-dependent constraints, globally coherent wave patterns embodying emergent properties of consciousness and meaning appear as neurons entrain and self-organize.
- Intentions are neurologically embodied in and enacted by such global dynamic process structures.
- Dynamic process structures can be described as **attractors** – *intentions are self-organized neural attractors.*

A DYNAMICAL SYSTEMS ACCOUNT OF INTENTIONAL CAUSATION

- Neural attractors embodying intentions *are characterized by emergent properties – including meaning and consciousness*;
- Neural attractors embodying intentions *cascade into behavior by resetting the natural intrinsic firing frequency of individual neurons* (including motor neurons) – and thus restricting their degrees of freedom;
- Resulting behavior thus embodies the emergent properties of the intention which constrained its trajectory.

*And that's how intentions cause
actions!*

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LOGIC OF EXPLANATION SUITABLE TO DYNAMICAL SYSTEMS

- Must take history and context (therefore particularity and individuation) seriously;
- Must take initial conditions seriously
- Is primarily retrospective; very little predictability
- Is always tentative and provisional
- Must take role of the explainer seriously

*Genealogical, hermeneutical
narrative is best suited as the
logic of explanation for actions*

Provides understanding, not
prediction!

NARRATIVE EXPLANATION OF ACTIONS

- *Explaining: formation of intention*
 - akin to accounting for phase change transition, the emergence and stabilization of a qualitatively novel neuronal attractor, with emergent properties of meaning and consciousness and directionality
- *Explaining: action itself*
 - akin to accounting for particular trajectory within the intentional attractor

FORMING INTENTION

- **Describe context that led agent far from equilibrium**
- **Describe perturbation/fluctuation that precipitated phase change**
- **Describe nature of intentional attractor (broad, specific, etc)**

EXPLAINING ACTION

- **Describe full context in which action was performed (agent's history, culture, frame of mind, etc.)**
- **Describe conditions that explain why this particular trajectory rather than that – full description with wealth of contextual detail necessary**

Charles Sanders Peirce

ABDUCTION

PRAGMATICS OF EXPLANATION

- Self-awareness of Explainer
- Knowledge of person to whom explanation is addressed
- Rhetorical devices
 - Metaphor
 - Drama

Dynamics in



Intentional
Behavior
as a Complex
System

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