Mechanisms as Constrained Systems

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Agenda

- Mechanism ≠ kind of explanation, but kind of system
- Accommodated/explained via D-N

- But no D-N conservativism (and no physics envy)
- On the contrary, a way to understand and use mechanisms better

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D-N, causal, mechanistic explanation

- D-N: conditions, „natural laws”; explanation as deduction („logical necessity”)
- Causal: event relations, explanation as a history of (contact) events
- Mechanism (mechanistic in the recent sense): components and operations based on entity relations

- So, mechanism = specific form, maybe a „better form” of the causal relation
- Generic, condition-free

But remember…

- Mechanisms were historically „discovered" in
  - Biology (Glennan, Machamer & Darden & Craver)
  - Machines (Bechtel)
  - Social systems (Elster)

- Then, creative generalizations…
- But why more so in some fields than in others (e.g. molecular mechanisms, but not quantum mechanics, epidemiology and electrodynamics?)

Instrumentalism vs. „materialism”

- An important note
- Instrumentalism (anything goes as explanation as long as successful), e.g. Dennett’s stances
- An alternative: „materialism”…
- …or complex systems view: understand explanations in terms of systems, variables/observables
- „Relevant if adequate and interpretable” (Kampis 1991)
  - Adequate: saves the phenomena
  - Interpretable: pertains to a class of „permissible descriptions”
    - Levels, subspaces, aggregates etc etc.

Understanding mechanisms: why certain systems can be „simplified"

- Instead of high-complexity, high-dimensional (ie. many-variable) description, low complexity, utmostly reduced, minimalist (pure entity based) description
- This question has a distinguished history:
  - M. Conrad: structural nonprogrammability
  - R. Rosen: activation-inhibition systems, material causation (Aristotle)
  - H. Pattee, M. Polanyi: constraints/boundary conditions
  - H. Morowitz: structual vs. dynamic information
- A cell is a mechanism, but by virtue of being member of a well-defined class of systems
- Understand mechanisms: characterize this class -> conditions, limits, potential benefits of mechanistic descriptions

Constrained systems

- Control the dynamics with extra-dynamical contingencies

D-N scheme	constraints and variables	totally constrained systems
C1…. Cn contingencies	Φ (x1…xn) = 0 constraints	Φ (x1…xn) = 0 constraints
	xi(o) = xio for all i initial c.'s	
L1…. Lm „laws"	L1…. Lm „laws"	_____
E1…. Ek explananda	E1…. Ek explananda	E1…. Ek explananda

- Φ a static (often graphically expressible) relation bw. xi-s
  - if some xi-s are entity-bound, then bw. entitites
  - effect of Φ: removing variables (step-by-step, replacing „laws")

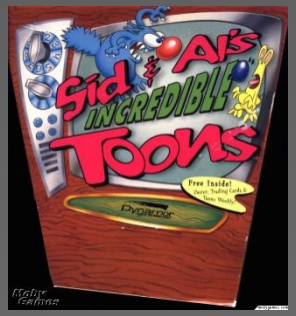
- Mechanisms = totally (or highly) constrained systems
- This can explain a number of their puzzling features
- E.g. Bechtel's visual diagrams are constraint maps

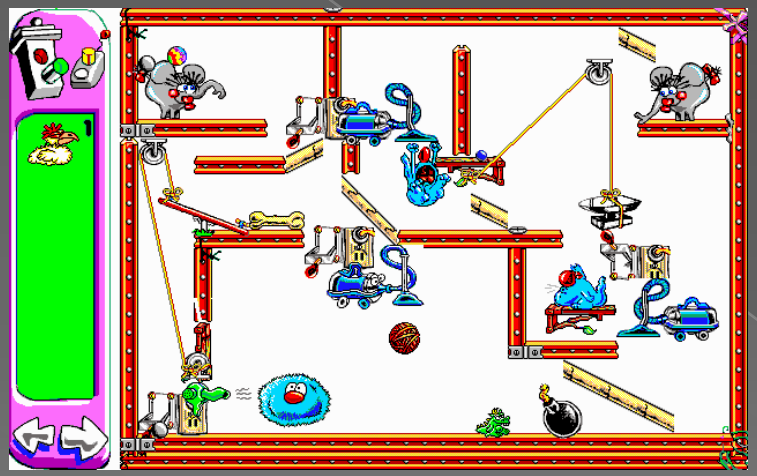
Hunting mechanisms

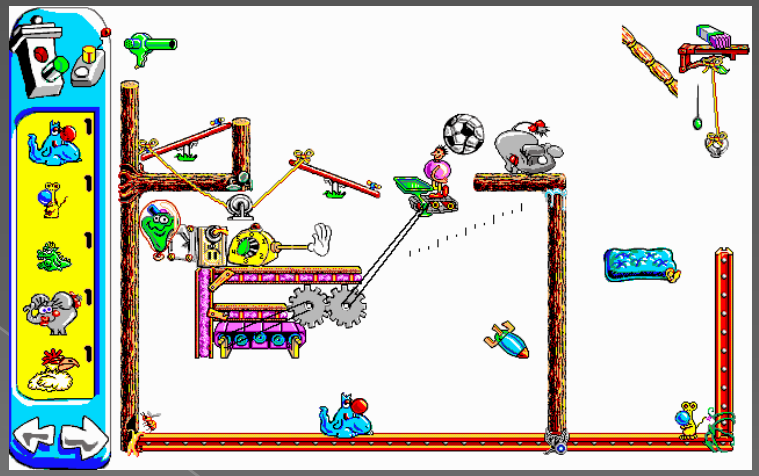
- How to find mechanisms
  - Build a physical system
    - or a good enough model of it
  - Introduce and increase constraints
  - To the point that you can remove all the physics
- „Stone soup" approach

An illustrative example

- Jeff Tunnell's Toons (using „The Incredible Machine"), 1993







- Simplest designs „unsolvable" (ie. takes physics, numbers)
- The more complex (ie. the more constraints) the easier
- Build mechanisms from physics

So,… (summary and outlook)

- Claim: mechanisms are constraint based…
- Counterfactual argument: no constraint, no mechanism
  - Not all inductive generalizations over (processes of) entities are
  - On the other hand: what is an entity? If constraints define mechanisms, this helps individuate entities (e.g. waves, fire)
- Constraint: in general, dimension reduction in complex systems
- A suggestion: mechanisms via their relation to constraints help understand complex systems (when are they tractable, how they should be managed, etc.)

Thank you!