INGENUITY THEORY: Applications to Health Policy

Health Innovation for Patients and Populations
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H.G. Wells

"Hard imaginative thinking has not increased so as to keep pace with the expansion and complications of human societies and organizations." This is "the darkest shadow upon the hopes of mankind."

Two Questions

Are our problems becoming harder?

Most definitely

If so, can we solve them?

Too often not

Larger Question

Are there ultimate constraints on human development?

It depends on how we define "development." But, by the current definition, yes.

Economic paradigm

Human beings are:
“Rational Consumers”

Key concepts:
Consumption/production;
Investment/saving

Factors of production (or system inputs):
Capital and labor
Sometimes land and ideas

Ingenuity paradigm

Human beings are:
"Pragmatic Problem-Solvers"

Key concepts:
Ingenuity *requirement* and *supply*

Factors of problem-solving
(or system inputs):
Matter, energy (work), and *ingenuity*

Human beings use ingenuity

To guide the application of energy

To arrange the matter around them (including materials and people)

In ways that they hope will solve their problems

Ingenuity

Sets of instructions (SOIs) that tell us how to arrange the constituent parts of our physical and social worlds in ways that help us achieve our goals.

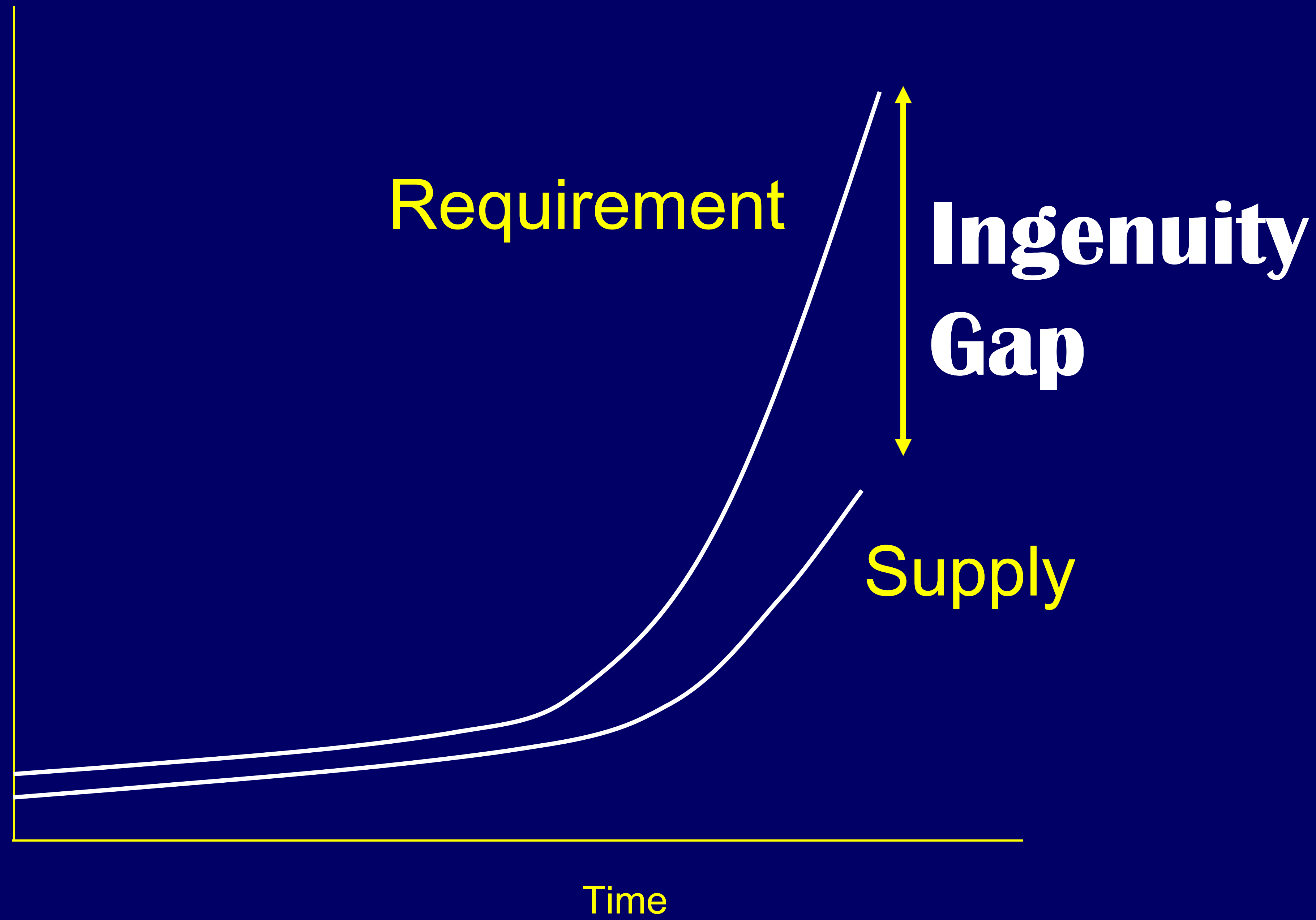
Measure of Ingenuity

- Length of SOIs
- or, more specifically
- Algorithmic complexity (with if/then gates)

Two types of ingenuity

Social

Technical


Requirement
Ingenuity Gap
Supply
Time

Value added of Ingenuity Theory:

It gives us a metric to operationalize the "difficulty" of a problem. This allows us to:

- Compare the difficulty of diverse problems across space
- Track the change in difficulty of a single problem across time
- Separate the issue of rising problem difficulty from the issue of our capacity to "keep up" (the two sides of the ingenuity gap).

Once we separate the two sides of the gap, we can:

- Analyze the factors making our problems more difficult
- Analyze the factors determining whether we can keep up.

Is our requirement for ingenuity rising?

Six Factors Affecting our Ingenuity Requirement

1. Changing values
2. Extended time horizon
3. Decreasing resources
4. Rising complexity
5. Increasing speed
6. More surprises

Factor:	Relates to:	Assumes:	Affects:
1. Changing values	Definition of problem		Maintenance requirement
2. Extended time horizon			
3. Decreasing resources	Inputs to problem solving	Constrained Substitutability	
4. Rising complexity	Intrinsic features of problem	Law of requisite variety	
5. Increasing pace			
6. More surprises			Extraordinary requirement

COMPLEX SYTEMS

- are more than the sum of their parts (they have *emergent* properties)
- can flip from one pattern of behavior to another (they have *multiple equilibriums)*
- show disproportionality of cause and effect (their behavior is often *nonlinear*, because of *feedbacks* and *synergies*), and
- cannot be easily *managed* because their behavior is often *unpredictable*.

Most obviously, complexity has risen because of:

- Advances in information technology
- Performance improvements at the level of system units (i.e., organizations, people, technologies)

These changes produce more complex networks with:

- More nodes
- A greater density of connections among nodes
- Faster movement of material, energy, and information along these connections

There are deeper explanations of rising complexity, at systemic level:

Functional/evolutionary:

W. Brian Arthur

- Structural deepening
- Niche filling
- Software capturing

Stochastic:

Murray Gell-Mann:

- “Frozen Accidents”

There are deeper explanations of rising complexity, at societal level:

Functional:

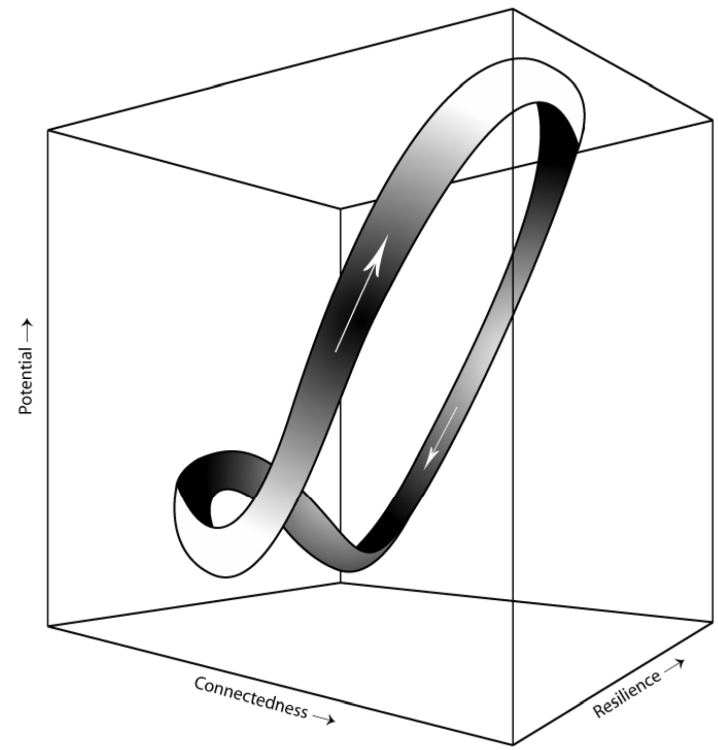
Joseph Tainter

Stream of exogenous problems; societies implement easiest solutions first, which produces diminishing returns

Ecological:

Buzz Holling:

Social units evolve to maximize productivity of available resources; emphasis on efficiency steadily raises complexity



Potential →
Connectedness →
Resilience →

IMPLICATIONS FOR HEALTH POLICY

- Aging populations, more sophisticated technologies, and web-empowered health-service consumers are rapidly boosting the cost of health care

- As rising costs run into funding limits, maximizing efficiency becomes a central principle of health administration

- Efforts to maximize efficiency increase the health-care system's complexity and reduce both its resilience and capacity for innovation

Can we always supply the ingenuity we need?

The ingenuity supply chain

Brains

Markets

Science

Politics

THREE THINGS TO DO

1. Recognize complexity of problems *and* solutions

2. Focus on increasing resilience

3. Use decentralized experimentation to search for solutions

1. Recognize complexity

Law of requisite variety:

Complex problems require complex solutions

Problem Types

	Problem Definition	Solution	Primary Locus of Problem Solving
Type I	Clear	Clear	Leader
Type II	Clear	Unclear	Leader/ Group
Type III	Unclear	Unclear	Group

2. Increase resilience

Resilience is the capability to withstand shock without catastrophic failure

A resilient person/organization exhibits

- Capacity for self-reliance
- Creativity in response to novel challenges

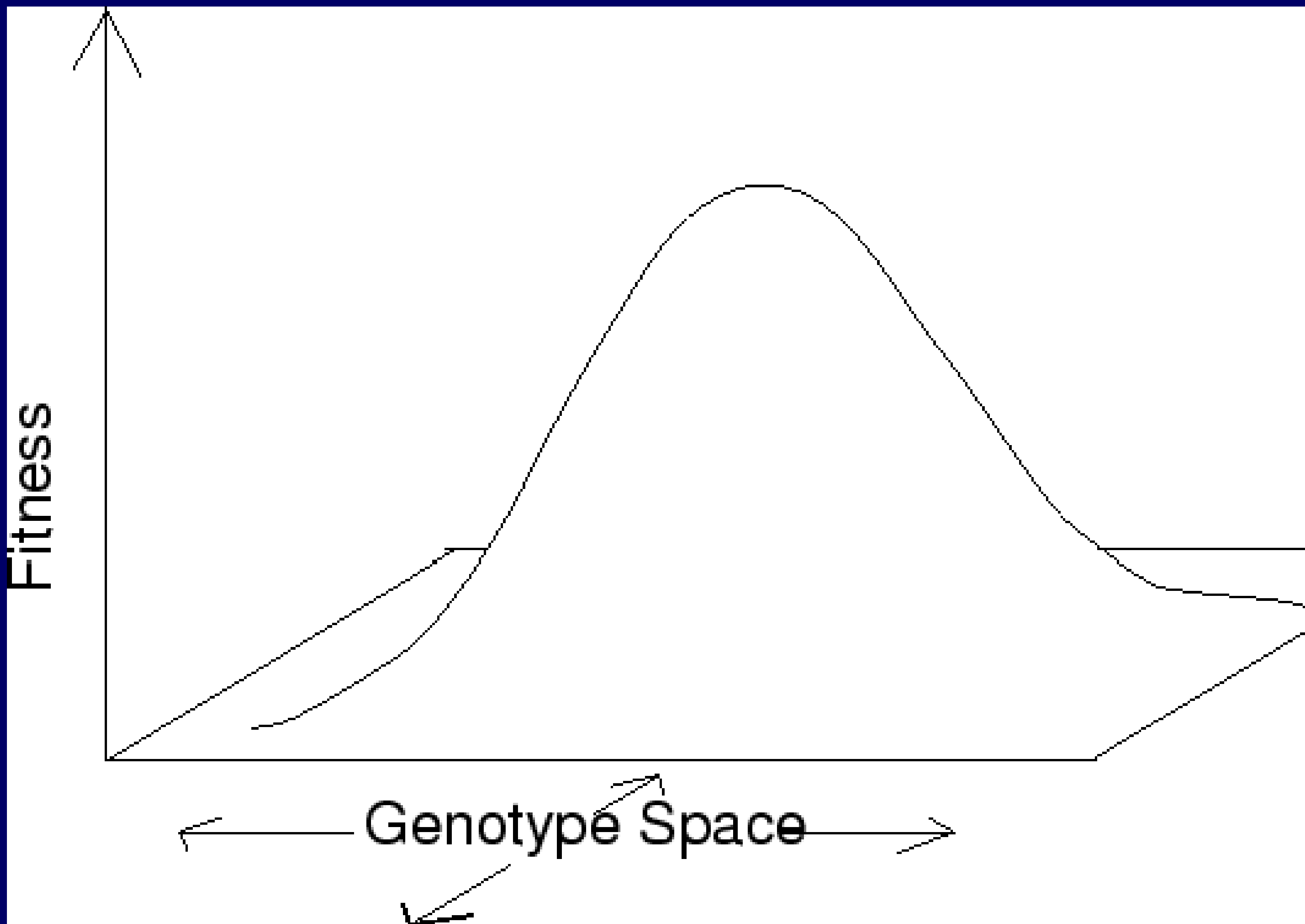
3. Decentralize response:

Multiple “agents” with diverse strategies

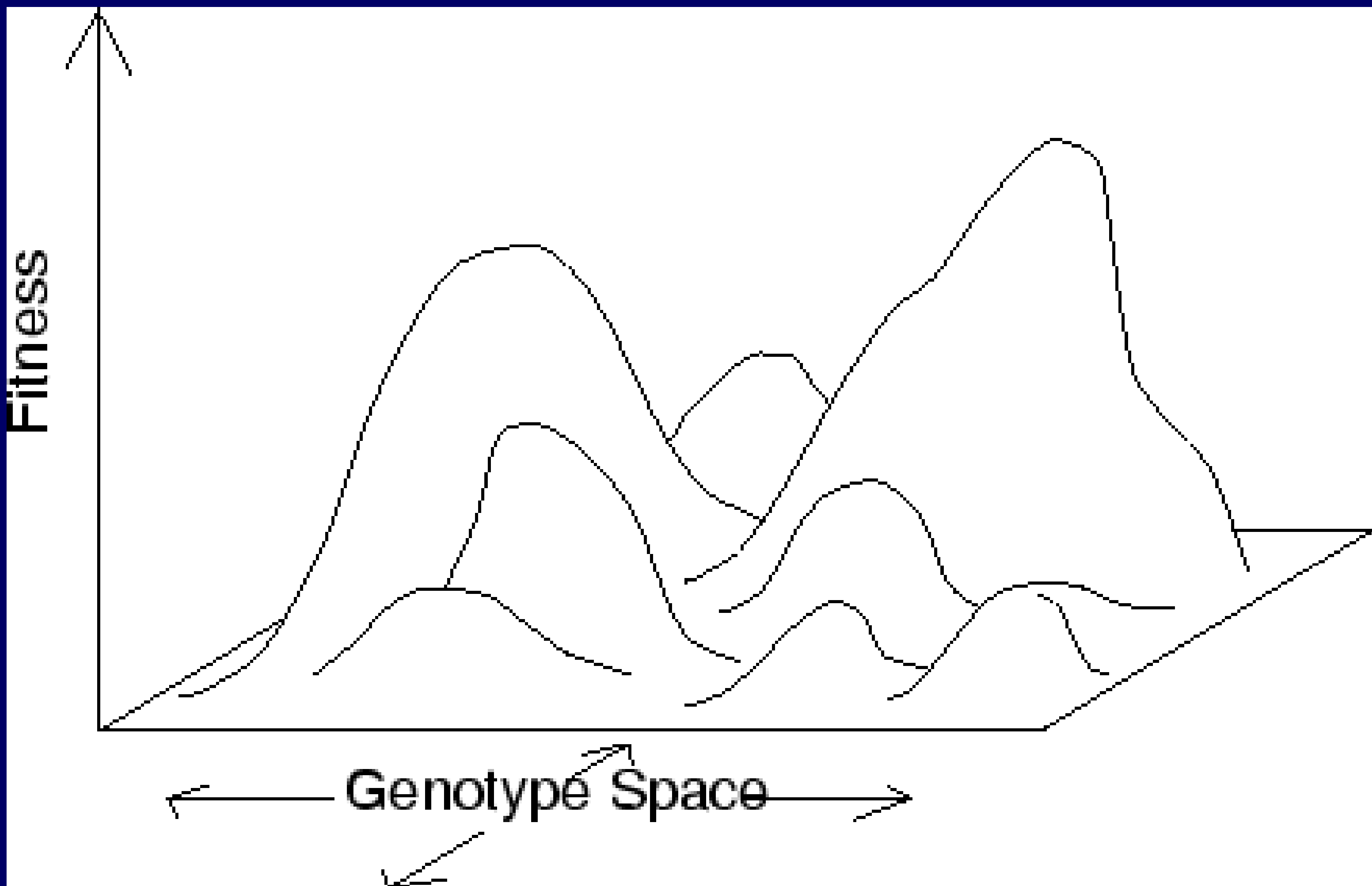
Linked together within a loose information network

Engaged in autonomous experimentation

And willing to learn from failure



Fitness
Genotype Space


Fitness
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Two Problem-Solving Paradigms

	Conventional	Complex Adaptive
Defining ontology	Mechanistic	Complex
Social organization	Centralized/hierarchical	Decentralized/distributed
Competence/Knowledge	High, technocratic, explicit	Mixed, experiential, tacit
Scale of testing	Small number of large tests with high consequence of failure	Abundant small scale, safe-fail experimentation
Sources of legitimacy/power	Policy communities, management elites	Civil society, democratic action, markets
Social location	Top	Bottom and middle
Goal	Optimization of expected utility (according to explicit, well-defined preferences)	Satisficing of multiple, often conflicting, and sometimes incommensurable values

Thomas Homer-Dixon, 2007