What is Neuroeconomics?

Neuroeconomics is an interdisciplinary research program with the goal of building a biological model of decision making in economic environments.

What does Neuroeconomics ask?

How does the embodied brain enable the mind (or groups of minds) to make economic decisions?

References

F.A. Hayek, The Sensory Order, The University of Chicago Press, Chicago Illinois, 1952.

Kevin McCabe, “Neuroeconomics,” Encyclopedia of Cognitive Science, Lynn Nadel ed., Nature Publishing Group, November, 2002.

Why Neuroeconomics?

To understand the heterogeneity of observed behavior when standard economic theories predict unique behavior.

Why Neuroeconomics?

To understand how behavior is affected by information in order to learn how institutions serve as extensions of our minds.

Why Neuroeconomics?

To use economic models to help understand how neural structures encode information in order to facilitate decision making.

Paul Glimcher, Decisions, Uncertainty and the Brain: The Science of Neuroeconomics, MIT Press, Nov. 2002.

More References

Damasio, Antonio, Hanna Damasio,
and Yves Christen, Neurobiology of Decision-Making,
Springer-Verlag, Berlin,1996.

Gazzaniga, Ed in Chief, The New Cognitive Neurosciences I-III, MIT Press, Cambridge Mass., 1995, 2000, 2005

Gazzaniga, Michael, Richard Ivry, George Mangun, Cognitive Neuroscience, Second Edition, W.W. Norton, New York, 2002.

Joseph LeDoux, Synaptic Self, Penguin Press, New York, 2002.

Basic Assumptions

The brain is a scarce resource that solves adaptive problems more efficiently by allocating resources to specialized cognitive mechanisms.

Basic Assumptions

The adaptive problems that the brain is designed to solve occurred regularly over evolutionary time spans and were problems that impacted reproductive success.

Basic Assumptions

Brain function can be modeled at the cognitive level in terms of computational theories that define data structures and processing algorithms.

Basic Assumptions

Computational models will be expressed as a connected set of cortical fields involving populations of neurons that can perform the computational task.

Basic Assumptions

Cortical fields will be assembled from the genetic code and modified by genetically determined mechanisms reacting to internal and external stimuli.

Basic Assumptions

Normal development will lead to similar computational strategies that deviate in predictable ways.

Basic Assumptions

Mind is maintained by cortical systems that function both explicitly, and implicitly, to produce an emergent order called self.

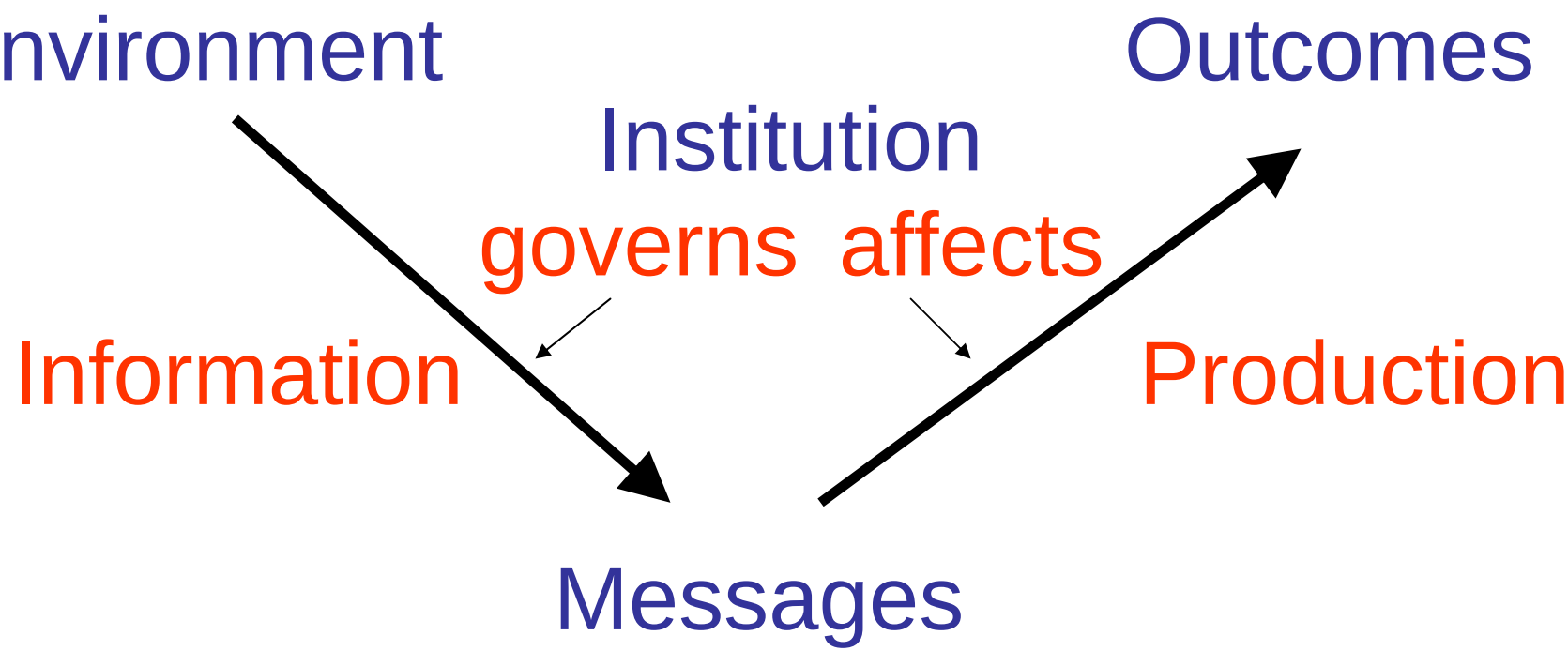
Basic Assumptions

The interaction between minds produces an emergent, although mostly hidden, order called culture.

Basic Assumptions

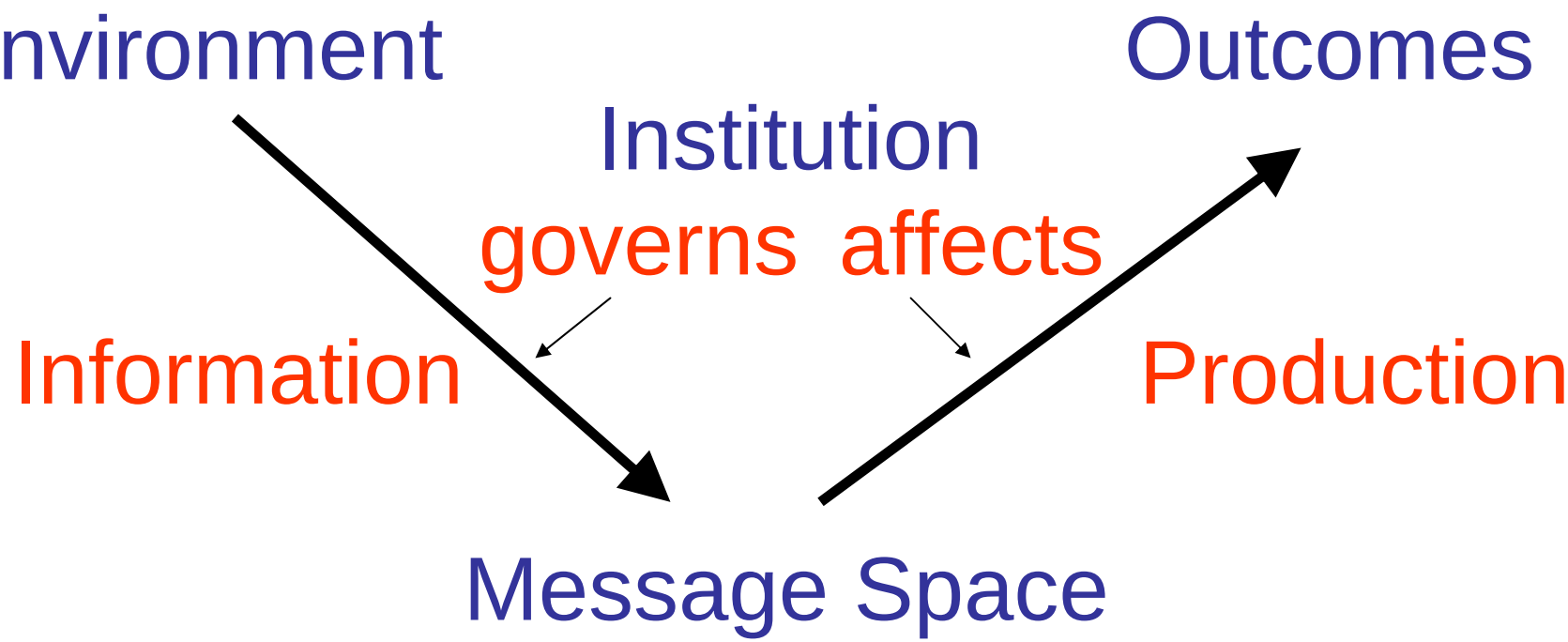
The hidden order behind culture can be studied using complex adaptive systems that recognize the potential for self and culture to act on each other.

Methodology: Experimental Economics



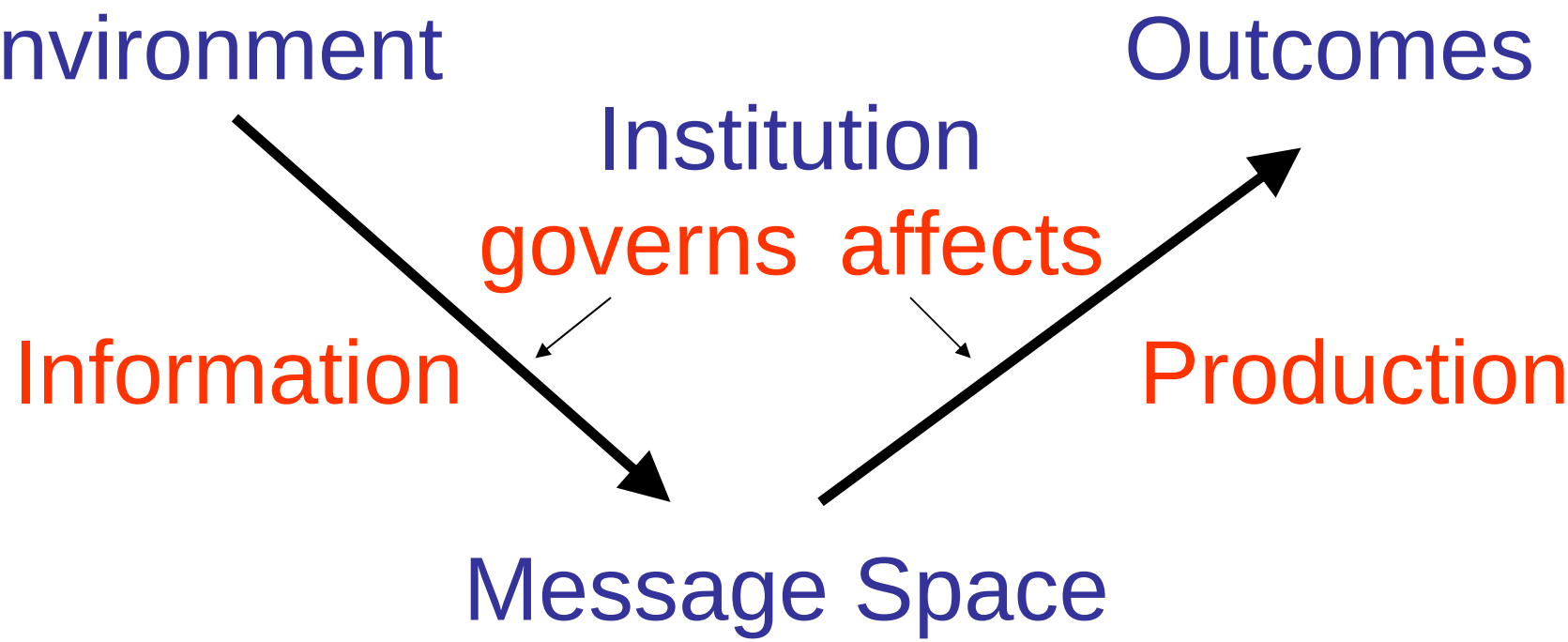
The Environment specifies subjects' preferences over outcomes.

Methodology: Experimental Economics



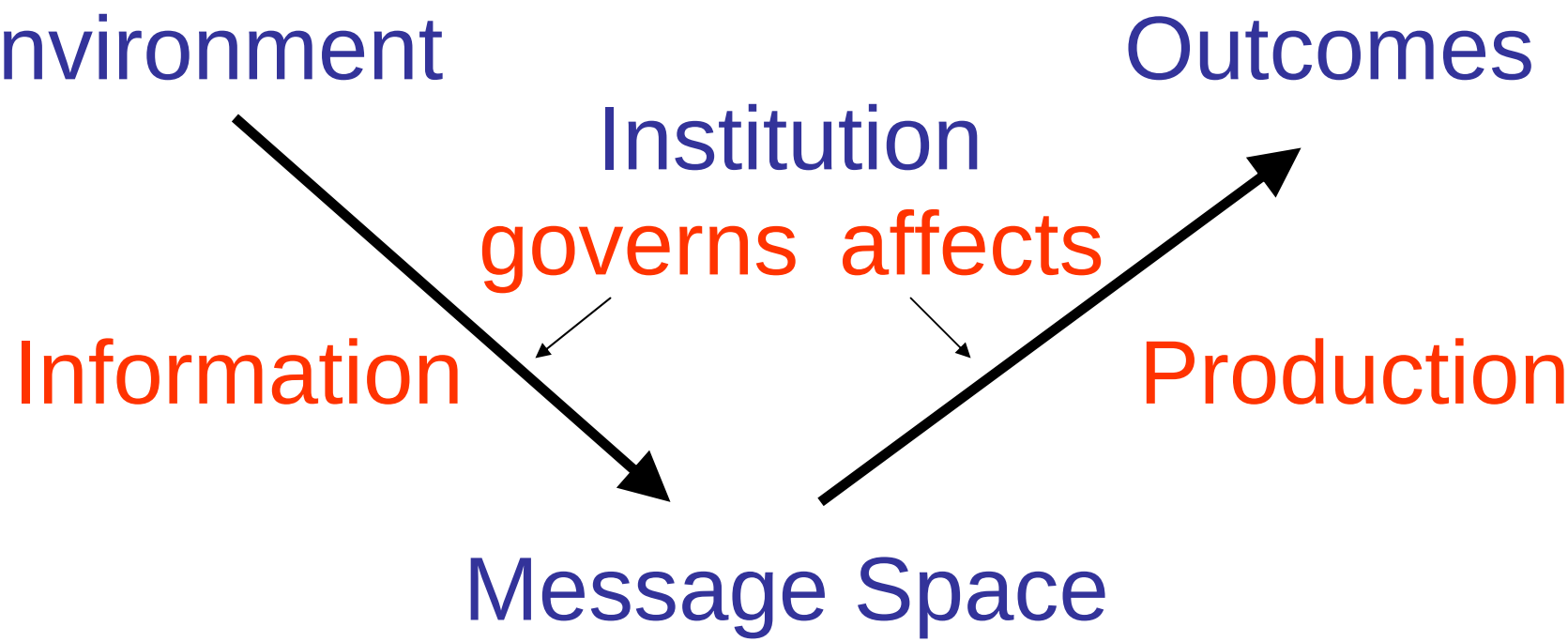
The Message Space specifies what messages subjects can send.

Methodology: Experimental Economics



The Institution governs what messages can be sent by what subjects, and when.

Methodology: Experimental Economics



The Institution also determines how messages affect outcomes.

Methodology: Experimental Economics

The Experimenter then **controls** for the **environment** and **institution** and **observes** subject **messages** and **outcomes**.

Vernon Smith, “Microeconomic Systems as an Experimental Science,” American Economic Review, (72)1982, pp. 923-955.

Methodology:
Cognitive Neuroscience

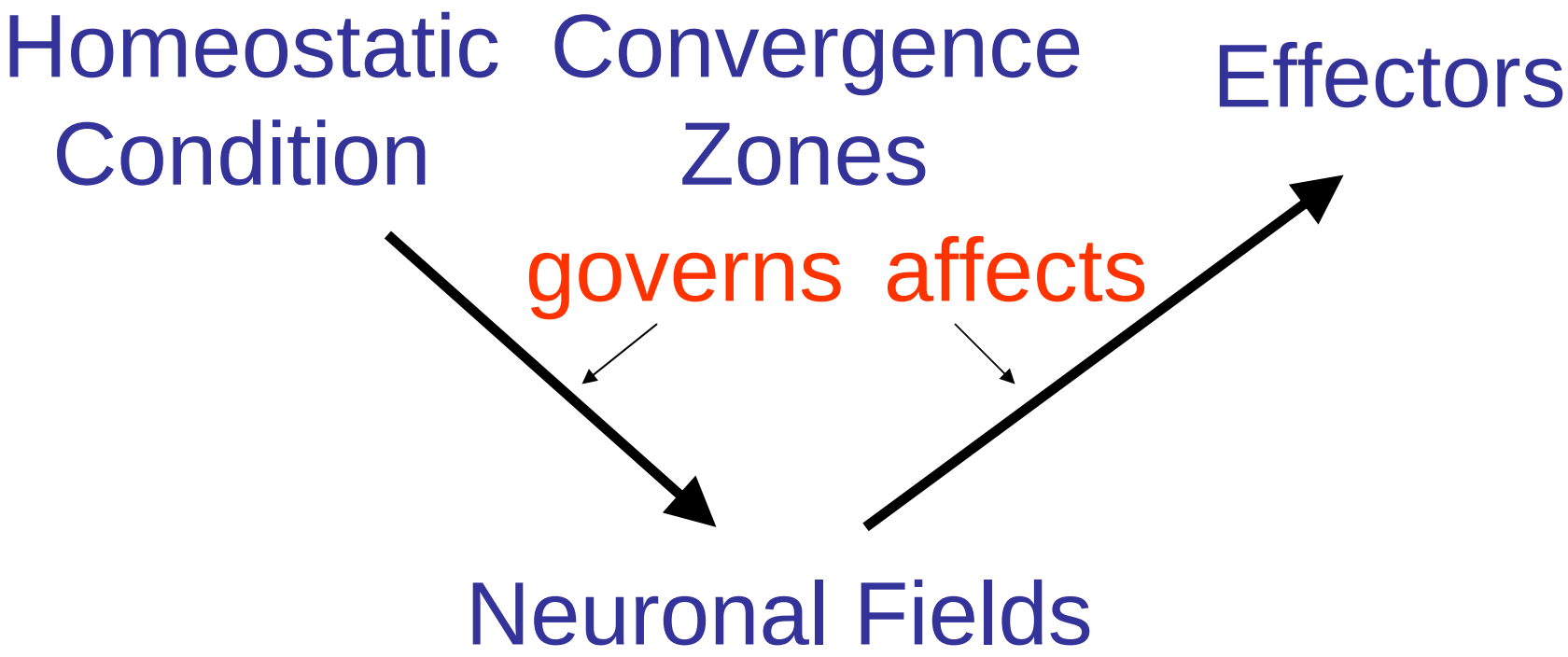
Synaptic
Connections

Experience

Evolution

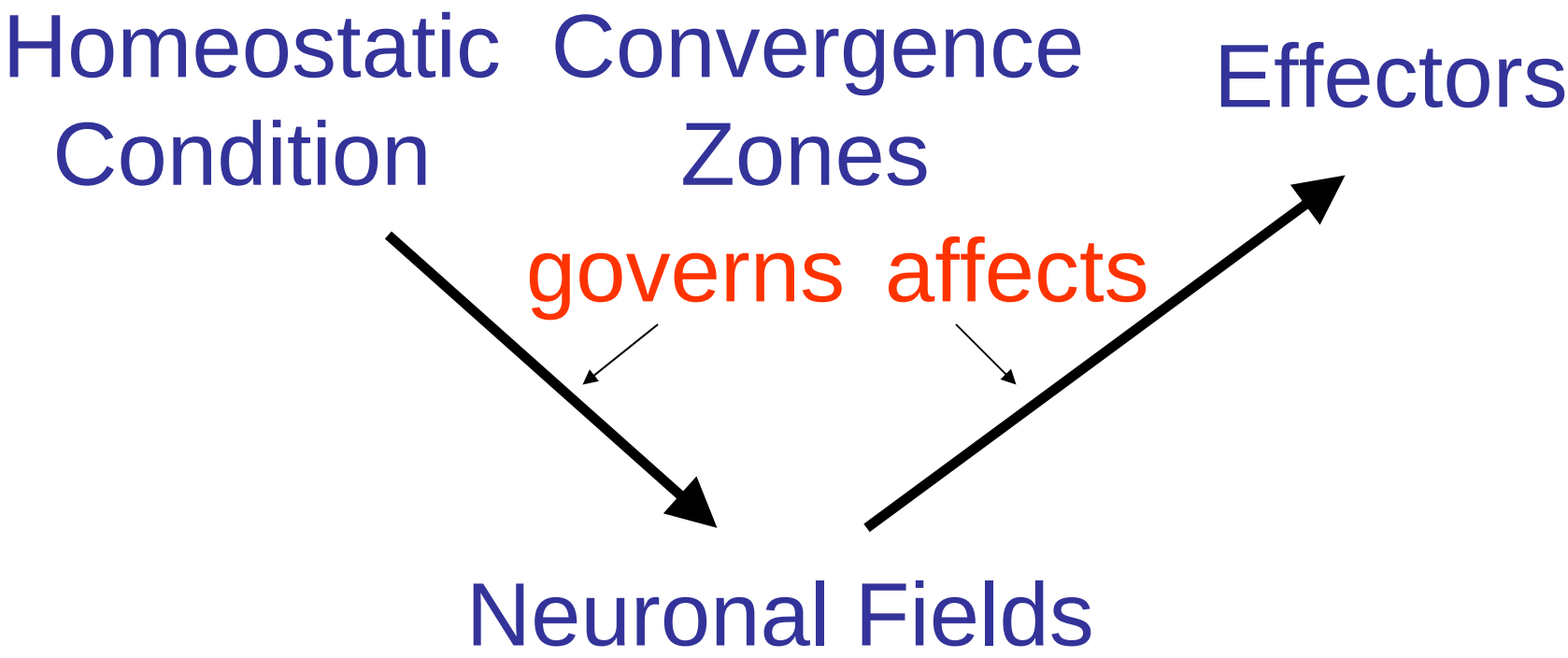
Experience and evolution shape Synaptic Connections which determine Neuronal Fields and Convergence Zones.

Methodology:
Cognitive Neuroscience



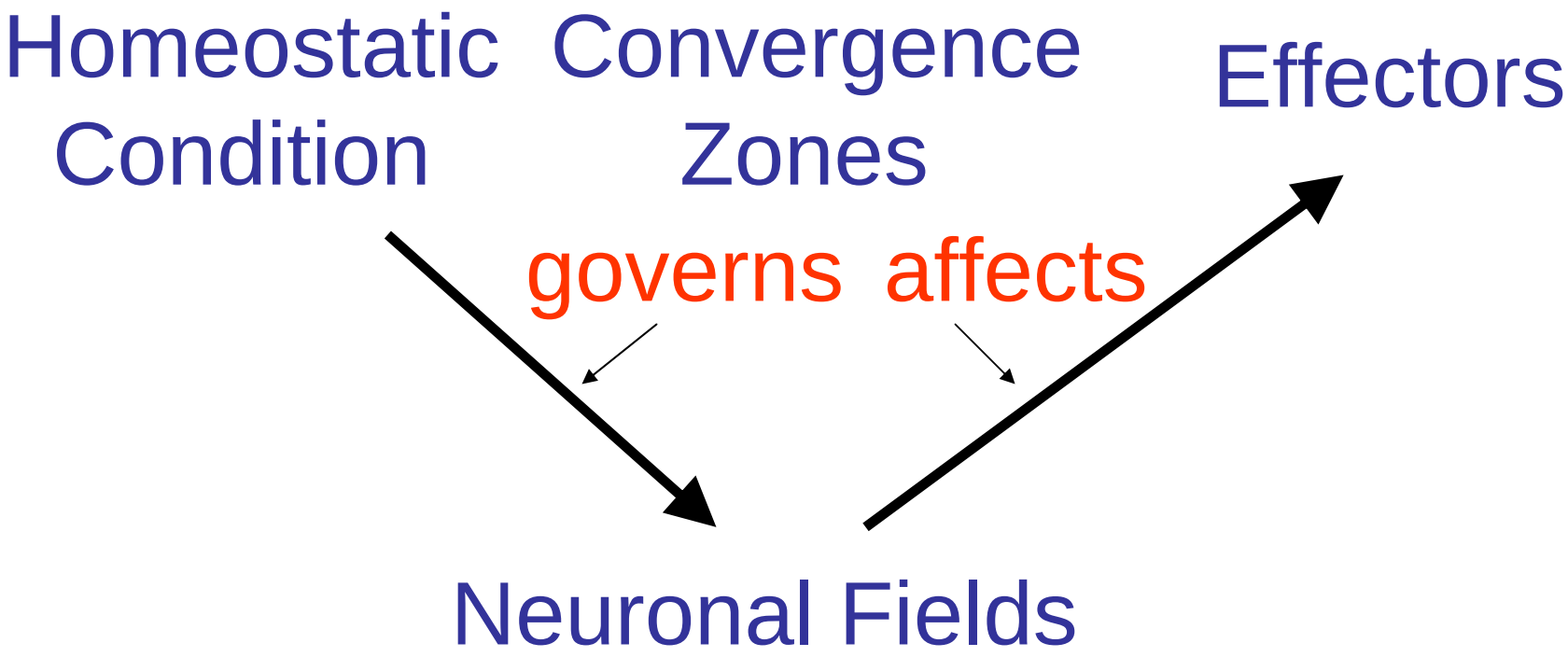
The homeostatic condition specifies the state of the organism.

Methodology:
Cognitive Neuroscience



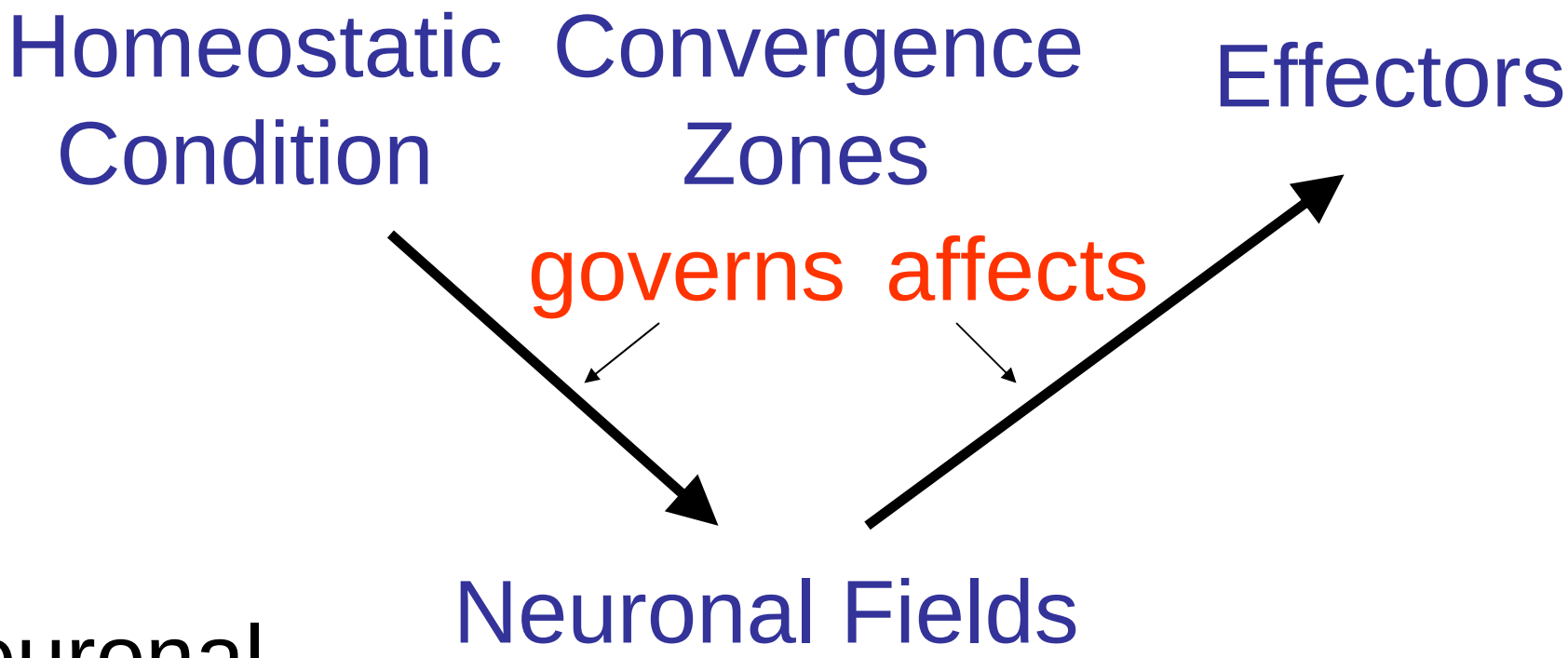
The Neuronal Fields determine what neural computations are possible.

Methodology:
Cognitive Neuroscience



Convergence zones govern what neuronal fields can be active, and when.

Methodology:
Cognitive Neuroscience



Neuronal field activity affects subjects' effectors resulting in changes to homeostasis.

Methodology:
Cognitive Neuroscience

The Experimenter then **controls** for the **homeostatic condition** by manipulating sensory inputs and **observes** neuronal field activity.

Methodology Neuroeconomics

Environment

Outcomes

Institution

Homeostatic Condition

Messages

Convergence Zones

Neuronal Fields

Methodology
Neuroeconomics

The Experimenter then **controls** for the **environment** and the **institution** and **observes** neuronal field activity, messages, and outcomes.

Research Program in Neuroeconomics

Adaptive Problem

First identify an adaptive problem that has produced evolutionary changes to produce a more efficient cognitive capability.

Modern Problem

Research Program in Neuroeconomics

Adaptive Problem

Second, show how this adapted problem persists as a modern problem and how cognitive demands have changed (or not).

Modern Problem

Research Program

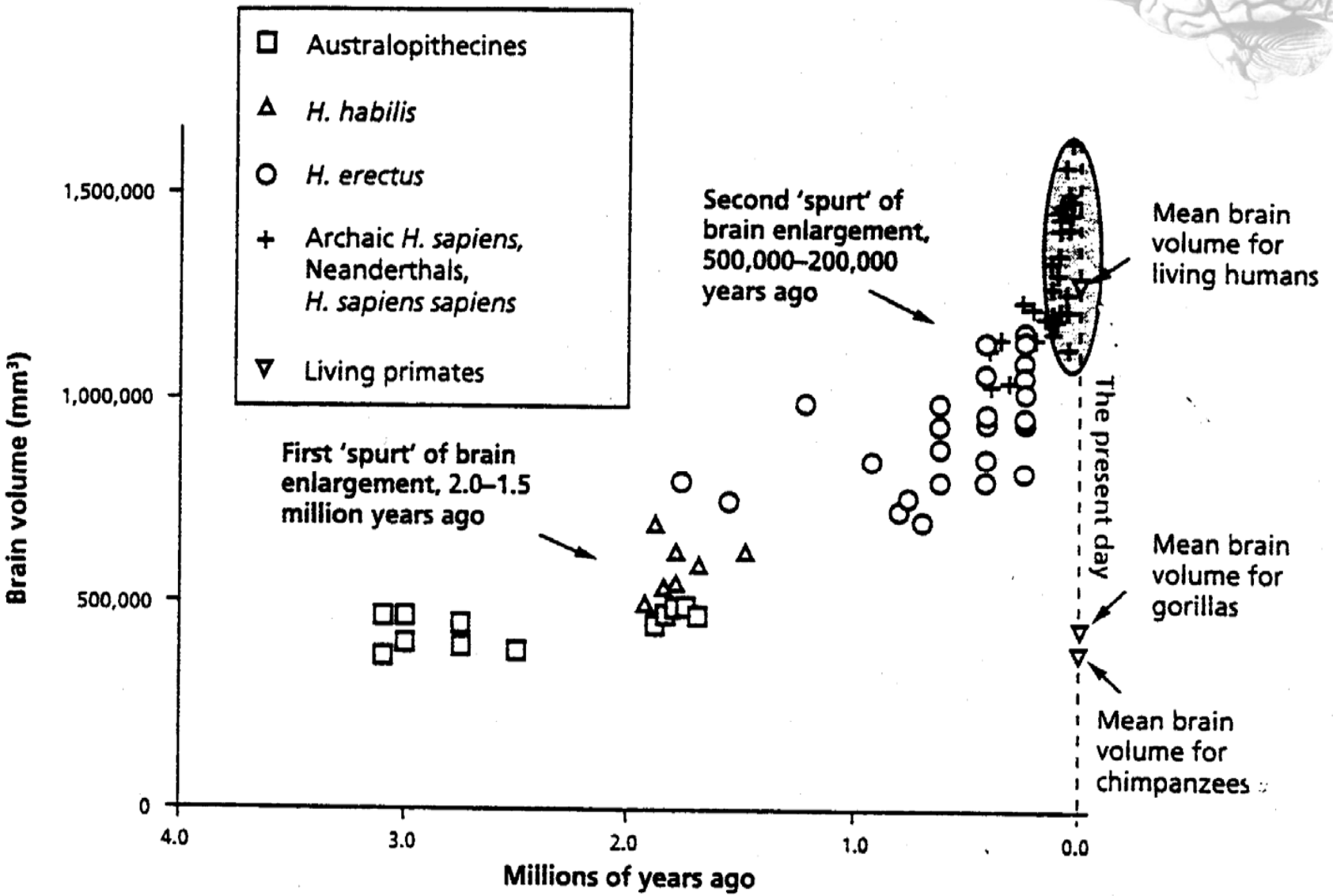
Adaptive Problem

Field Research

Archeology
Anthropology
Evolutionary Psychology
Economic History
Primate Studies

Modern Problem

Brain Volume



Evolutionary Psychology

Evolutionary psychologists argue that much of what we call "culture," social exchange, reciprocity is instinctive

1. For more than 2 million years our ancestors lived as hunter gathers in small groups of families and extended families. .

2. For such activity to sustain life, and bring us to the agricultural revolution within the last 10,000 years, required a solution to the ever-present temptation to cheat or free ride on the efforts of others. What were the mechanisms making such a development possible and how might they relate to the evolution of the mind as a biological entity?

Reference

Hoffman, Elizabeth, Kevin McCabe, and Vernon Smith, 1998, "Behavioral Foundations of Reciprocity: Experimental Economics and Evolutionary Psychology," Economic Inquiry, (36) 335-352.

Research Program in Neuroeconomics

Adaptive Problem

Environments

Next, specify an environment for for the adaptive problem and how the environment has changed for the modern problem.

Behaviors

Modern Problem

Research Program in Neuroeconomics

Adaptive Problem

Environments

Now ask how do these different environments affect message sending behaviors using methods from experimental economics.

Behaviors

Modern Problem

Research Program

Adaptive Problem

Behavior

Cross-Cultural Studies
Laboratory Experiments
Comparative Economics
Social Psychology
Field Experiments

Environments

Modern Problem

Field Research

Lab & Field Experiments

Experimental Economics

Smith, V.L., 1976,Experimental economics: Induced value theory, American Economic Review 66. 274-279.

Smith, V.L., 1982, Microeconomic systems as an experimental science, American Economic Review 72. 923-955.

Research Program in Neuroeconomics

Adaptive Problem

Environments

Strategy

Next define a strategy that maps a subject's Information into actions.

Information

Behaviors

Modern Problem

Research Program in Neuroeconomics

Adaptive Problem

Environments

Strategy

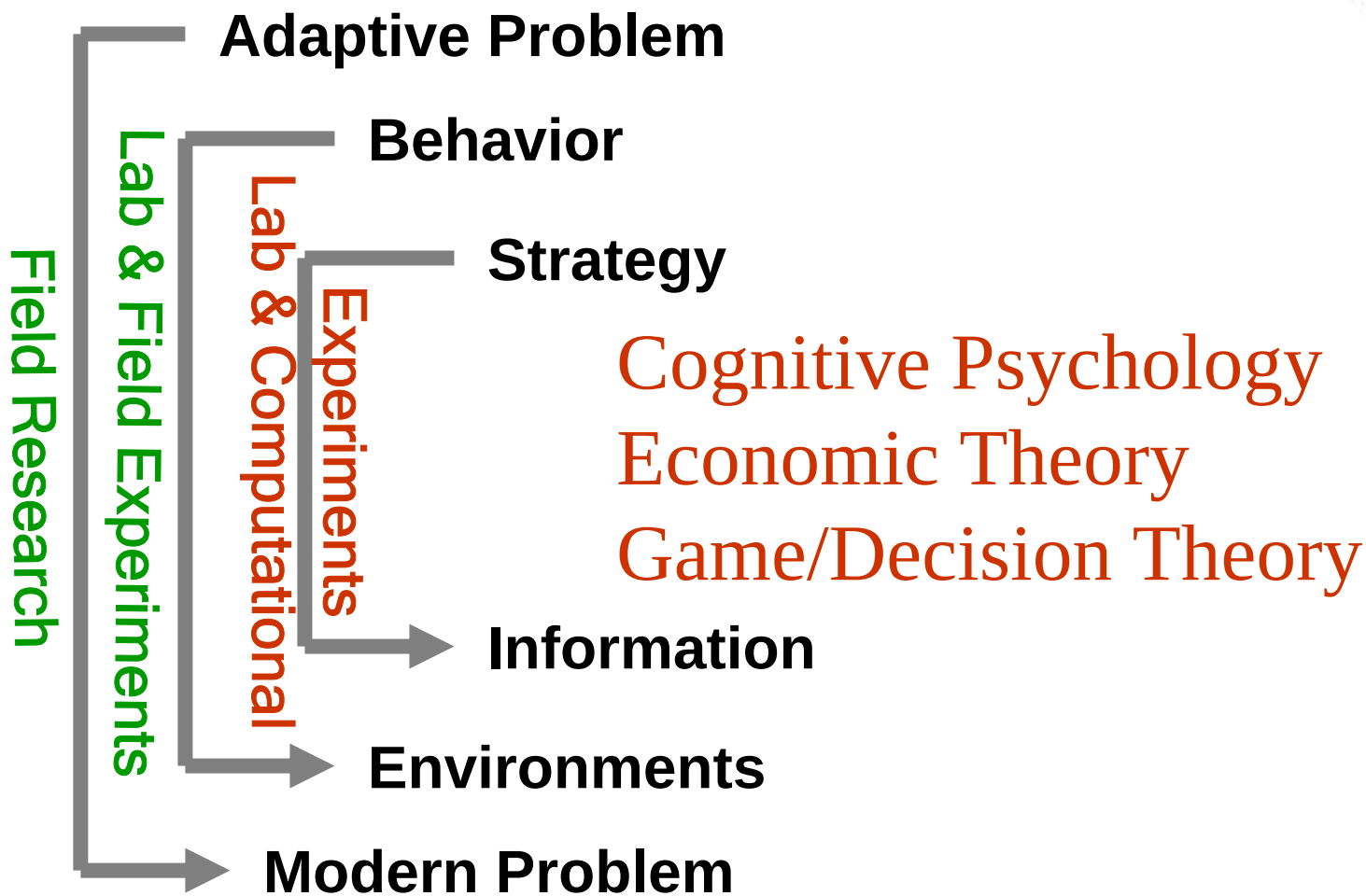
Then test the strategy by varying the available information.

Information

Behaviors

Modern Problem

Research Program

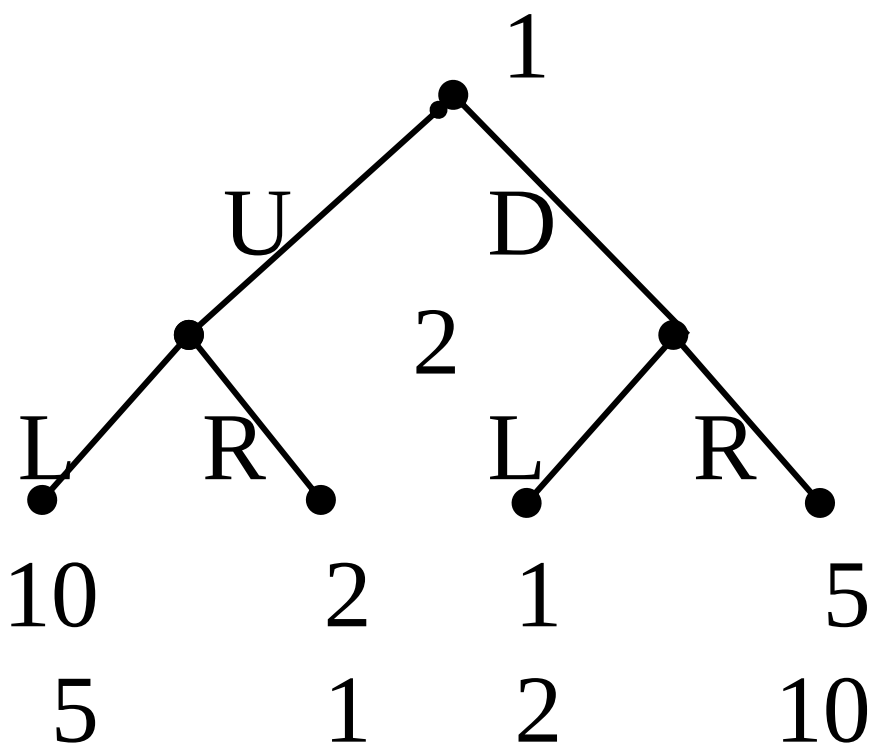


Game Forms

Normal Form

1 \ 2	left	right
up	10, 5	2, 1
down	1, 2	5, 10

Extensive Form

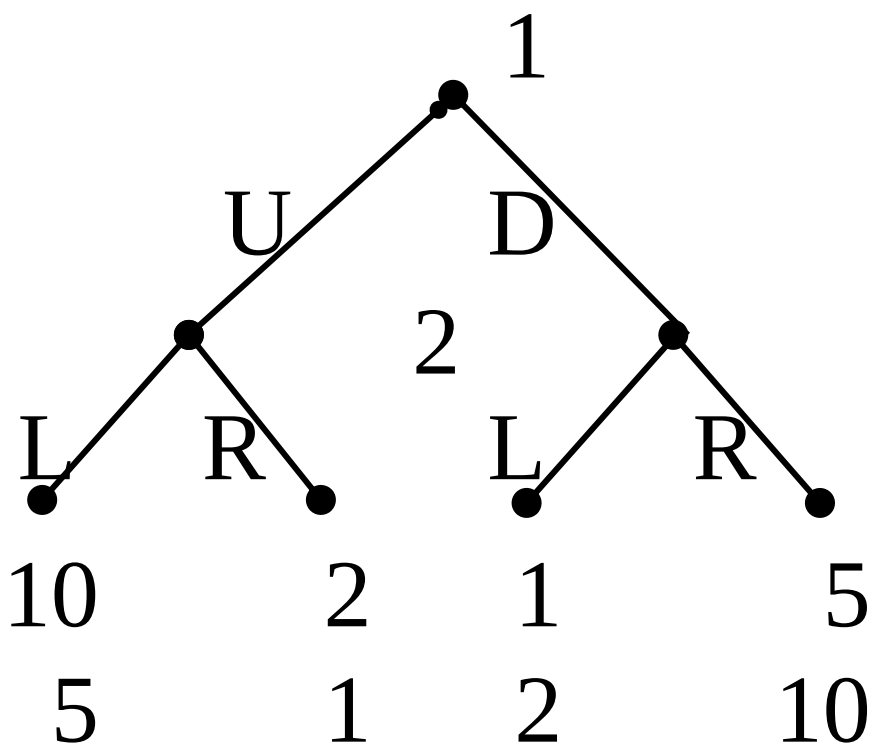


Game Forms

Normal Form

1 \ 2	left	right
up	5 NE 10	1 2
down	2 1	10 NE 5

Extensive Form



Game Forms

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1 \ 2	left	right
up	5 NE 10	1 2
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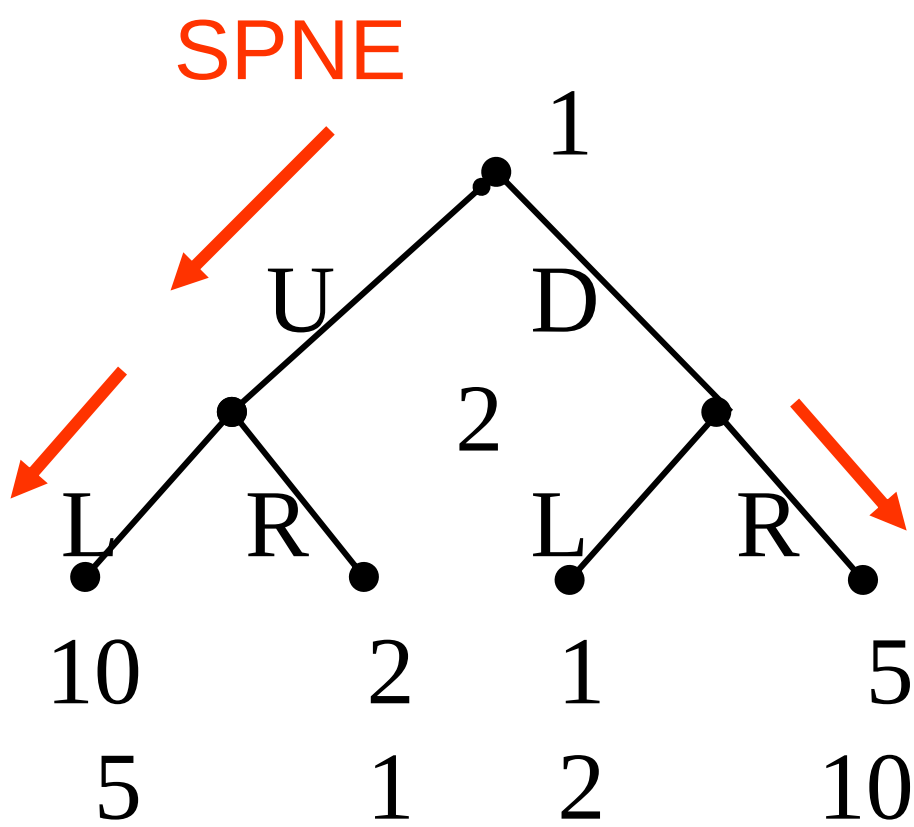
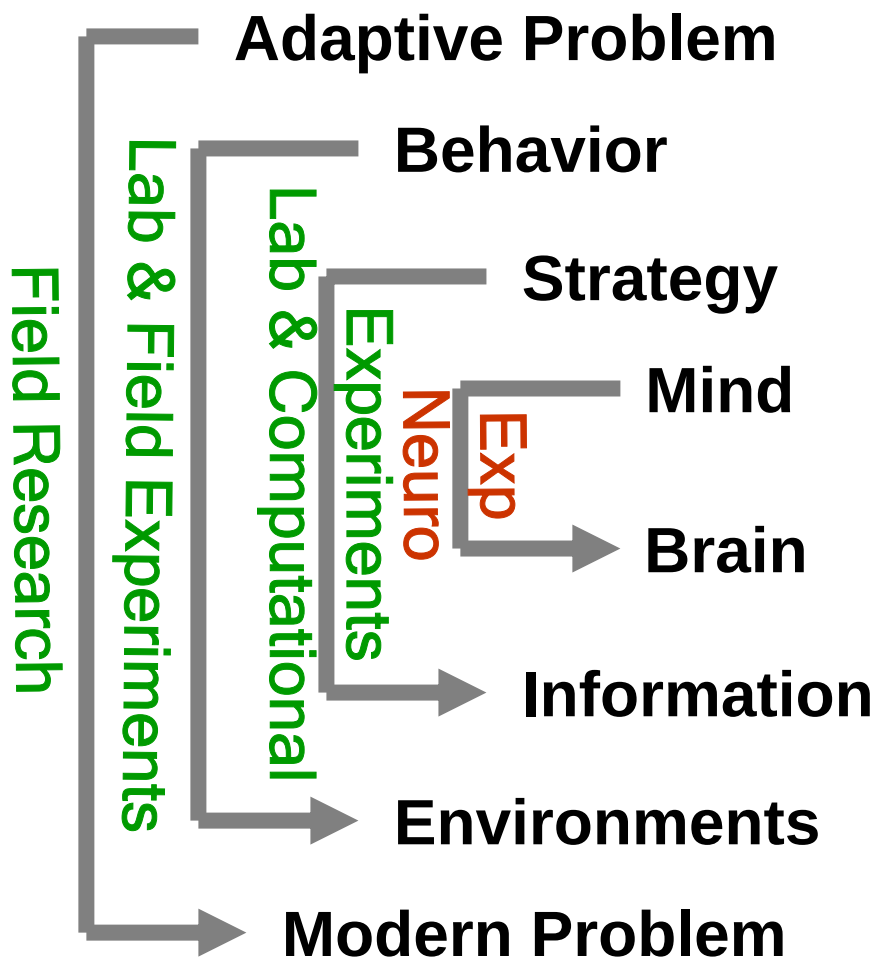
Extensive Form



Research Program



Lesion Studies
Imaging Studies
Cell Recording
Active Stimulation
Computational Models

fMRI Scanner