


31 July to 4 August 2023 - Copenhagen

# The biosemiotic process: How to reproduce and adapt the identity of social systems by combining emotions and language

Mario GIAMPIETRO





A large group of Buddhist monks in orange robes are riding a motorcycle. The monks are packed closely together, and the motorcycle is visible in the foreground. The background shows green foliage and a clear sky.

1. INTRO – why I am here

2. The great convergence on biosemiotics

3. The functional cycle and non-equilibrium thermodynamics  
(the missing ingredient . . . group autocatalysis)

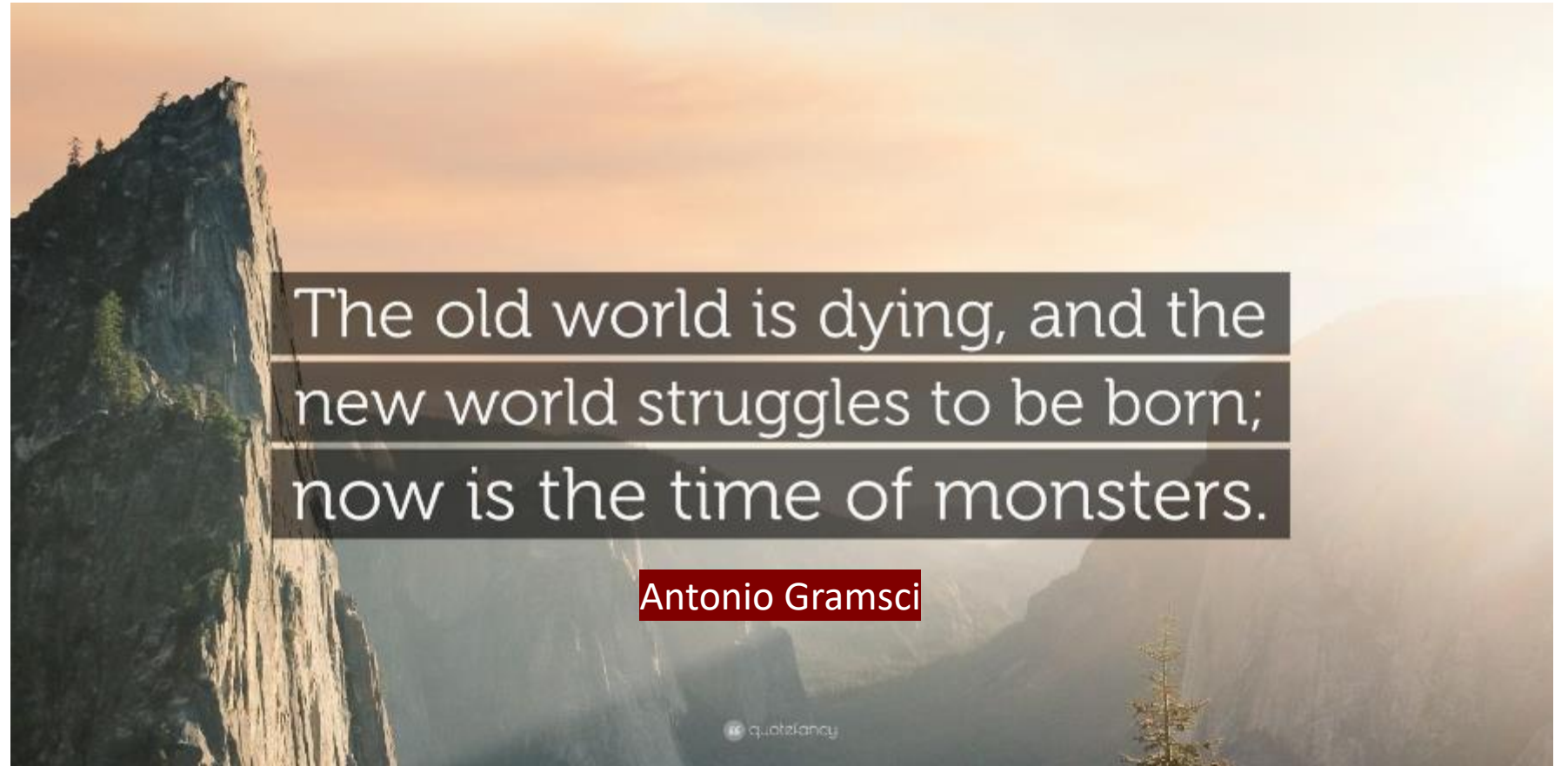
4. The adaptive cycle in theoretical ecology

5. The biosemiotic process in human societies

1. INTRO – why I am here

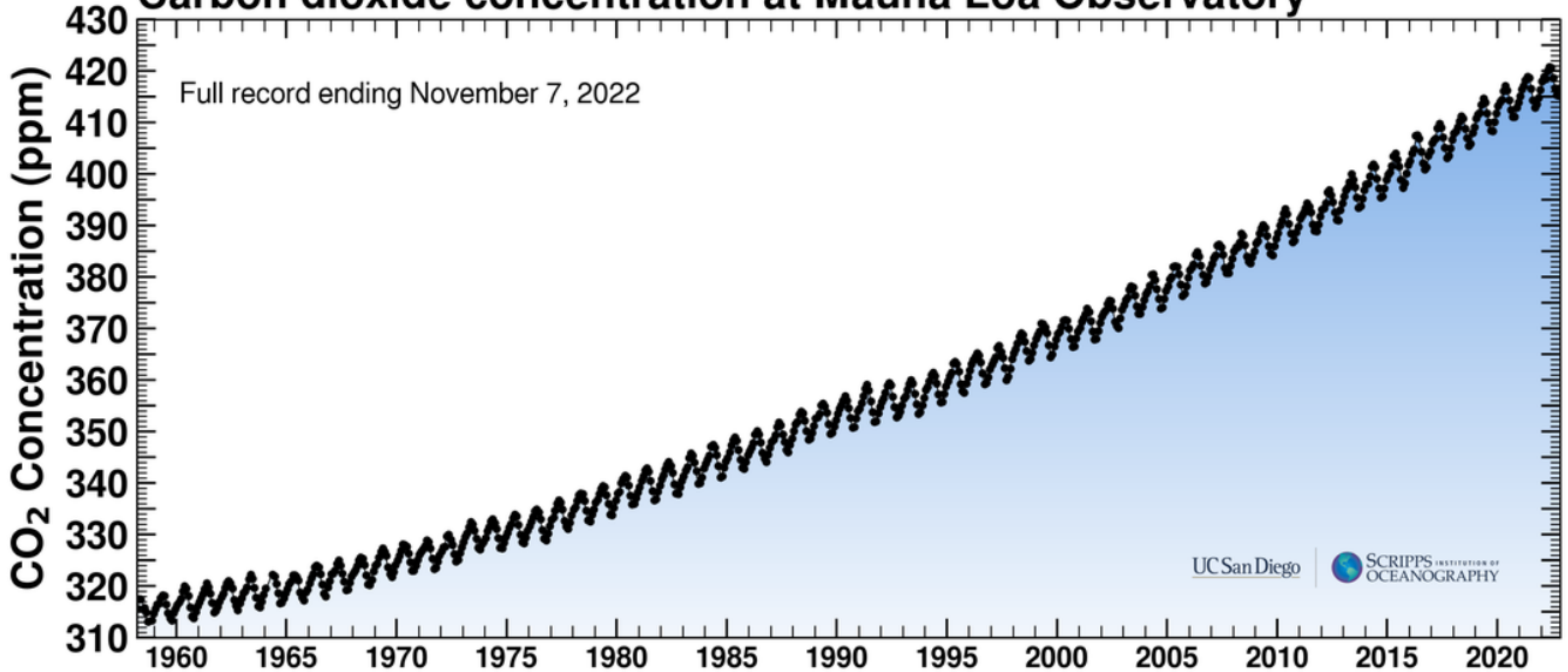


The sustainability crisis consists precisely in the fact that . . .



1. INTRO – why I am here

# Carbon dioxide concentration at Mauna Loa Observatory



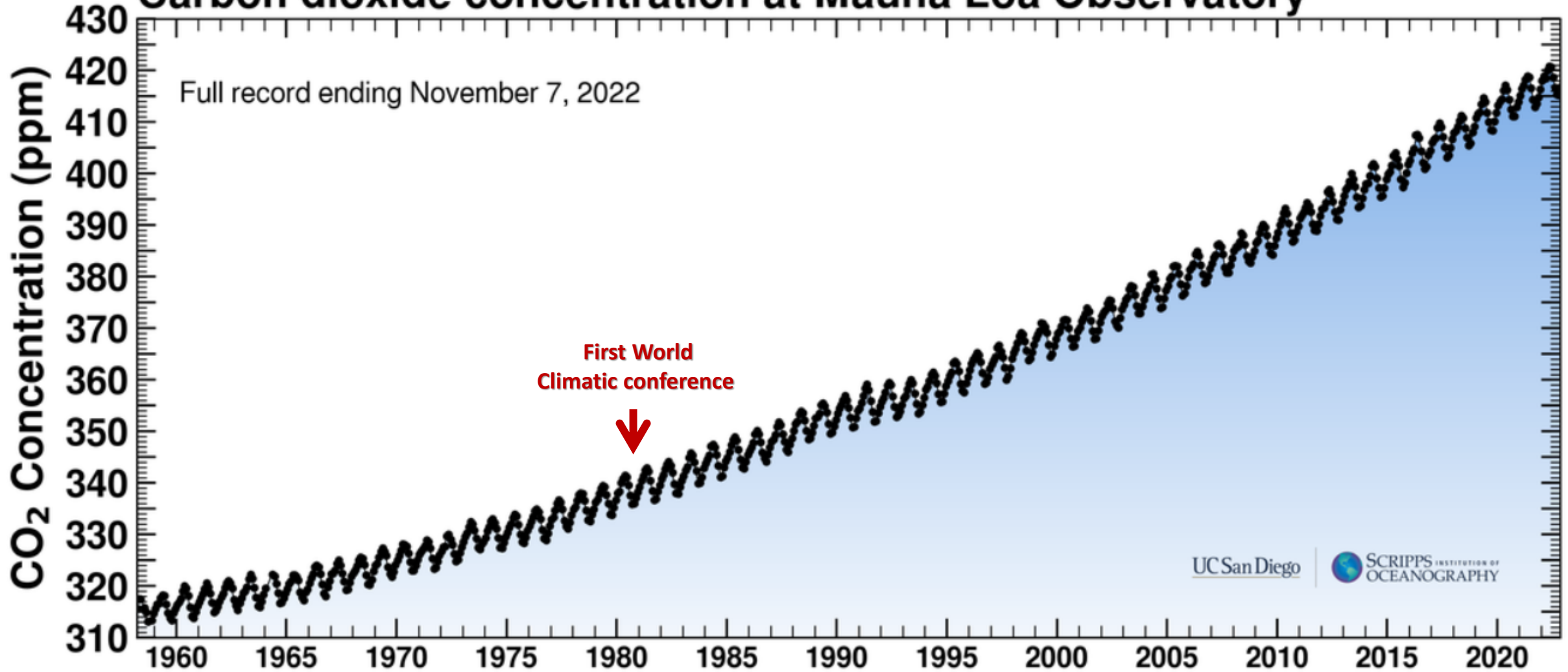
<https://keelingcurve.ucsd.edu/>

full record – 1960-2022



Earth System Research Laboratories  
Global Monitoring Laboratory

# Carbon dioxide concentration at Mauna Loa Observatory



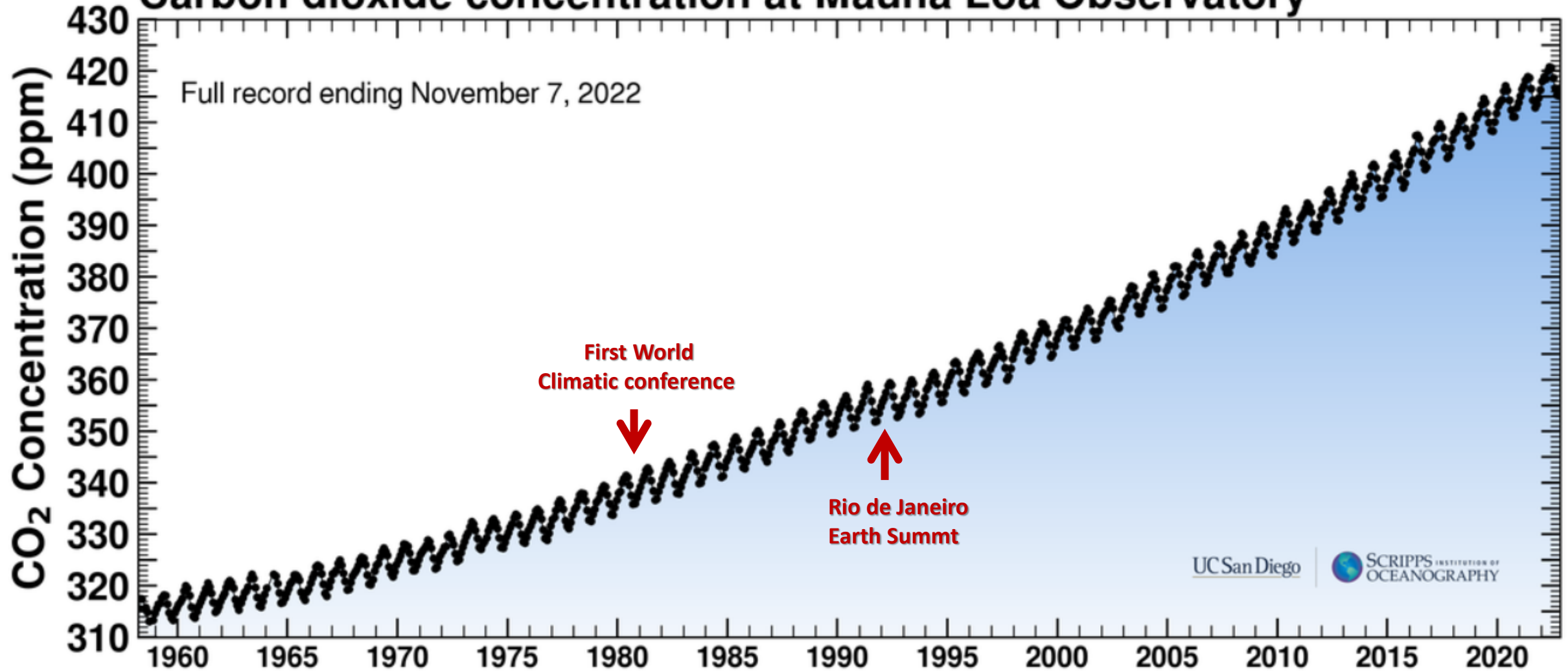
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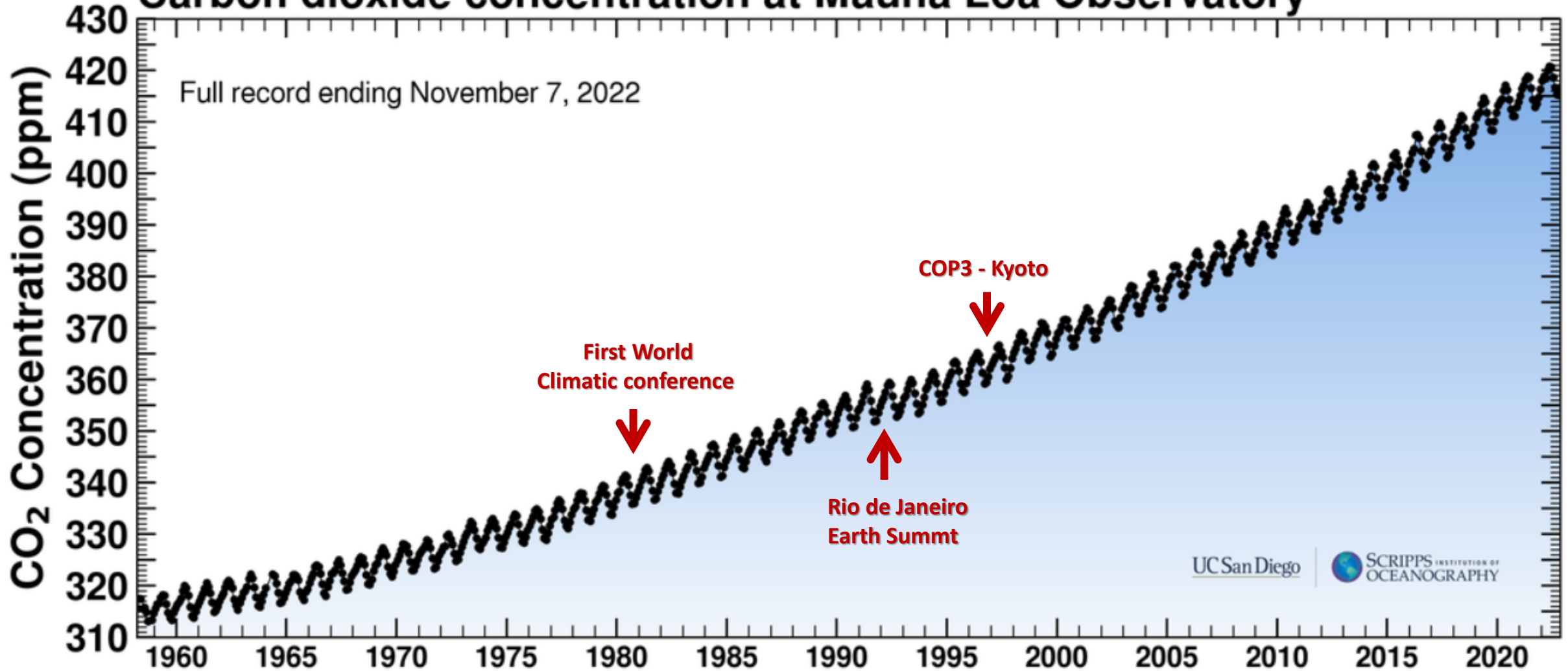
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Earth System Research Laboratories  
Global Monitoring Laboratory



# Carbon dioxide concentration at Mauna Loa Observatory



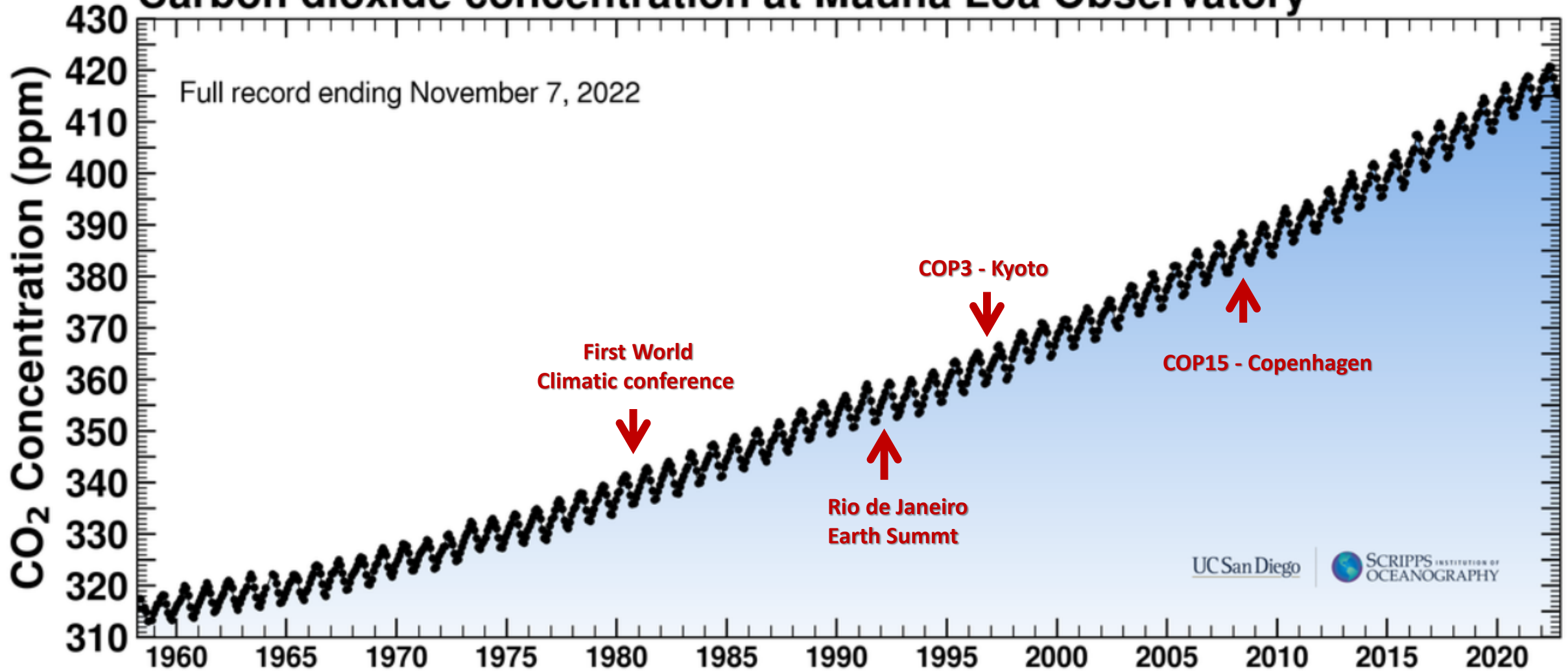
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Earth System Research Laboratories  
Global Monitoring Laboratory

# Carbon dioxide concentration at Mauna Loa Observatory



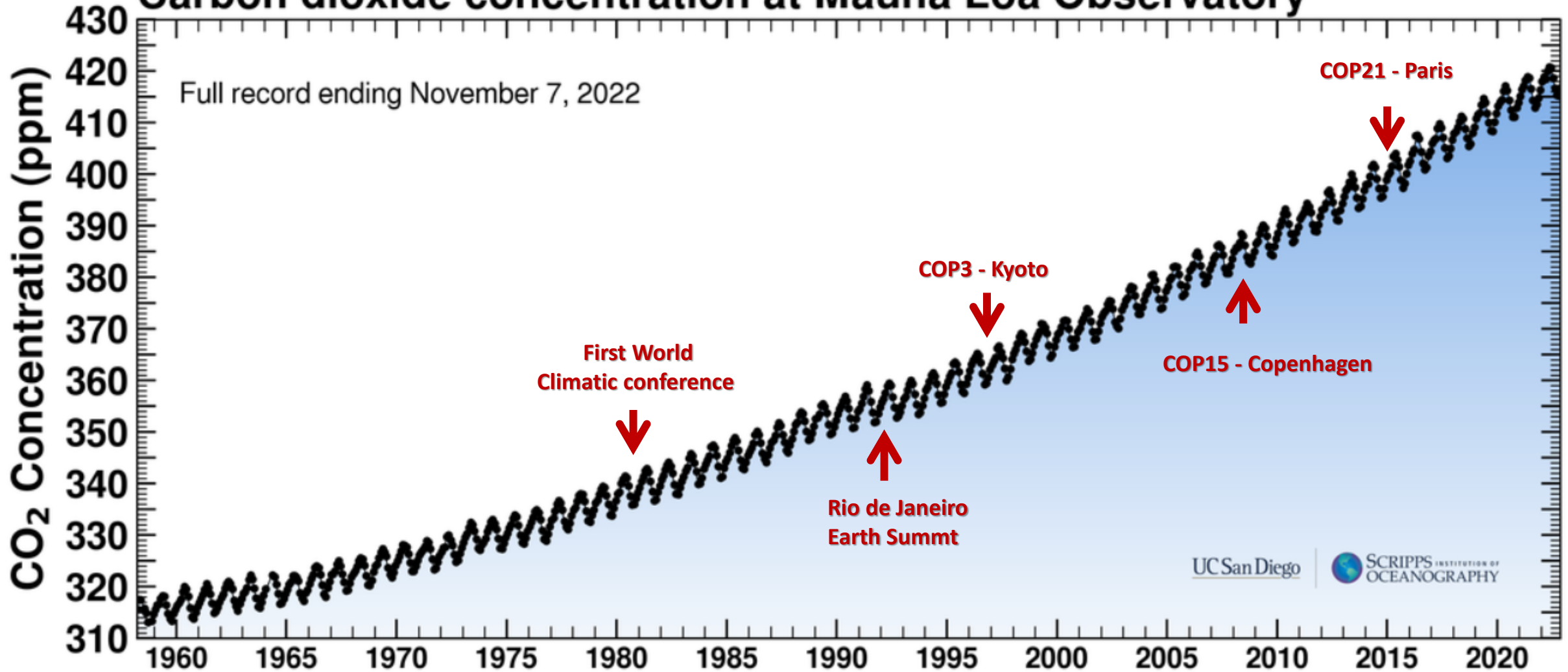
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full record – 1960-2022



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Global Monitoring Laboratory

# Carbon dioxide concentration at Mauna Loa Observatory



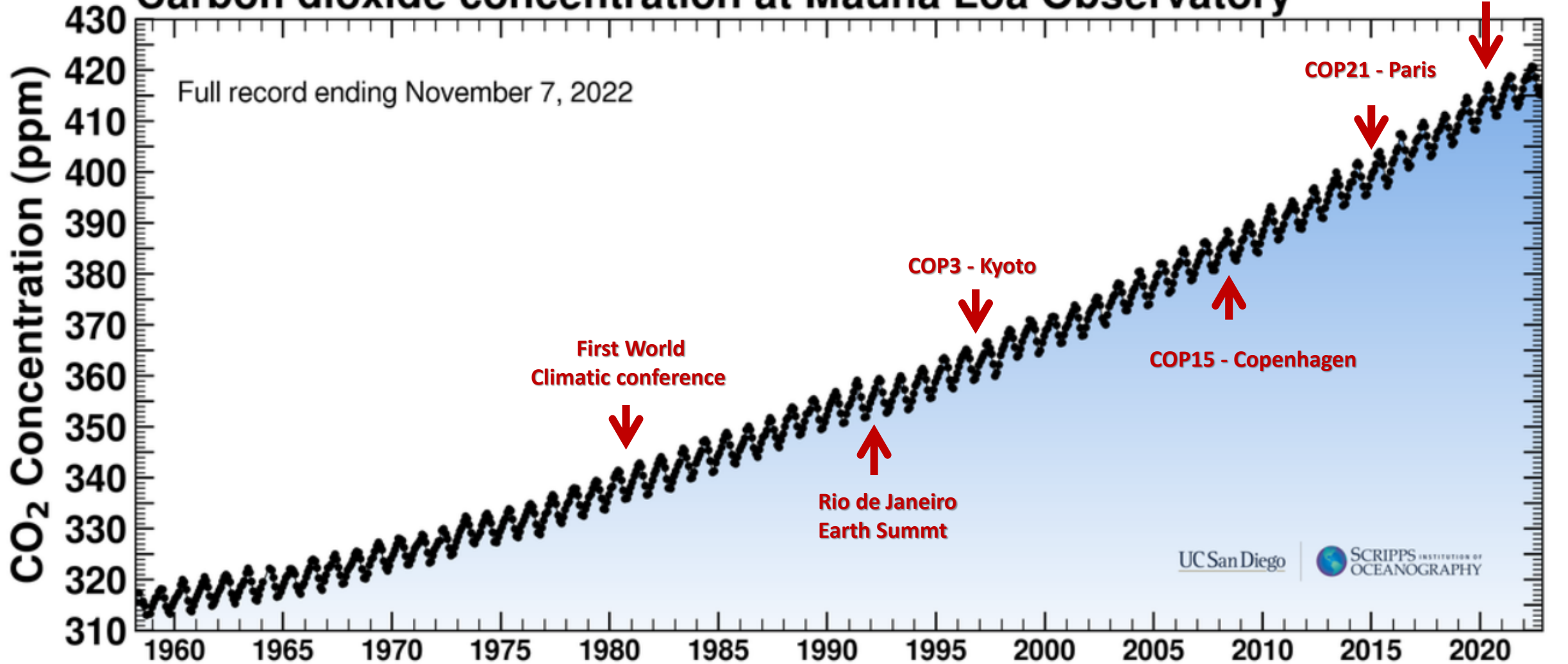
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full record – 1960-2022



Earth System Research Laboratories  
Global Monitoring Laboratory

# Carbon dioxide concentration at Mauna Loa Observatory



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full record – 1960-2022



Earth System Research Laboratories  
Global Monitoring Laboratory

# The narrative of N. Luhmann

*epistemic cut*

*epistemic cut*

The narrative of N. Luhmann

## COMMUNICATIONS

REPRESENT

Validating knowledge

IDENTITY

**NOTIONAL SIDE**

**TANGIBLE SIDE**

IDENTITY

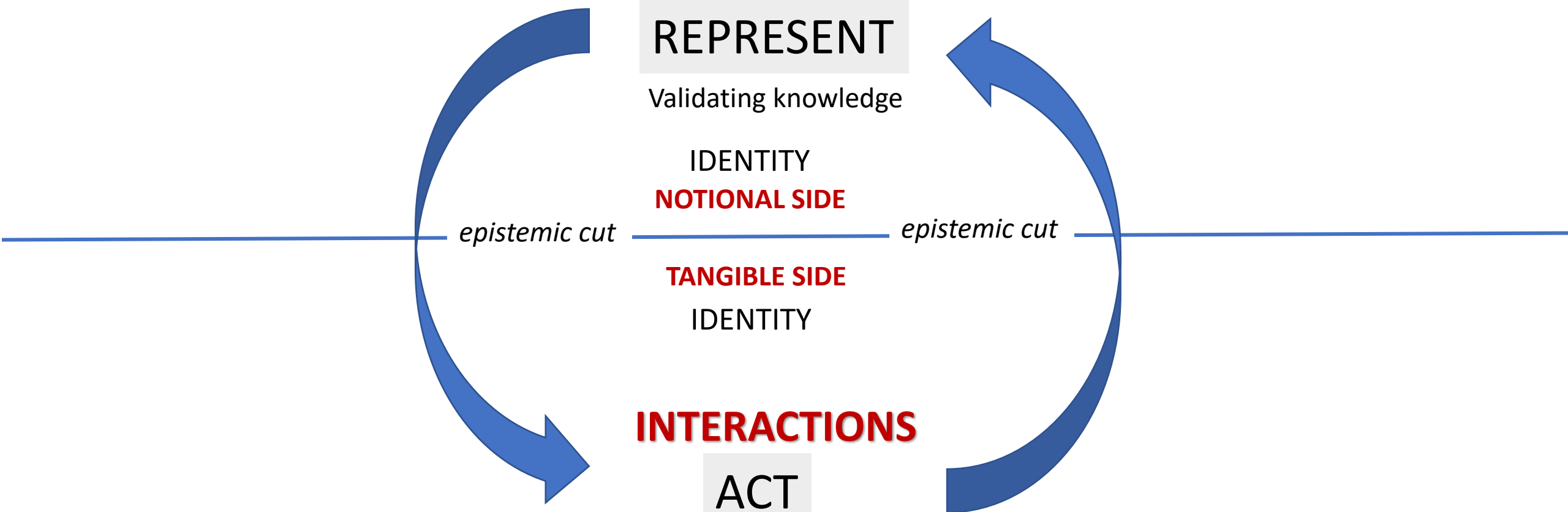
## INTERACTIONS

ACT

Using knowledge

*epistemic cut*

*epistemic cut*



The narrative of N. Luhmann

**Validated knowledge based on narratives/taxonomies referring to types**

*knowledge claims*

institutions

rules/controls

data/models

**INTERPRETATION**



*POLITICAL POWER*

GUIDING ACTION

MONITORING AND CONTROL

# COMMUNICATIONS

**REPRESENT**

Validating knowledge

IDENTITY

**NOTIONAL SIDE**

**TANGIBLE SIDE**

IDENTITY

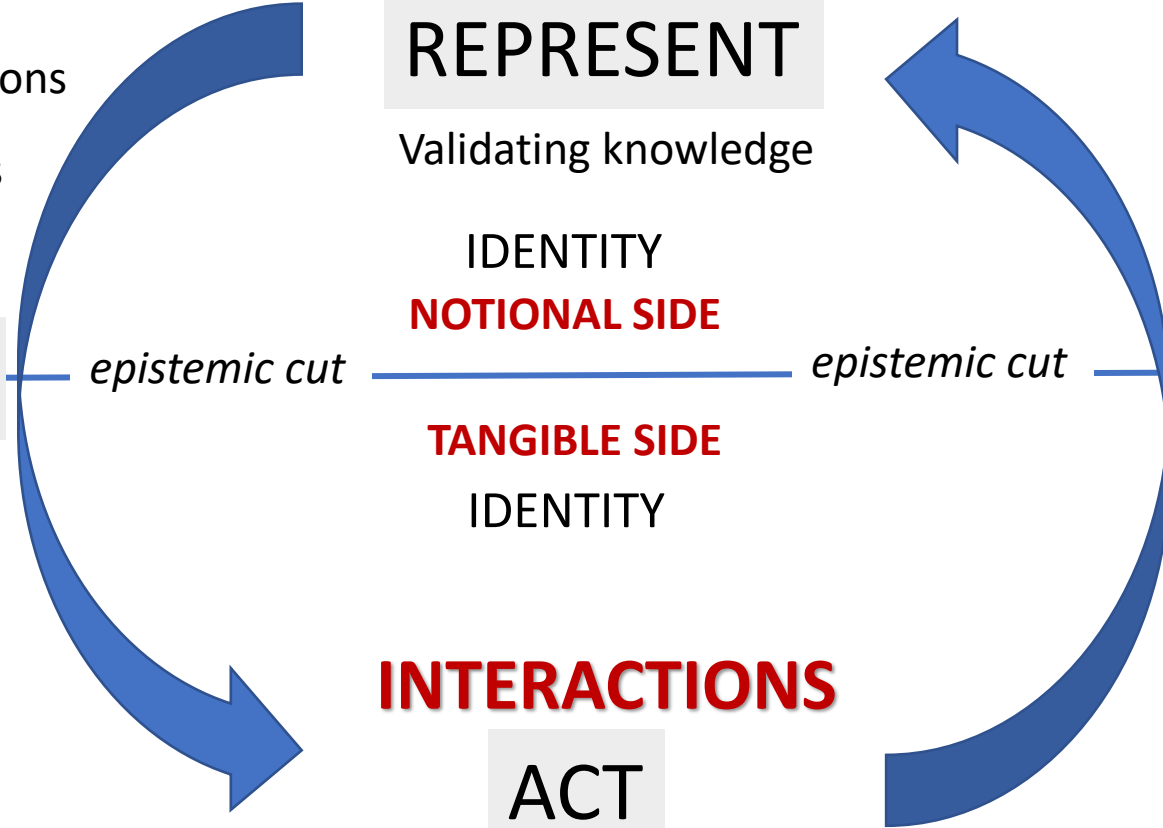
# INTERACTIONS

**ACT**

Using knowledge

*epistemic cut*

*epistemic cut*



The narrative of N. Luhmann

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*knowledge claims* institutions  
rules/controls  
data/models

**INTERPRETATION**



*POLITICAL POWER*

GUIDING ACTION  
MONITORING AND CONTROL

**COMMUNICATIONS**

**REPRESENT**

Validating knowledge

IDENTITY

**NOTIONAL SIDE**

**TANGIBLE SIDE**

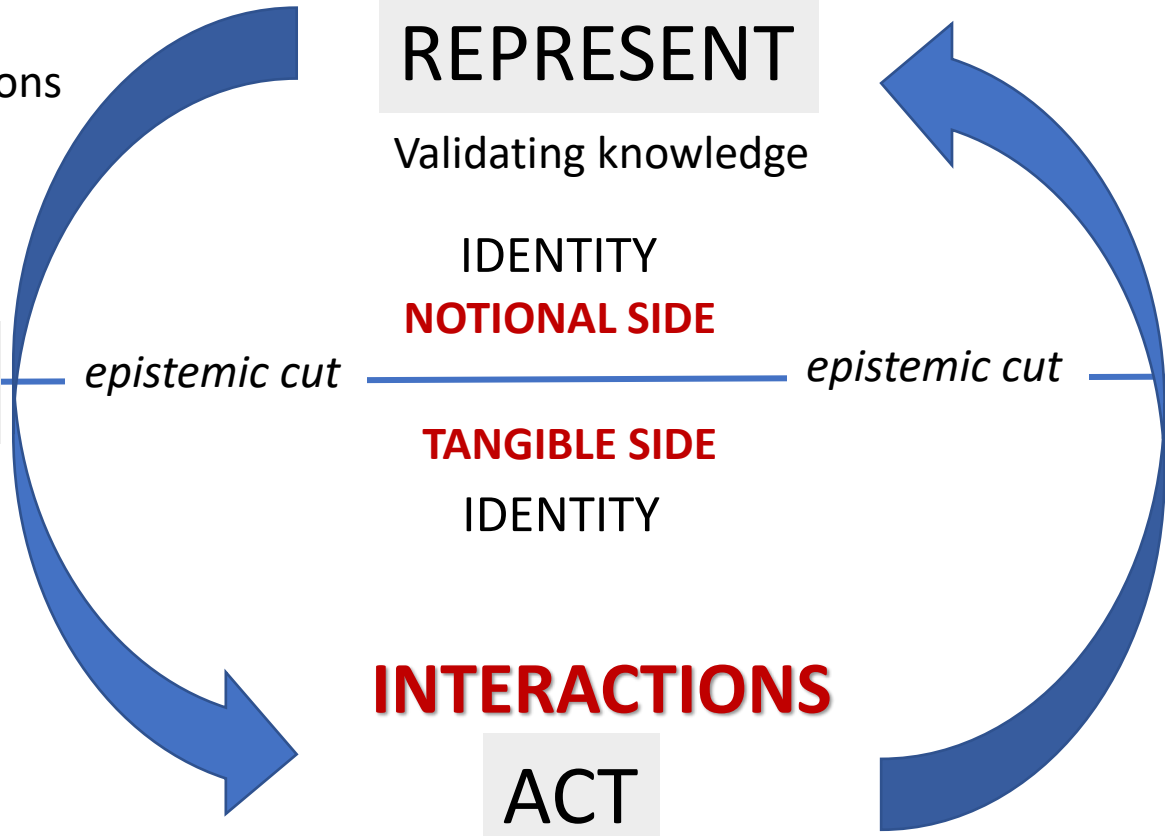
IDENTITY

**INTERACTIONS**

**ACT**

Using knowledge

**Social Practices**





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# COMMUNICATIONS

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**TANGIBLE SIDE**

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# INTERACTIONS

**ACT**

Using knowledge

*epistemic cut*

*epistemic cut*

**EMBEDDING ECOSYSTEMS**



**Metabolic pattern of biophysical interactions**

**Social Practices**

The narrative of N. Luhmann

**Validated knowledge based on narratives/taxonomies referring to types**

*knowledge claims*  
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*POLITICAL POWER*

GUIDING ACTION  
MONITORING AND CONTROL

# COMMUNICATIONS

**REPRESENT**

Validating knowledge

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**NOTIONAL SIDE**

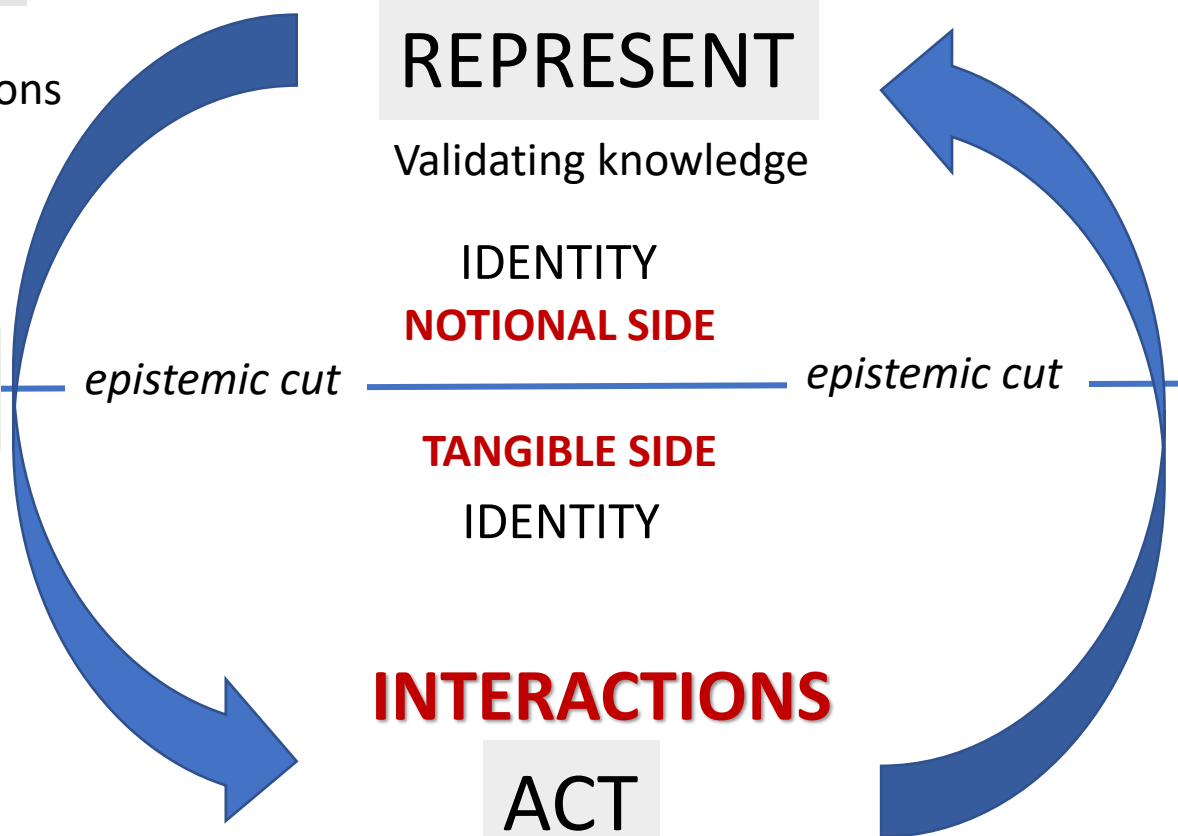
**TANGIBLE SIDE**

IDENTITY

# INTERACTIONS

**ACT**

Using knowledge



**EMBEDDING ECOSYSTEMS**



**Metabolic pattern of biophysical interactions**

**Social Practices**



**Psychic Structure made of instances of humans feeling the effect of affective interactions**

The narrative of N. Luhmann

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# COMMUNICATIONS

## REPRESENT

Validating knowledge

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**NOTIONAL SIDE**

**TANGIBLE SIDE**

IDENTITY

# INTERACTIONS

## ACT

Using knowledge

LEGITIMIZING  
UPDATING

*MORAL POWER*

## INTERPRETATION

*affective interactions*

feelings

fears/dreams

archetypes

## INTERPRETATION



*POLITICAL POWER*

GUIDING ACTION  
MONITORING AND CONTROL

## EMBEDDING ECOSYSTEMS



**Metabolic pattern of biophysical interactions**

## Social Practices

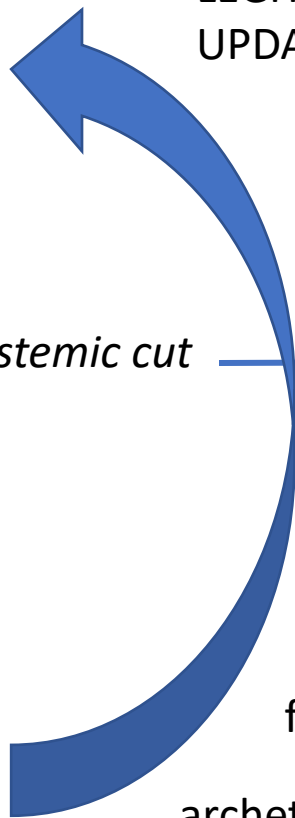


**Psychic Structure made of instances of humans feeling the effect of affective interactions**

*epistemic cut*

*epistemic cut*

*knowledge claims*  
institutions  
rules/controls  
data/models

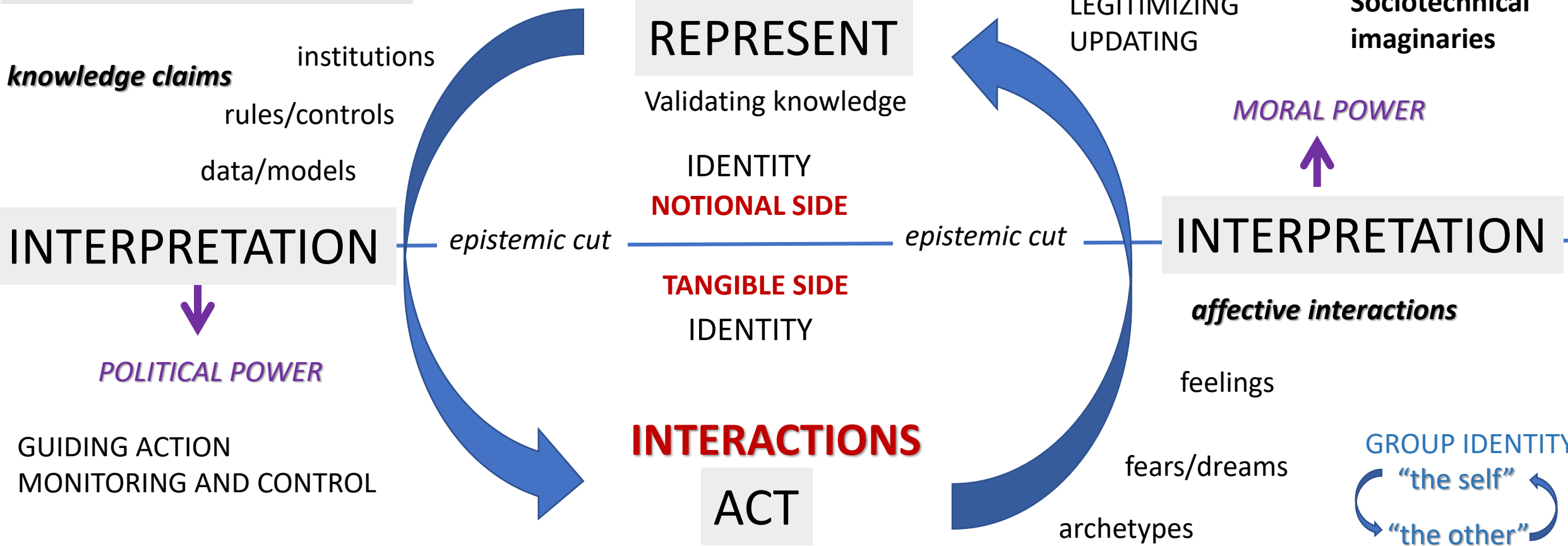


The narrative of N. Luhmann

**Validated knowledge based on narratives/taxonomies referring to types**

**Shared purpose giving justification to the chosen identity**

# COMMUNICATIONS



**INTERPRETATION**

**INTERPRETATION**

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Using knowledge

*epistemic cut*

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**EMBEDDING ECOSYSTEMS**

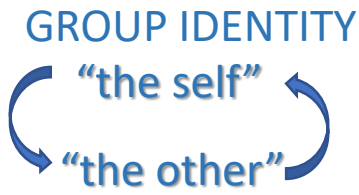


**Metabolic pattern of biophysical interactions**

**Social Practices**



**Psychic Structure made of instances of humans feeling the effect of affective interactions**



*POLITICAL POWER*

GUIDING ACTION  
MONITORING AND CONTROL

*MORAL POWER*

LEGITIMIZING  
UPDATING

Sociotechnical  
imaginaries

*affective interactions*

feelings

fears/dreams

archetypes

The narrative of N. Luhmann

Validated knowledge based on narratives referring to institutions



Shared purpose giving justification to the chosen identity

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UPDATING

Sociotechnical  
imaginaries

*MORAL POWER*



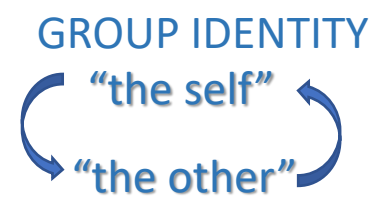
**INTERPRETATION**

*affective interactions*

feelings

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archetypes



**INTERPRETATION**



*POLITICAL POWER*

GUIDING ACTION  
MONITORING AND CONTROL

*epistemic cut*

*epistemic cut*

**EMBEDDING ECOSYSTEMS**



Metabolic pattern of biophysical interactions

**Social Practices**



Psychic Structure made of instances of humans feeling the effect of affective interactions

The narrative of N. Luhmann

Validated knowledge based on narratives referring to institutions



knowledge claims  
rules/controls  
data/models

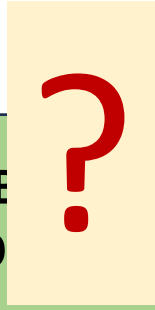
**INTERPRETATION**



*POLITICAL POWER*

GUIDING ACTION  
MONITORING AND CONTROL

EMERGING  
ECOSYSTEMS



Metabolic pattern of biophysical interactions

*outside*

**Social Practices**



Psychic Structure made of instances of humans feeling the effect of affective interactions

# COMMUNICATIONS

**REPRESENT**

Validating knowledge

IDENTITY

**NOTIONAL SIDE**

**TANGIBLE SIDE**

IDENTITY

# INTERACTIONS

**ACT**

Using knowledge

LEGITIMIZING  
UPDATING

Shared purpose giving justification to the chosen identity

Sociotechnical imaginaries

*MORAL POWER*



**INTERPRETATION**

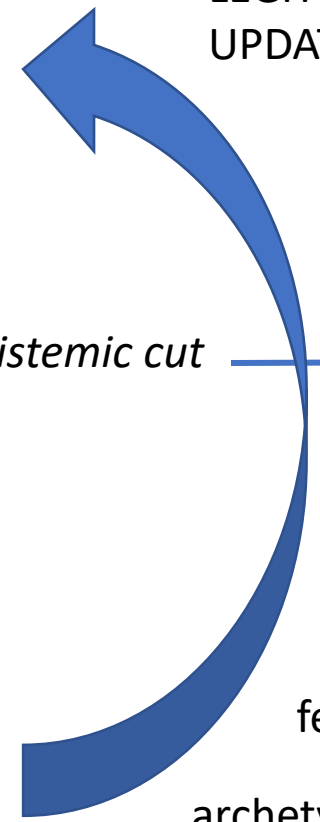
*affective interactions*

feelings

fears/dreams

archetypes

GROUP IDENTITY  
"the self"  
"the other"



*epistemic cut*

*epistemic cut*

The narrative of N. Luhmann

Validated knowledge based on narratives referring to institutions



knowledge claims  
rules/controls  
data/models

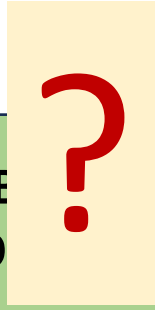
**INTERPRETATION**



*POLITICAL POWER*

GUIDING ACTION  
MONITORING AND CONTROL

EMERGING  
ECOSYSTEMS



Metabolic pattern of biophysical interactions

*outside*

**Social Practices**



Psychic Structure made of instances of humans feeling the effect of affective interactions

**COMMUNICATIONS**

**REPRESENT**

Validating knowledge

IDENTITY

**NOTIONAL SIDE**

**TANGIBLE SIDE**

IDENTITY

**INTERACTIONS**

**ACT**

Using knowledge

LEGITIMIZING  
UPDATING

Shared justification chosen



Social imaginaries

*MORAL POWER*



**INTERPRETATION**

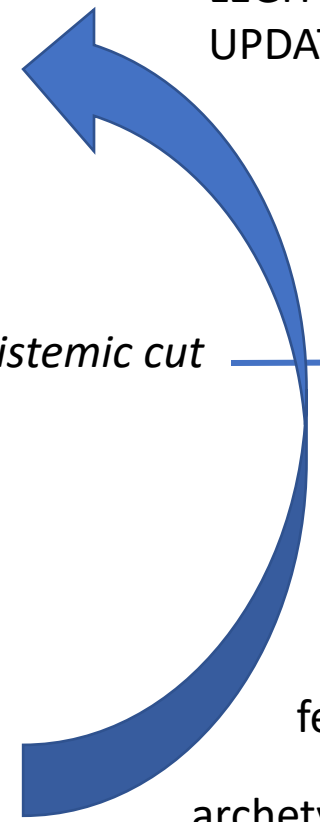
*affective interactions*

feelings

fears/dreams

archetypes

GROUP IDENTITY  
"the self"  
"the other"



*epistemic cut*

*epistemic cut*

The narrative of N. Luhmann

Validated knowledge based on narratives referring to institutions



Shared justification chosen by the community



# COMMUNICATIONS

**REPRESENT**  
Validating knowledge

IDENTITY  
**NOTIONAL SIDE**

**TANGIBLE SIDE**  
IDENTITY

# INTERACTIONS

**ACT**  
Using knowledge

LEGITIMIZING  
UPDATING

Social  
imaginaries

*MORAL POWER*



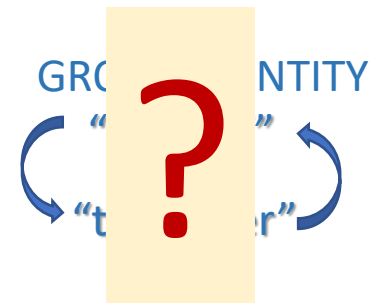
**INTERPRETATION**

*affective interactions*

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**INTERPRETATION**

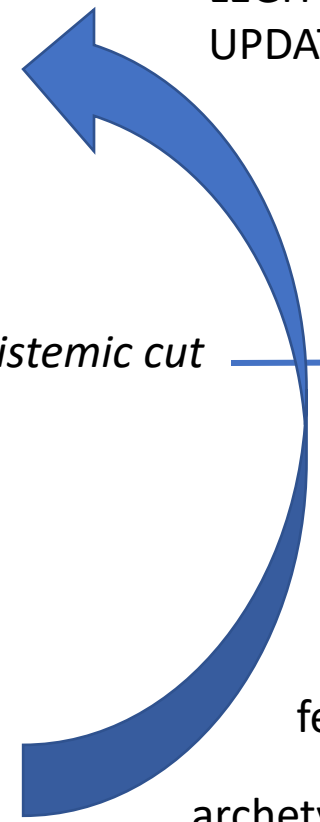
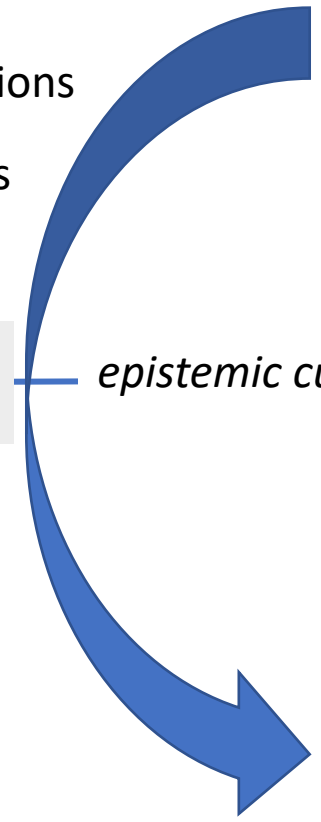


*POLITICAL POWER*

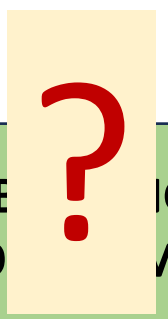
GUIDING ACTION  
MONITORING AND CONTROL

*epistemic cut*

*epistemic cut*



EMERGING  
ECOSYSTEMS



Metabolic pattern of biophysical interactions

**Social Practices**



Psychic Structure made of instances of humans feeling the effect of affective interactions





Orthodox definition of **Biosemiotics**  
**SIGNS INTERPETATION IN LIVING SYSTEMS**

Orthodox definition of **Biosemiotics**  
**SIGNS INTERPETATION IN LIVING SYSTEMS**

Can we use a complementing definition?  
i.e. about the **Biosemiotic process**

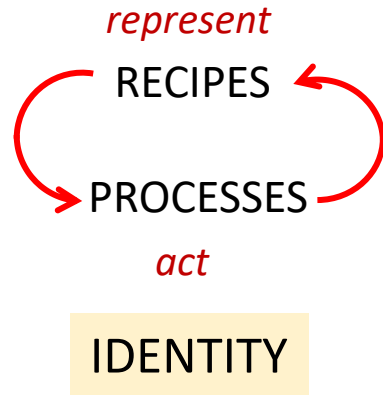
**The process used by Complex Adaptive Systems  
(including living systems and human societies)  
to generate, reproduce, and adapt their identity  
during their evolution**

## 2. The great convergence on biosemiotics

## 2. The great convergence on biosemiotics



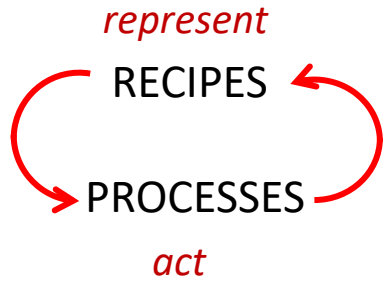
**Herbert Simon**  
Complexity



## 2. The great convergence on biosemiotics



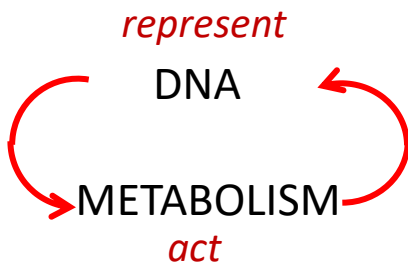
**Herbert Simon**  
Complexity



IDENTITY



**Ilya Prigogine**  
Non-equilibrium  
thermodynamics

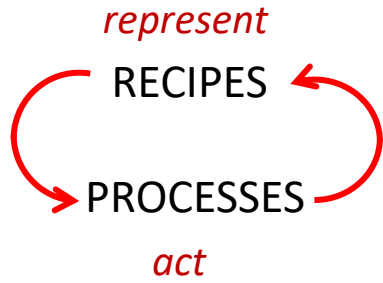


IDENTITY

## 2. The great convergence on biosemiotics



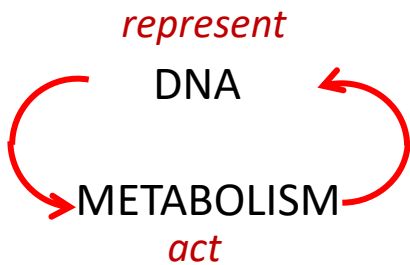
**Herbert Simon**  
Complexity



IDENTITY



**Ilya Prigogine**  
Non-equilibrium  
thermodynamics



IDENTITY

**Howard T. Odum**  
Theoretical Ecology



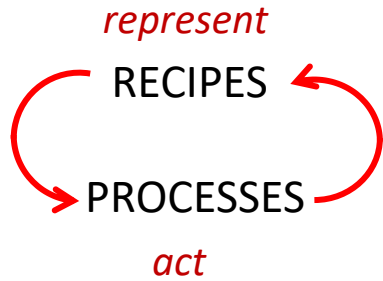
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INFORMED AUTOCATALYTIC LOOPS

## 2. The great convergence on biosemiotics



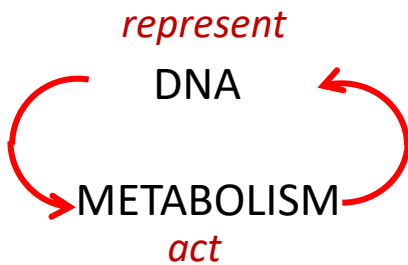
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Complexity



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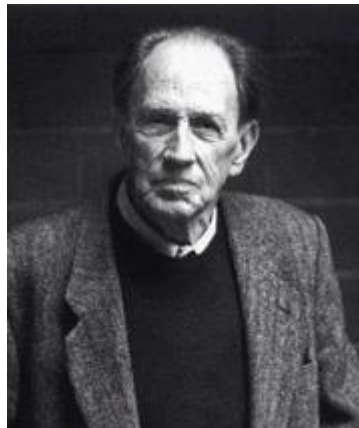
IDENTITY

INFORMED AUTOCATALYTIC LOOPS

SENDING MESSAGES TO THEMSELVES  
INTO THE FUTURE . . .

IDENTITY

**Ramon Margalef**  
Theoretical Ecology

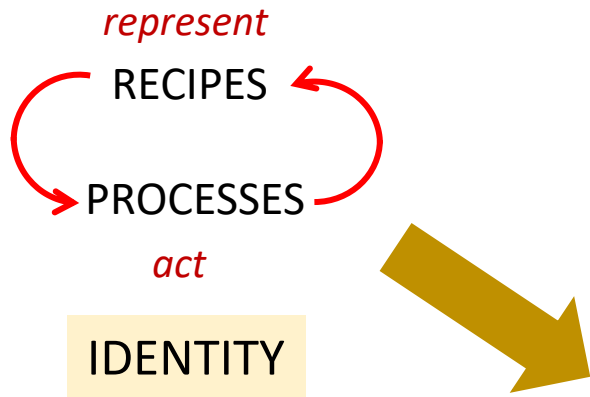




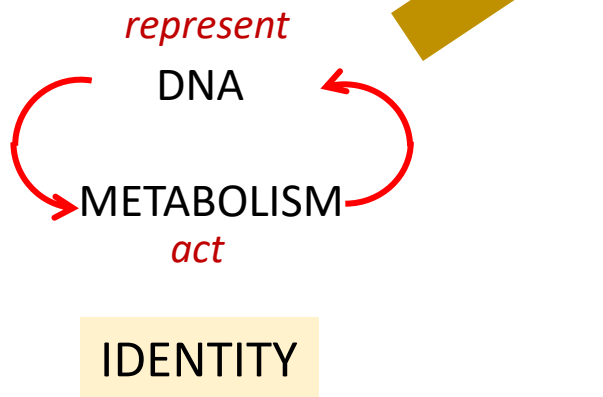
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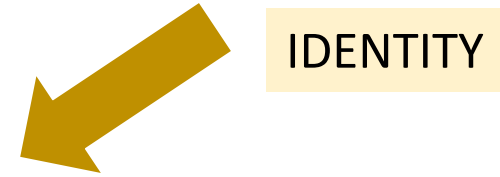
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Complexity



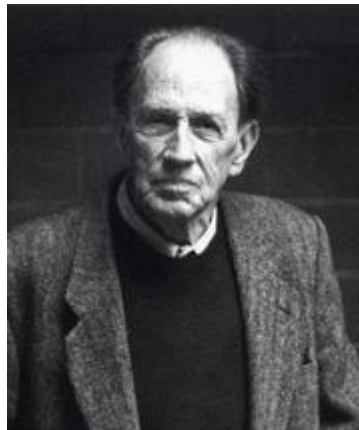
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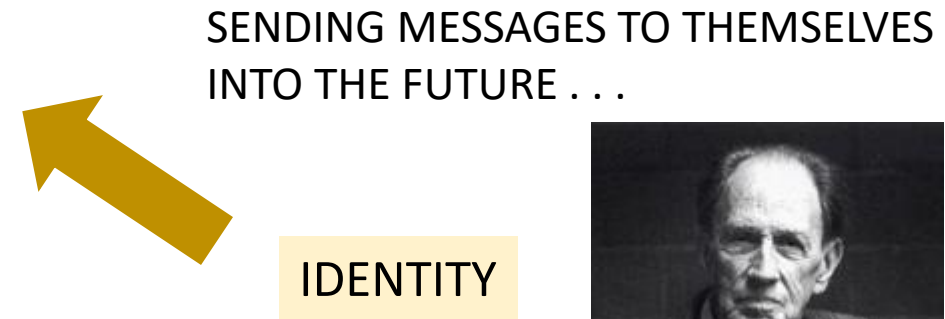
**Howard T. Odum**  
Theoretical Ecology



INFORMED AUTOCATALYTIC LOOPS



**Ramon Margalef**  
Theoretical Ecology

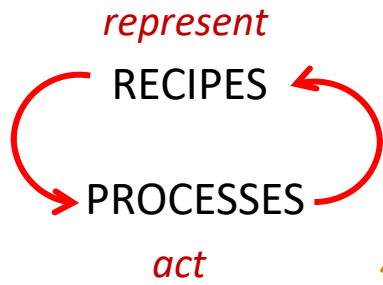


SENDING MESSAGES TO THEMSELVES  
INTO THE FUTURE . . .

## 2. The great convergence on biosemiotics



**Herbert Simon**  
Complexity



IDENTITY

### Complex Adaptive Systems

NOTIONAL

REPRESENT

*IDENTITY*  
Functional cycle  
*IDENTITY*

ACT

TANGIBLE

INTERPRETATION

INTERPRETATION

**Howard T. Odum**  
Theoretical Ecology



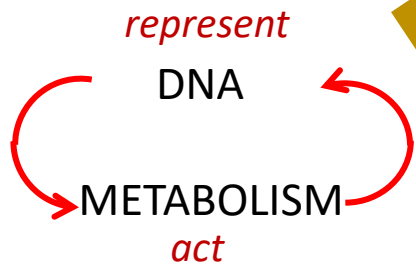
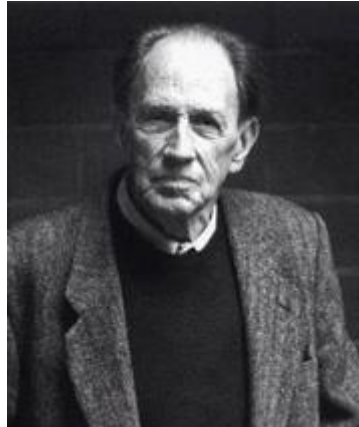
IDENTITY

INFORMED AUTOCATALYTIC LOOPS

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**Ramon Margalef**  
Theoretical Ecology



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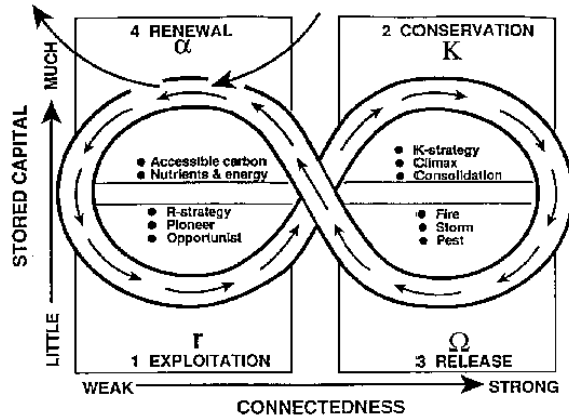
**Ilya Prigogine**  
Non-equilibrium  
thermodynamics

## 2. The great convergence on biosemiotics

# IDENTITY



C.S. "Buzz" Holling  
The Adaptive Cycle

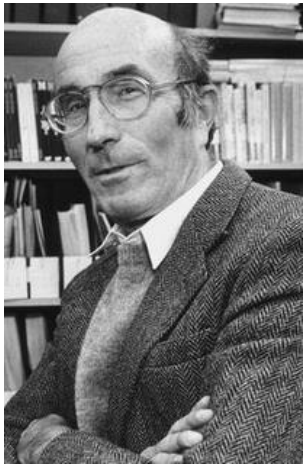
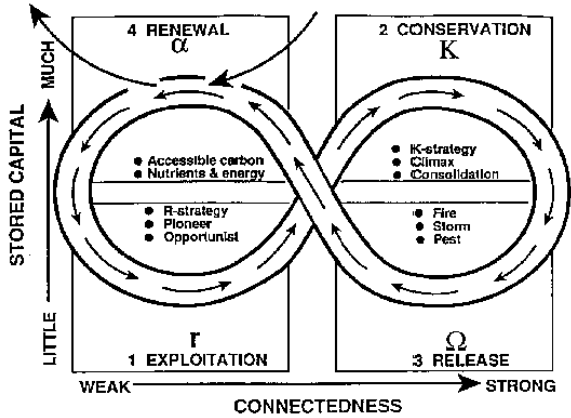


2. The great convergence on biosemiotics



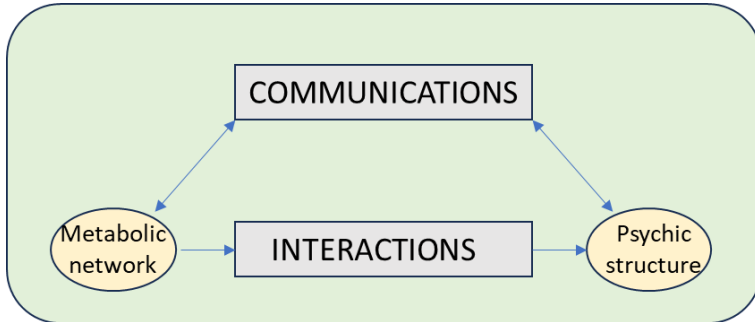
**C.S. "Buzz" Holling**  
The Adaptive Cycle

IDENTITY



**Niklas Luhmann**  
Social System Theory

IDENTITY

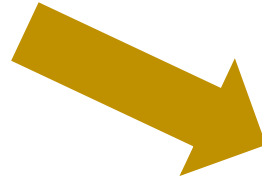
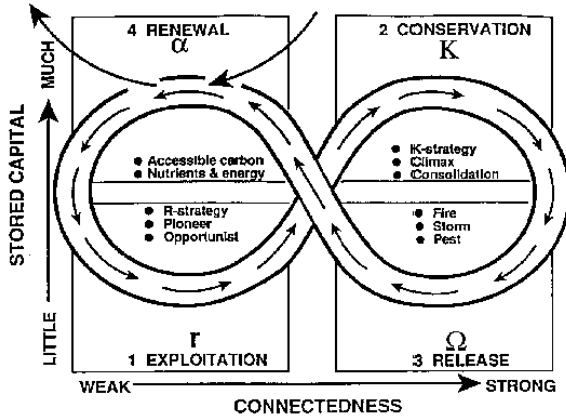


2. The great convergence on biosemiotics

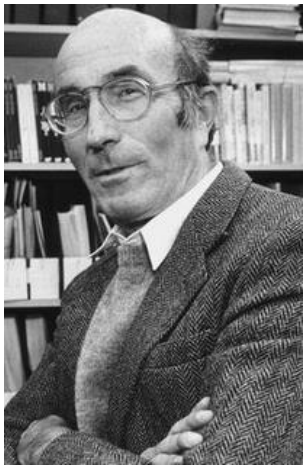
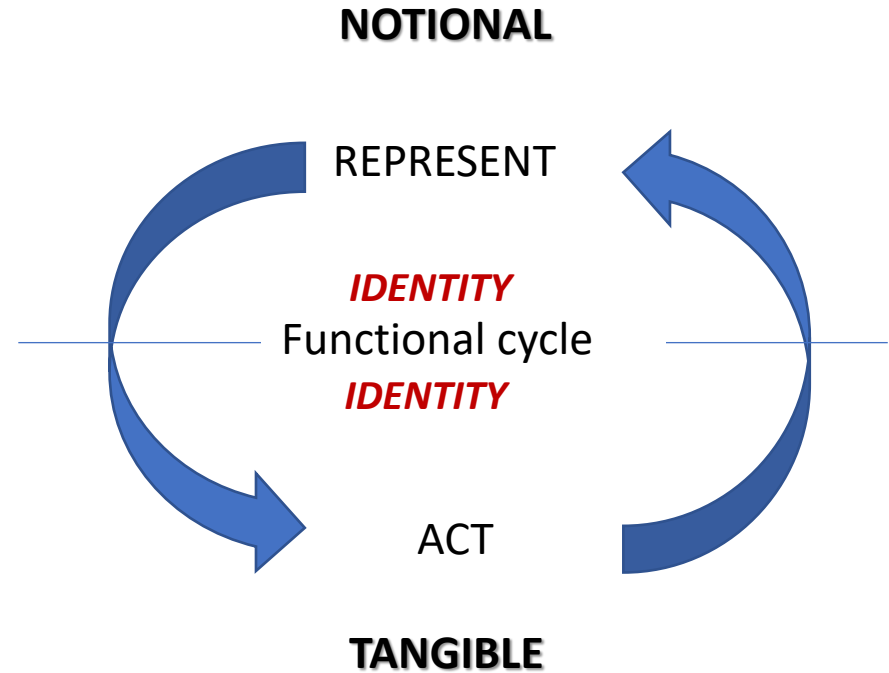


C.S. "Buzz" Holling  
The Adaptive Cycle

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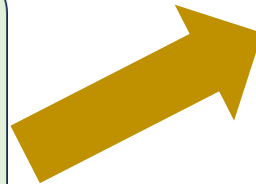
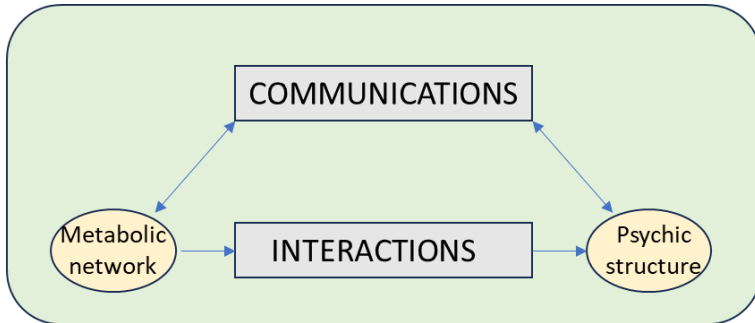


Complex Adaptive Systems



Niklas Luhmann  
Social System Theory

IDENTITY

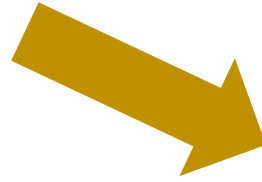
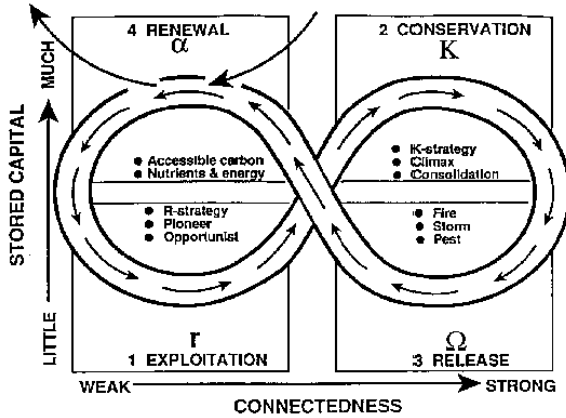


2. The great convergence on biosemiotics



C.S. "Buzz" Holling  
The Adaptive Cycle

IDENTITY



Complex Adaptive Systems

**NAMED**

**NOTIONAL**

*before*

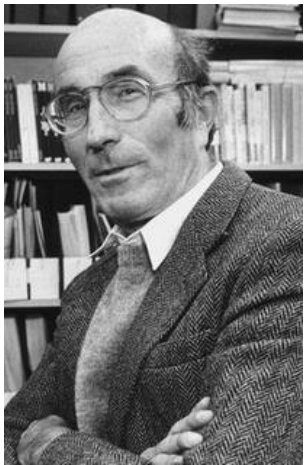
*after*



**TANGIBLE**

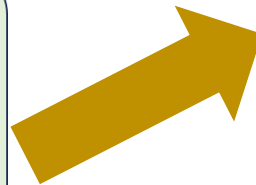
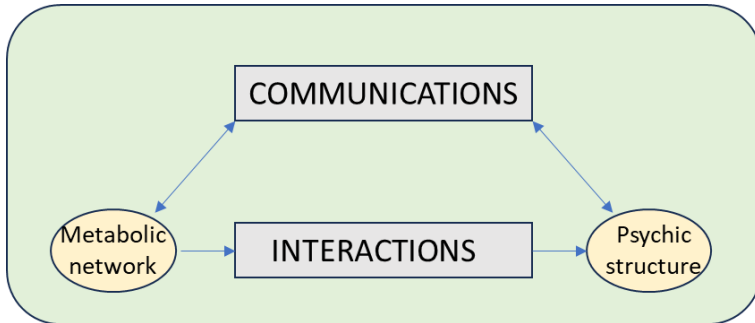
**TAO**

*eternal unfolding present*



Niklas Luhmann  
Social System Theory

IDENTITY



### 3. The functional cycle and non-equilibrium thermodynamics (the missing ingredient . . . group autocatalysis)



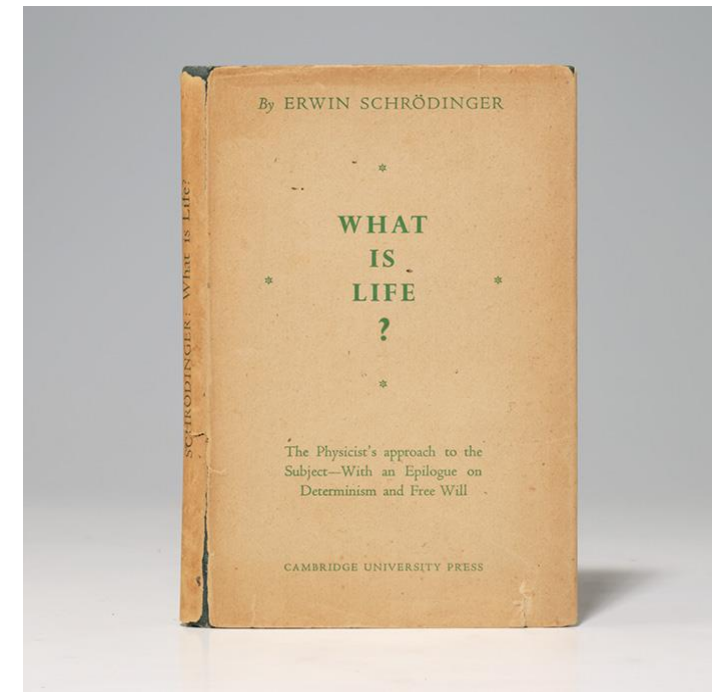
### 3. The functional cycle and non-equilibrium thermodynamics (the missing ingredient . . . group autocatalysis)

Living systems must remain different from their environment in order to remain alive  
Therefore, the study of life belongs to the domain of non-equilibrium thermodynamics

1. Types (equivalence classes) VS Instances
2. From being to becoming
3. Structural coupling of Dissipative Systems



**Erwin Schroedinger**



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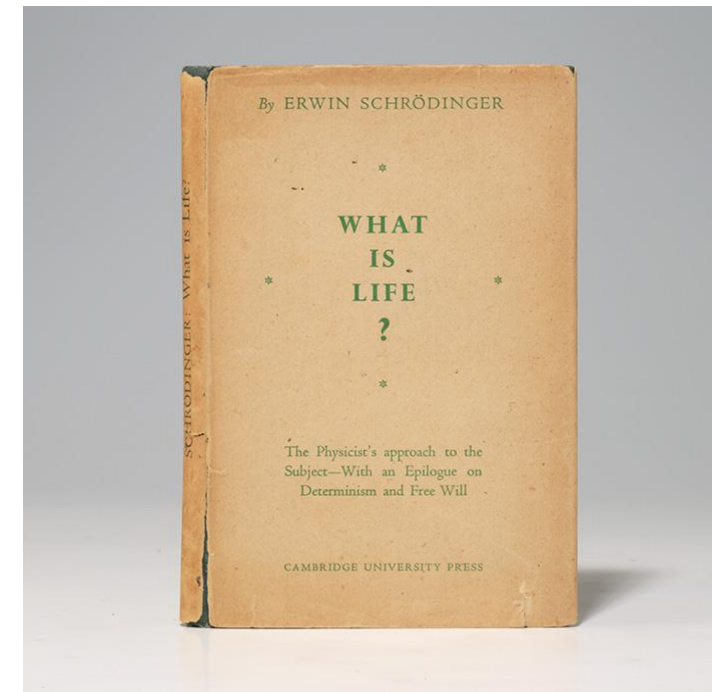
**NOTIONAL**

**TANGIBLE**

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**Erwin Schroedinger**



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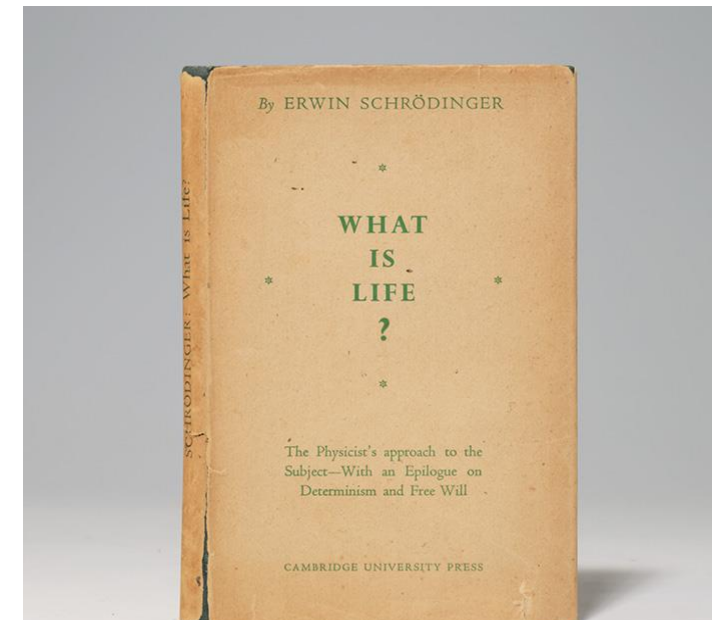
**NOTIONAL**

**TANGIBLE**

1. Types (equivalence classes) VS Instances
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3. Structural coupling of Dissipative Systems



Erwin Schroedinger



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**NOTIONAL**

**TANGIBLE**

1. Types (equivalence classes) VS Instances

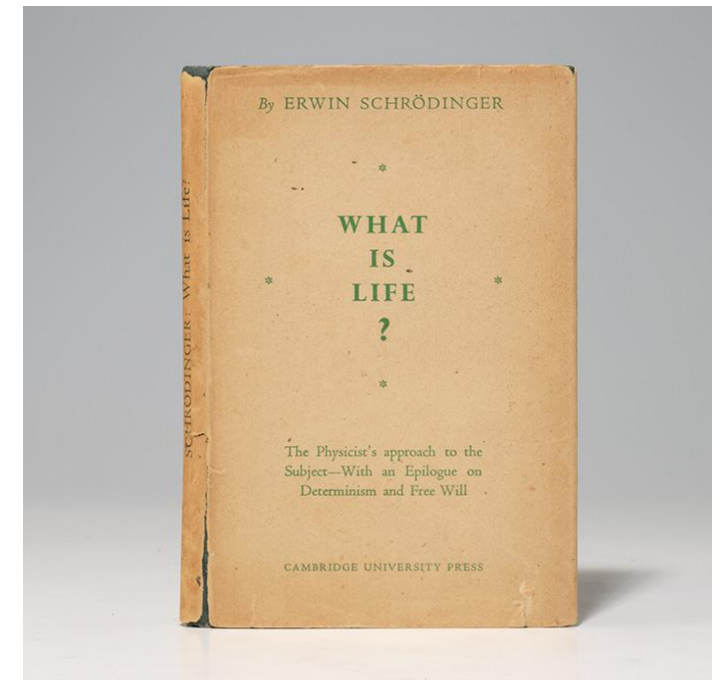
2. From being to becoming **PARTS vs WHOLE**

3. Structural coupling of Dissipative Systems

**IDENTITY  $\leftrightarrow$  ADMISSIBLE ENVIRONMENT (UMWELT)**

**$+dSi \leftrightarrow -dSe$**

Erwin Schroedinger



# Identity of a dissipative system

notional

tangible

**EPISTEMIC  
CUT**

**DIGITAL**

**ANALOGIC**

# Identity of a dissipative system



notional

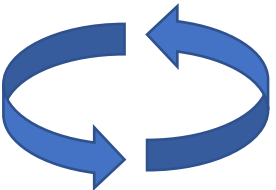
**EPISTEMIC  
CUT**

tangible

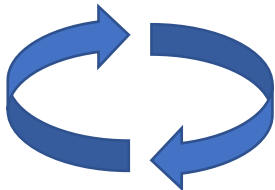
## Type (expected)

It depends on boundary conditions  
random events initiating conditions  
PHYSICAL LAWS

Anti-clockwise



Clockwise



**DIGITAL**

**ANALOGIC**

# Identity of a dissipative system



notional

**EPISTEMIC CUT**

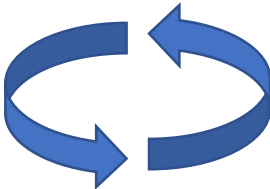


tangible

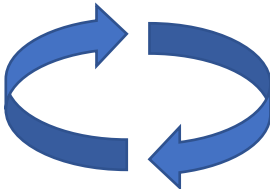
## Type (expected)

It depends on boundary conditions  
random events initiating conditions  
PHYSICAL LAWS

Anti-clockwise



Clockwise



**DIGITAL**

## Instance (established)

Locked-in → path-dependent identity

Keep record of 1 bite of information  
as long as it remains "alive" . . .

**ANALOGIC**







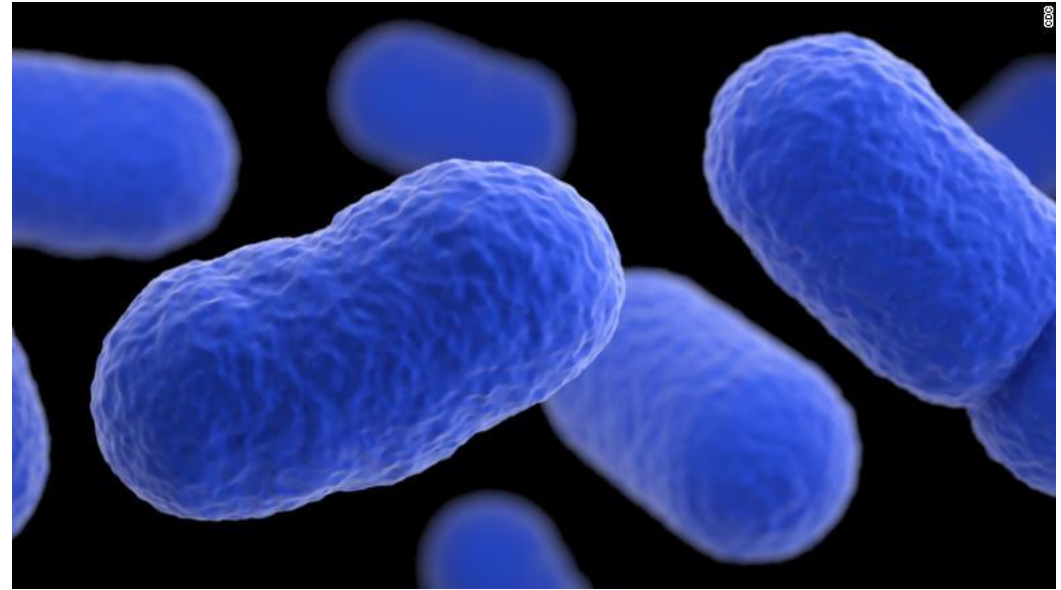
A flame

Dissipative structure whose identity is different from the environment but **fully determined by physical laws** (initiating and boundary conditions)



A flame

Dissipative structure whose identity is different from the environment but **fully determined by physical laws** (initiating and boundary conditions)



Bacteria

Complex adaptive systems **obey physical laws**,  
HOWEVER  
their identity is **generated by semiotic controls\***  
that prevent physical laws from fully determining  
their structural and functional features



A flame

Dissipative structure whose identity is different from the environment but **fully determined by physical laws** (initiating and boundary conditions)



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Complex adaptive systems **obey physical laws**,  
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**\*Semiotic freedom = communication based on codes,  
whose meaning depend on purposes and memories**



A flame

Dissipative structure whose identity is different from the environment but **fully determined by physical laws** (initiating and boundary conditions)

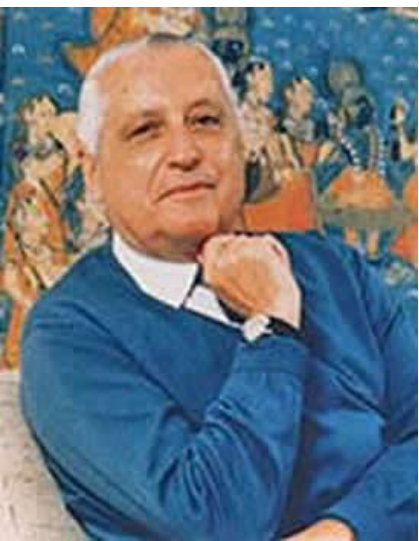


They can become something different while remaining the same!

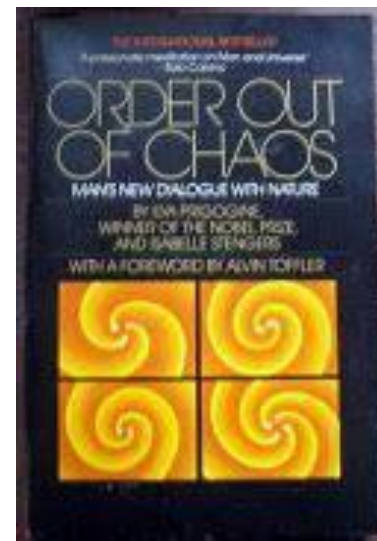
## Bacteria

Complex adaptive systems **obey physical laws**,  
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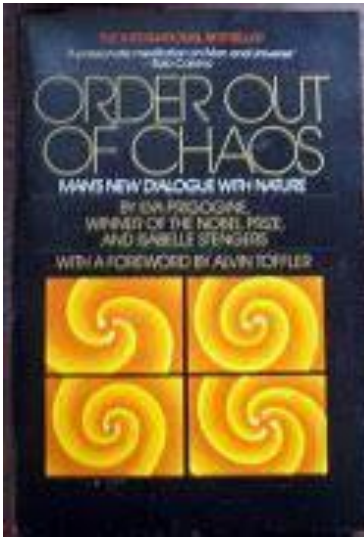
*Ilya Prigogine*



**THE PHYSICAL LAW:  
STRUCTURAL COUPLING**  
**(the origin of UMWELT)**

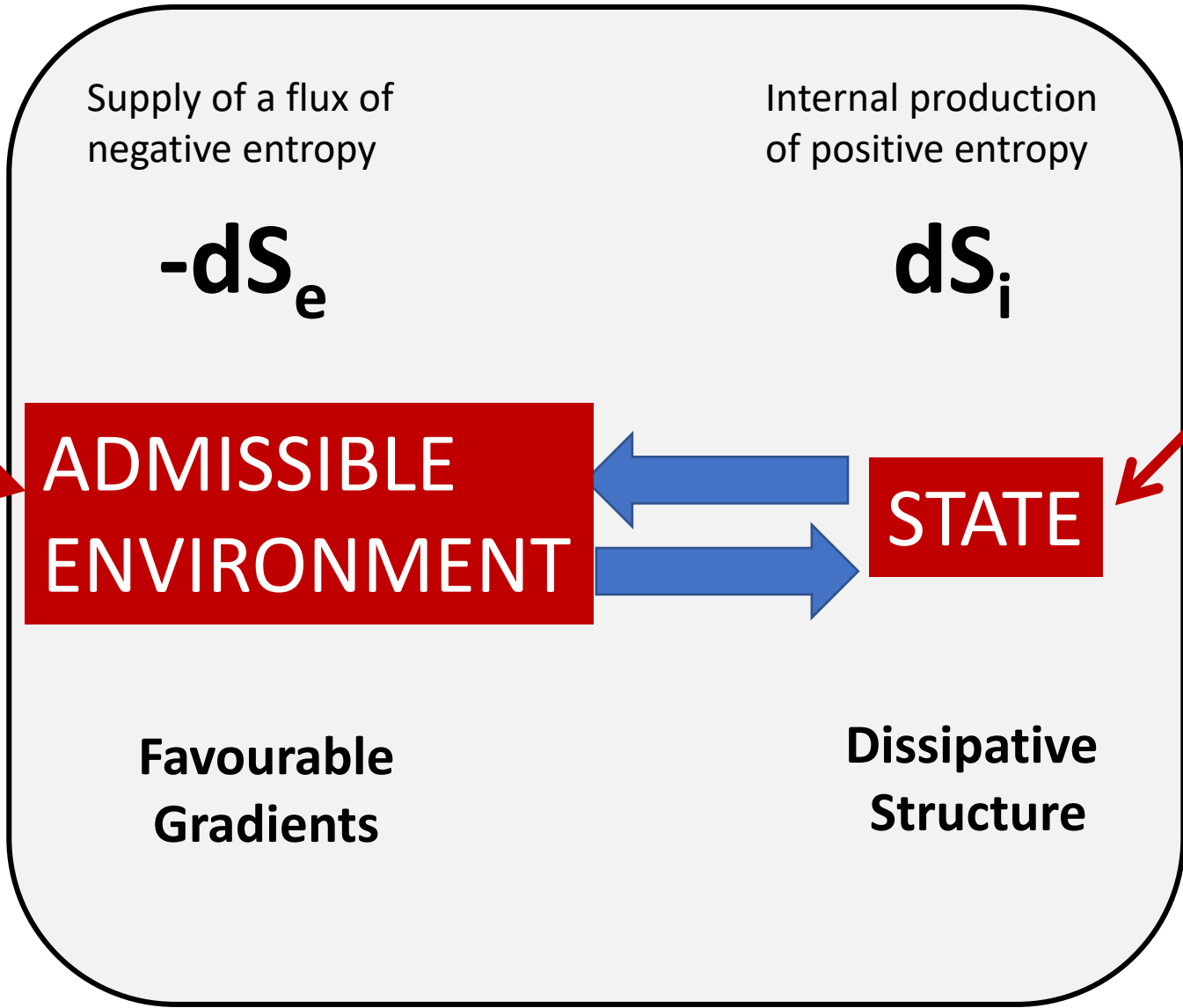


*Ilya Prigogine*



**THE PHYSICAL LAW:  
STRUCTURAL COUPLING  
(the origin of UMWELT)**

Processes taking place outside the semiotic control

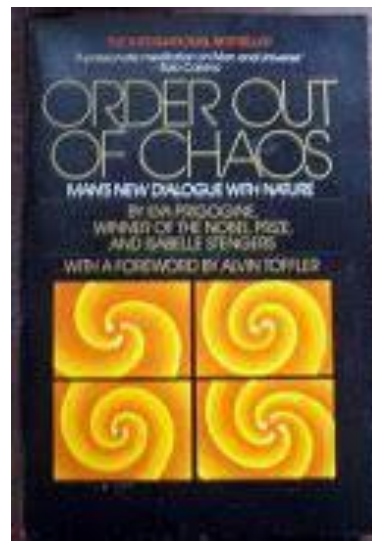


Processes taking place under semiotic control



*Ilya Prigogine*

A living system is a **Dissipative System**

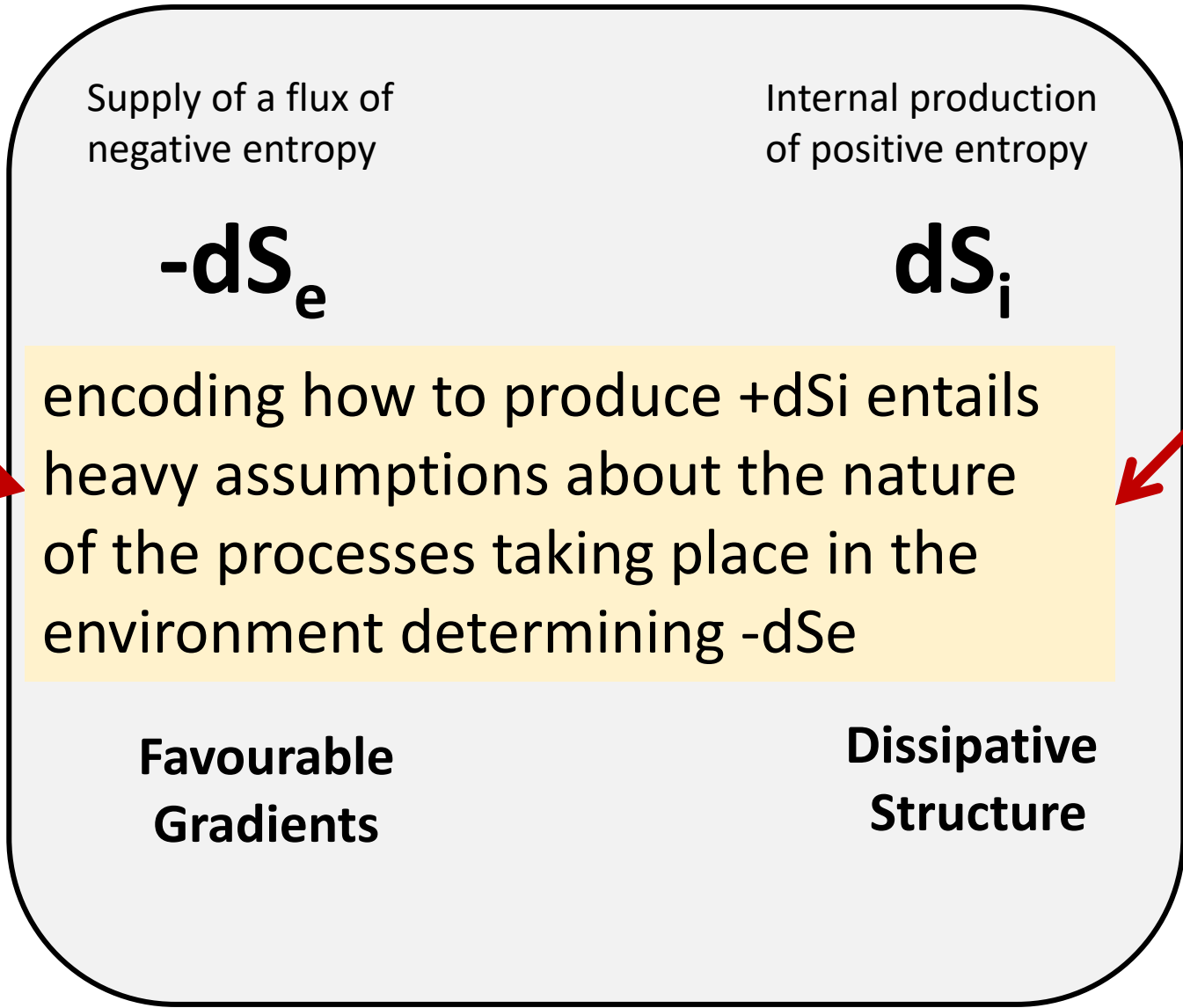


**THE PHYSICAL LAW:  
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Processes taking place outside the semiotic control



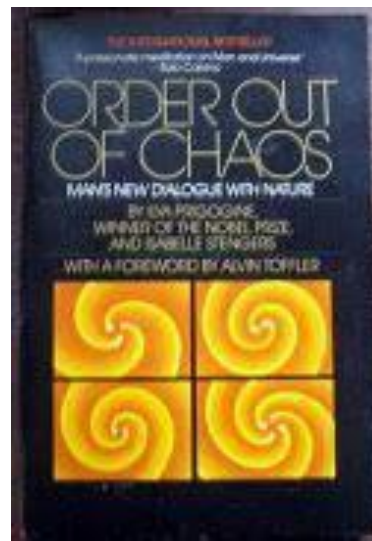
Processes taking place under semiotic control



A living system is a **Dissipative System**



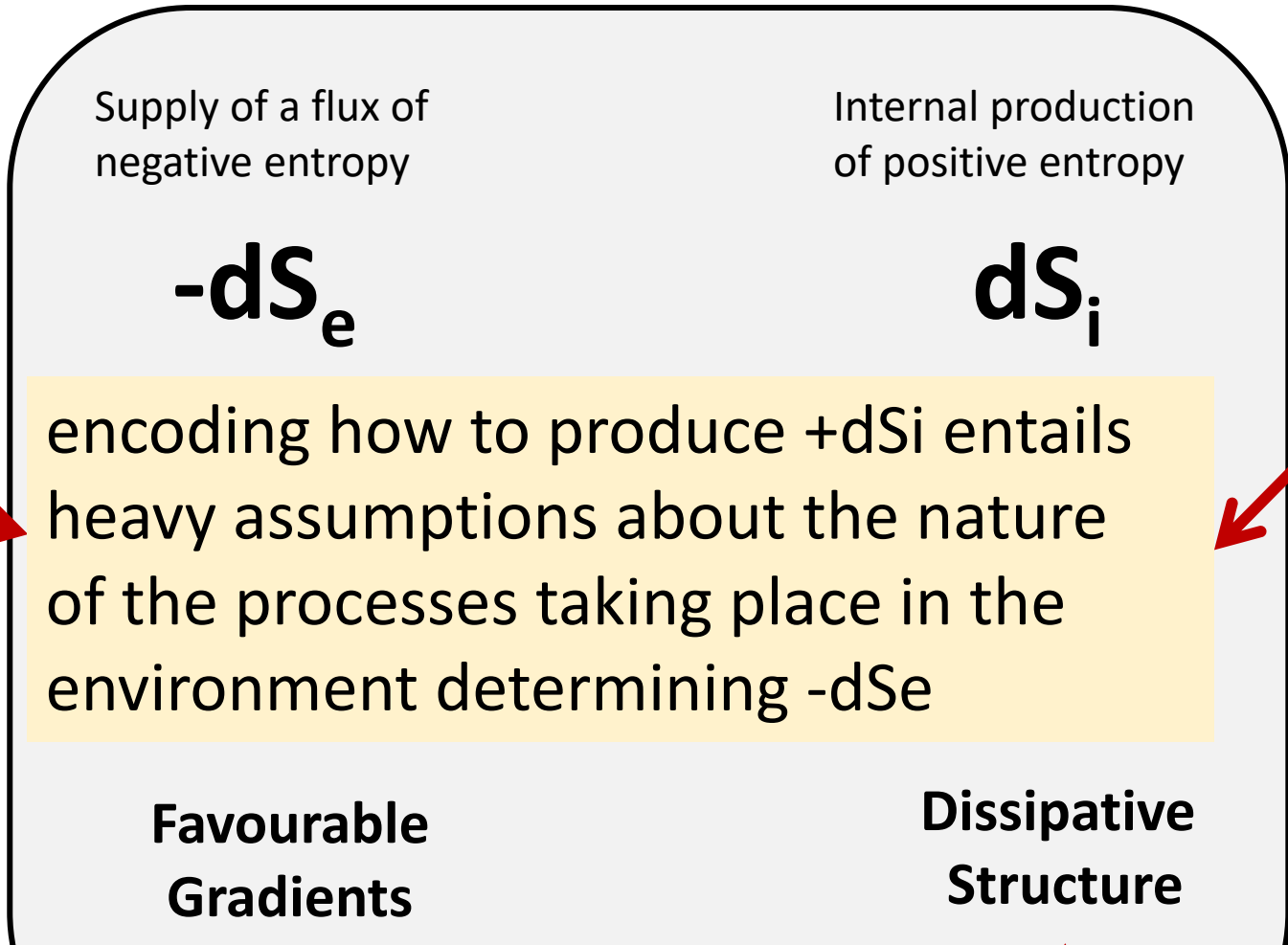
*Ilya Prigogine*





**THE PHYSICAL LAW:  
STRUCTURAL COUPLING  
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Processes taking place outside the semiotic control



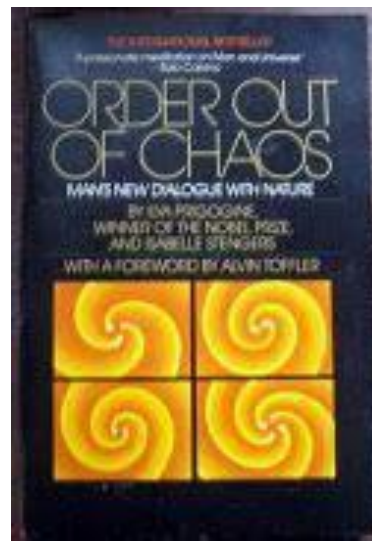
Processes taking place under semiotic control

for a dissipative structure that is producing  $+dS_i$  the environment is a system producing  $-dS_e$

A living system is a **Dissipative System**

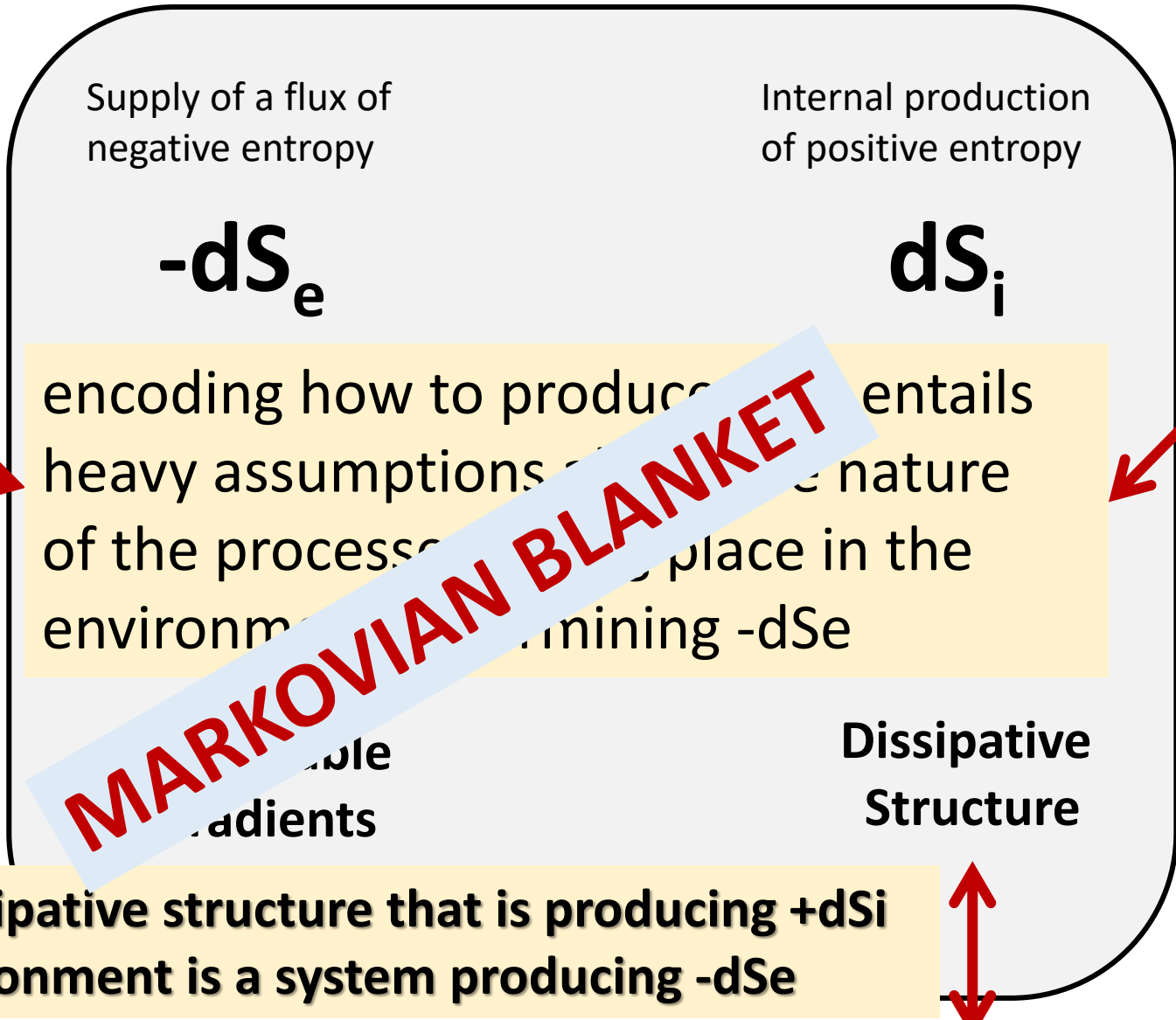


Ilya Prigogine



**THE PHYSICAL LAW:  
STRUCTURAL COUPLING  
(the origin of UMWELT)**

Processes taking place outside the semiotic control



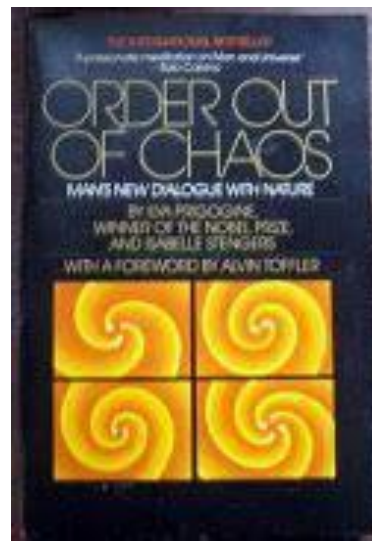
Processes taking place under semiotic control



Ilya Prigogine

for a dissipative structure that is producing +dSi the environment is a system producing -dSe

A living system is a **Dissipative System**

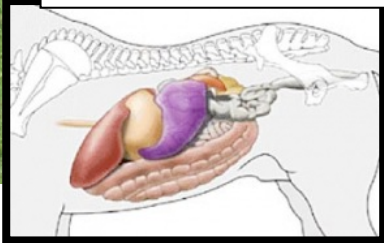
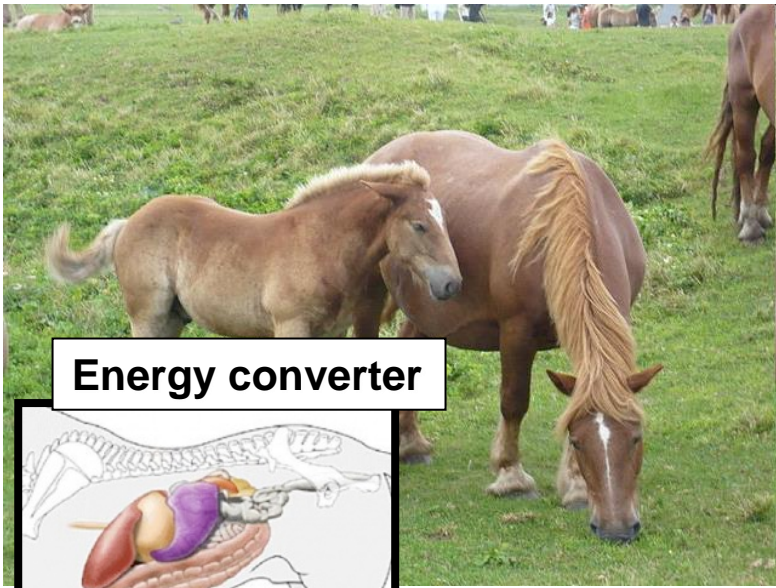




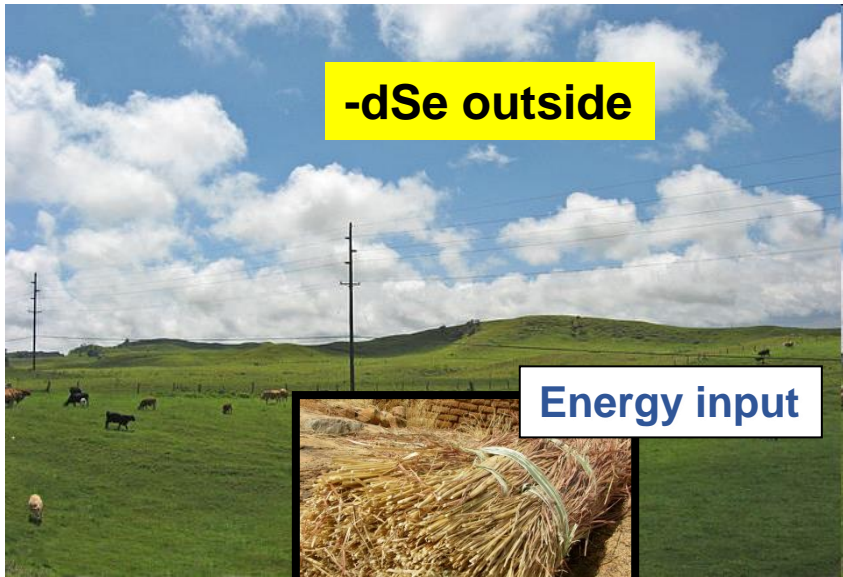




**Energy input**



**Energy converter**



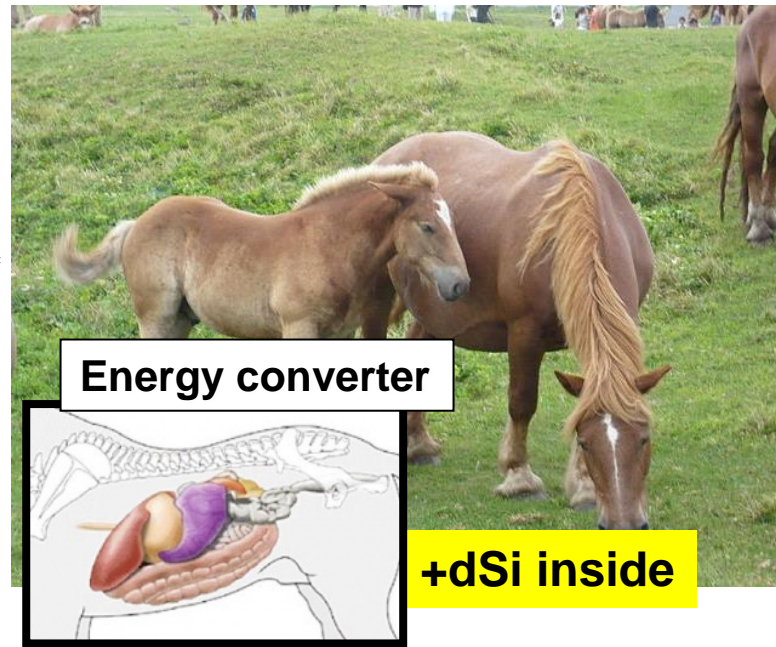
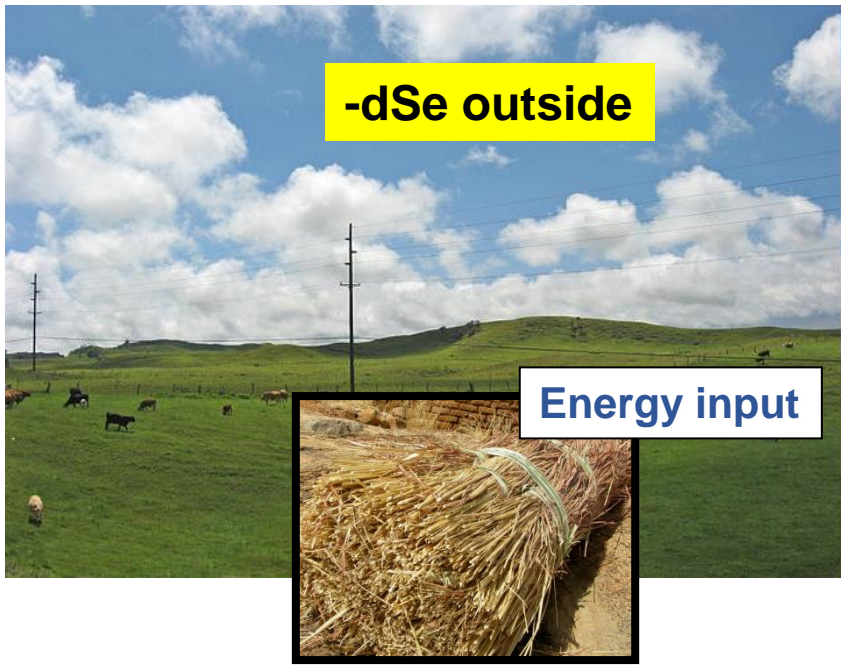
**-dSe outside**

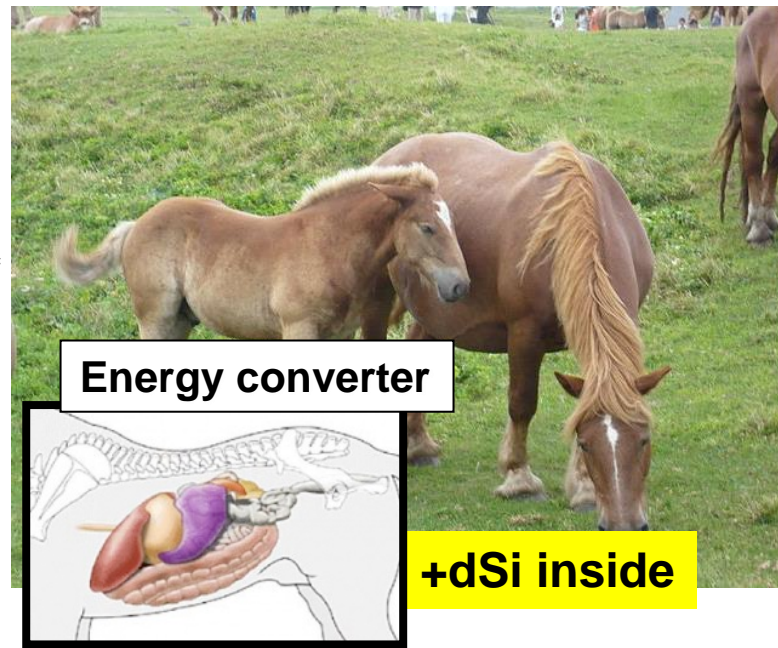
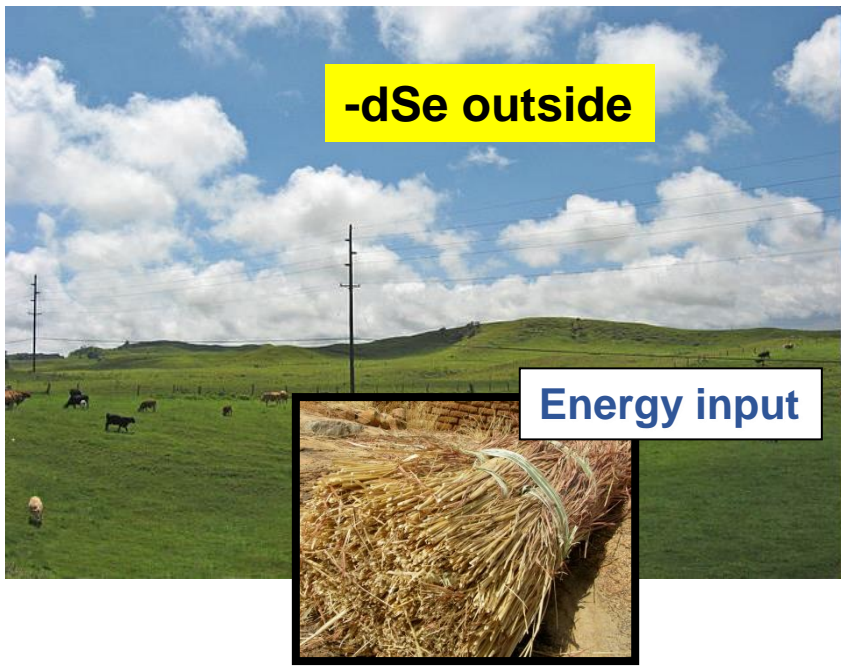
**Energy input**



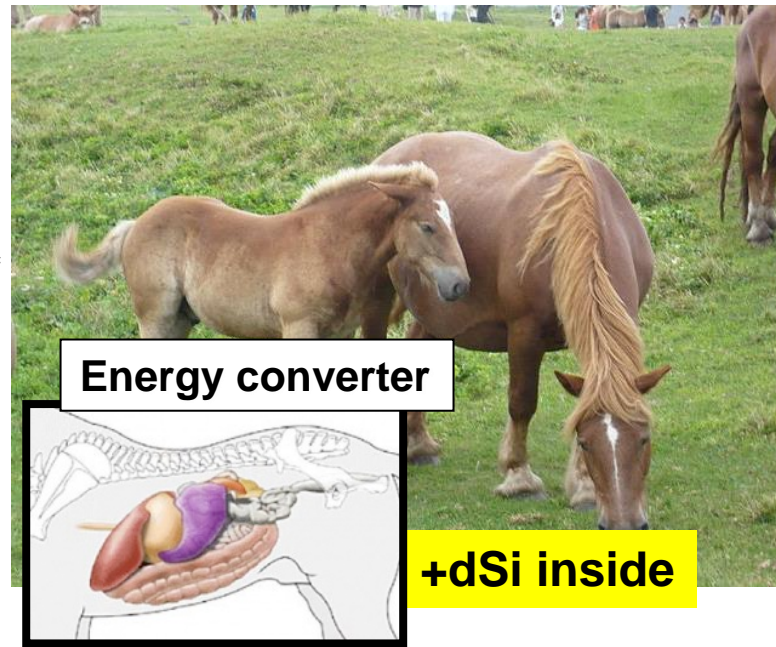
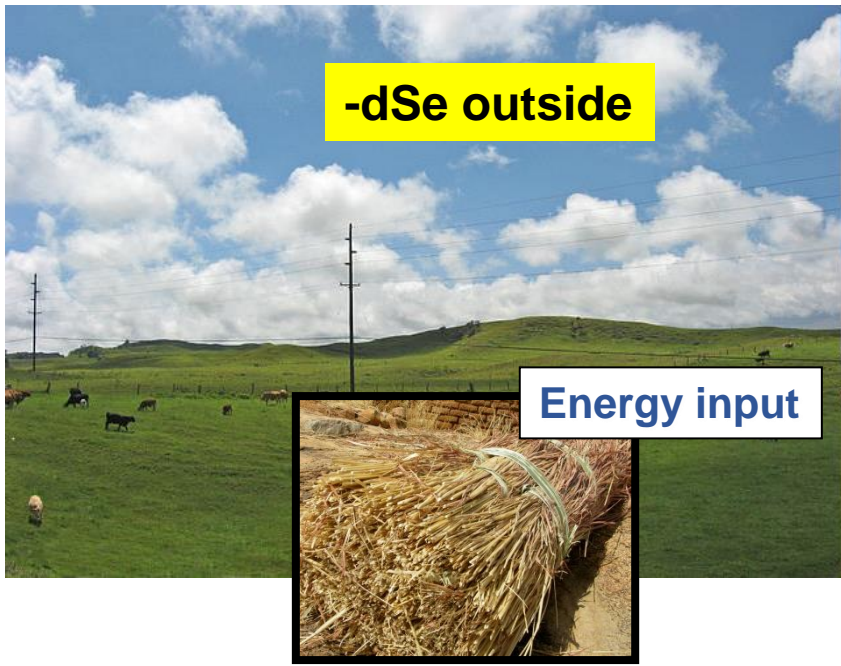
**Energy converter**

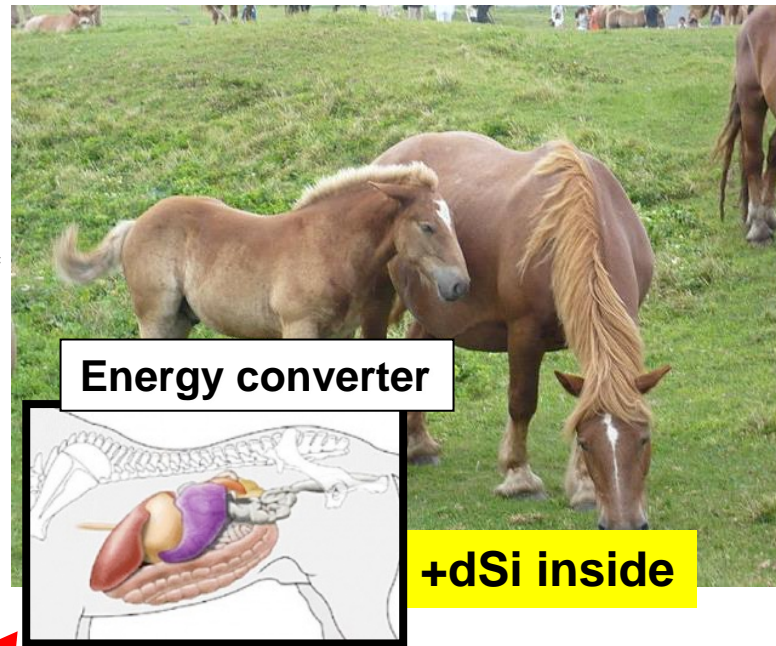
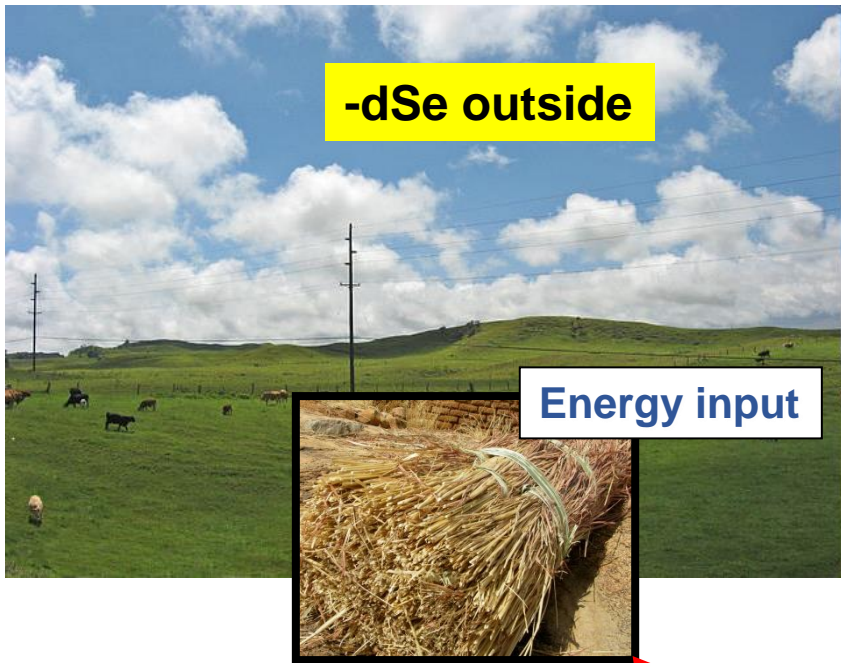
**+dSi inside**



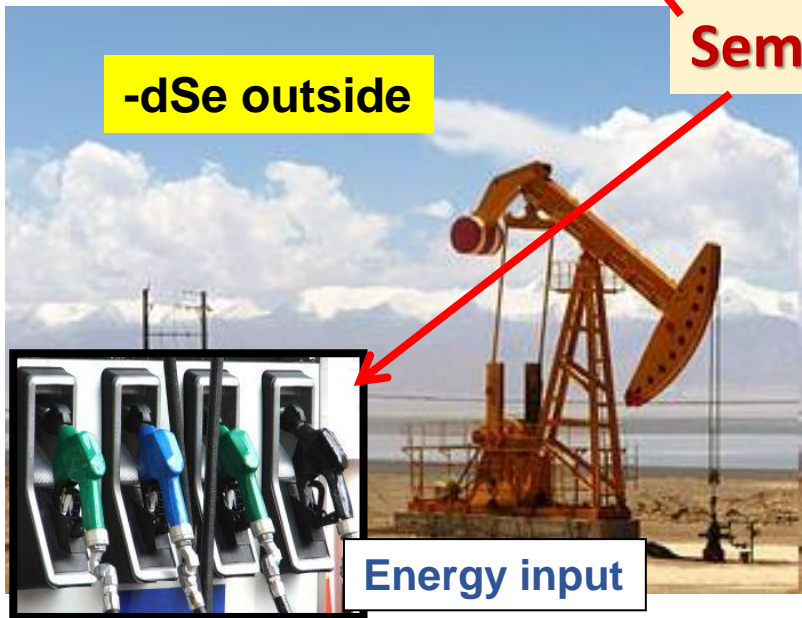


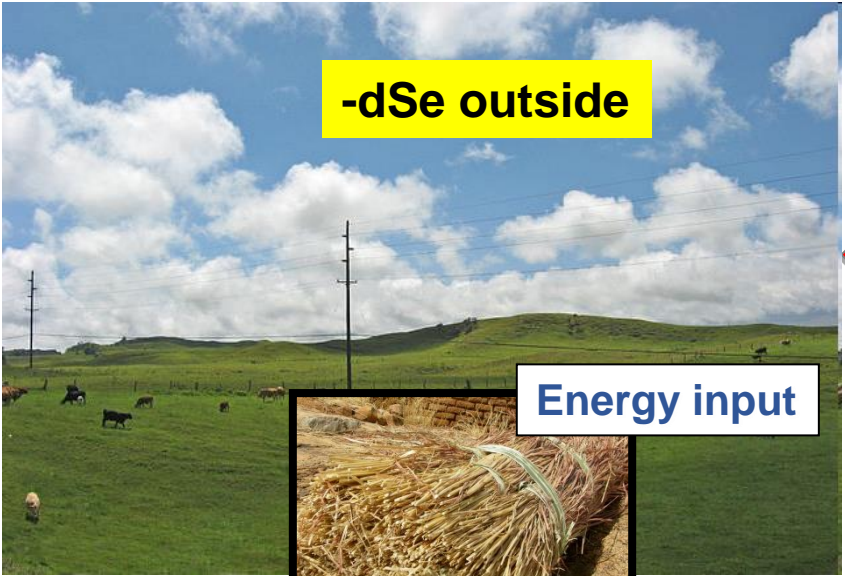






**Semiotic controls**





Hay yield = 82 GJ/ha

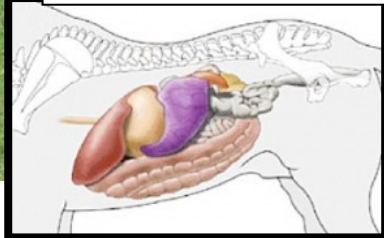


Hay = 11 MJ/kg

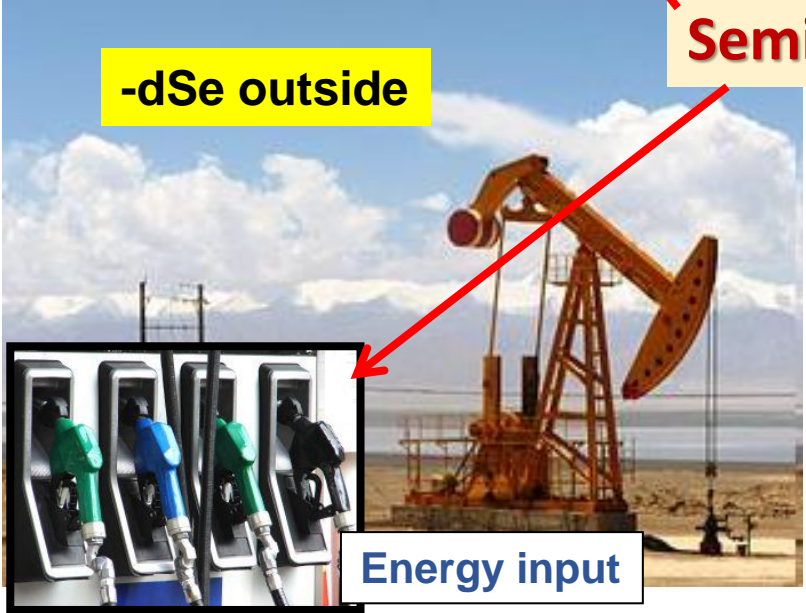


+dSi inside

Metabolism = 0.02 MJ/kg



Semiotic controls



-dSe outside

Energy input



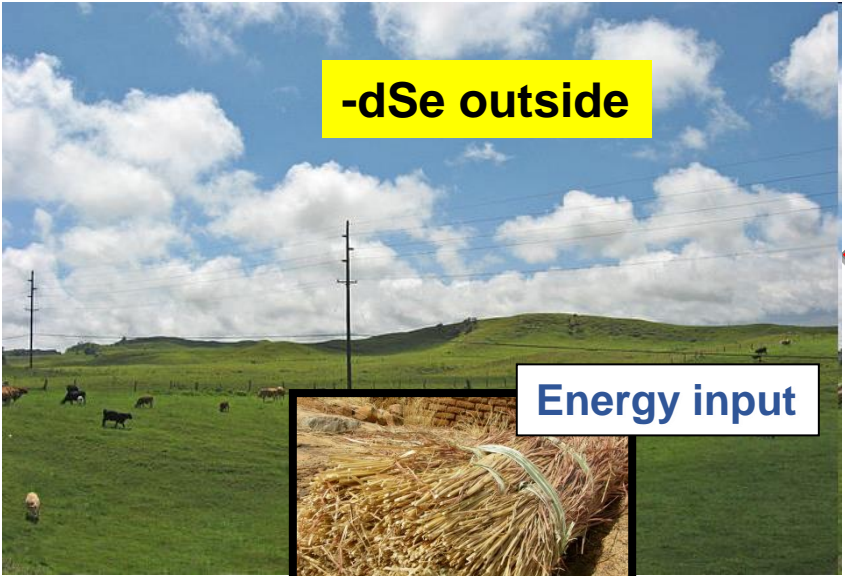
Energy converter

+dSi inside

**MAPPING THE STRUCTURAL COUPLING: THE UMWELT OF HORSES**

**kg of horses**

**ha of pasture**



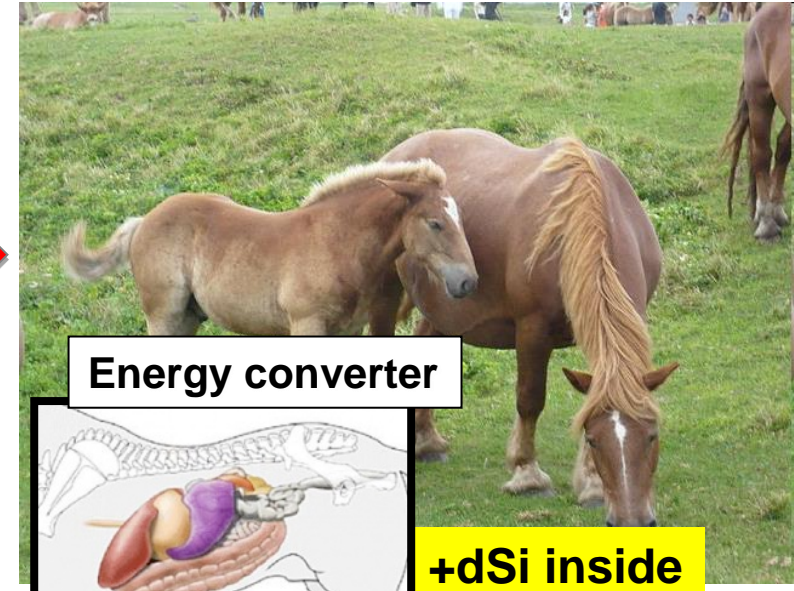
**-dSe outside**

**Energy input**

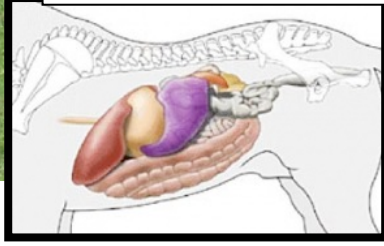


**Hay yield = 82 GJ/ha**

**Hay = 11 MJ/kg**



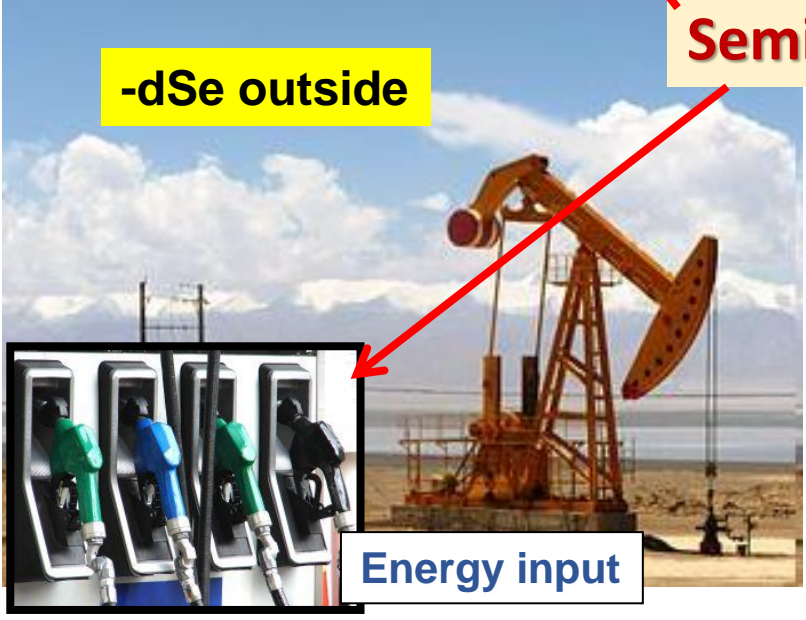
**Energy converter**



**+dSi inside**

**Metabolism = 0.02 MJ/kg**

**Semiotic controls**



**-dSe outside**

**Energy input**



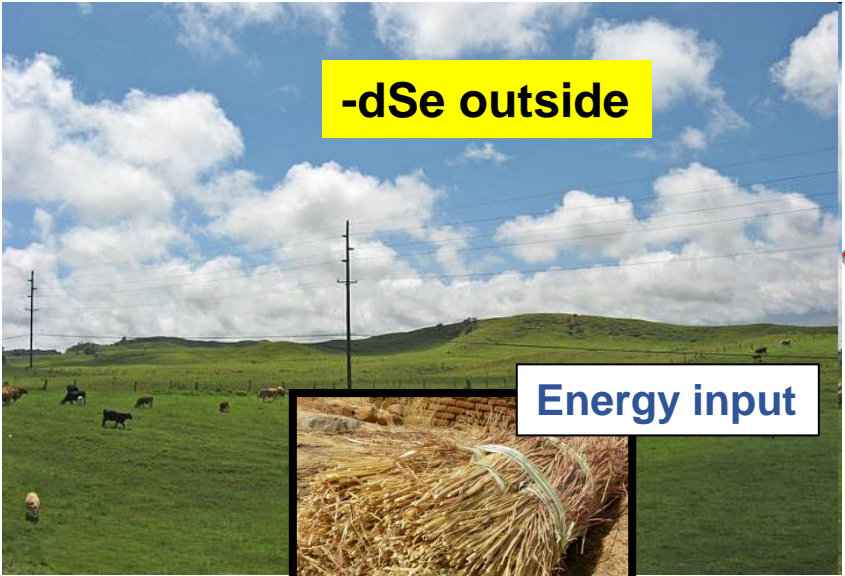
**Energy converter**

**+dSi inside**

**MAPPING THE STRUCTURAL COUPLING: THE UMWELT OF HORSES**

**kg of horses**

**ha of pasture**



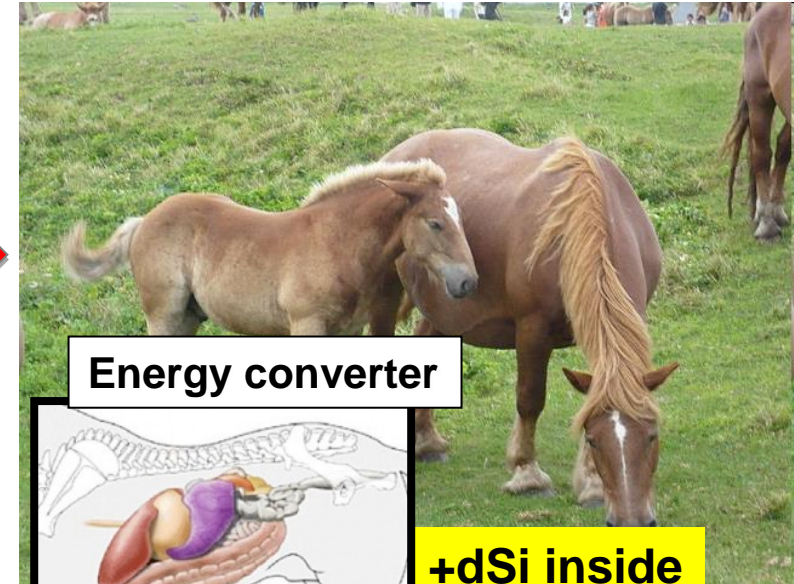
**-dSe outside**



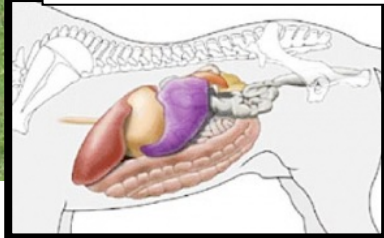
**Energy input**

**Hay yield = 82 GJ/ha**

**Hay = 11 MJ/kg**



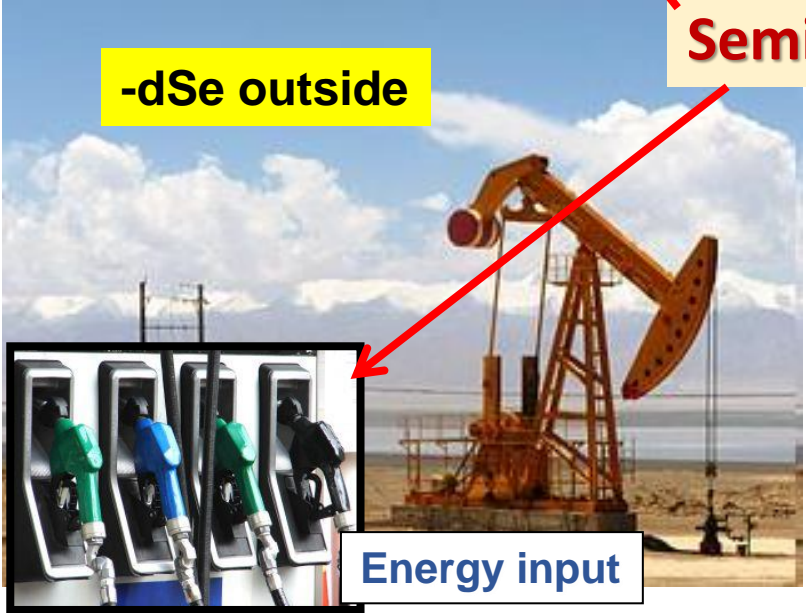
**Energy converter**



**+dSi inside**

**Metabolism = 0.02 MJ/kg**

**Semiotic controls**



**-dSe outside**

**Energy input**

**MJ Gasoline/MJ Oil = 0.42**

**Gasoline = 44.4 MJ/kg**

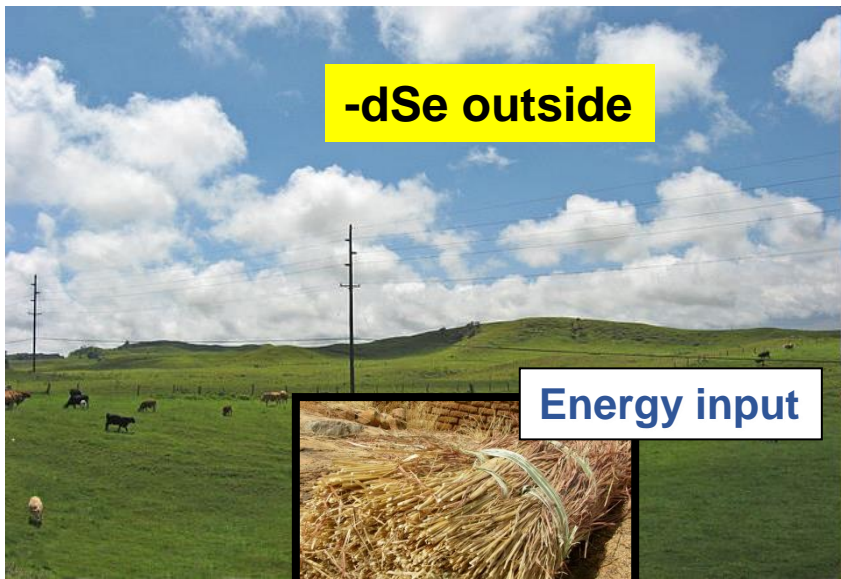


**Energy converter**

**+dSi inside**

**Metabolism = 0.4 MJ/km**

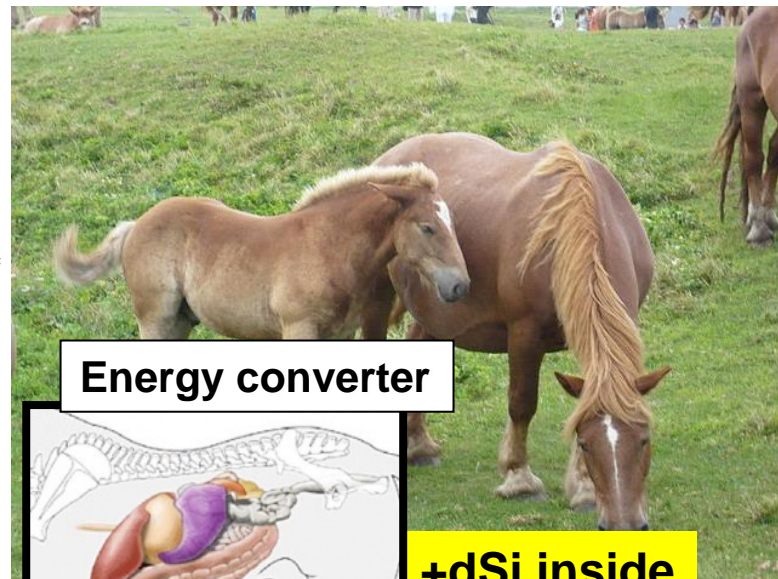
ha of pasture



-dSe outside



Energy input

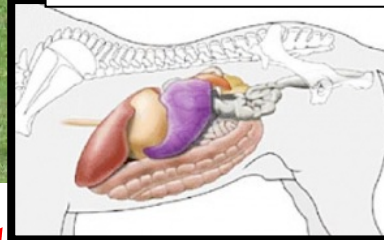


Energy converter

+dSi inside

MAPPING THE STRUCTURAL COUPLING: THE UMWELT OF HORSES

kg of horses



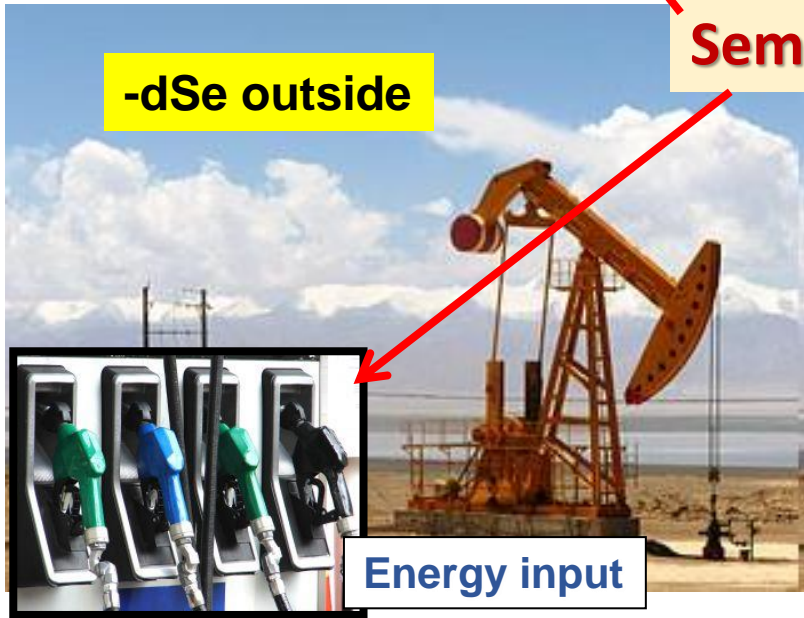
Metabolism = 0.02 MJ/kg

Hay = 11 MJ/kg

Hay yield = 82 GJ/ha

Semiotic controls

Tons of light oil



-dSe outside

Energy input



Energy converter

+dSi inside

MAPPING THE STRUCTURAL COUPLING: THE UMWELT OF CARS

km of mobility

Metabolism = 0.4 MJ/km

Gasoline = 44.4 MJ/kg

MJ Gasoline/MJ Oil = 0.42

ha of pasture



-dSe outside



MAPPING THE STRUCTURAL COUPLING: THE UMWELT OF HORSES

# NEGENTROPY IS A SEMANTIC CONCEPT!!!

orses



Hay yield = 82 GJ/ha



Hay = 11 MJ/kg

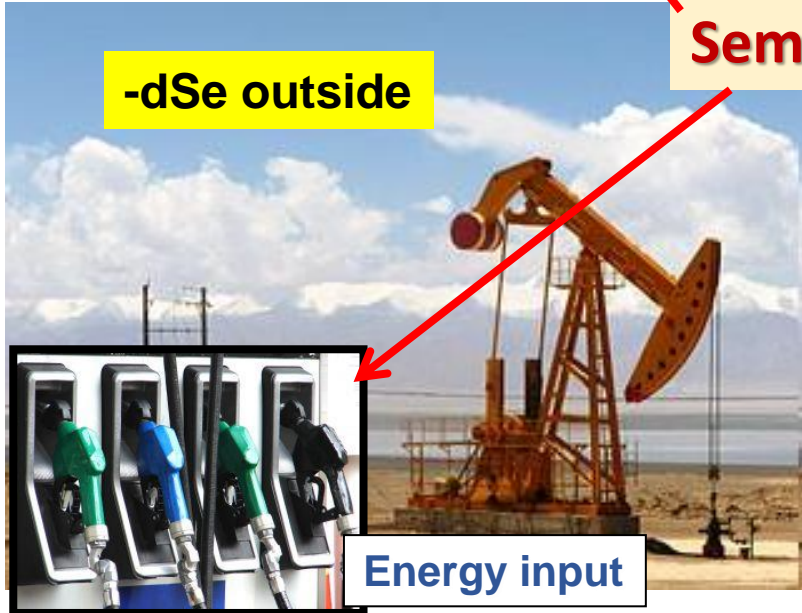


+dSi inside

Metabolism = 0.02 MJ/kg

Semiotic controls

Tons of light oil



-dSe outside

Energy input



Energy converter

MAPPING THE STRUCTURAL COUPLING: THE UMWELT OF CARS

km of mobility



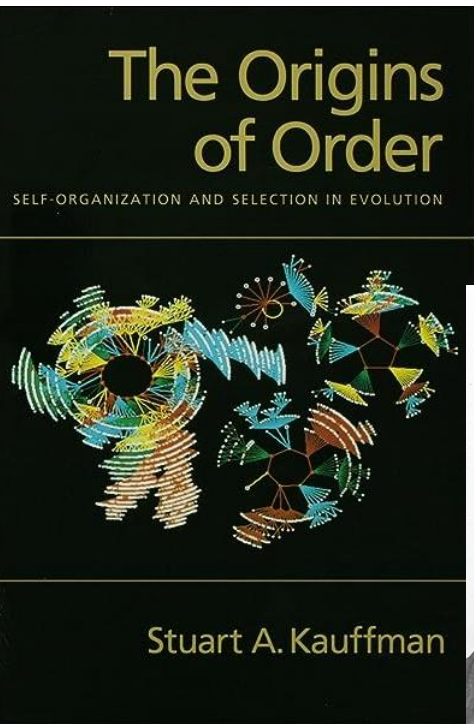
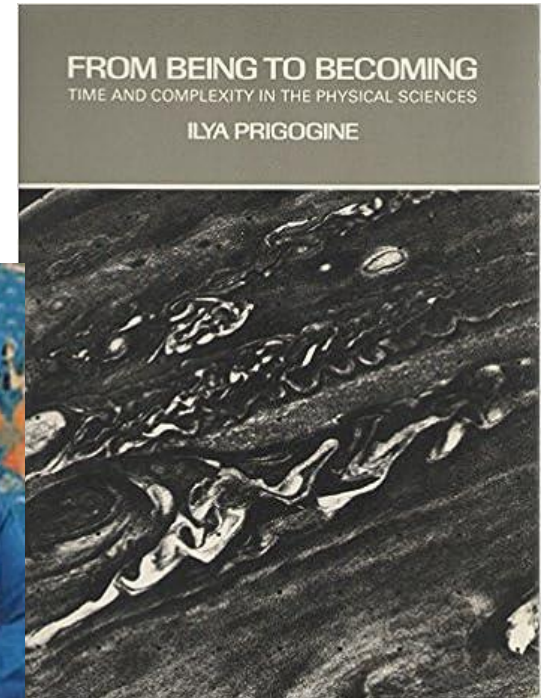
+dSi inside

Metabolism = 0.4 MJ/km

MJ Gasoline/MJ Oil = 0.42

Gasoline = 44.4 MJ/kg

# The magic of group autocatalysis

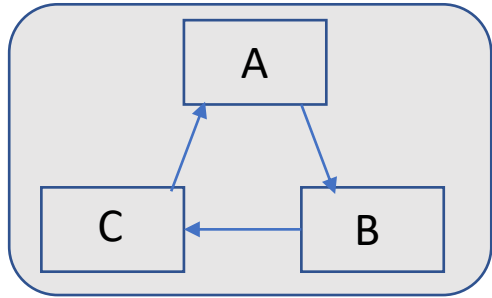


Handling “the epistemic cut” (across levels and scales) in terms of “mutual” and “direct” information a.k.a. DOWNWARD and UPWARD causation

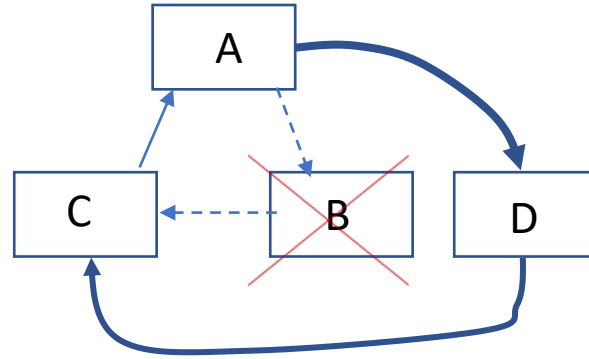
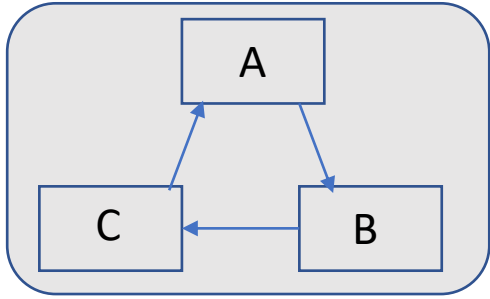


Evolution of a group autocatalytic loop, which can remain the same while becoming something else . . .

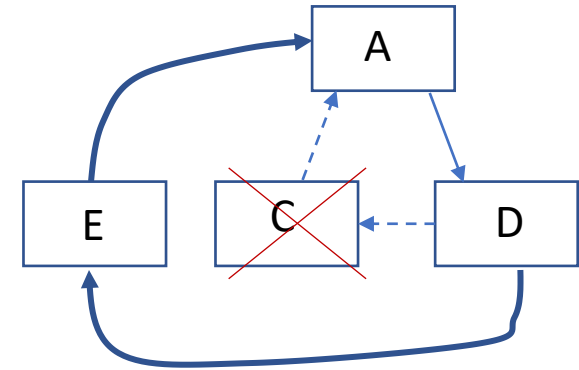
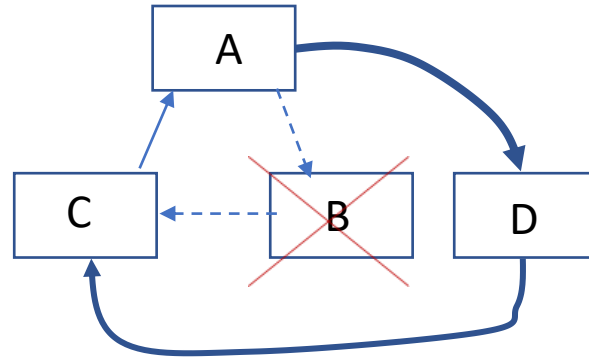
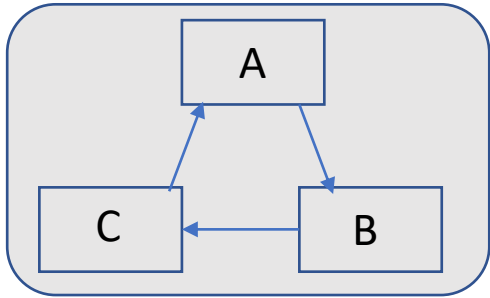
Evolution of a group autocatalytic loop, which can remain the same while becoming something else . . .



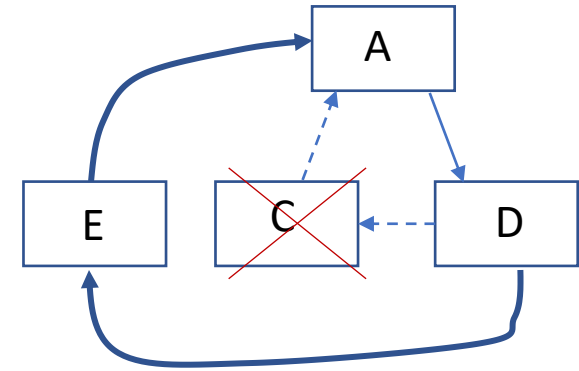
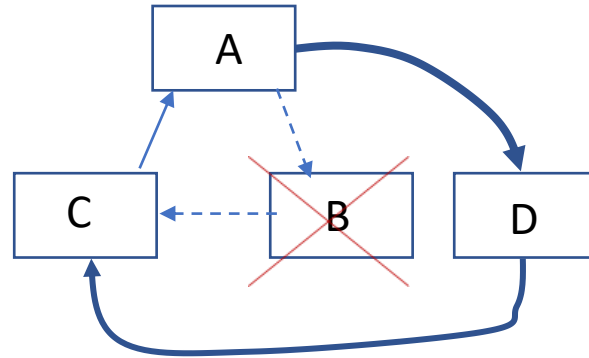
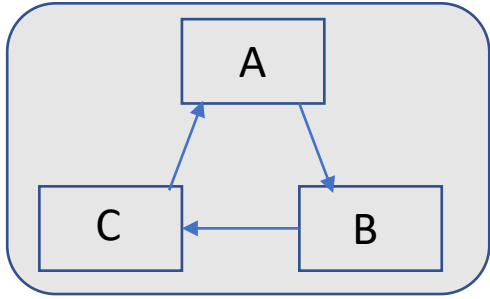
Evolution of a group autocatalytic loop, which can remain the same while becoming something else . . .



Evolution of a group autocatalytic loop, which can remain the same while becoming something else . . .



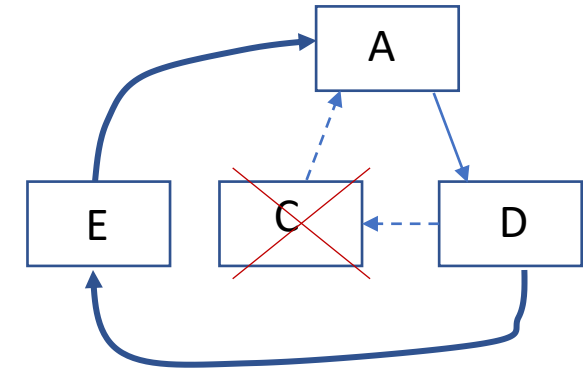
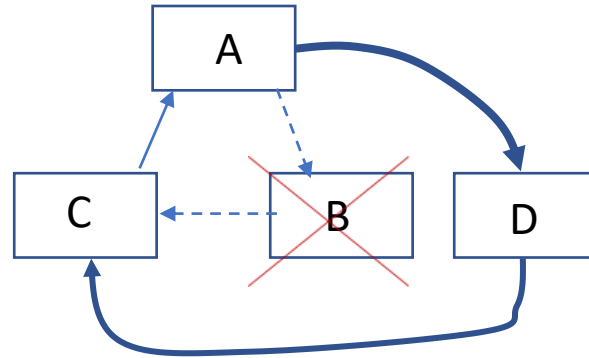
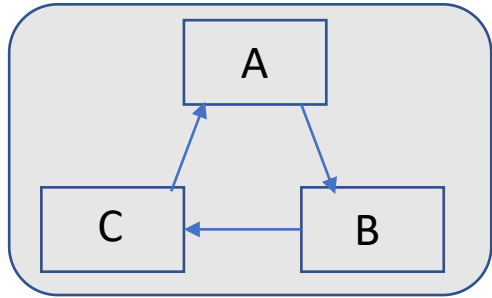
Evolution of a group autocatalytic loop, which can remain the same while becoming something else . . .



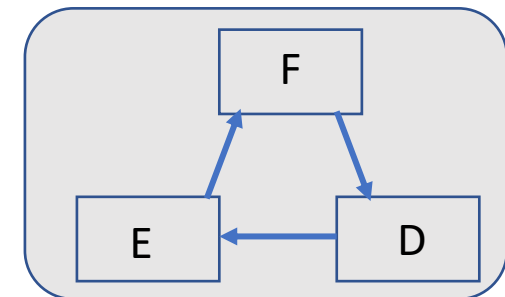
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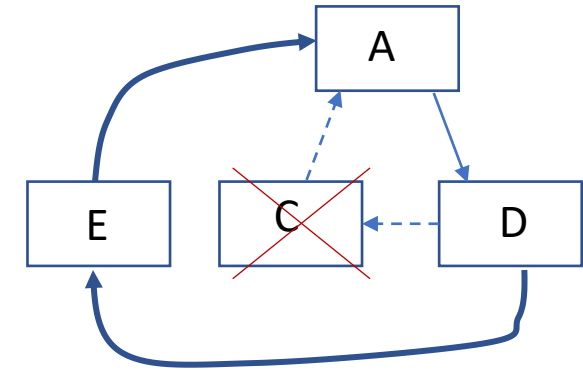
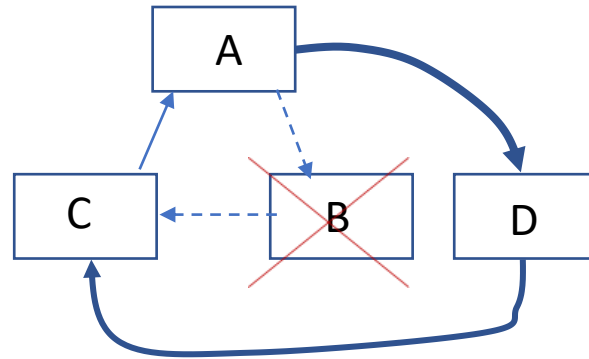
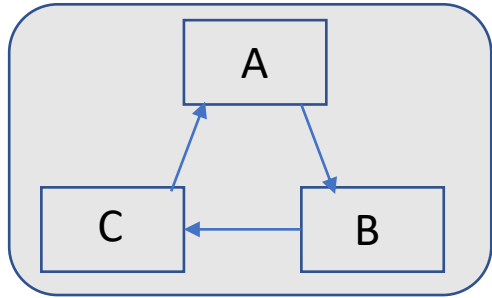
Evolution of a group autocatalytic loop, which can remain the same while becoming something else . . .



...



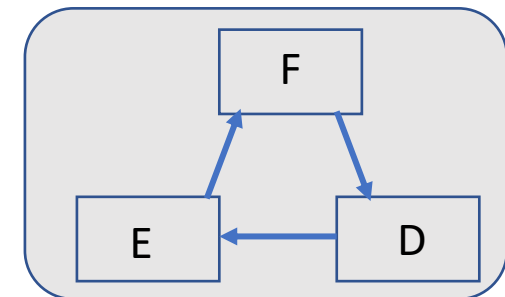
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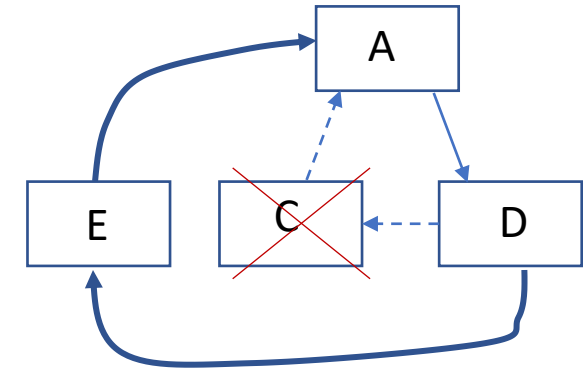
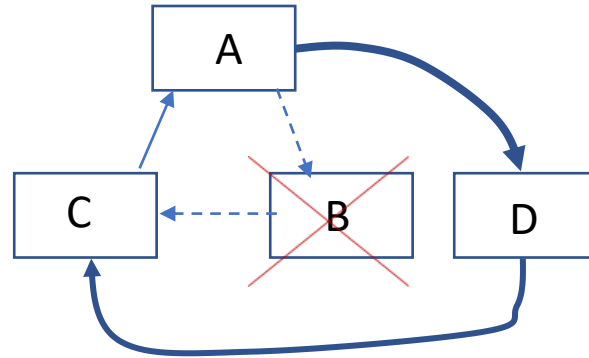
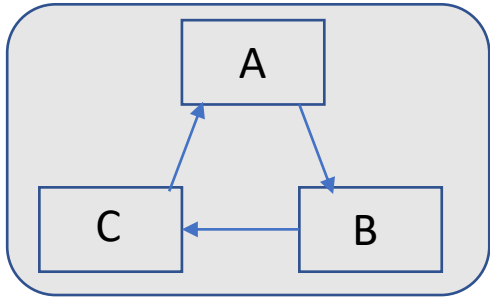
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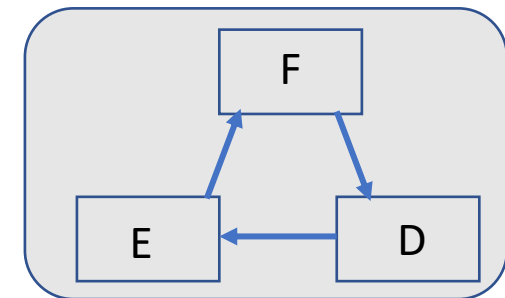
**SAME "WHOLE"  
DIFFERENT "PARTS"**



Evolution of a group autocatalytic loop, which can remain the same while becoming something else . . .



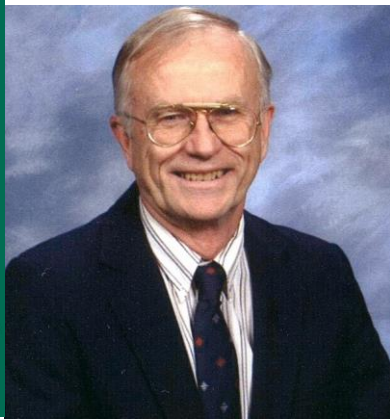
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**SAME "WHOLE"  
DIFFERENT "PARTS"**

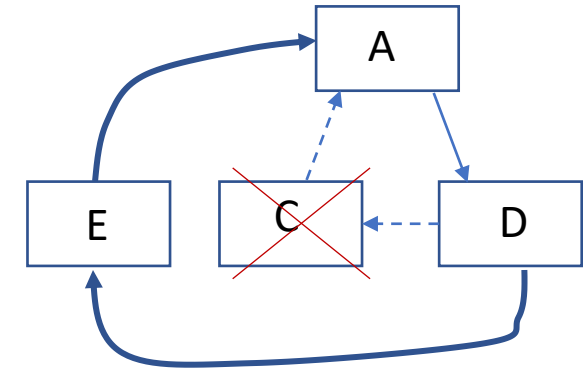
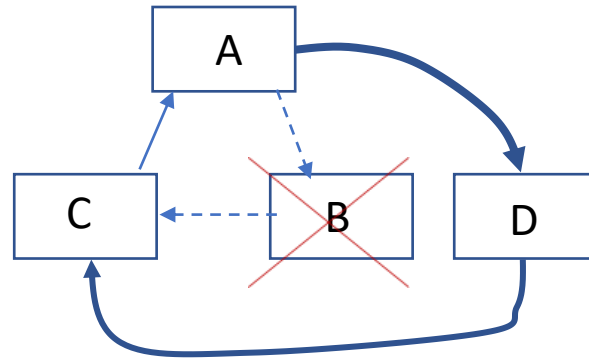
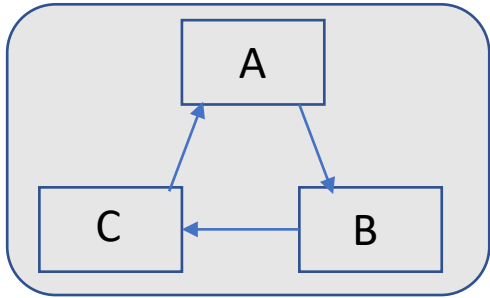
**ECOLOGY,  
THE  
ASCENDENT  
PERSPECTIVE**

ROBERT E. ULANOWICZ





Evolution of a group autocatalytic loop, which can remain the same while becoming something else . . .

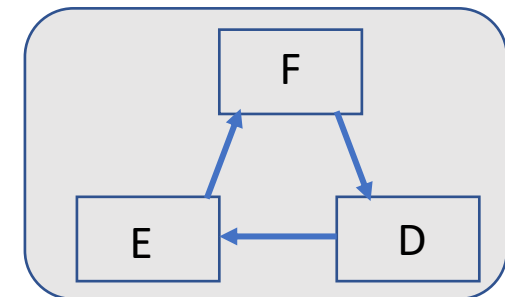


*What is remaining the same?*

...

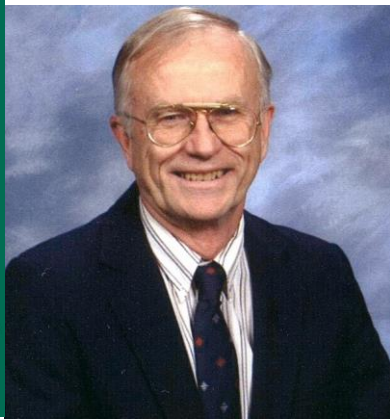


**SAME "WHOLE"  
DIFFERENT "PARTS"**



ECOLOGY,  
THE  
ASCENDANT  
PERSPECTIVE

ROBERT E. ULANOWICZ

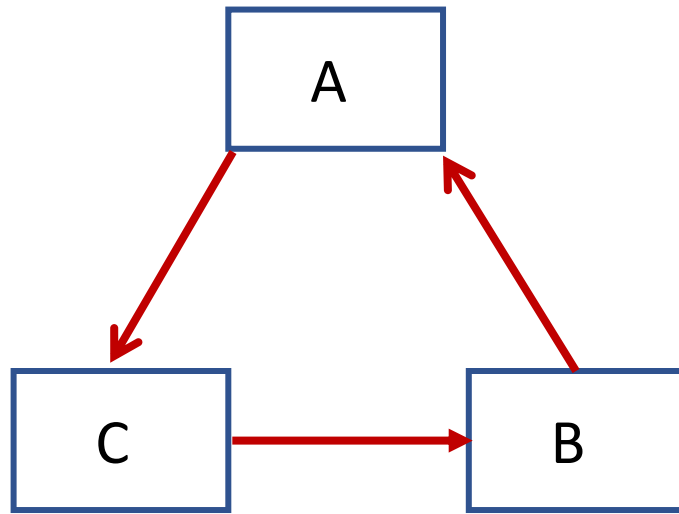


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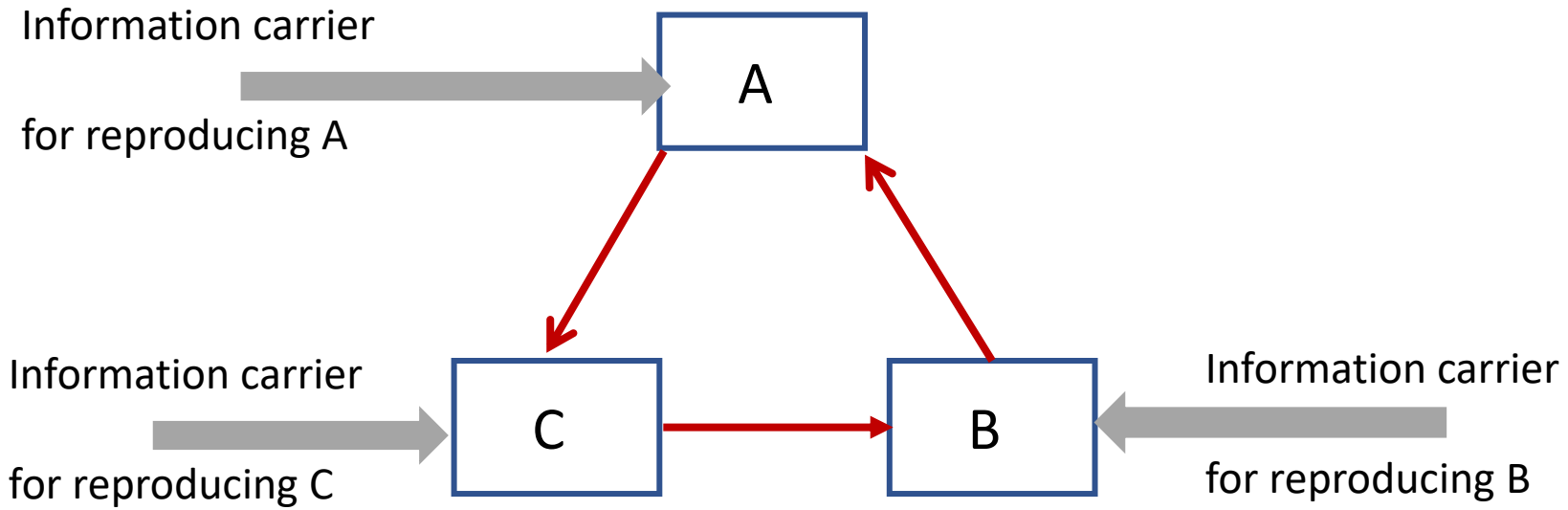
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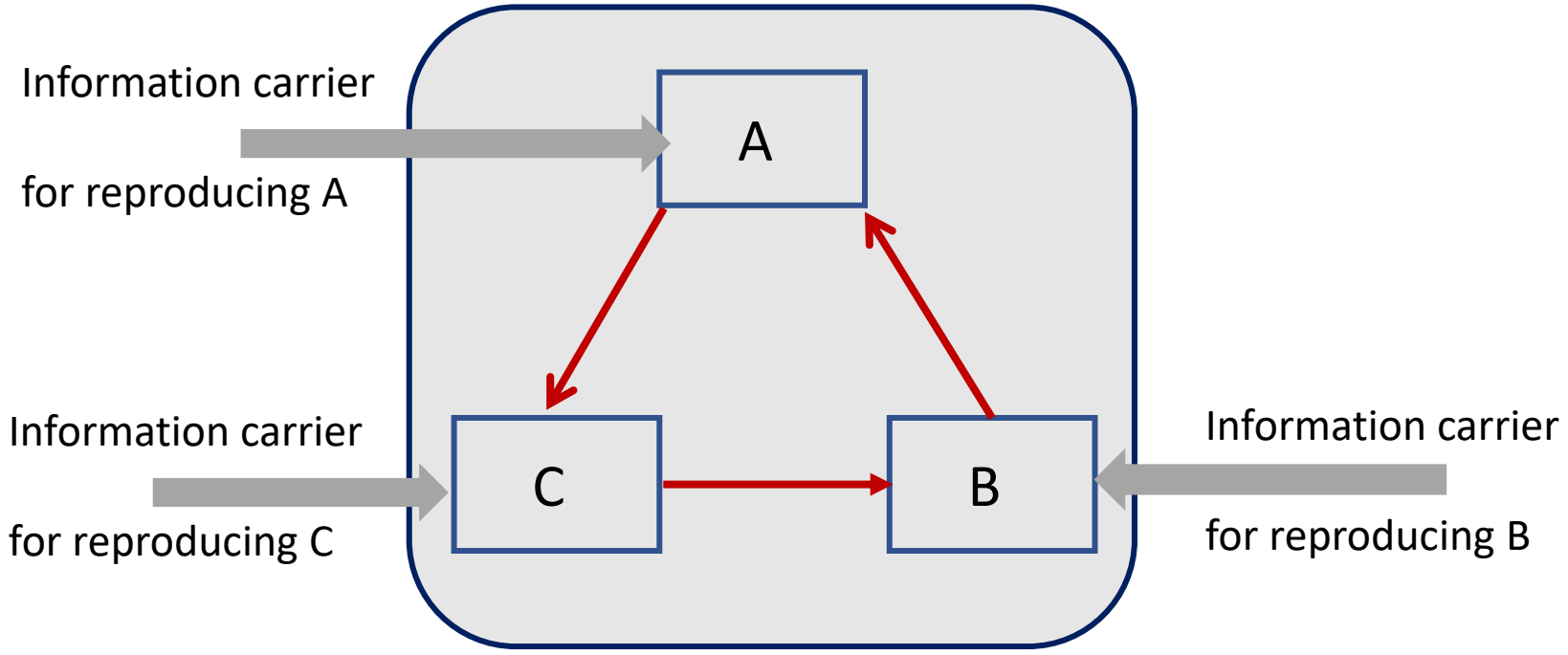
A hypothetical 3-component  
group autocatalytic loop



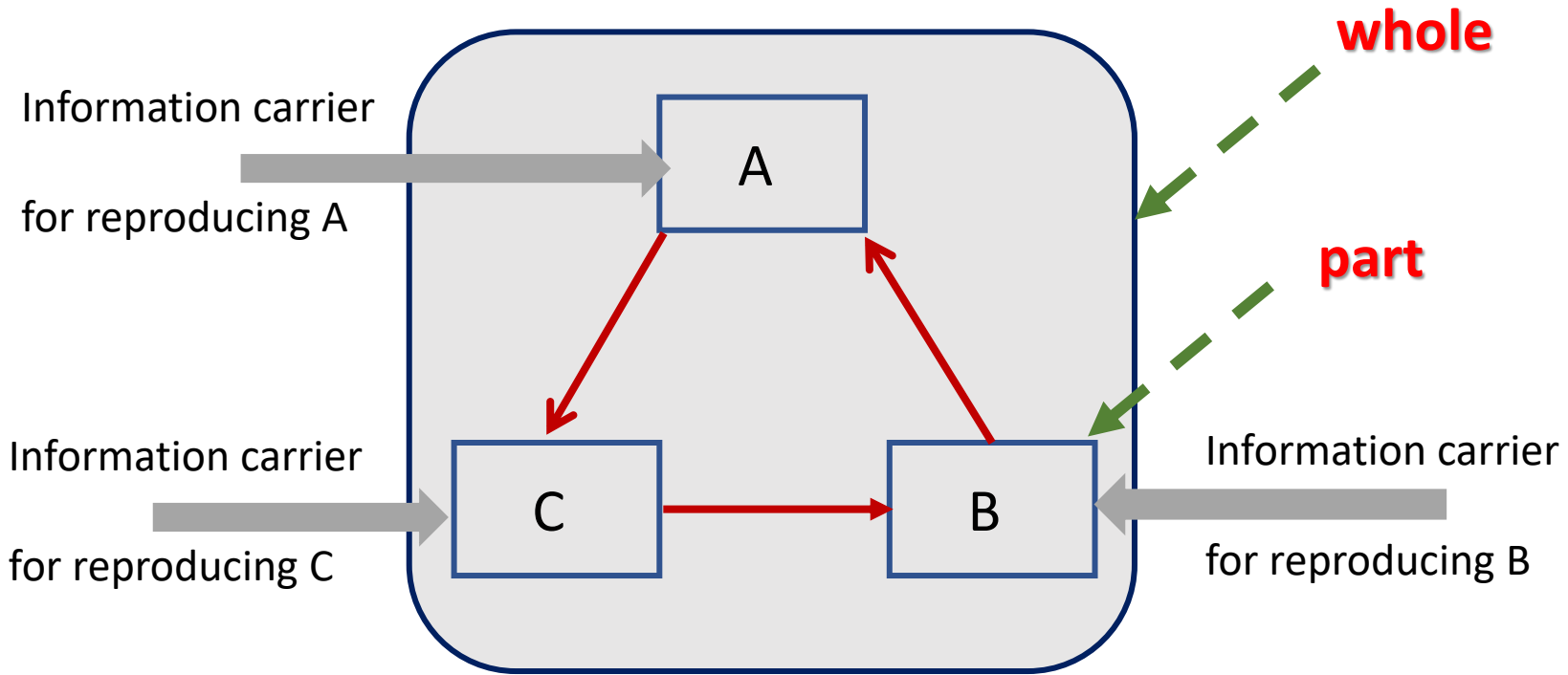
A hypothetical 3-component  
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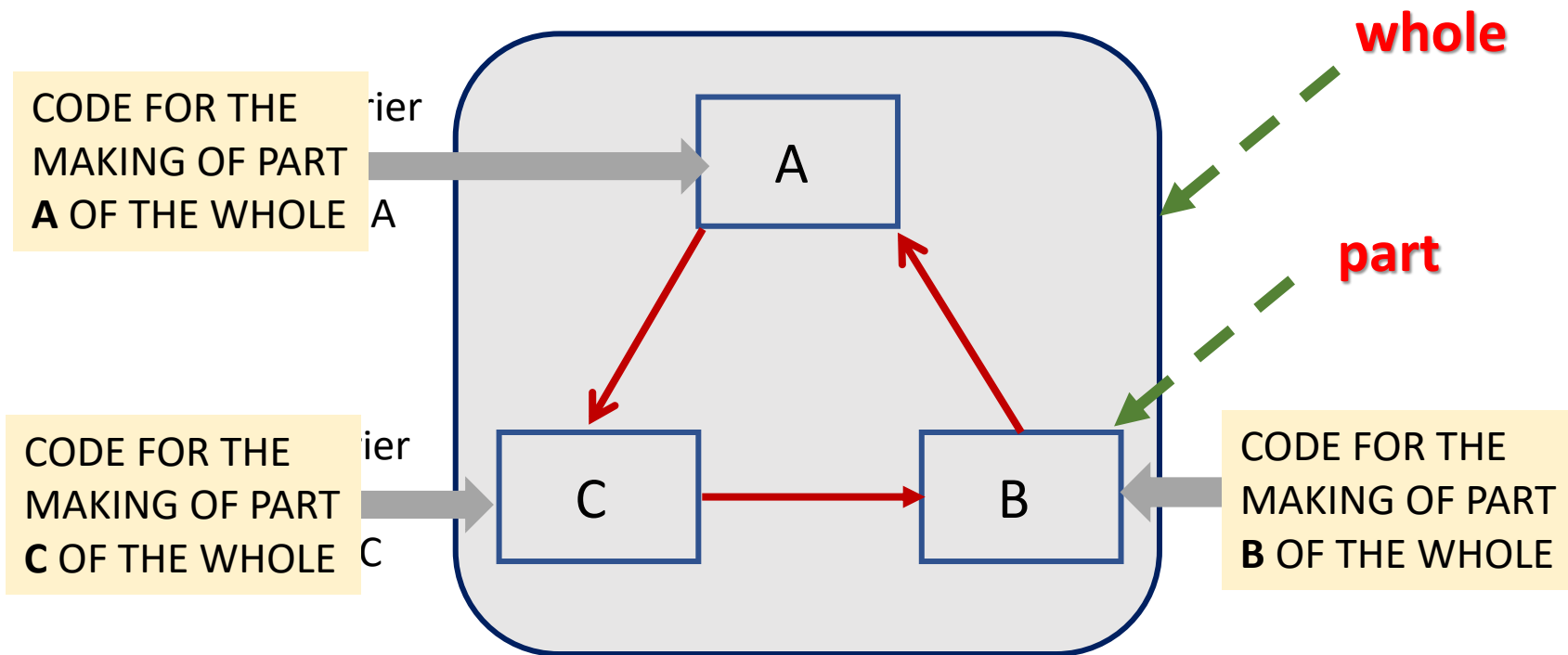
A hypothetical 3-component group autocatalytic loop



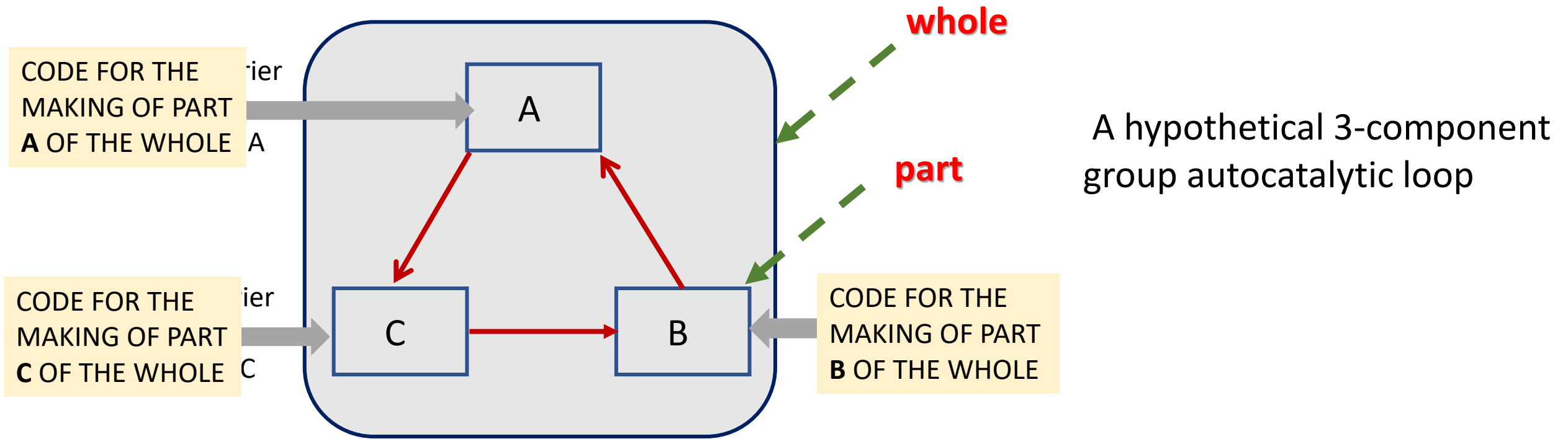
A hypothetical 3-component group autocatalytic loop



A hypothetical 3-component  
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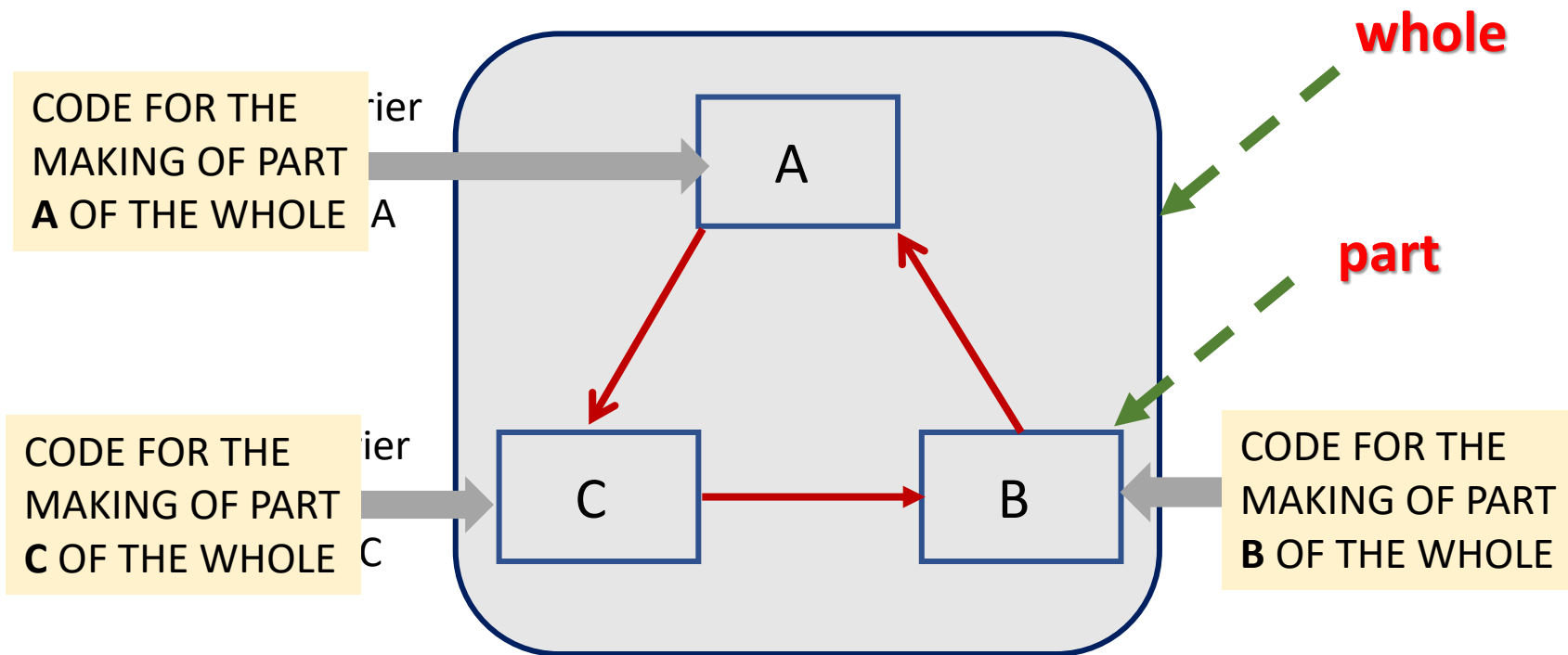
A hypothetical 3-component group autocatalytic loop



As soon as you establish a “part/whole”<sup>\*</sup> relation the information carriers used to make the parts become **codes** for the making of the whole

EMERGENT PROPERTY = **what gave meaning to the parts**

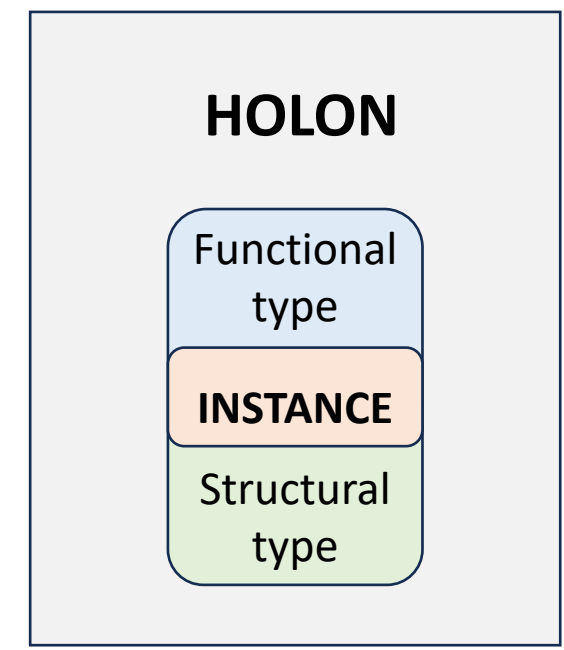




A hypothetical 3-component group autocatalytic loop

As soon as you establish a “part/whole”\* relation the information carriers used to make the parts become *codes* for the making of the whole

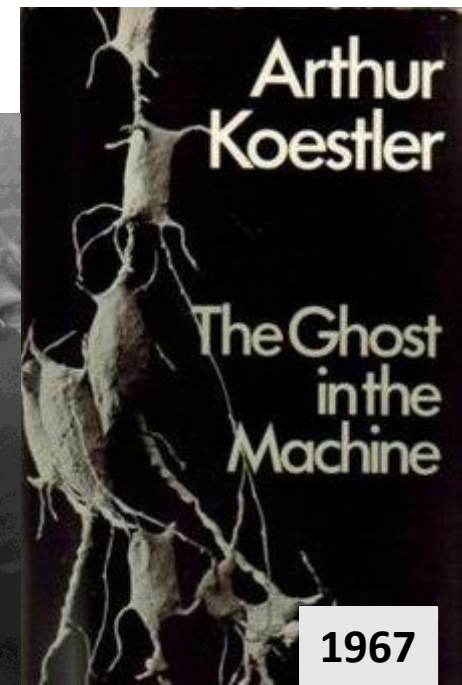
EMERGENT PROPERTY = **what gave meaning to the parts**



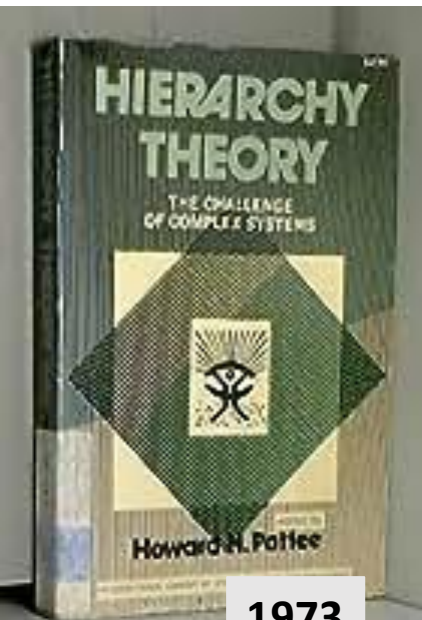
*Defined across the epistemic cut!*



**THE HOLON &  
HOLARCHIES**



1967

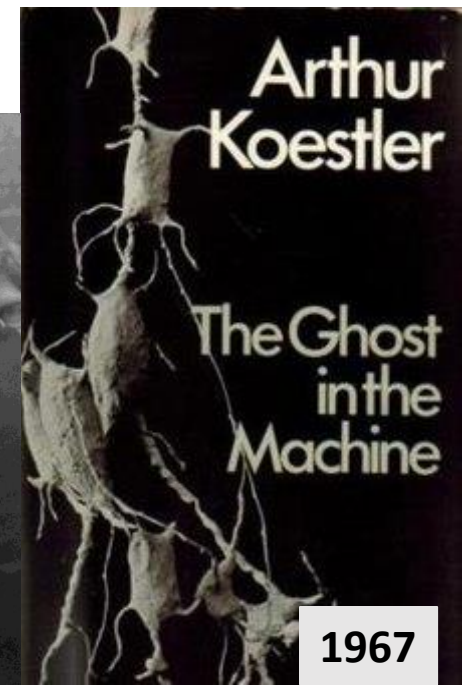


1973

Howard H. Pattee



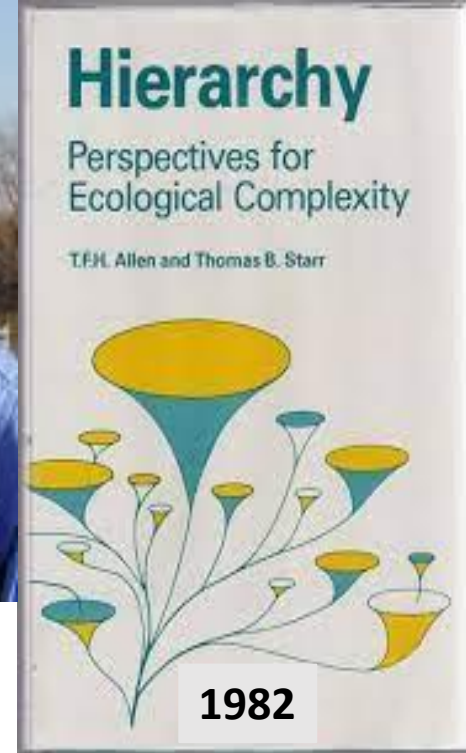
**THE HOLON &  
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1967

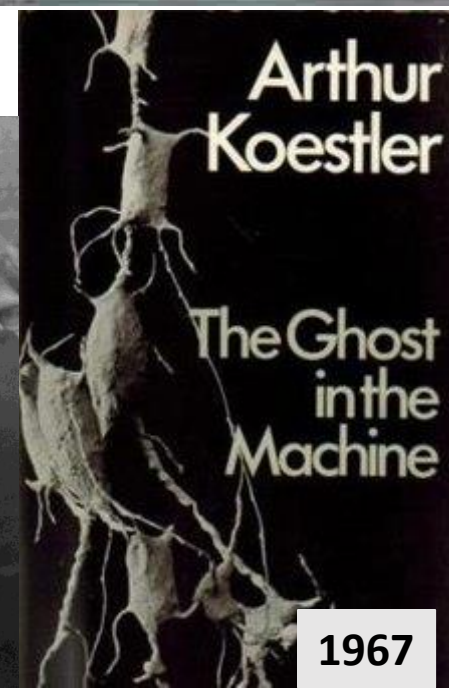


Timothy F.H. Allen

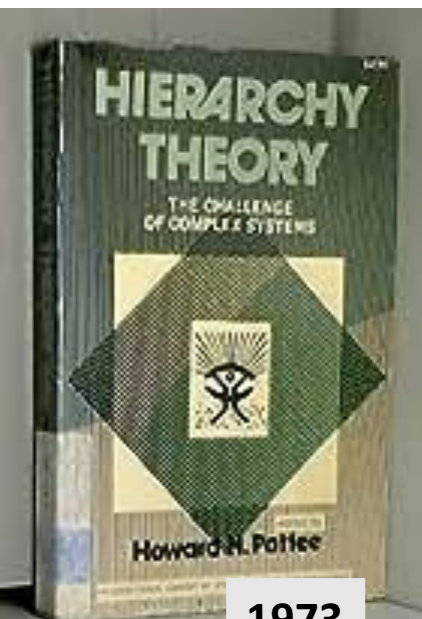


1982

**THE HOLON &  
HOLARCHIES**



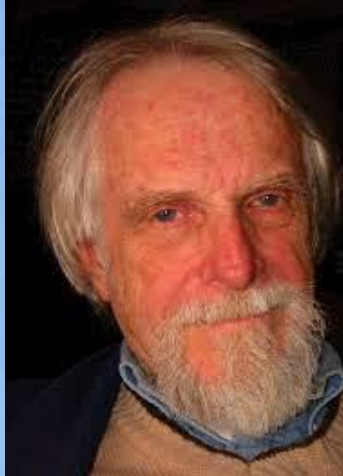
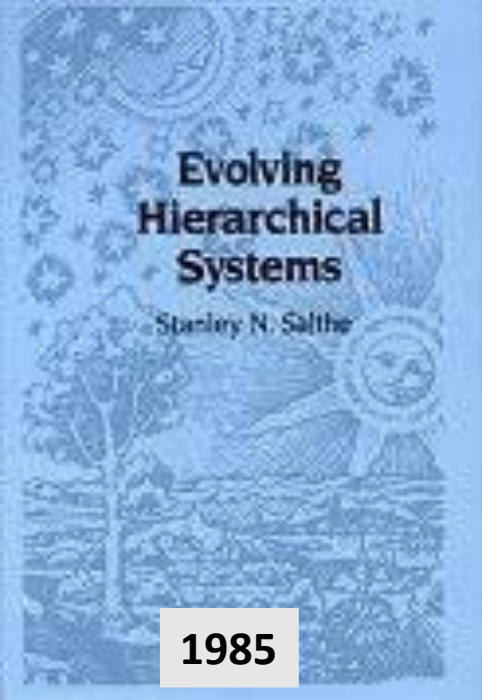
1967



1973

Howard H. Pattee



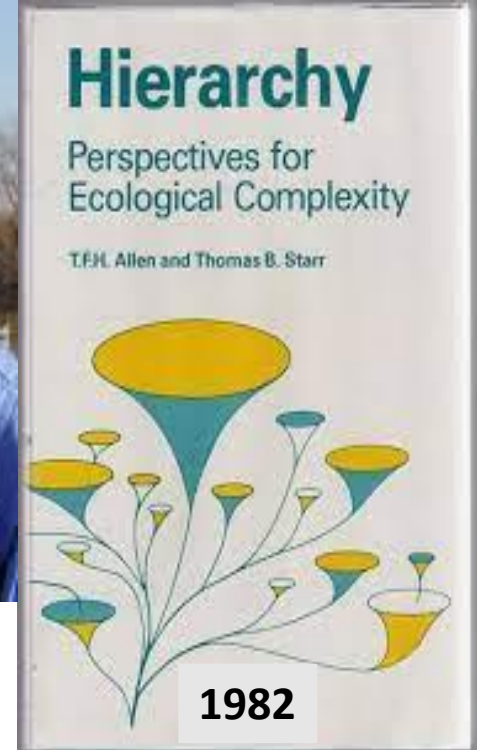


Stanley N. Salthe

1985

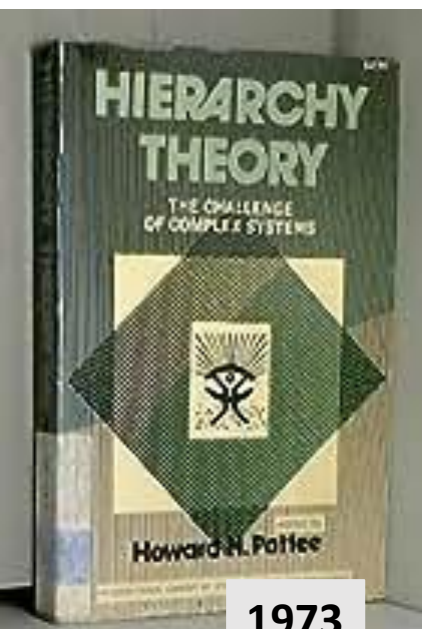


Timothy F.H. Allen



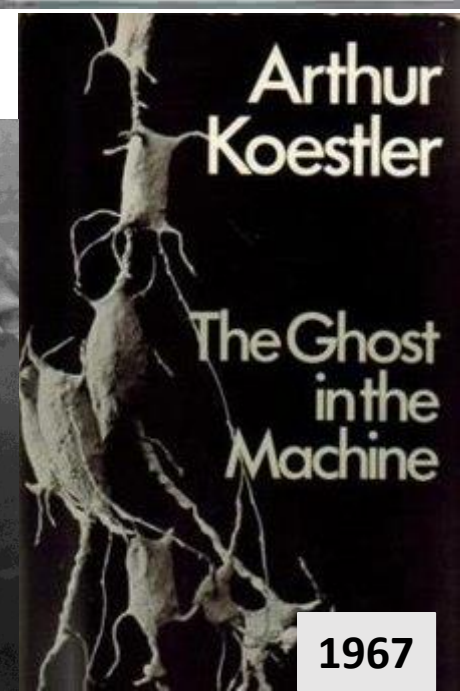
1982

**THE HOLON &  
HOLARCHIES**

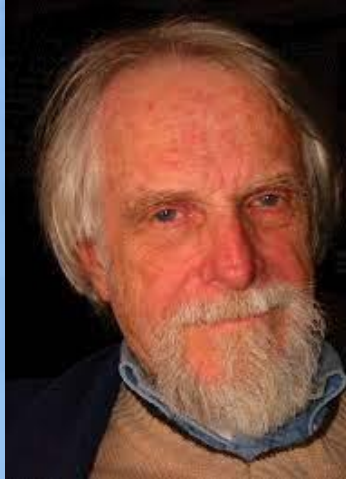
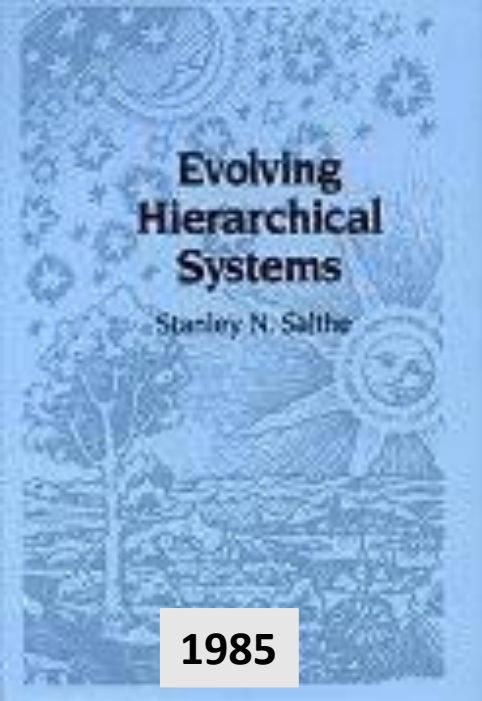


Howard H. Pattee

1973

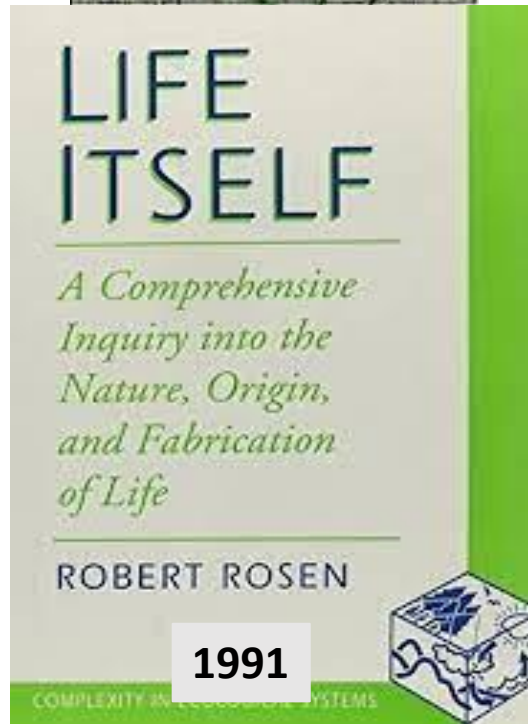


1967



Stanley N. Salthe

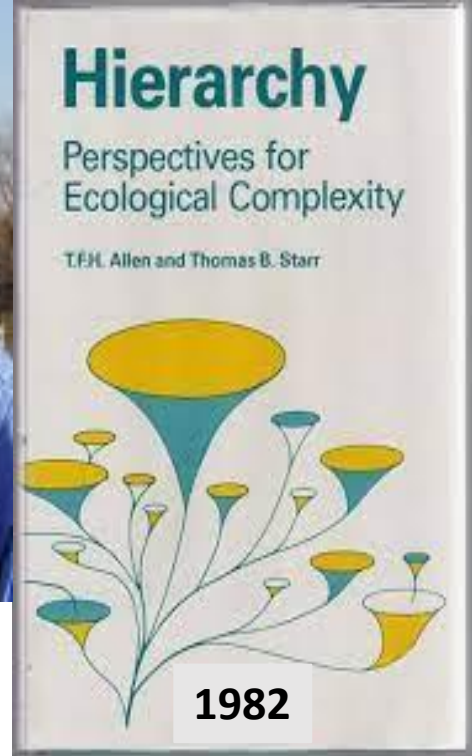
1985



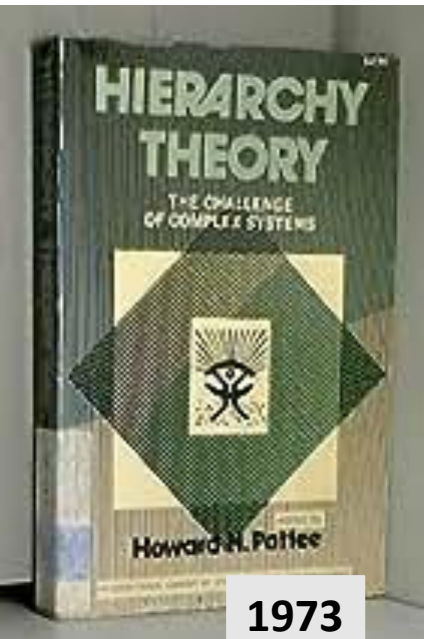
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Timothy F.H. Allen



1982



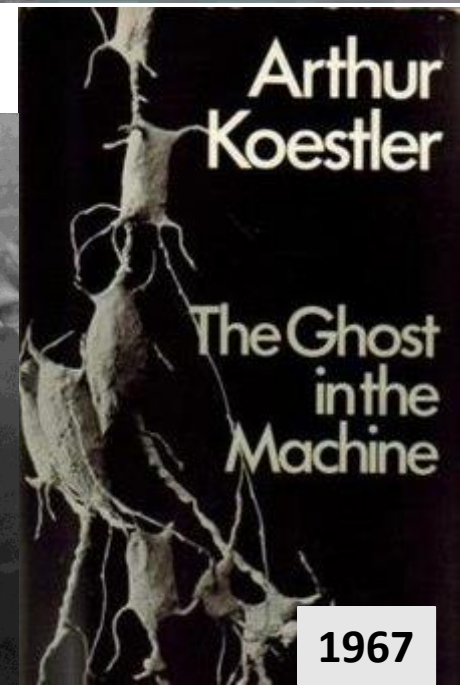
1973



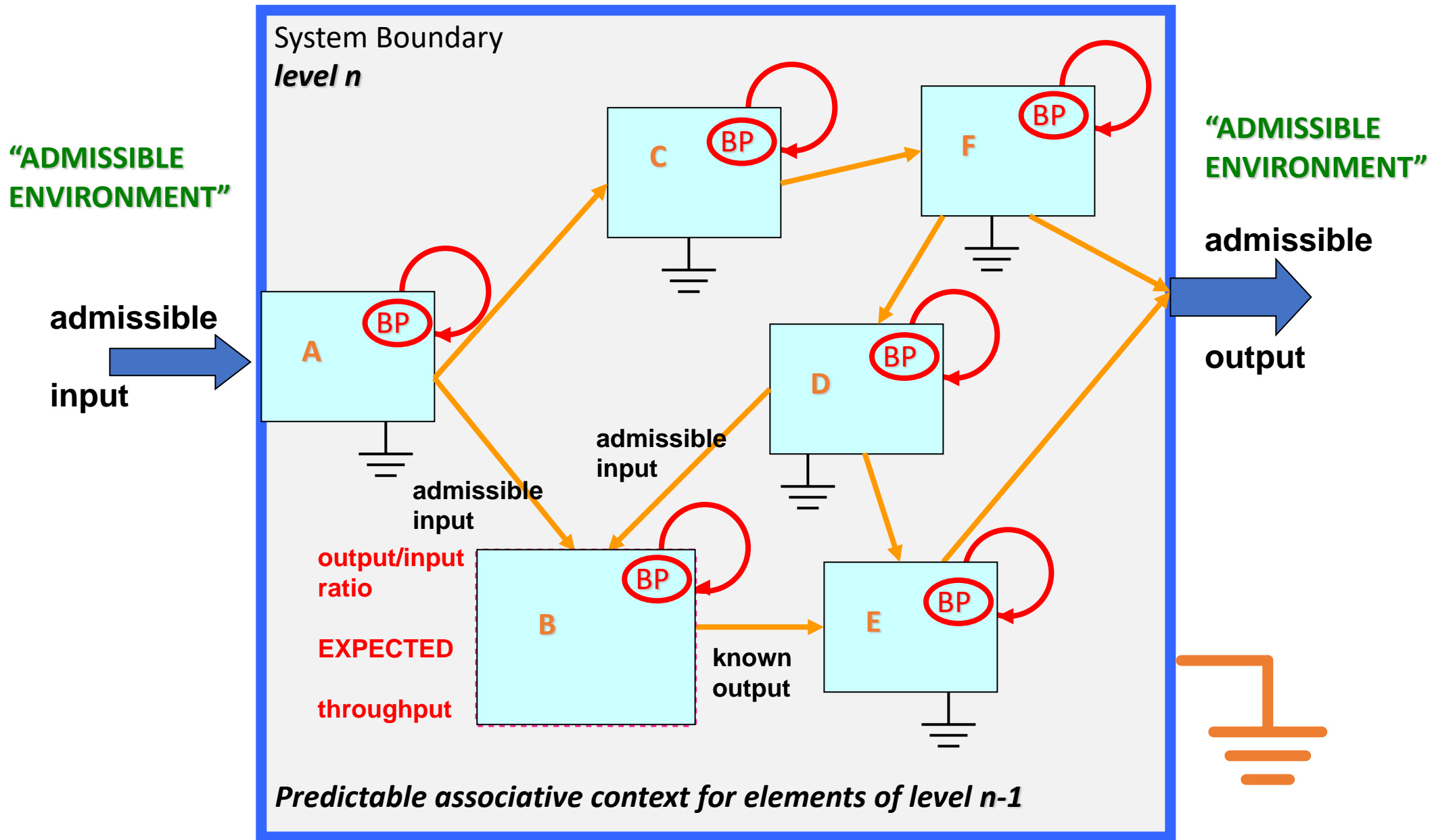
Howard H. Pattee



THE HOLON &  
HOLARCHIES

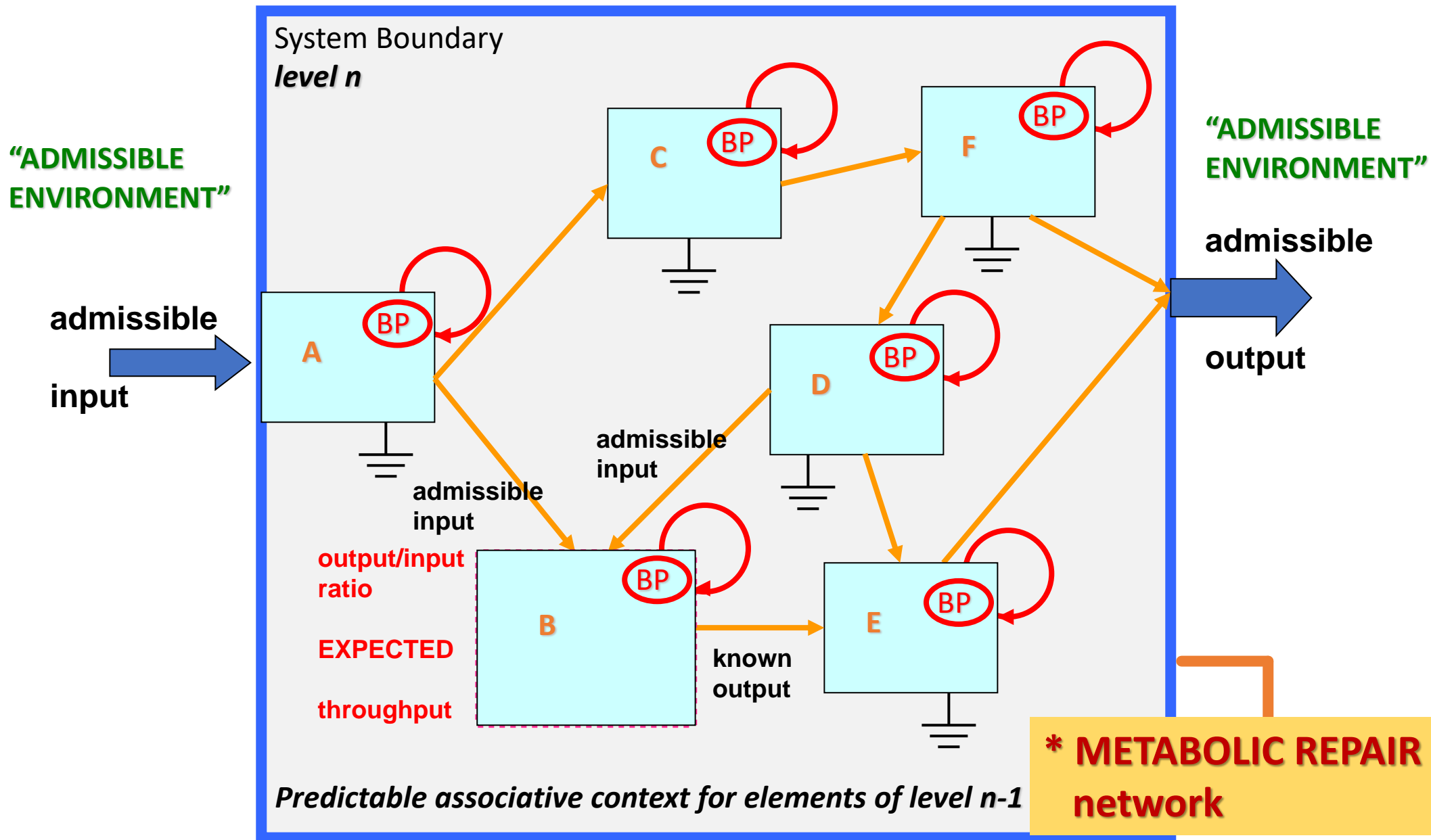


1967

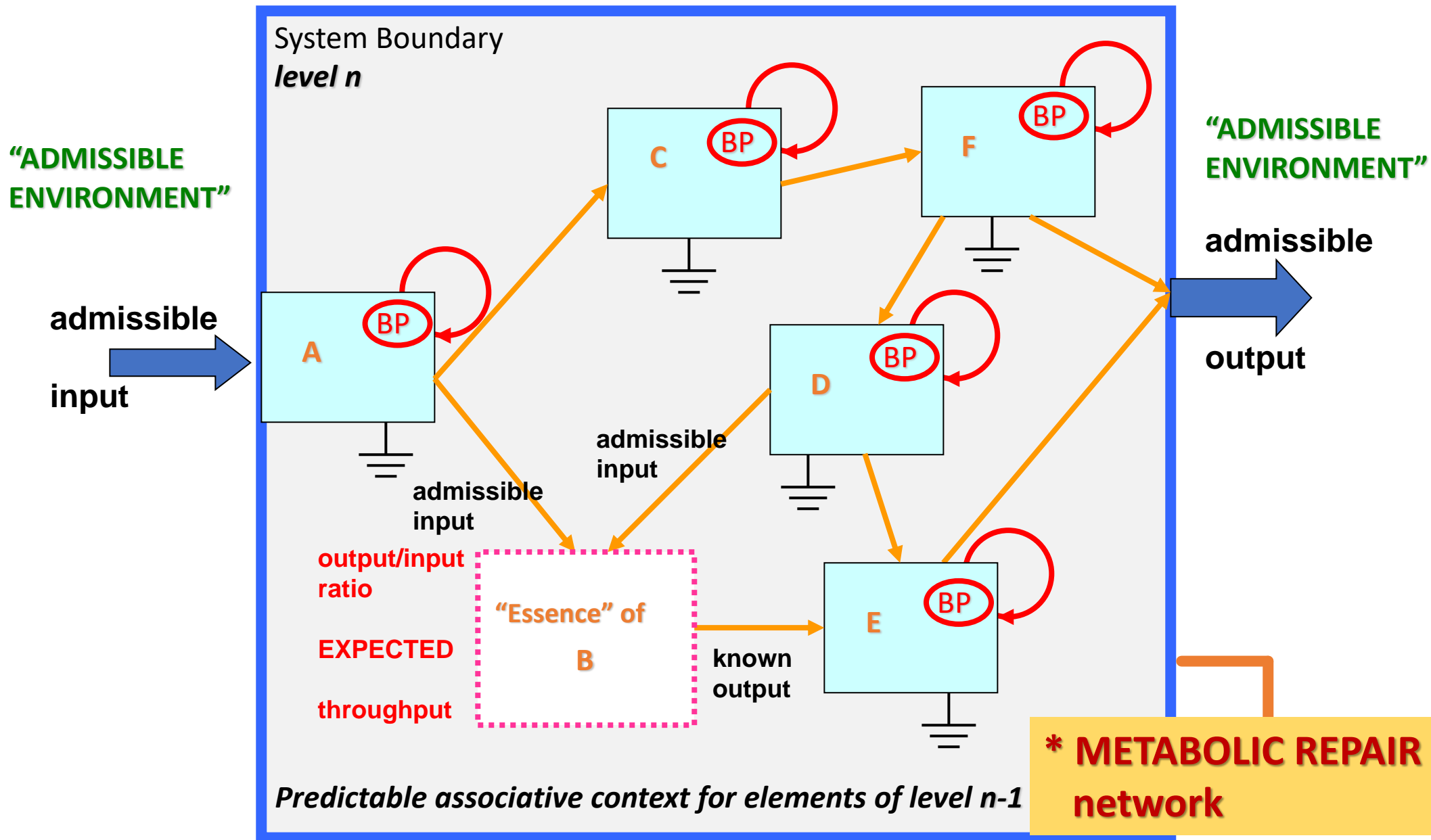


Definition of mutual information over the identity of nodes in a **MR-network\***





Definition of mutual information over the identity of nodes in a **MR-network\***



Definition of mutual information over the identity of nodes in a **MR-network\***

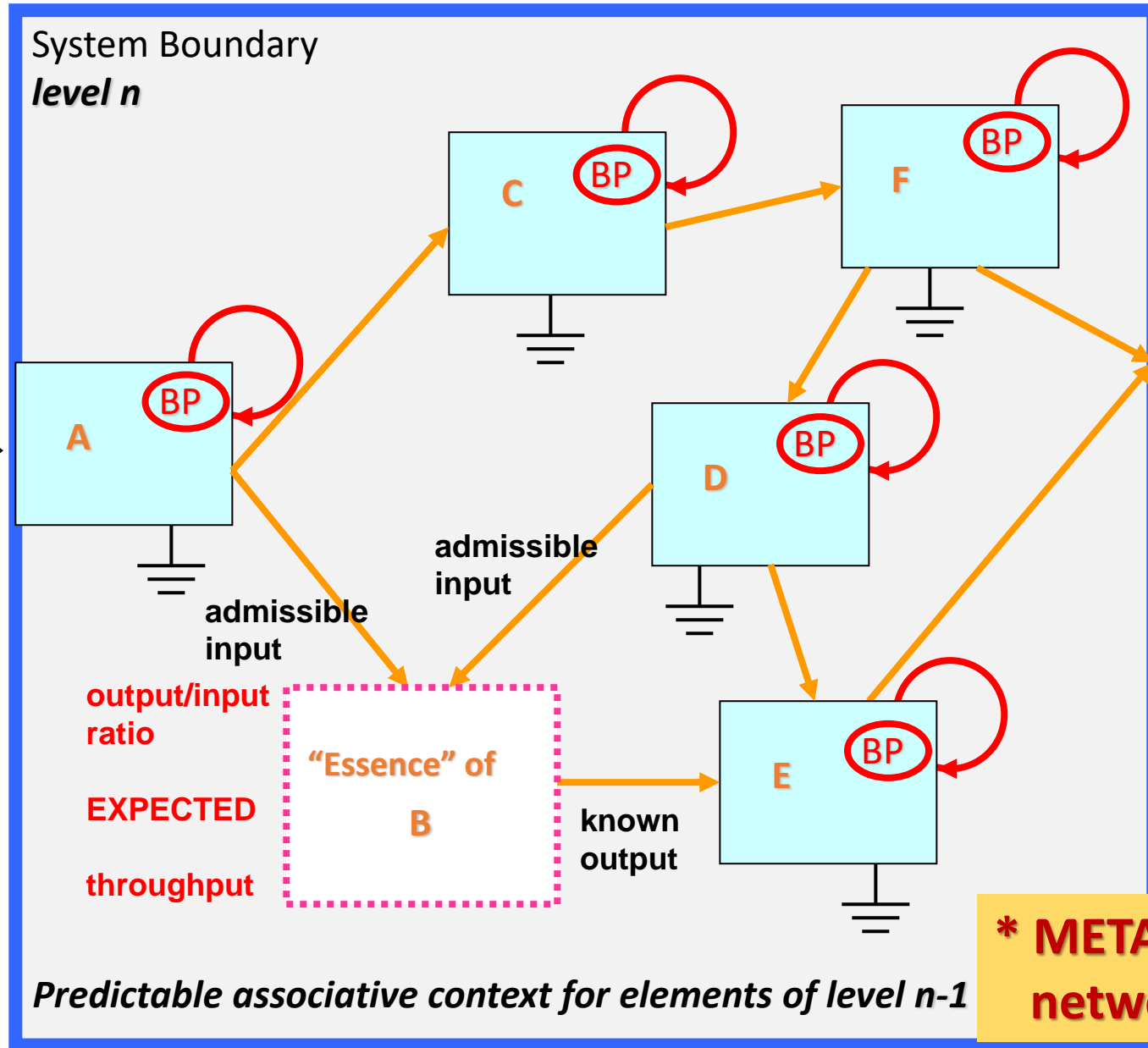
**MUTUAL INFORMATION**

The ecological network niche

= the UMWELT of a salmon

“ADMISSIBLE ENVIRONMENT”

admissible input



Definition of mutual information over the identity of nodes in a **MR-network\***

# SUDOKU EFFECT!

MUTUAL  
INFORMATION

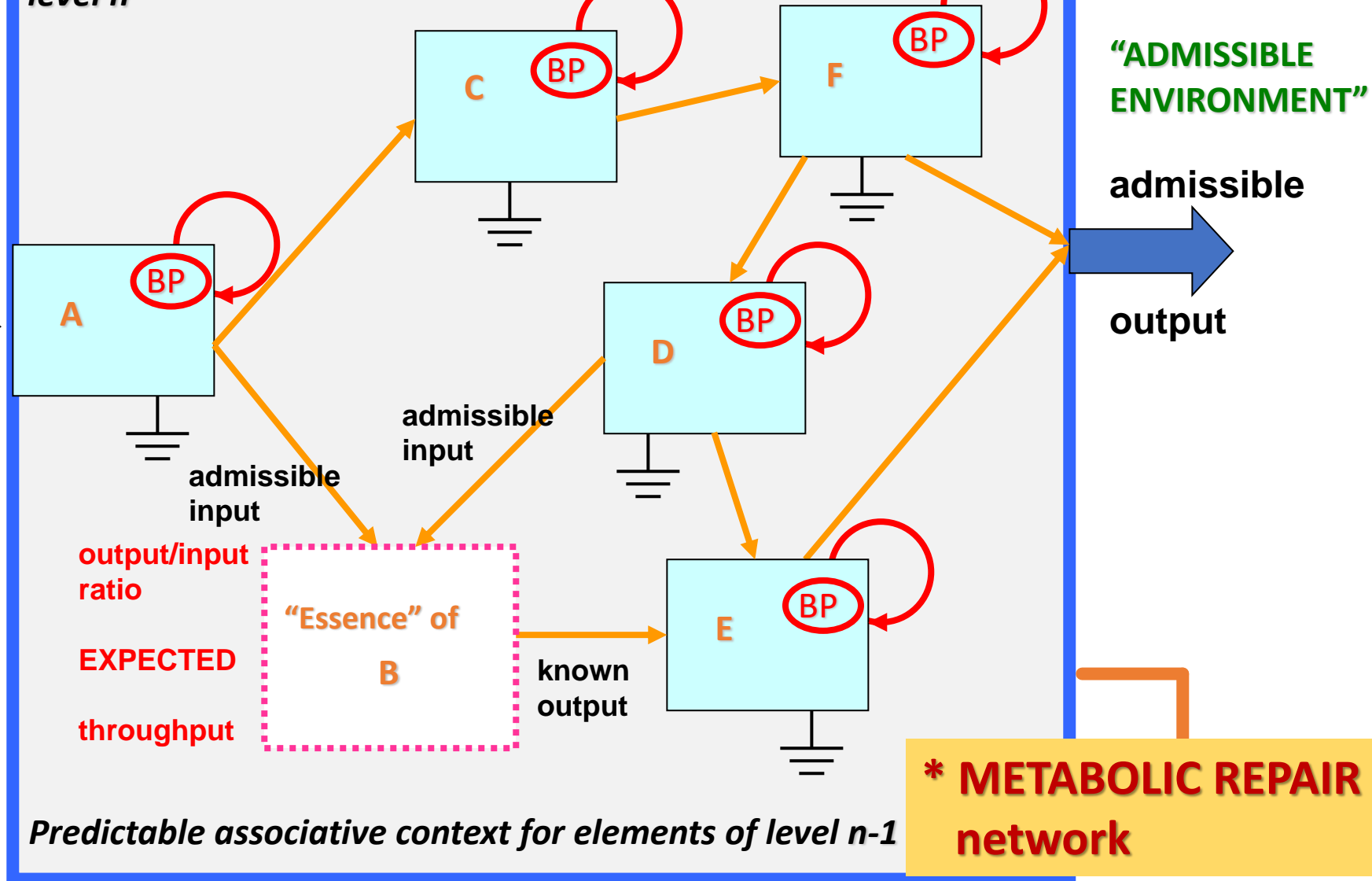
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network niche

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“ADMISSIBLE  
ENVIRONMENT”

admissible  
input

System Boundary  
level  $n$



Definition of mutual information over the identity of nodes in a **MR-network\***

# SUDOKU EFFECT!

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The ecological network niche

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## DIRECT INFORMATION

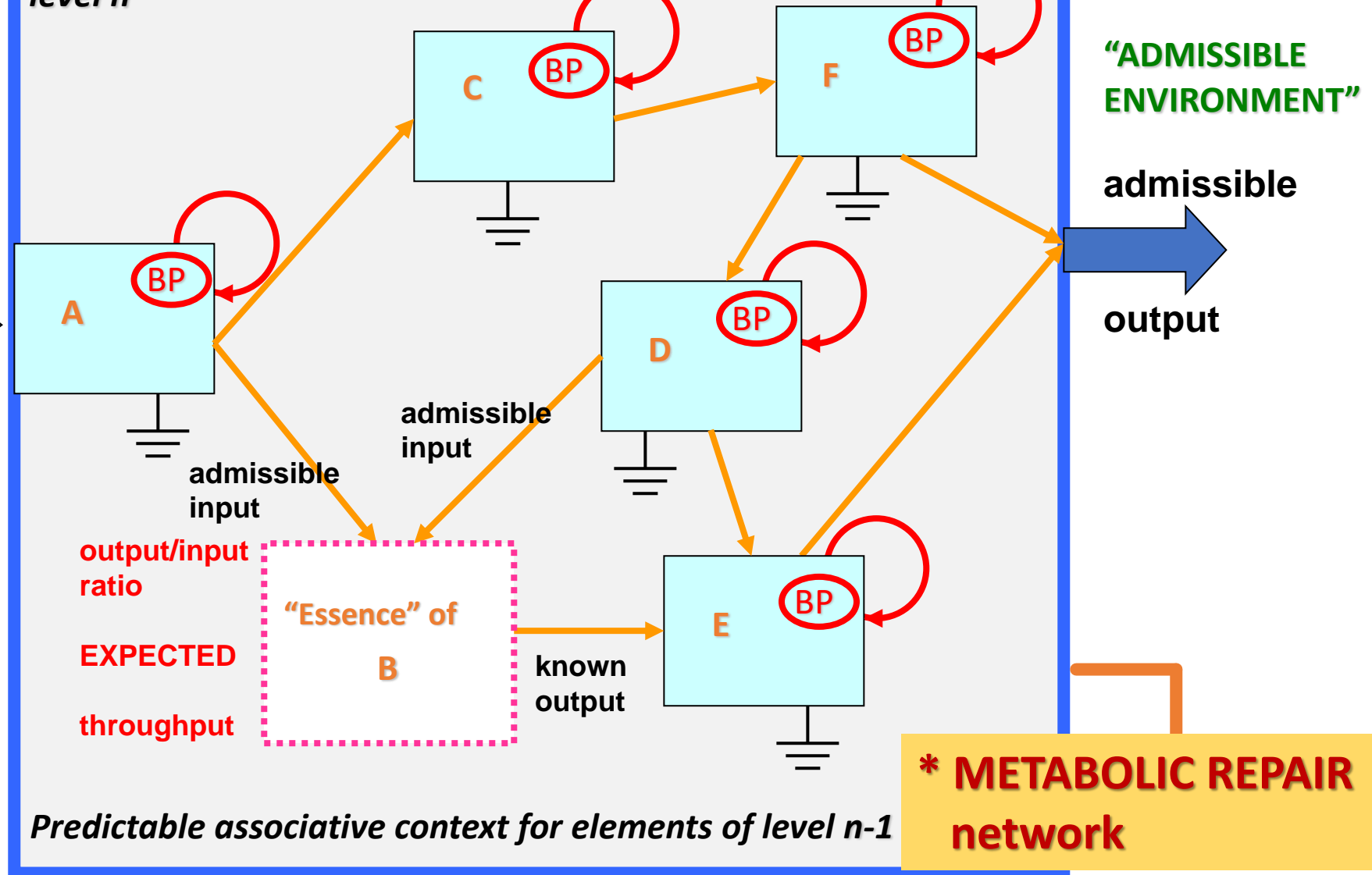
The genetic information

= how to produce an instance of salmon

“ADMISSIBLE ENVIRONMENT”

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System Boundary  
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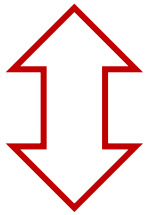
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**DIRECT INFORMATION**

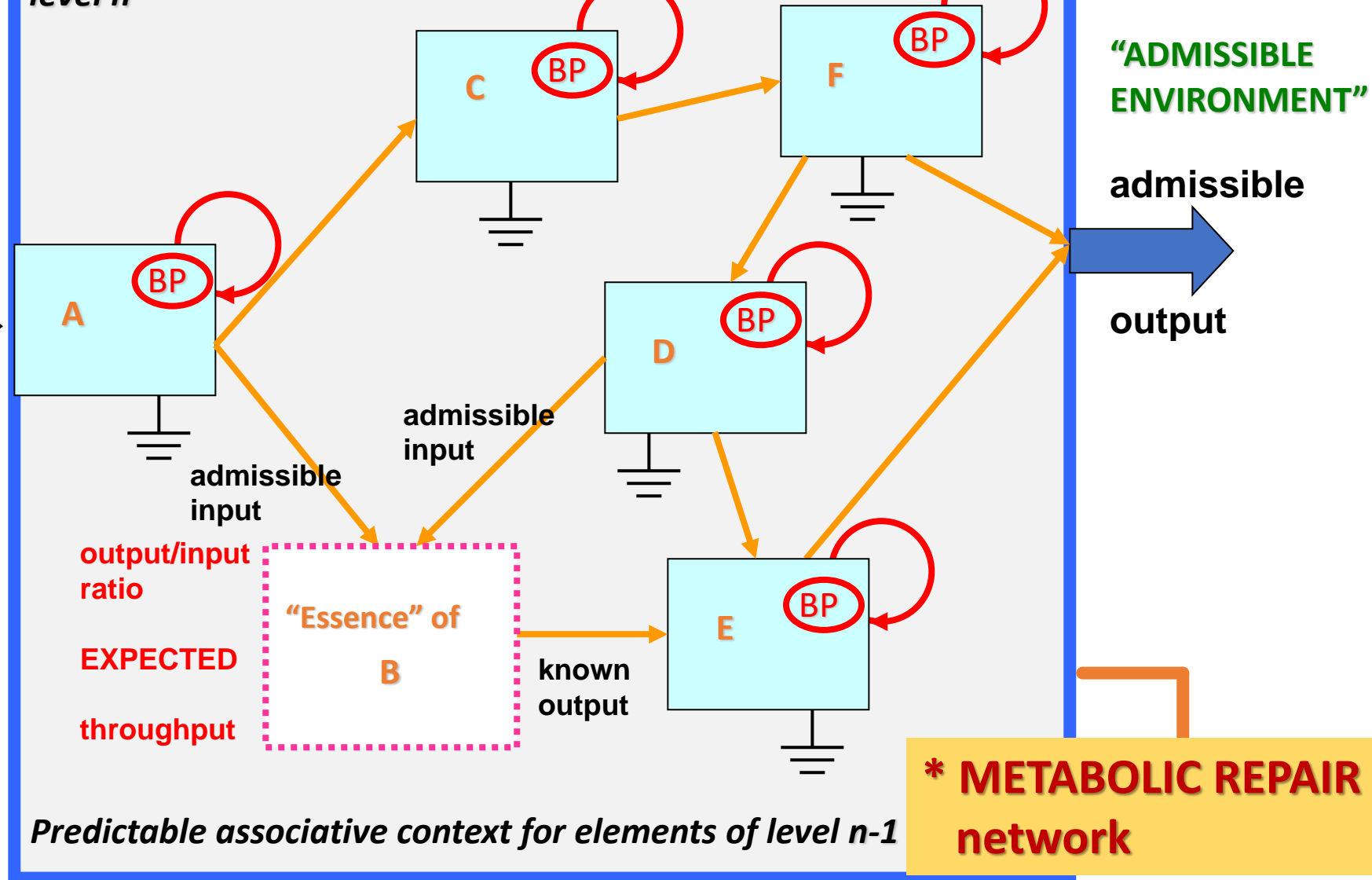
The genetic information

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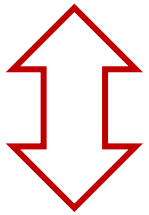
Definition of mutual information over the identity of nodes in a **MR-network\***

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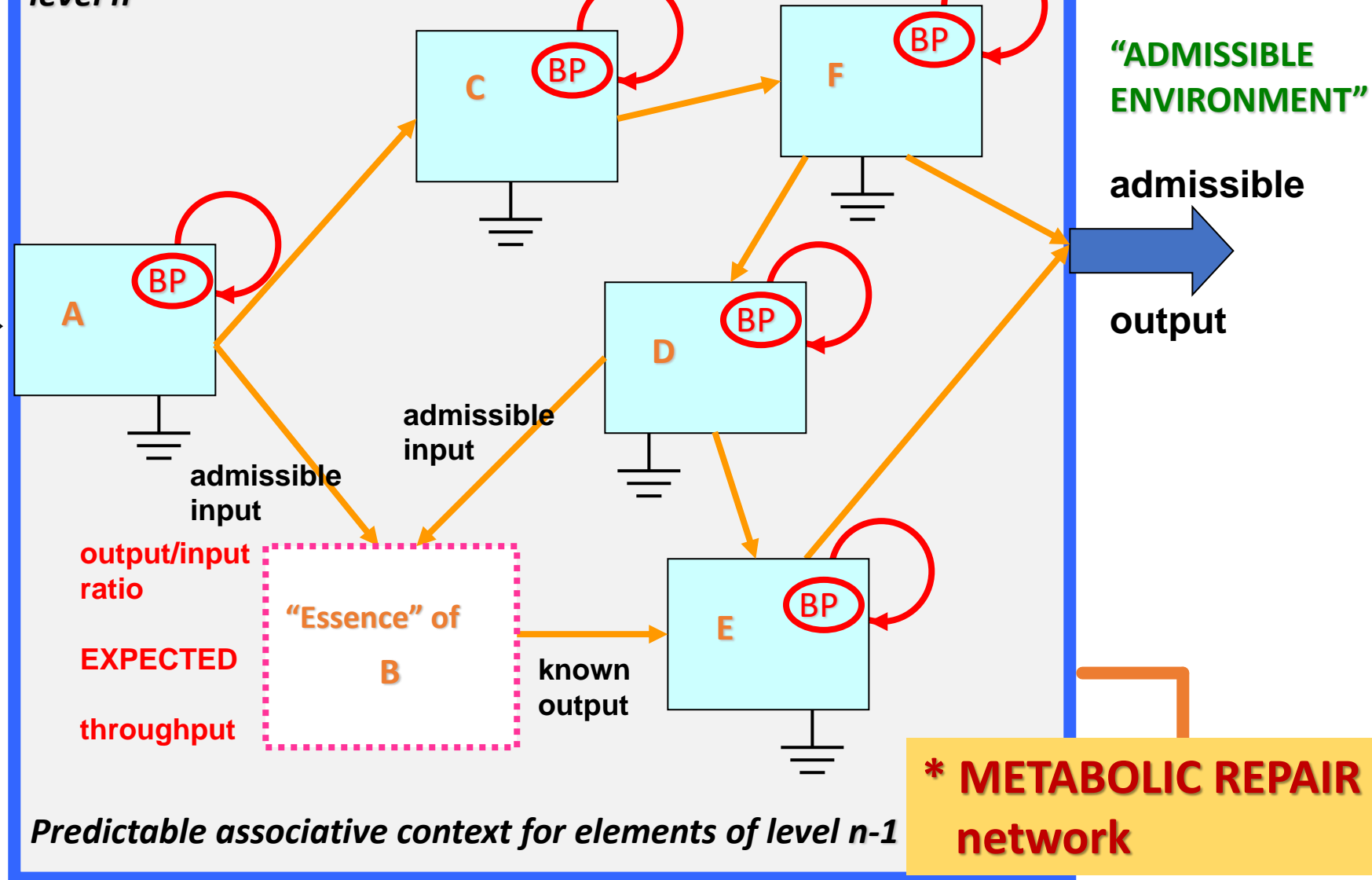
= how to produce an instance of salmon

purpose driven agent with an umwelt-based identity

“ADMISSIBLE ENVIRONMENT”

admissible input

System Boundary level  $n$

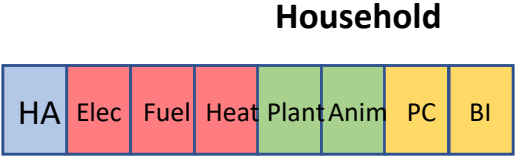


Definition of mutual information over the identity of nodes in a **MR-network\***

The metabolic pattern of society: looking at the RELATIONS OVER vectors describing different end-uses in different functional compartments of society



Energy Sector



Manufacturing  
Construction



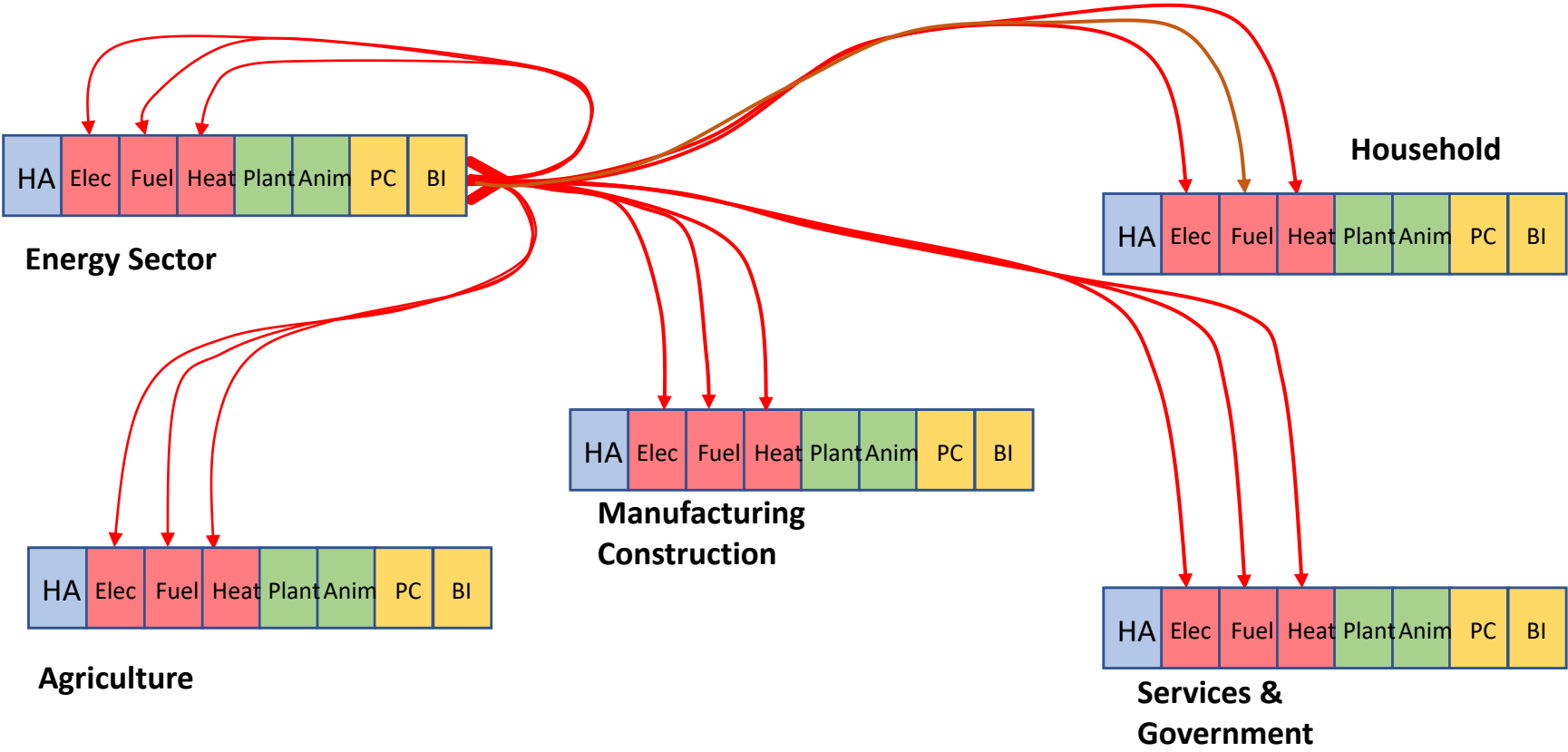
Agriculture



Services &  
Government



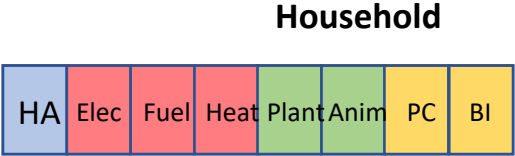
The metabolic pattern of society: looking at the RELATIONS OVER vectors describing different end-uses in different functional compartments of society



The metabolic pattern of society: looking at the RELATIONS OVER vectors describing different end-uses in different functional compartments of society



Energy Sector



Manufacturing  
Construction

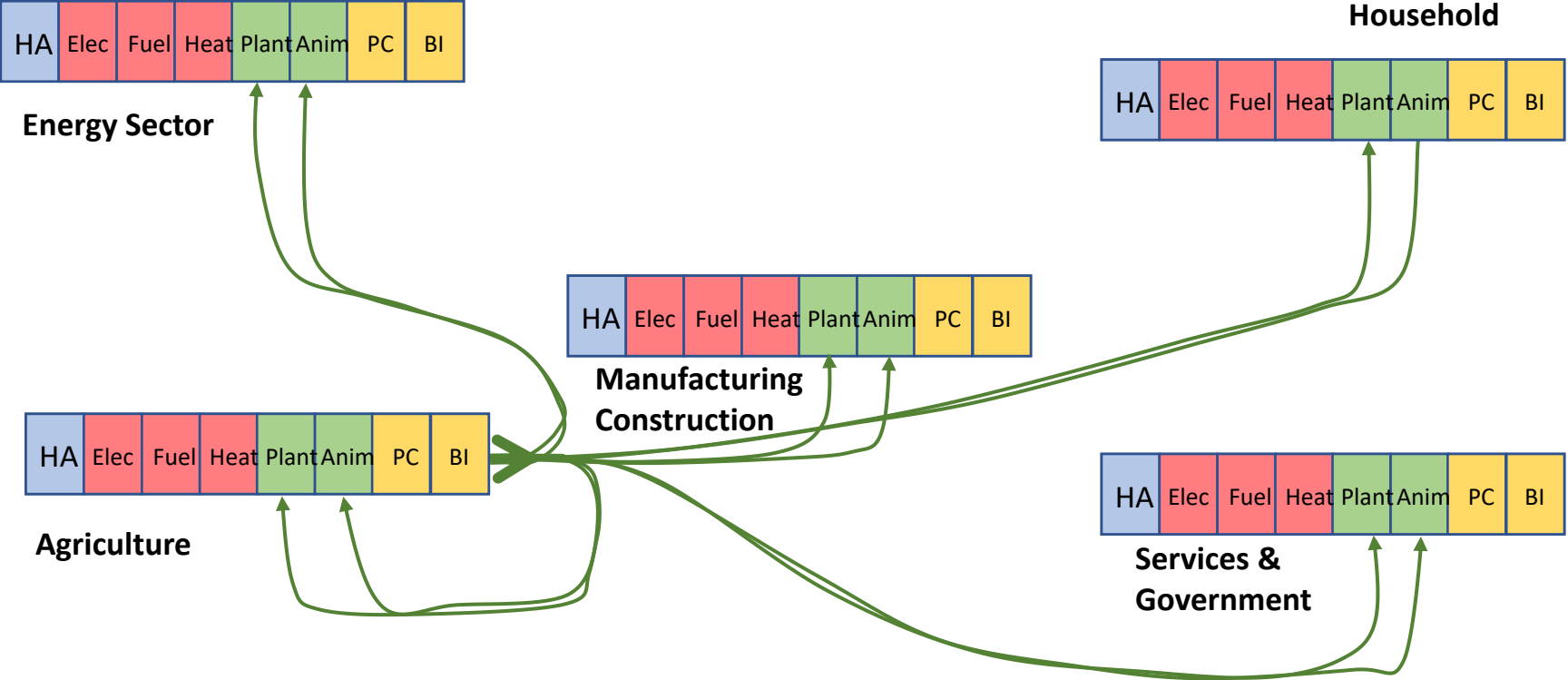


Agriculture



Services &  
Government

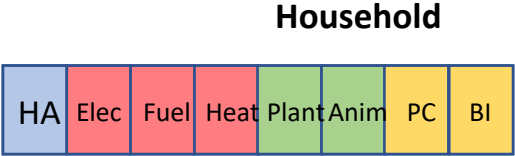
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Energy Sector



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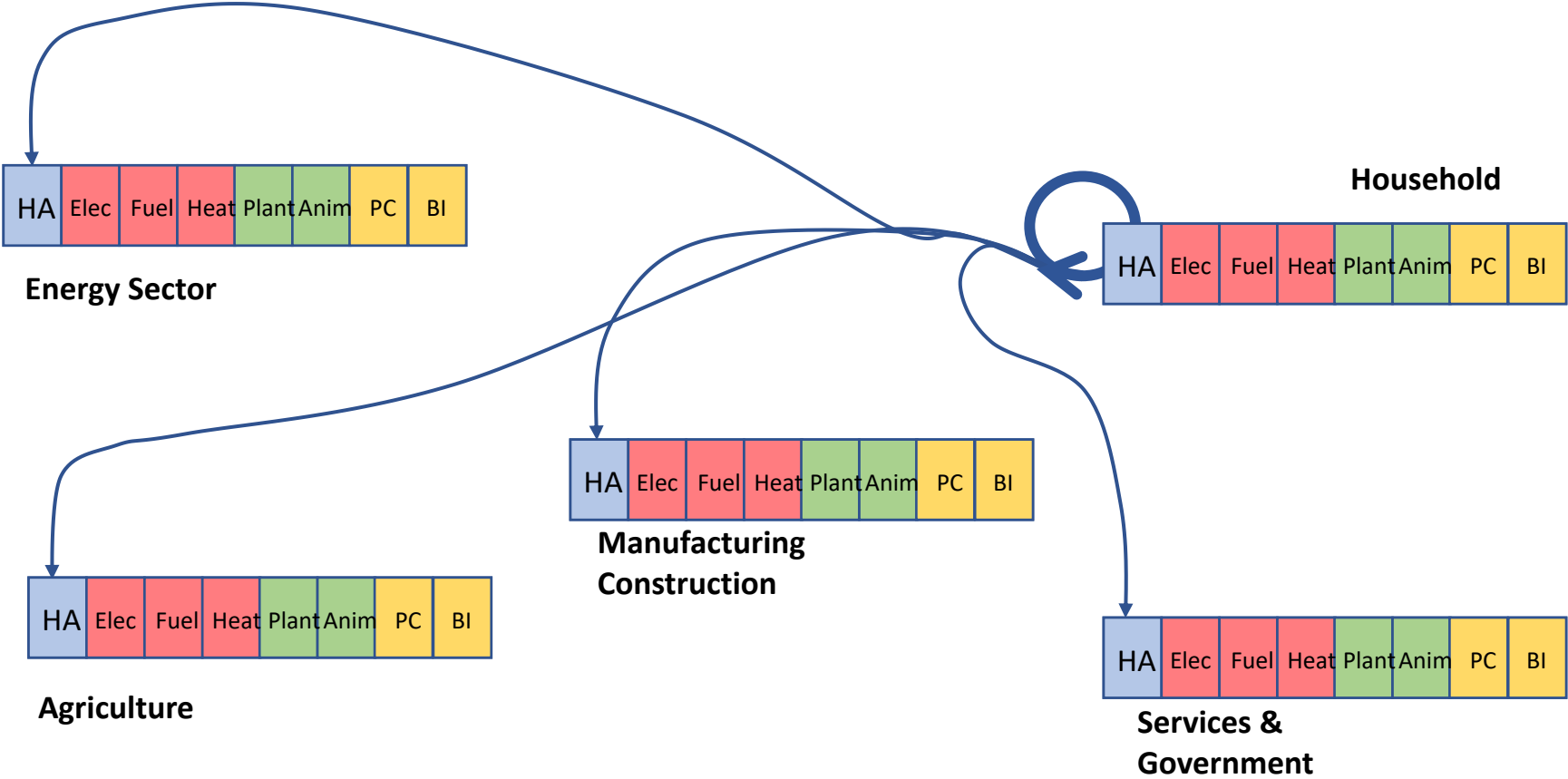


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Services &  
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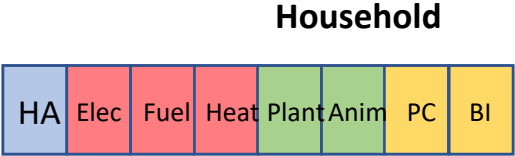
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Energy Sector



Manufacturing  
Construction

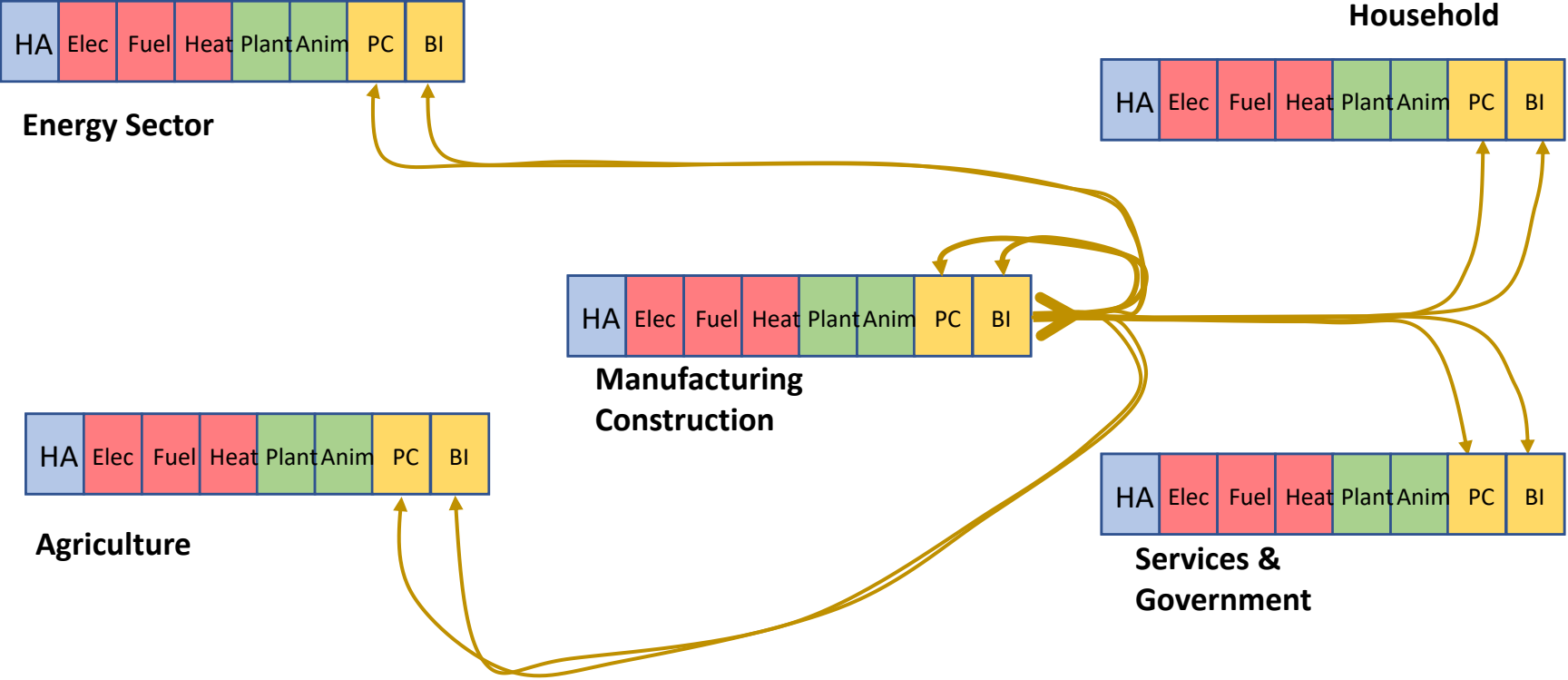


Agriculture



Services &  
Government

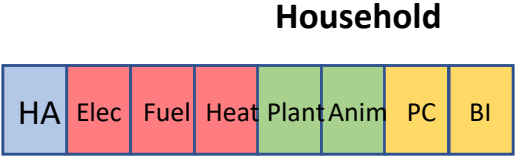
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Energy Sector



Manufacturing  
Construction



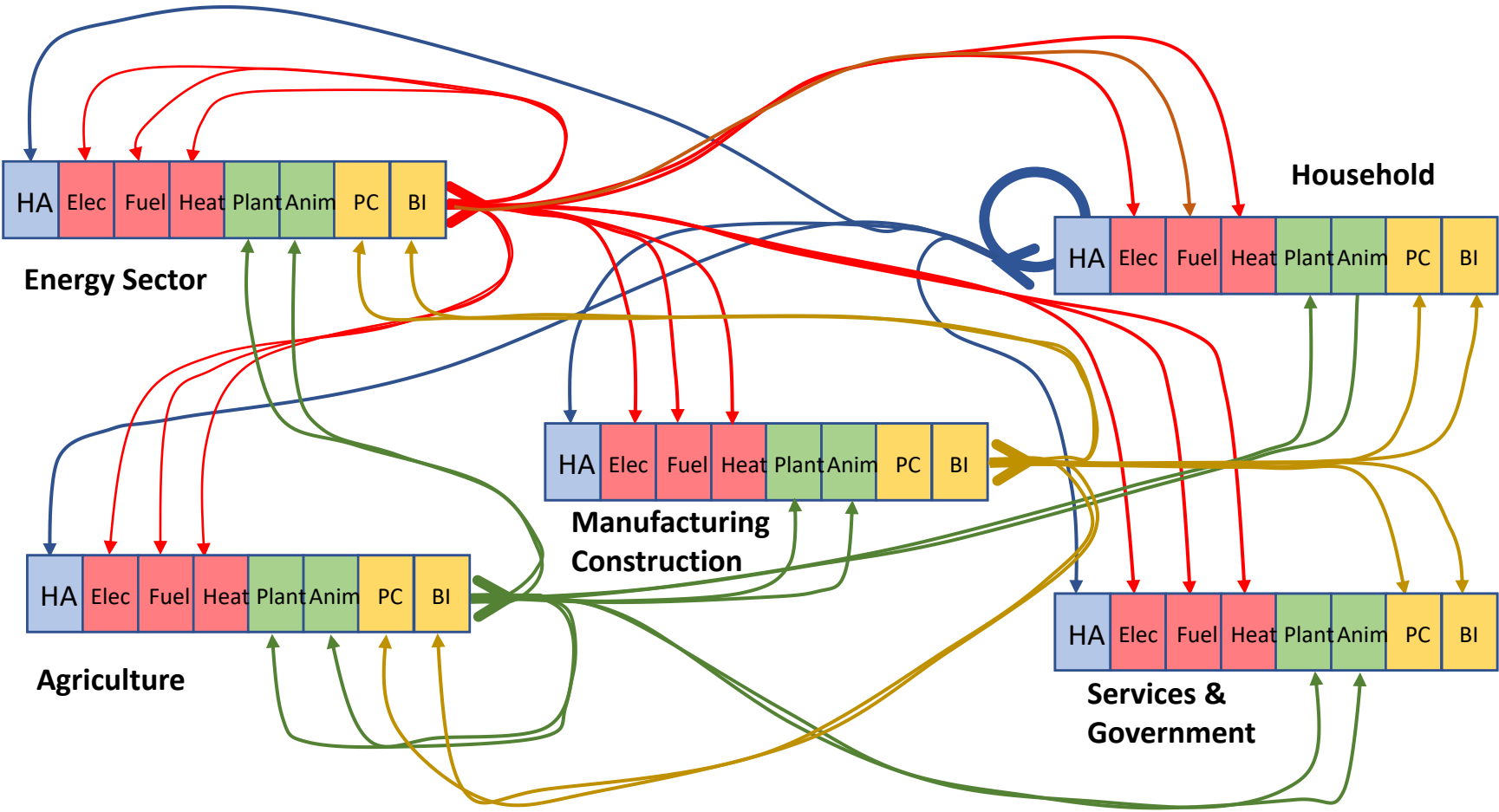
Agriculture



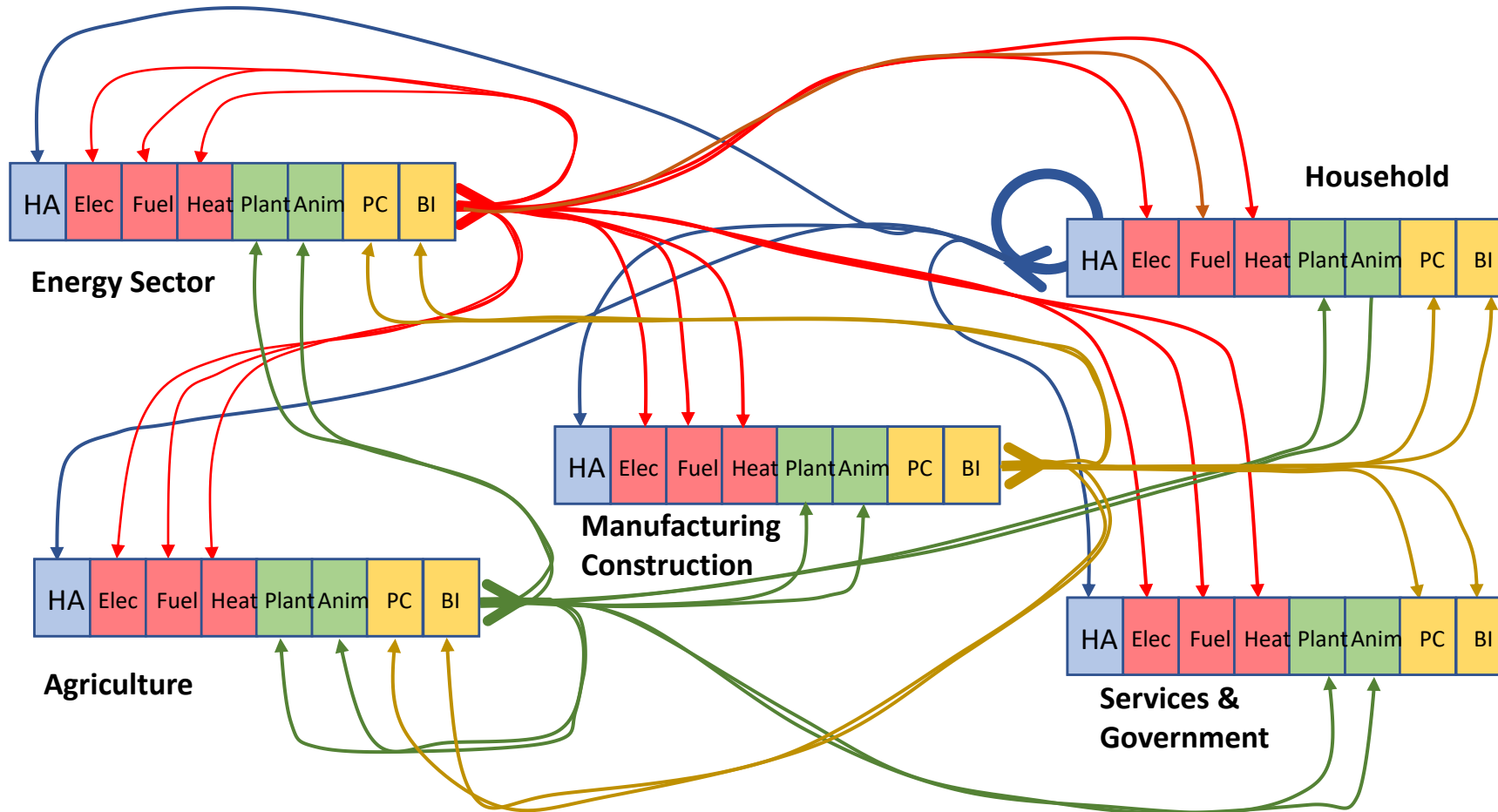
Services &  
Government



The metabolic pattern of society: looking at the RELATIONS OVER vectors describing different end-uses in different functional compartments of society



The metabolic pattern of society: looking at the RELATIONS OVER vectors describing different end-uses in different functional compartments of society

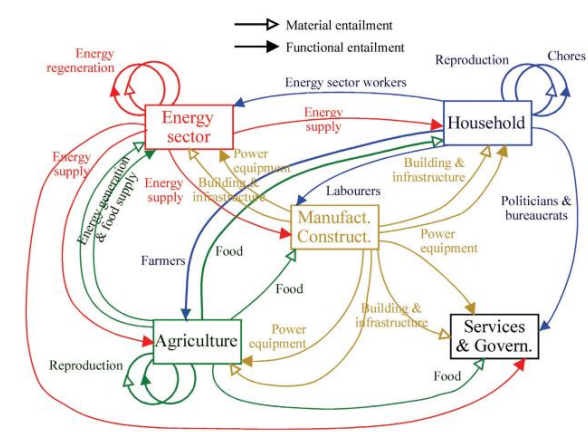


The economy reproduces the processes producing and consuming goods and services . . .

Nicholas Georgescu-Roegen

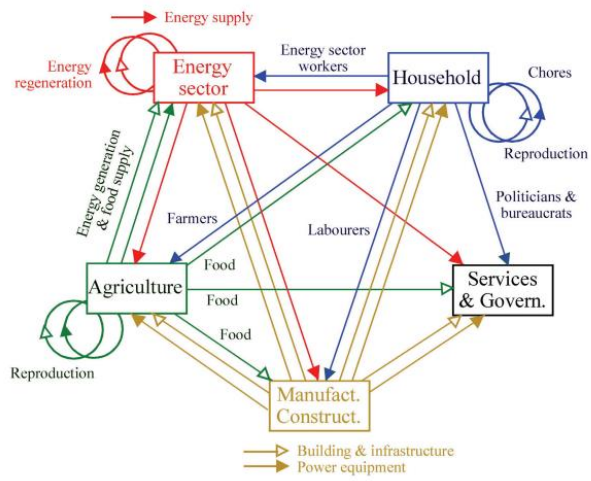


**Using relational biology to  
conceptualize the analysis**

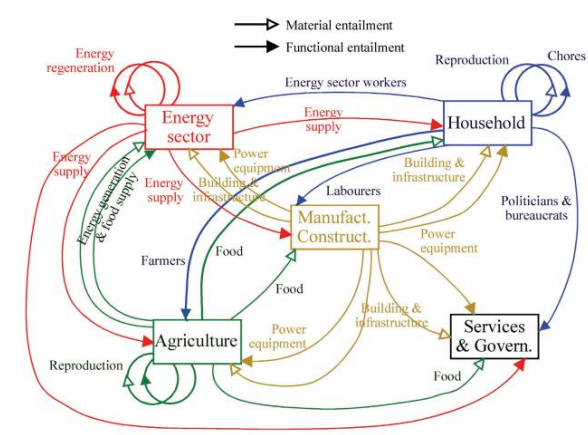


## Metabolic Repair Network (MRN)

**Using relational biology to conceptualize the analysis**

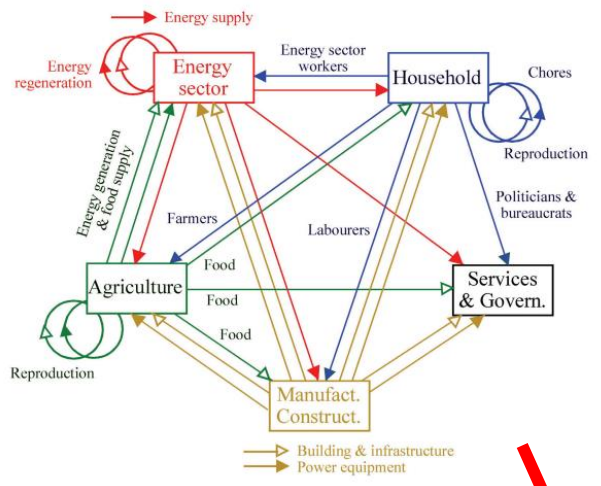


Transforming the graph into a pentagram . . .

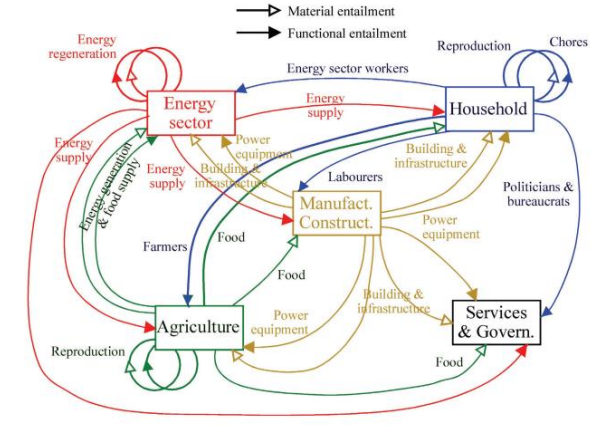


Metabolic Repair Network (MRN)

Using relational biology to conceptualize the analysis

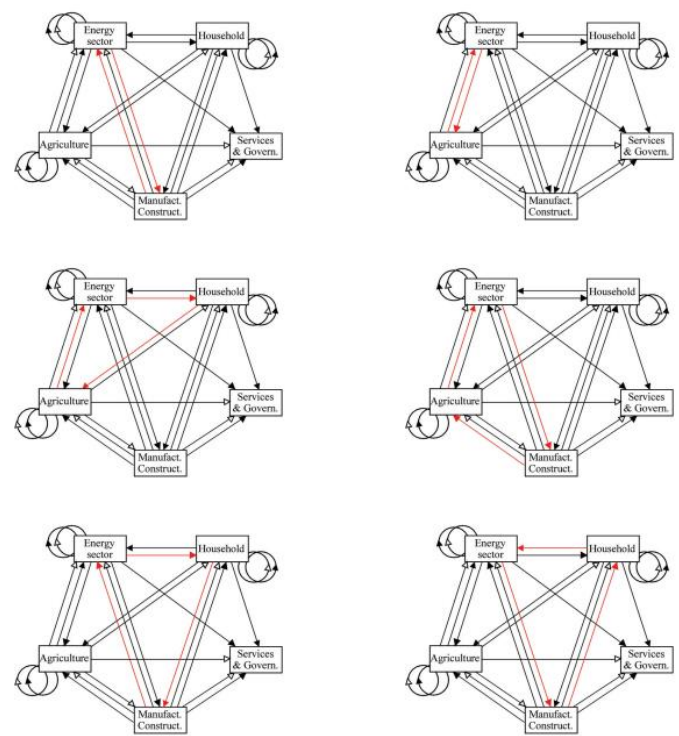


Transforming the graph into a pentagram . . .

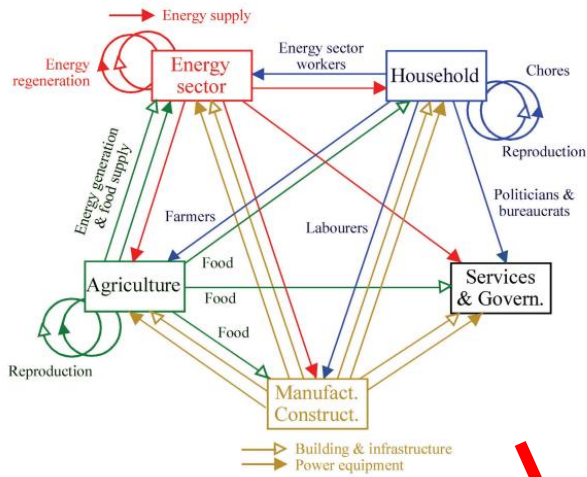


Metabolic Repair Network (MRN)

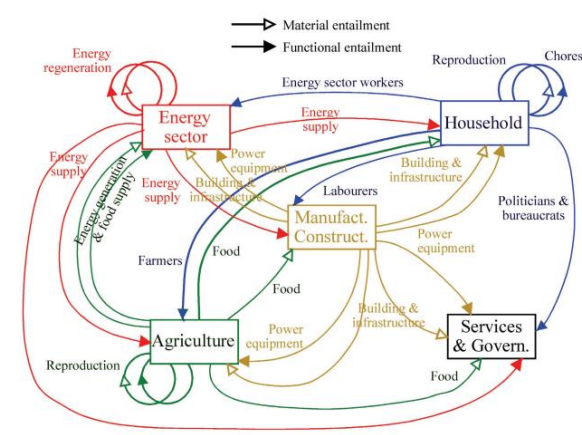
Using relational biology to conceptualize the analysis



Identifying hierarchical cycles

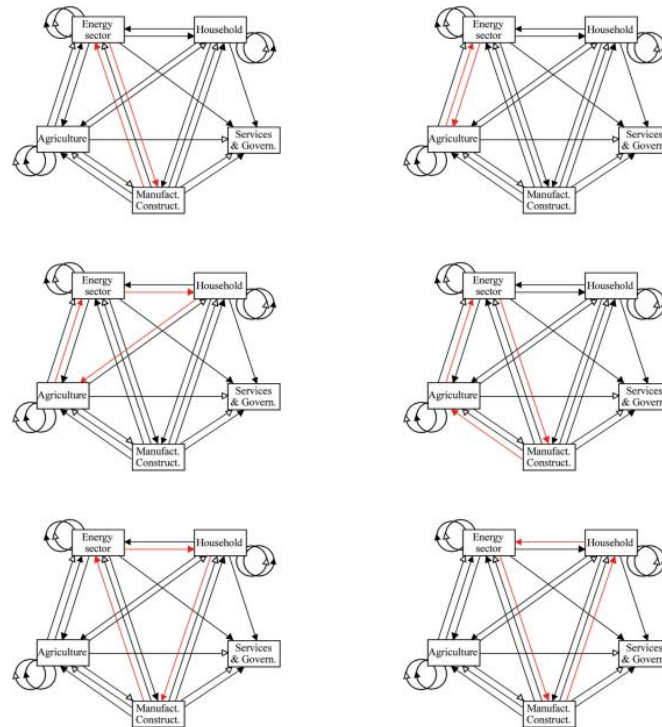


Transforming the graph into a pentagram . . .

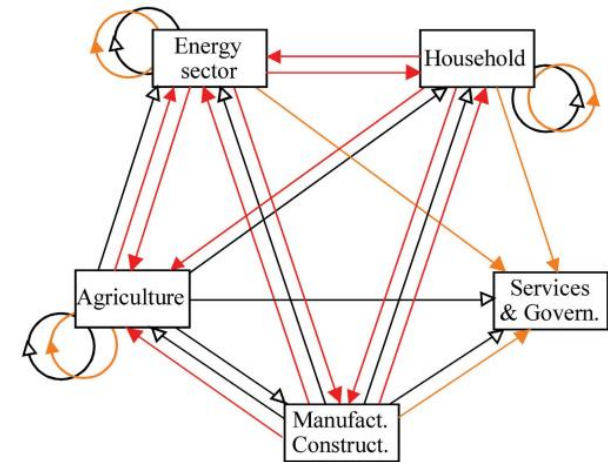


Metabolic Repair Network (MRN)

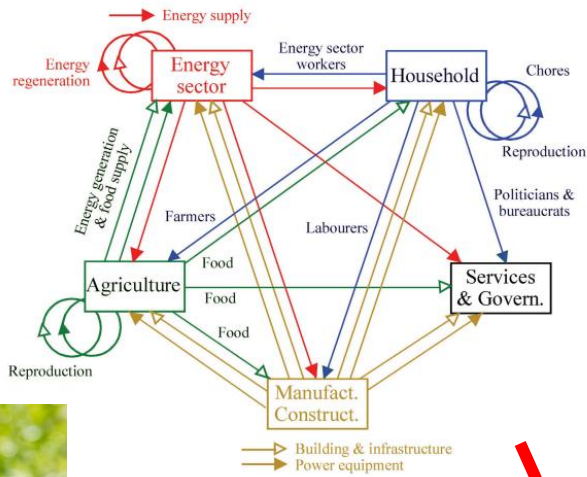
Using relational biology to conceptualize the analysis



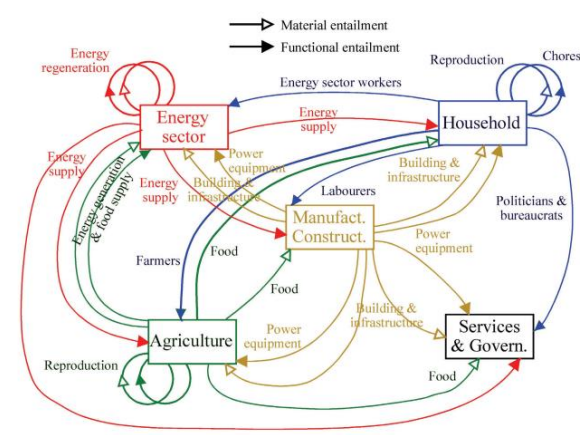
Identifying hierarchical cycles



Confirming that the MRN is closed to efficient causation!



Transforming the graph into a pentagram . . .



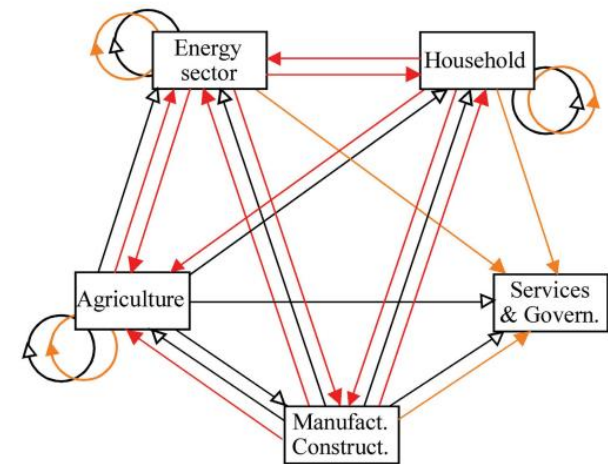
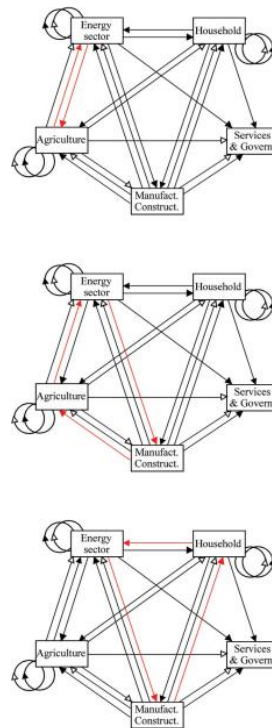
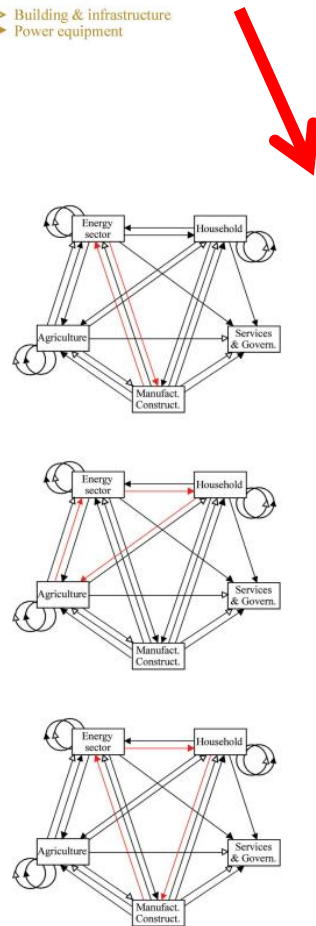
Metabolic Repair Network (MRN)

Using relational biology to conceptualize the analysis



Aloisius Louie

Identifying hierarchical cycles

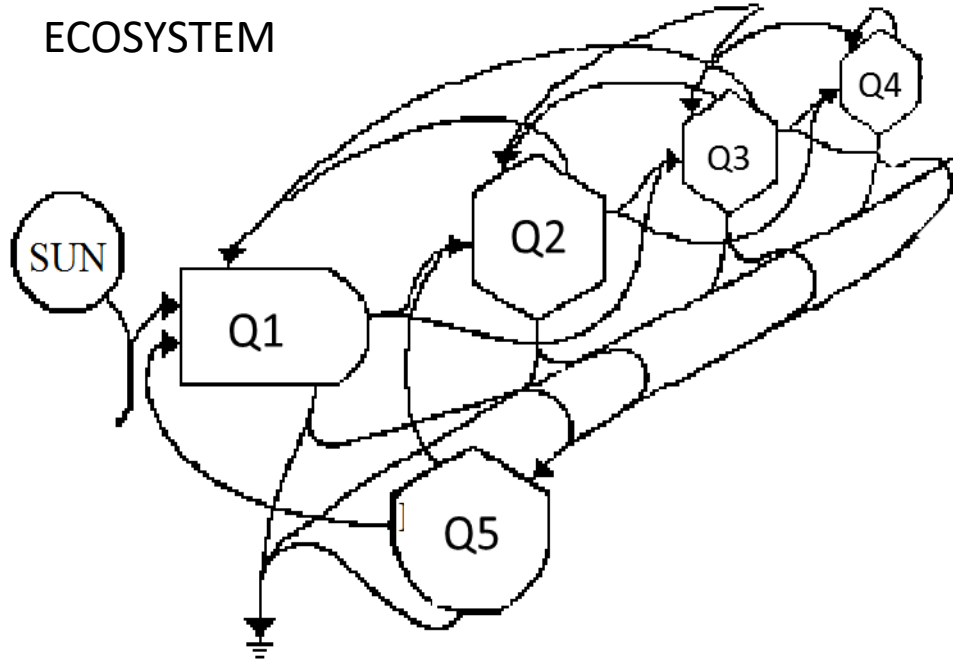


Confirming that the MRN is closed to efficient causation!





# ECOSYSTEM



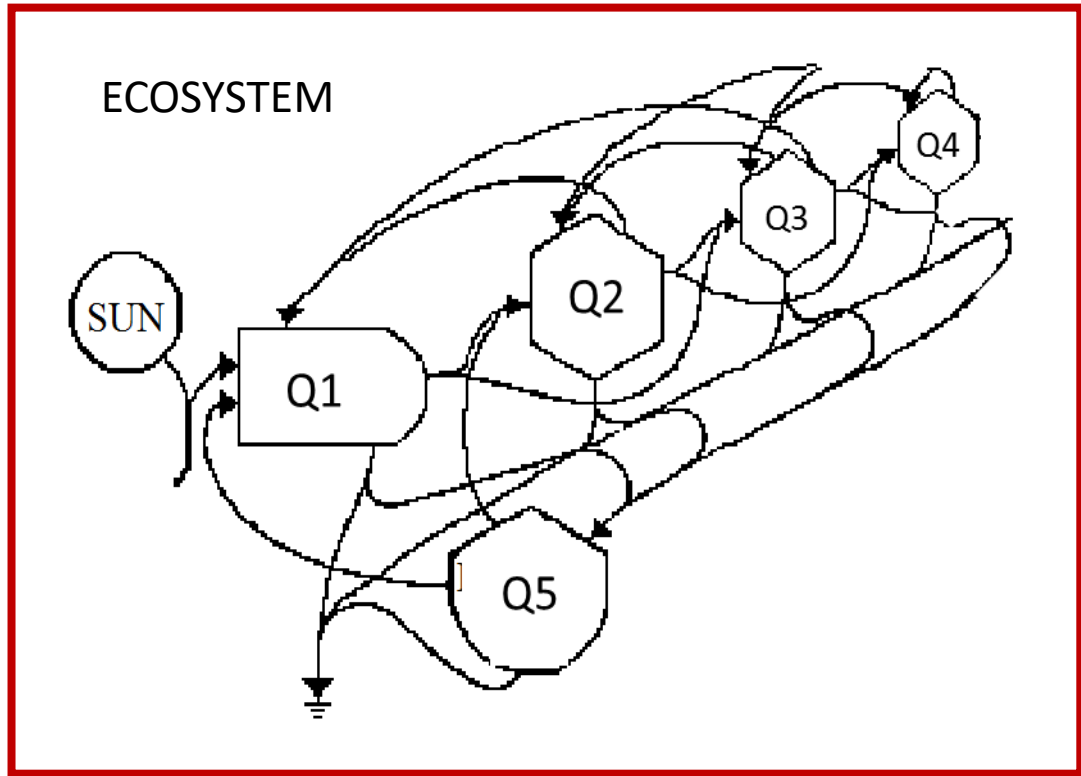
Q1 = autotrophic (plants)

Q2 = herbivores

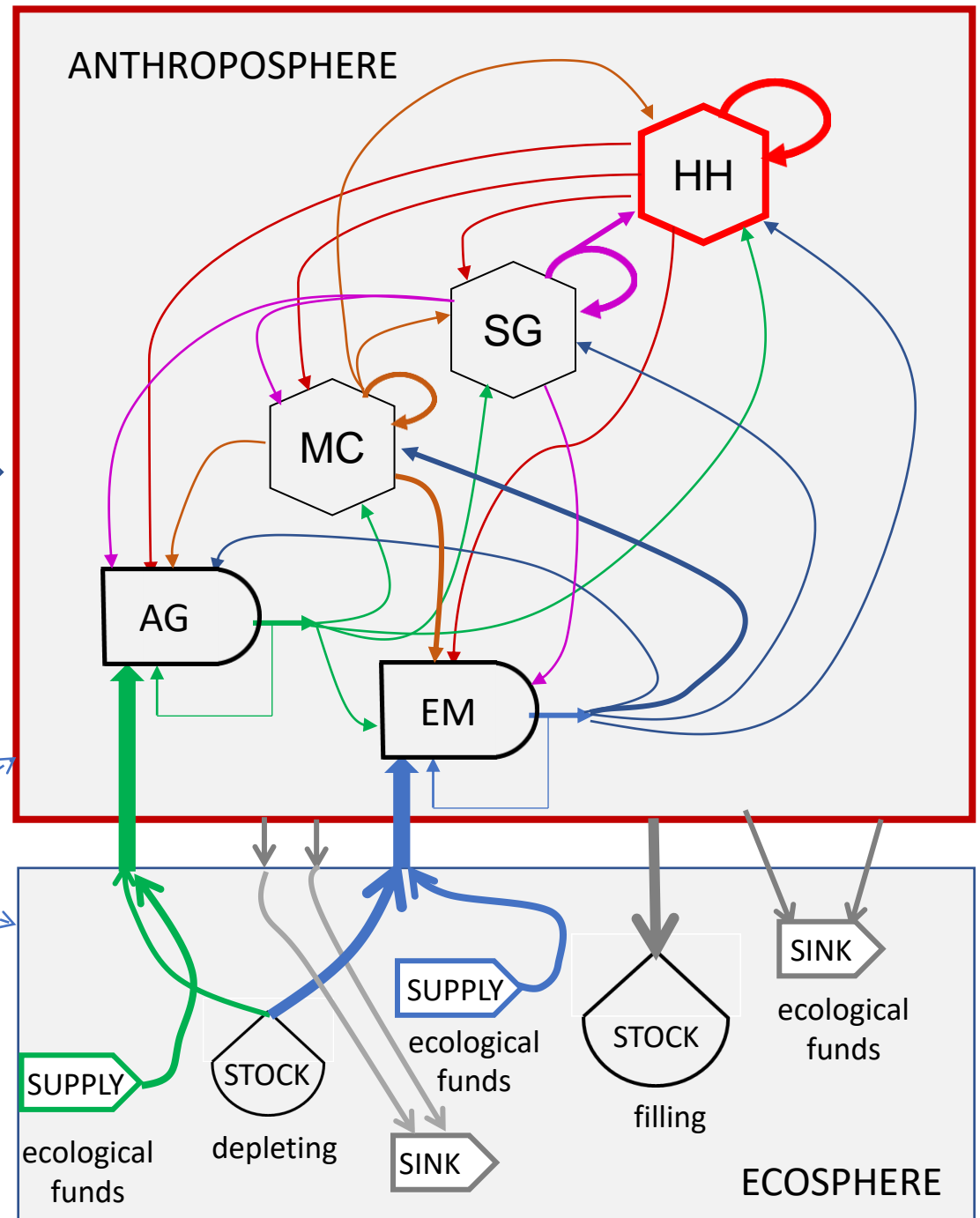
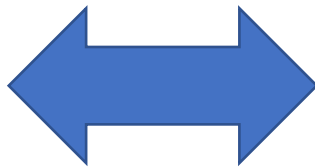
Q3 = first level carnivores

Q4 = second level carnivores

Q5 = detritus feeders



- Q1 → AG – Agriculture
- Q1 → EM – Energy and Mining
- Q2 → MC – Manufacturing and Construction
- Q3 → SG – Service and Government
- Q4 → HH – Household Sector (final consumption)
- Q5 → ECOSPHERE



## 4. The adaptive cycle in theoretical ecology

## 4. The adaptive cycle in theoretical ecology

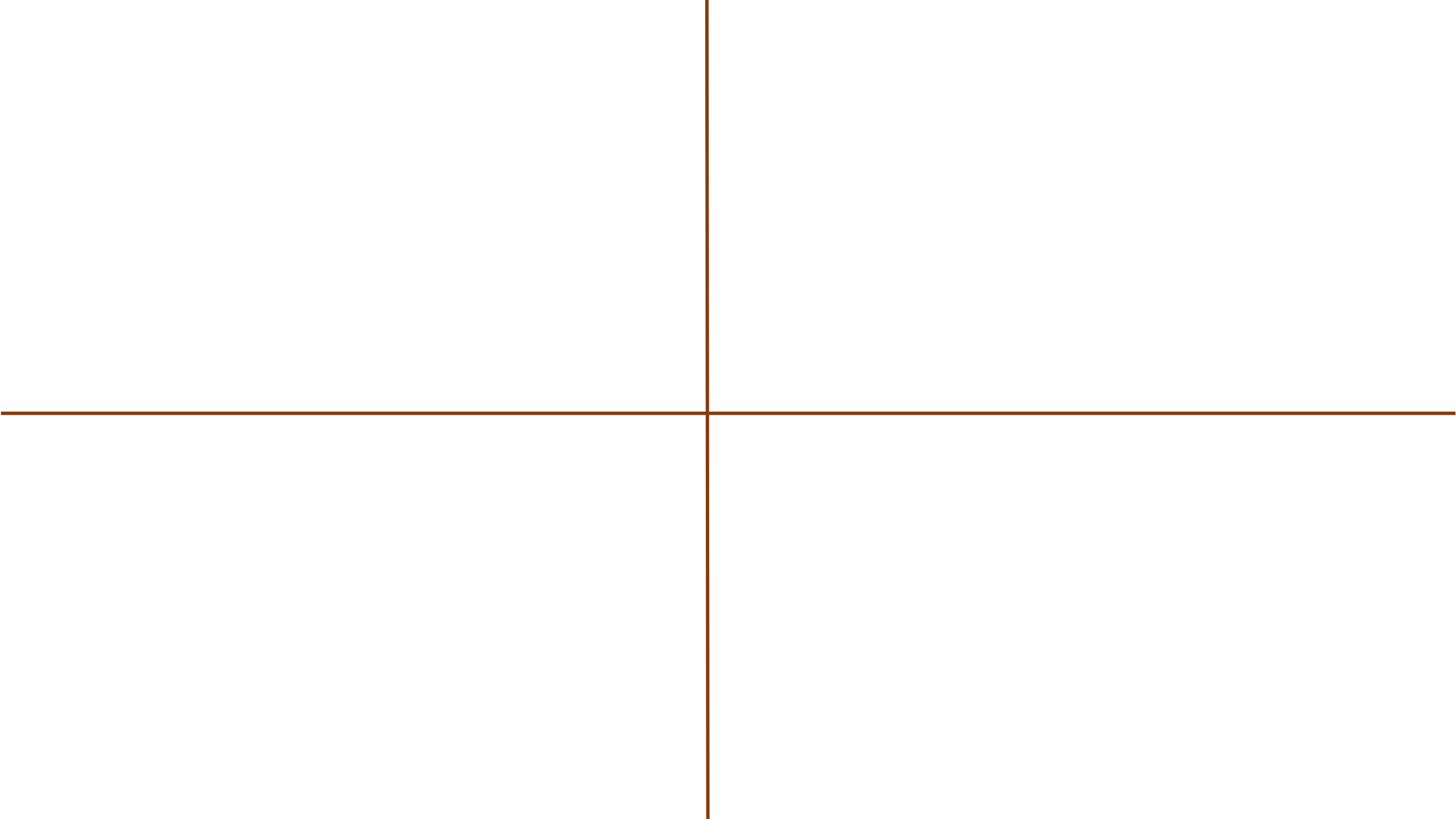
### **The adaptive cycle (Holling)**

## 4. The adaptive cycle in theoretical ecology

### The adaptive cycle (Holling)

In their semiotic process ecosystems send messages to themselves in the future (Margalef). In this way, at each cycle, they preserve and update, the integrated sets of identities operating in them. This requires adapting and integrating the impredicative relations over functional and structural elements by combining:

- \* METABOLIC codes – guaranteeing the structural coupling across levels;
- \* HOLONIC relations - guaranteeing meaningful functional coupling (parts/whole) across levels;
- \* GENETIC codes – guaranteeing the stability of the identity of *purpose driven agents with an UMWELT/identity* defined across different scales inside MR-Networks.



NOTIONAL

LOCAL SCALE

LARGE SCALE

NOTIONAL

TANGIBLE

LOCAL SCALE

LARGE SCALE

TANGIBLE



NOTIONAL

LOCAL SCALE

LARGE SCALE

NOTIONAL

TYPES

TYPES

TOKENS

TOKENS

TANGIBLE

LOCAL SCALE

LARGE SCALE

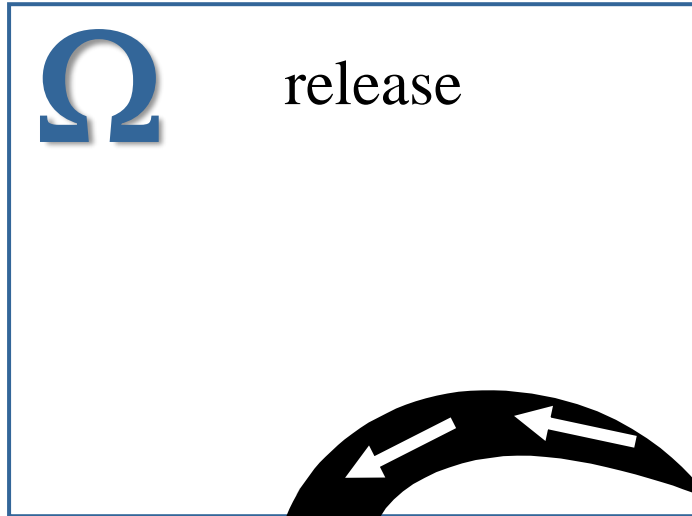
TANGIBLE

NOTIONAL

LOCAL SCALE

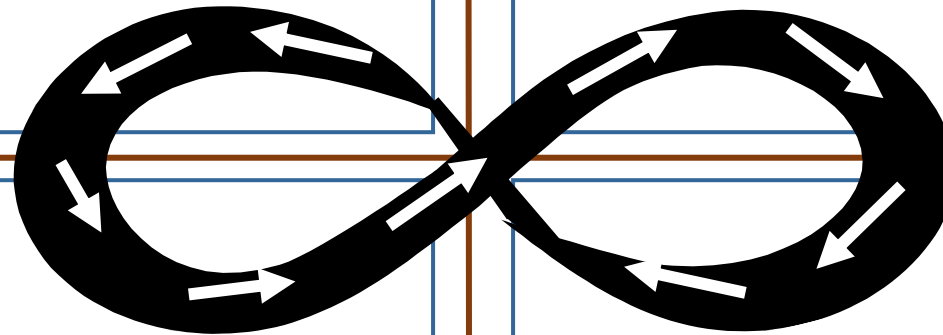
LARGE SCALE

NOTIONAL



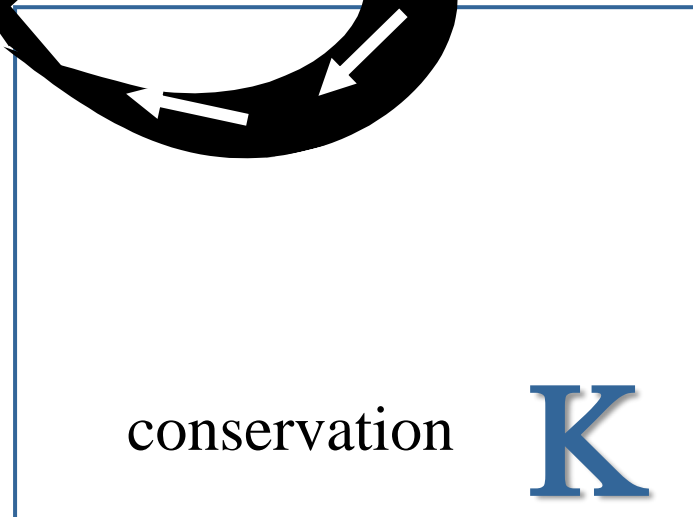
TYPES

TYPES



TOKENS

TOKENS



TANGIBLE

LOCAL SCALE

LARGE SCALE

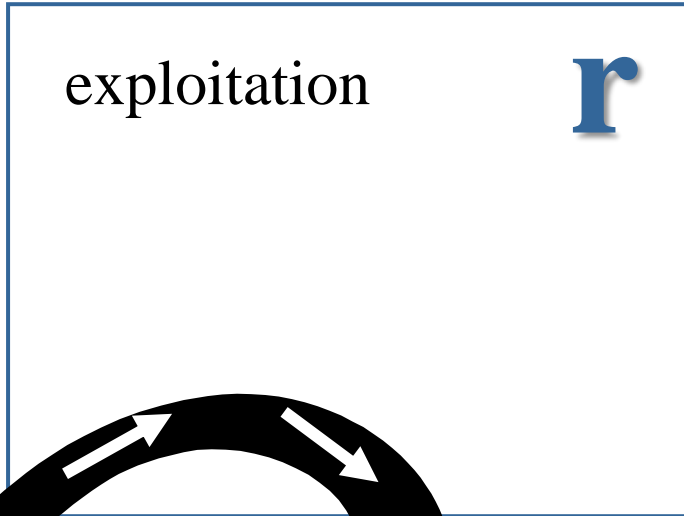
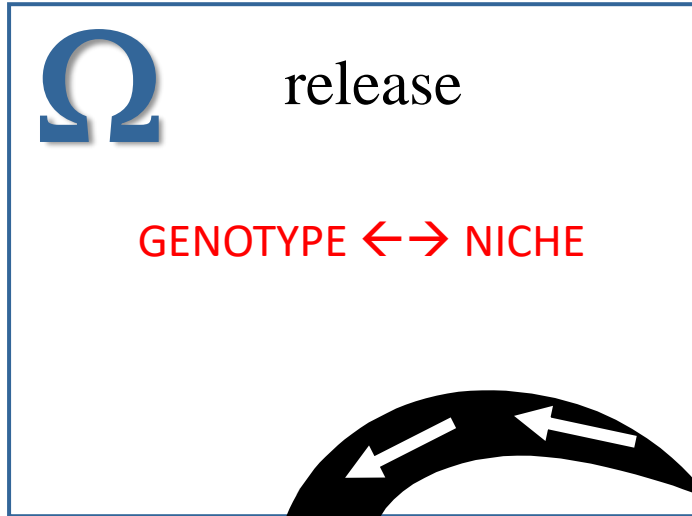
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NOTIONAL

LOCAL SCALE

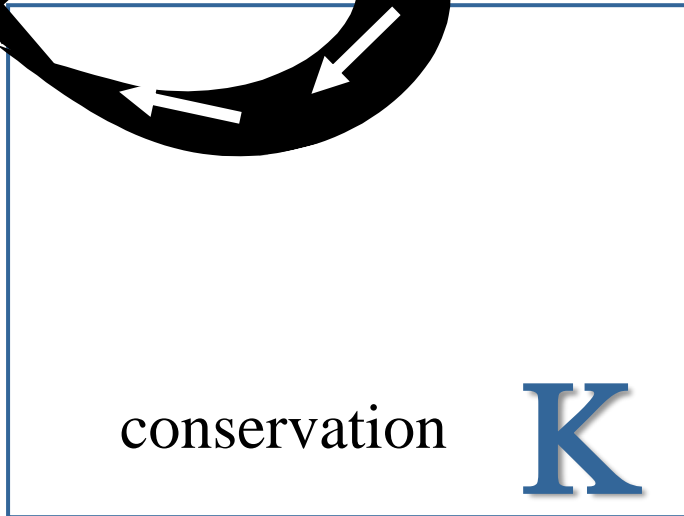
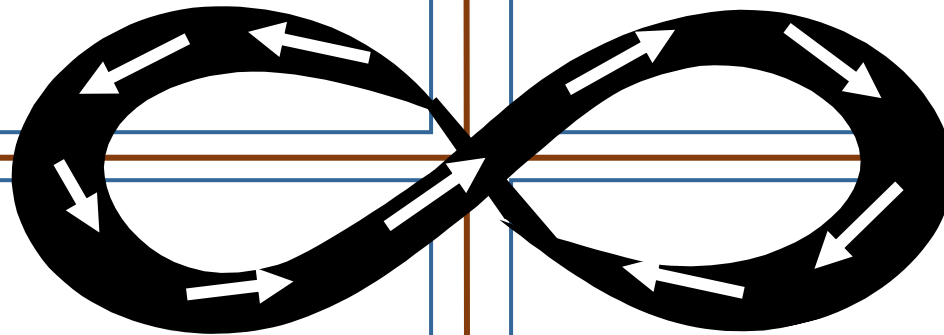
LARGE SCALE

NOTIONAL



TYPES

TYPES



TOKENS

TOKENS

TANGIBLE

LOCAL SCALE

LARGE SCALE

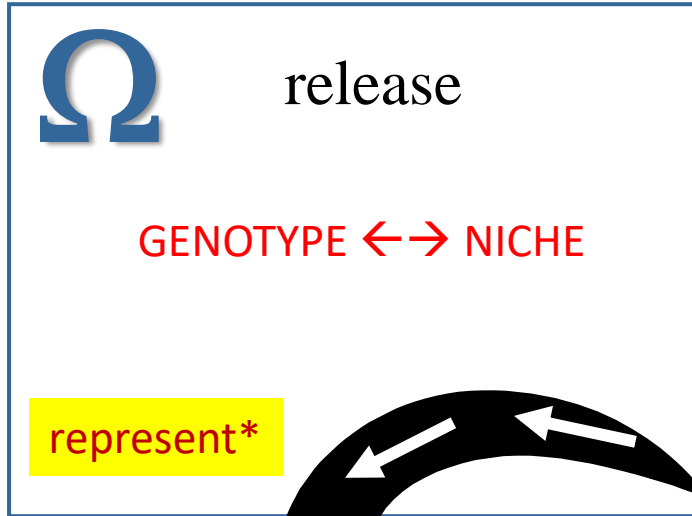
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NOTIONAL

LOCAL SCALE

LARGE SCALE

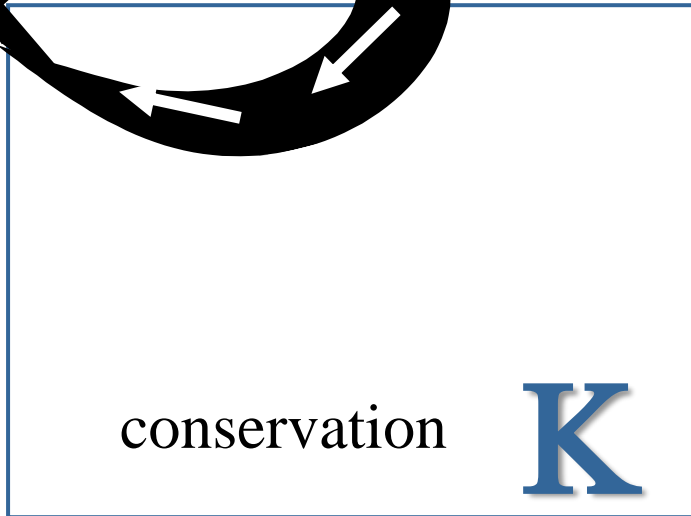
NOTIONAL



TYPES

TYPES

\* direct information  
(information carriers)



TOKENS

TOKENS

TANGIBLE

LOCAL SCALE

LARGE SCALE

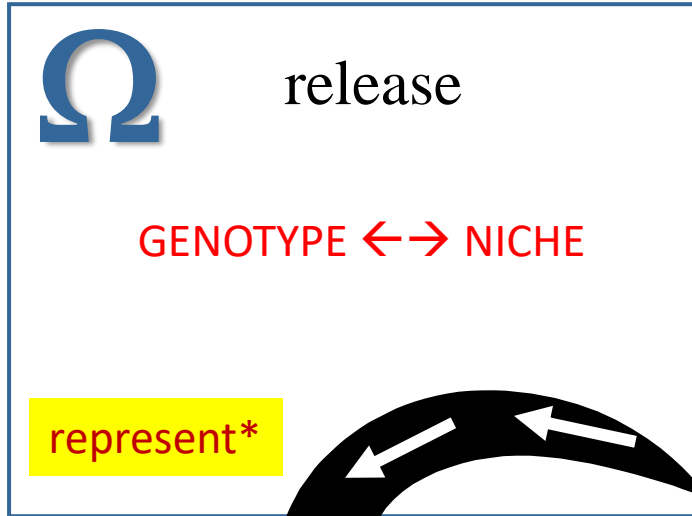
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NOTIONAL

LOCAL SCALE

LARGE SCALE

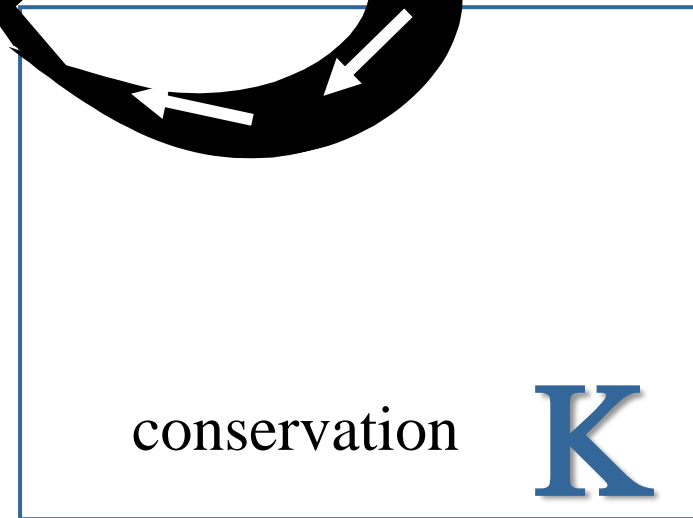
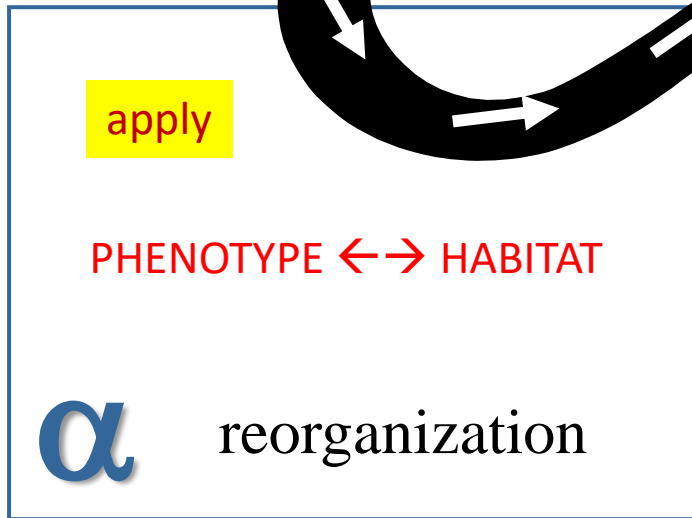
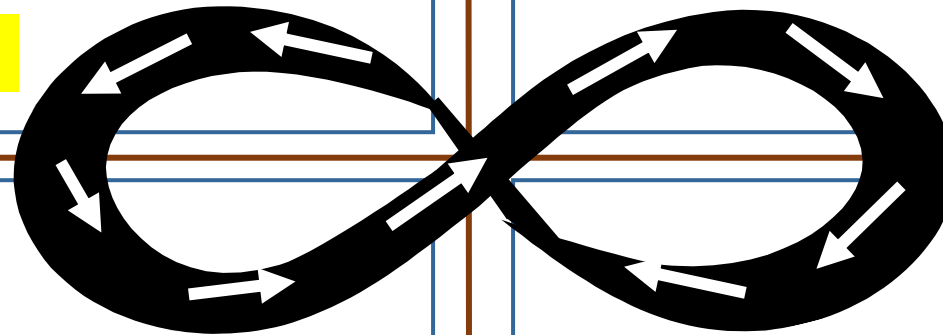
NOTIONAL



TYPES

TYPES

\* direct information (information carriers)



TOKENS

TOKENS

TANGIBLE

LOCAL SCALE

LARGE SCALE

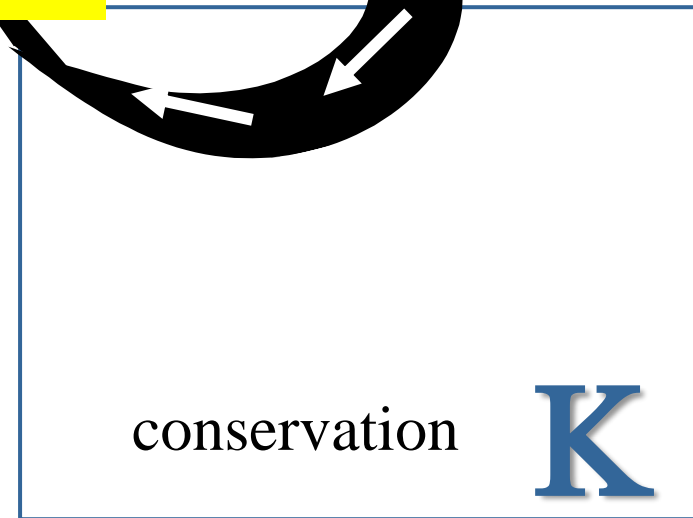
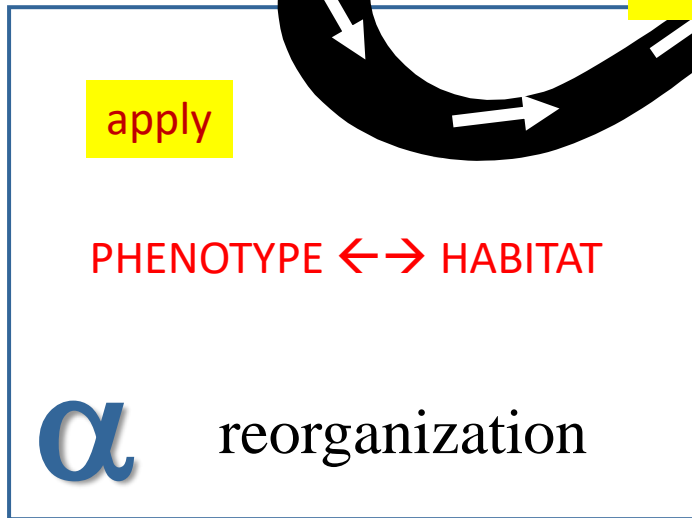
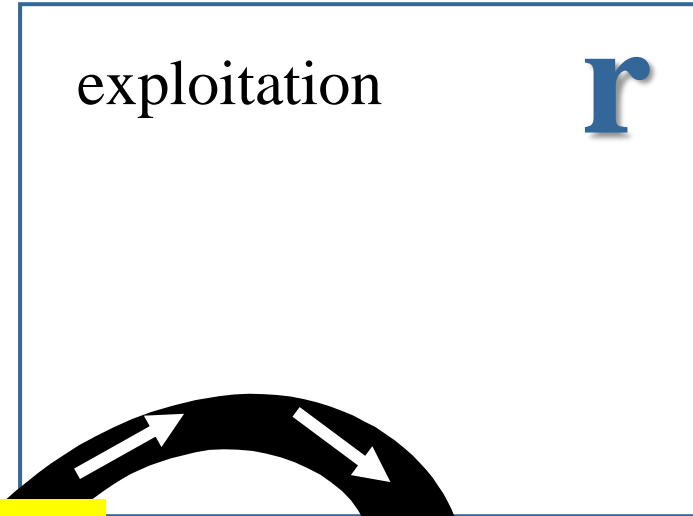
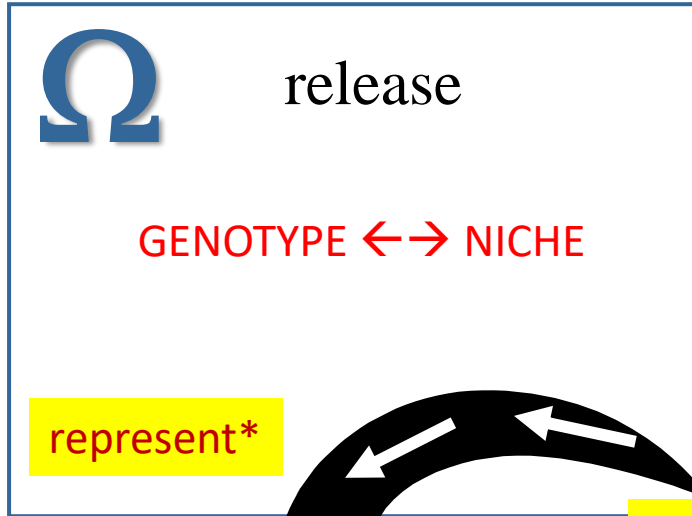
TANGIBLE

NOTIONAL

LOCAL SCALE

LARGE SCALE

NOTIONAL



TYPES

TYPES

TOKENS

TOKENS

TANGIBLE

LOCAL SCALE

LARGE SCALE

TANGIBLE

\* direct information (information carriers)

represent\*

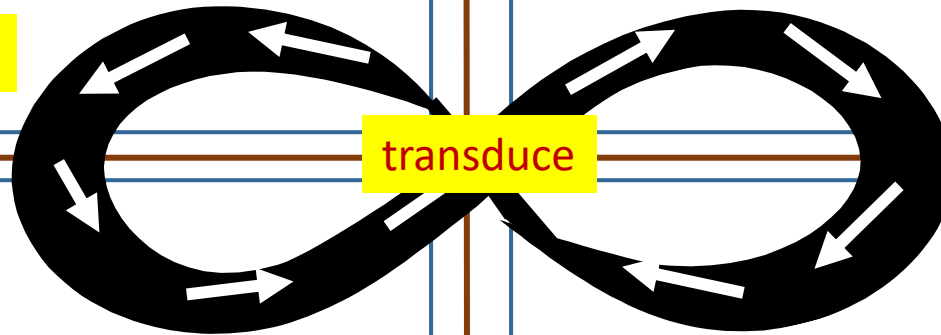
transduce

apply

PHENOTYPE  $\leftrightarrow$  HABITAT

reorganization

conservation



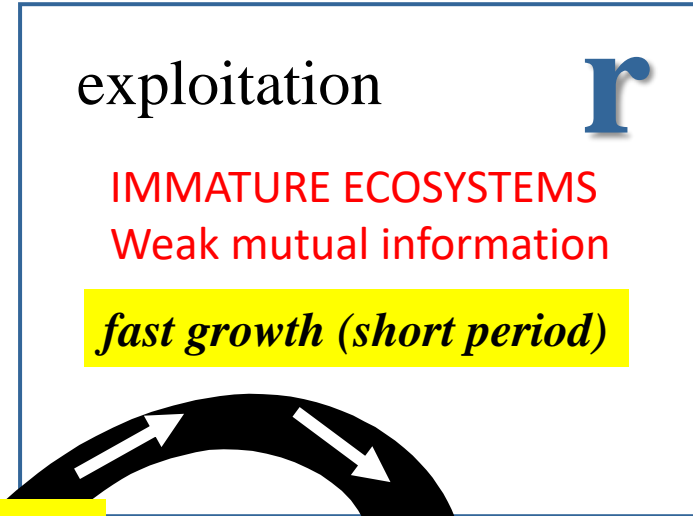
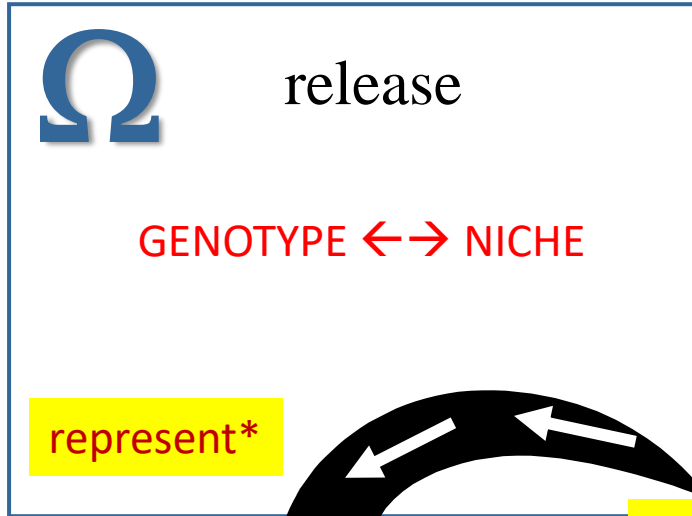
NOTIONAL

LOCAL SCALE

LARGE SCALE

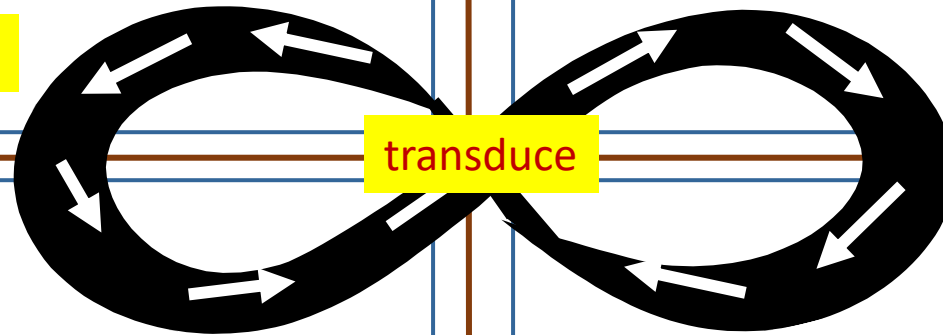
NOTIONAL

TYPES

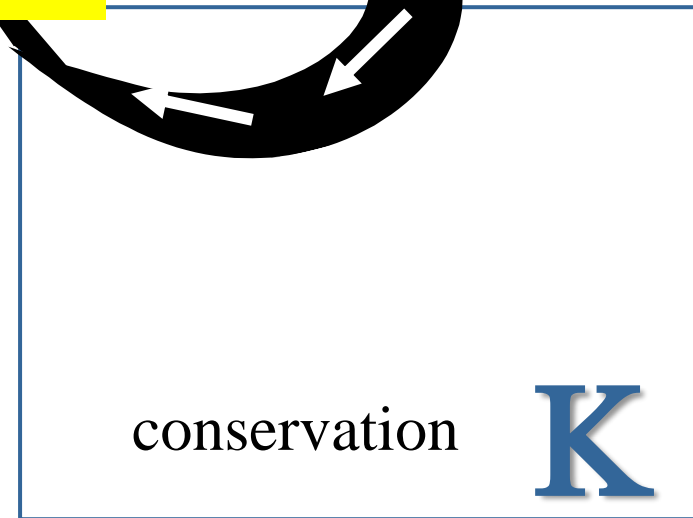
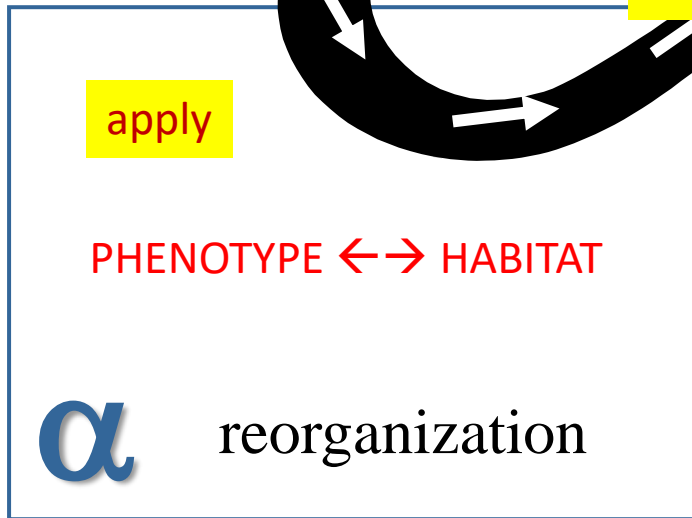


TYPES

\* direct information (information carriers)



TOKENS



TOKENS

TANGIBLE

LOCAL SCALE

LARGE SCALE

TANGIBLE

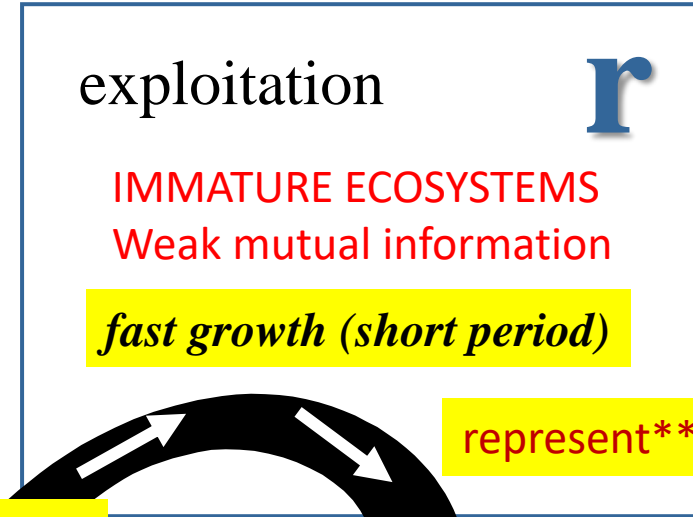
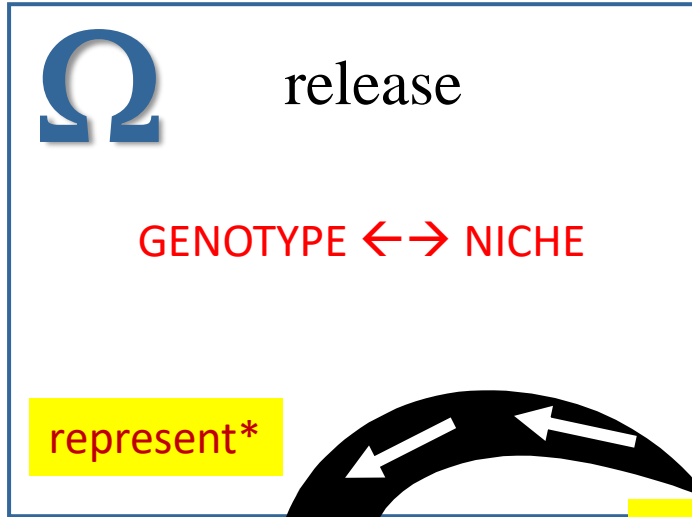
NOTIONAL

LOCAL SCALE

LARGE SCALE

NOTIONAL

TYPES



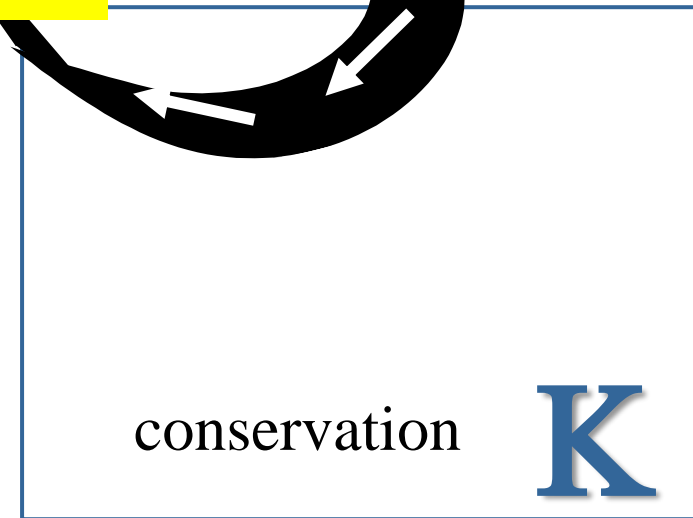
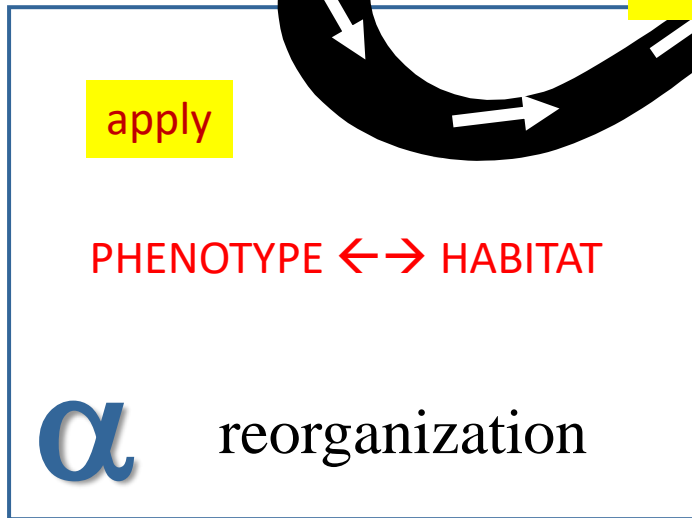
TYPES

\* direct information  
(information carriers)

\*\* mutual information  
(sudoku effect)

transduce

TOKENS



TOKENS

TANGIBLE

LOCAL SCALE

LARGE SCALE

TANGIBLE



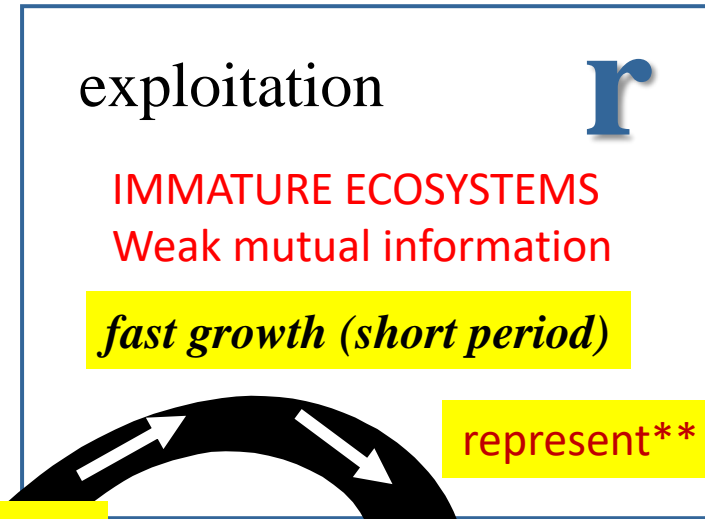
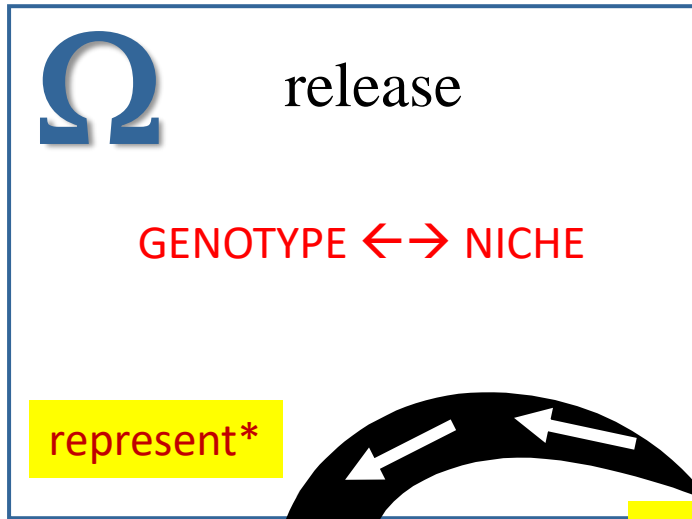
NOTIONAL

LOCAL SCALE

LARGE SCALE

NOTIONAL

TYPES



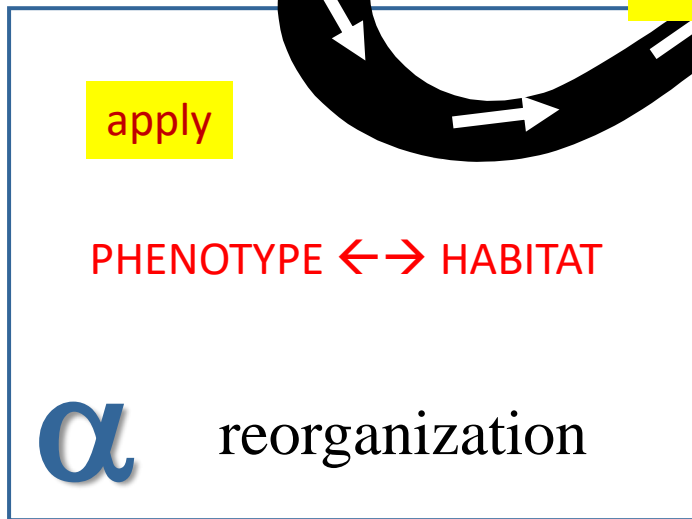
TYPES

\* direct information (information carriers)

\*\* mutual information (sudoku effect)

transduce

TOKENS



TOKENS

TANGIBLE

LOCAL SCALE

LARGE SCALE

TANGIBLE

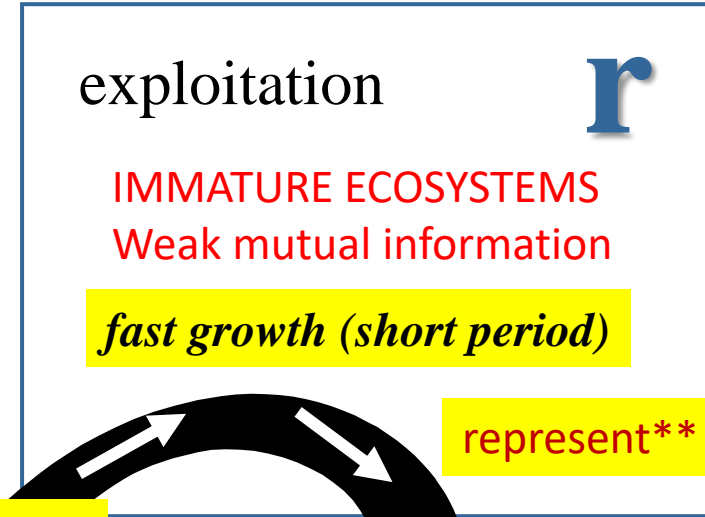
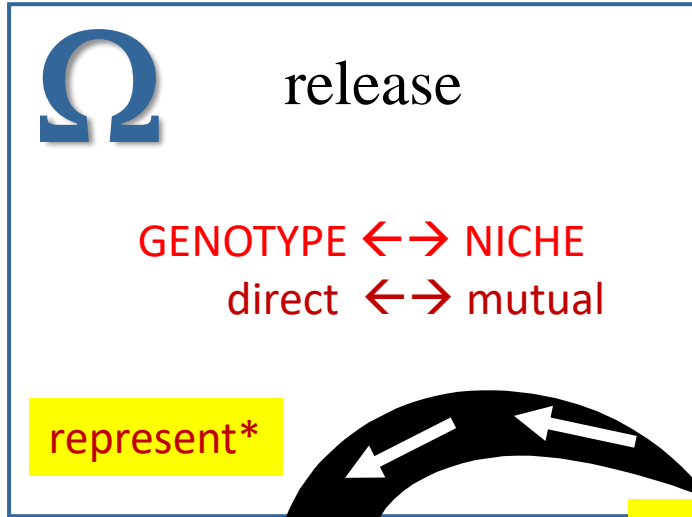
NOTIONAL

LOCAL SCALE

LARGE SCALE

NOTIONAL

TYPES

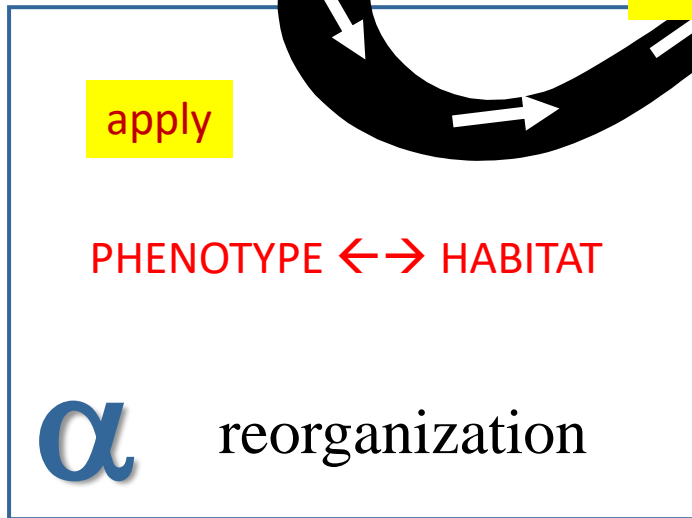


TYPES

\* direct information  
(information carriers)

\*\* mutual information  
(sudoku effect)

TOKENS



TOKENS

TANGIBLE

LOCAL SCALE

LARGE SCALE

TANGIBLE

**Local Scale**

**Large Scale**

**NOTIONAL  
(Represent)**

**types**

**(Interpret)**



**Realizations  
Instances**

**TANGIBLE  
(Act)**

**NOTIONAL  
(Represent)**

**types**

**(Interpret)**



**Realizations  
Instances**

**TANGIBLE  
(Act)**

**Local Scale**

**Large Scale**

**NOTIONAL  
(Represent)**

**types**

**(Interpret)**



**Realizations  
Instances**

**TANGIBLE  
(Act)**

**mutual information** about  
expected relations over parts

VALIDATED INFORMATION

**NOTIONAL  
(Represent)**

**types**

**(Interpret)**



**Realizations  
Instances**

**TANGIBLE  
(Act)**

# Local Scale

# Large Scale

**NOTIONAL  
(Represent)**

**types**

**(Interpret)**



**Realizations  
Instances**

**TANGIBLE  
(Act)**

**direct information**  
about structural coupling  
parts (formal cause)

VALIDATING INFORMATION

*Functional types*   *HOLONS*   *Structural types*

**mutual information** about  
expected relations over parts

VALIDATED INFORMATION



**NOTIONAL  
(Represent)**

**types**

**(Interpret)**



**Realizations  
Instances**

**TANGIBLE  
(Act)**

# Local Scale

# Large Scale

**NOTIONAL  
(Represent)**

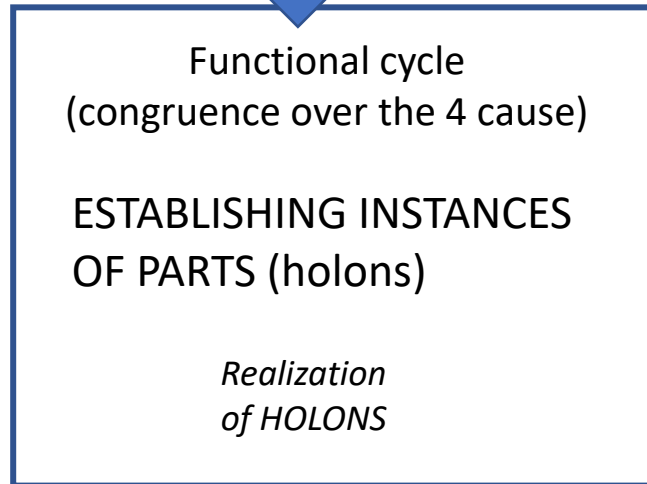
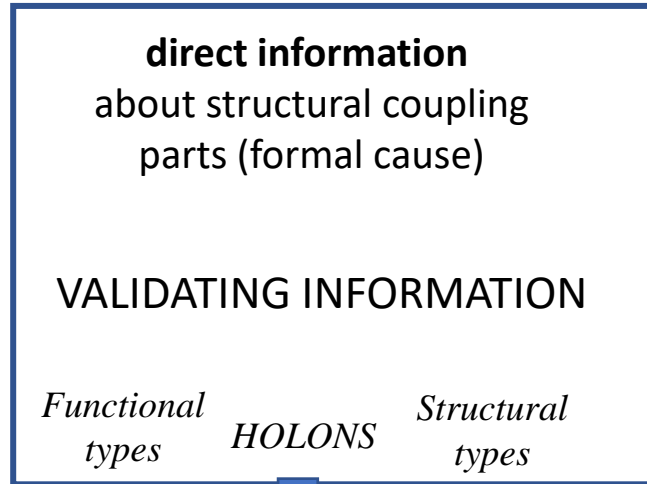
**types**

**(Interpret)**



**Realizations  
Instances**

**TANGIBLE  
(Act)**



**NOTIONAL  
(Represent)**

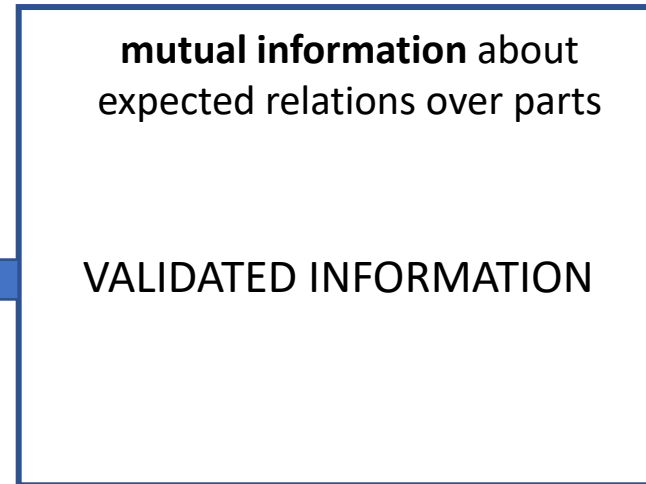
**types**

**(Interpret)**



**Realizations  
Instances**

**TANGIBLE  
(Act)**



# Local Scale

# Large Scale

**NOTIONAL  
(Represent)**

**types**

direct information  
about structural coupling  
parts (formal cause)

VALIDATING INFORMATION

*Functional types*   *HOLONS*   *Structural types*

mutual information about  
expected relations over parts

VALIDATED INFORMATION

**NOTIONAL  
(Represent)**

**types**

**(Interpret)**



**Realizations  
Instances**

**TANGIBLE  
(Act)**

Functional cycle  
(congruence over the 4 cause)

ESTABLISHING INSTANCES  
OF PARTS (holons)

*Realization  
of HOLONS*

Functional cycle  
(congruence over the 4 causes)

ESTABLISHING INSTANCES  
OF WHOLES (holarchies)

*METABOLIC REPAIR NETWORK  
Admissibility of the environment  
across the levels of the holarchy*

**(Interpret)**



**Realizations  
Instances**

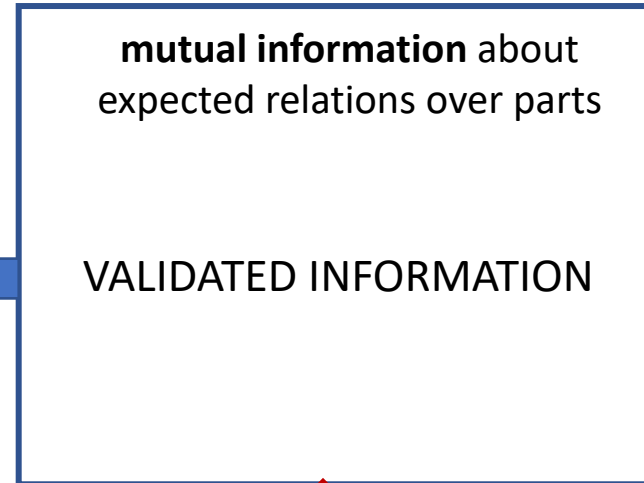
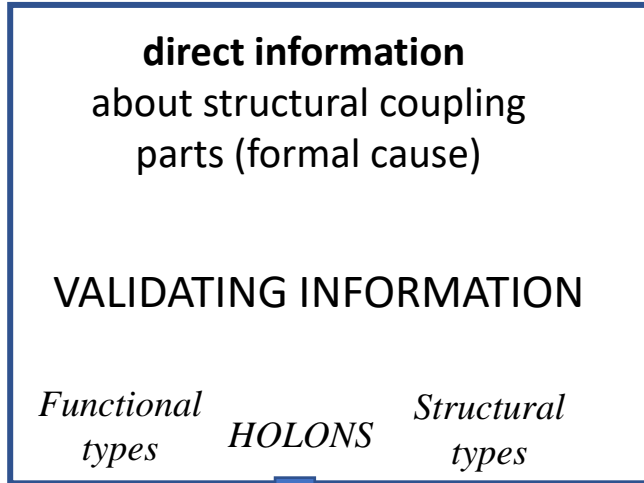
**TANGIBLE  
(Act)**

# Local Scale

# Large Scale

**NOTIONAL  
(Represent)**

**types**



**NOTIONAL  
(Represent)**

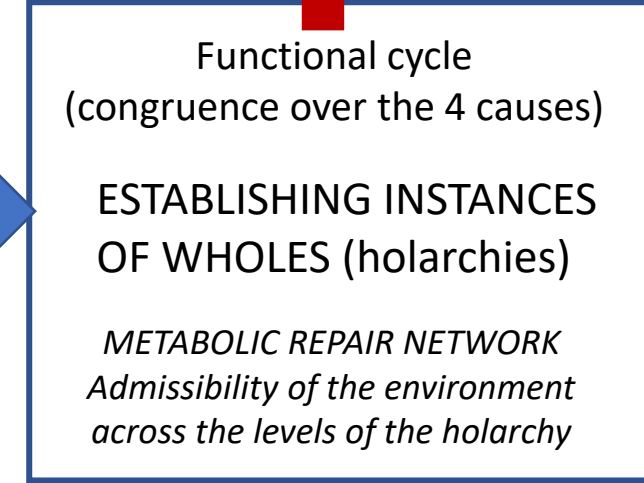
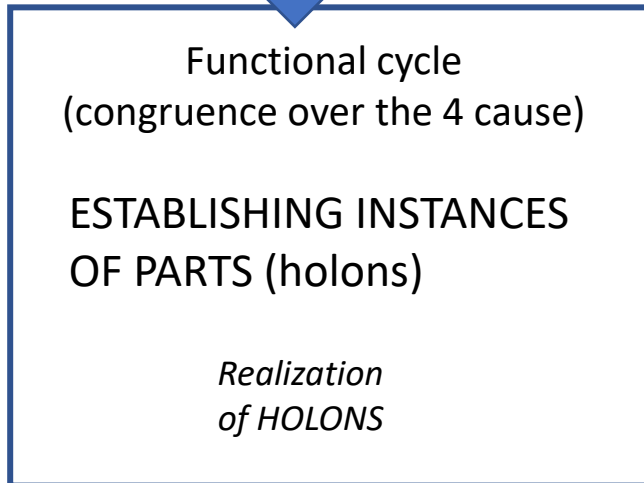
**types**

**(Interpret)**



**Realizations  
Instances**

**TANGIBLE  
(Act)**



**(Interpret)**



**Realizations  
Instances**

**TANGIBLE  
(Act)**



# Local Scale

# Large Scale

Meaningful information about PARTS/WHOLE

Meaningful information about WHOLE/CONTEXT

**NOTIONAL  
(Represent)**

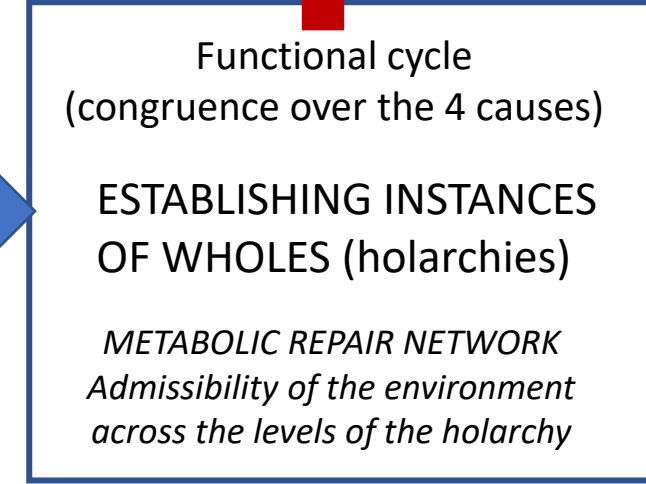
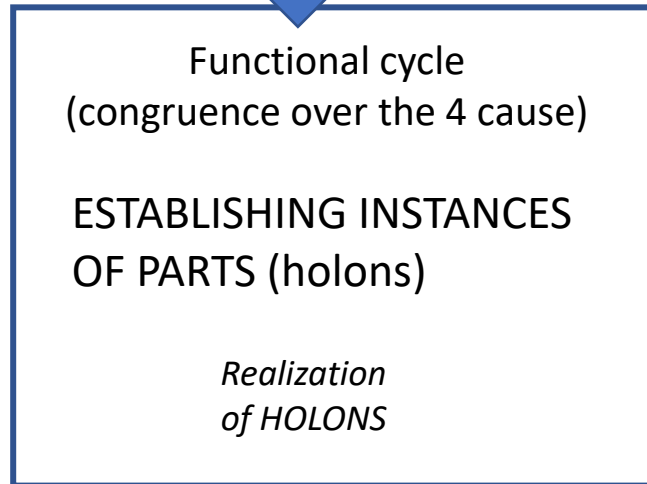
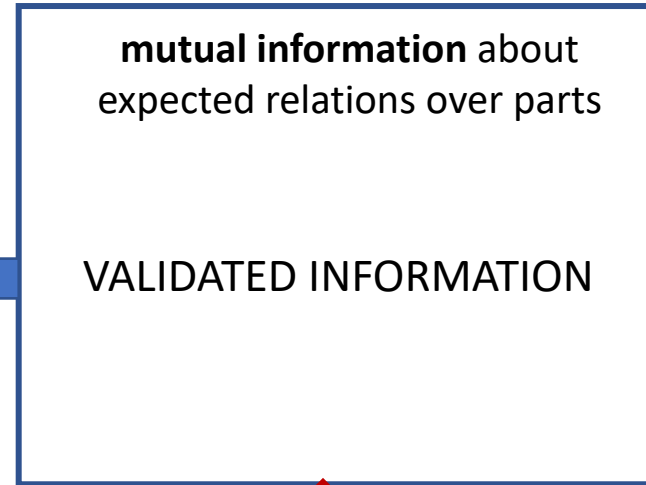
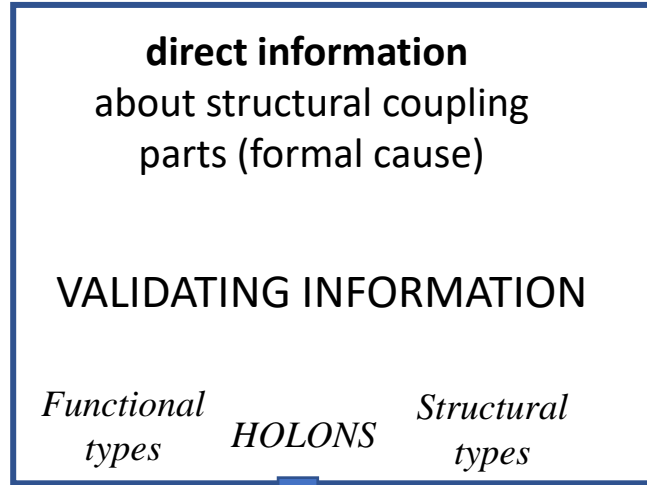
**NOTIONAL  
(Represent)**

**types**

**types**

**(Interpret)**

**(Interpret)**



**Realizations  
Instances**

**Realizations  
Instances**

**TANGIBLE  
(Act)**

**TANGIBLE  
(Act)**

Self-reproducing PARTS

Self-reproducing WHOLE

inside the black-box

# Local Scale

# Large Scale

black-box/context

Meaningful information about PARTS/WHOLE

Meaningful information about WHOLE/CONTEXT

**NOTIONAL  
(Represent)**

**NOTIONAL  
(Represent)**

**types**

**types**

**(Interpret)**

**(Interpret)**

**direct information**  
about structural coupling parts (formal cause)

VALIDATING INFORMATION

*Functional types*   *HOLONS*   *Structural types*

**mutual information** about expected relations over parts

VALIDATED INFORMATION

Functional cycle (congruence over the 4 cause)

ESTABLISHING INSTANCES OF PARTS (holons)

*Realization of HOLONS*

Functional cycle (congruence over the 4 causes)

ESTABLISHING INSTANCES OF WHOLES (holarchies)

*METABOLIC REPAIR NETWORK*  
*Admissibility of the environment across the levels of the holarchy*

**Realizations  
Instances**

**Realizations  
Instances**

**TANGIBLE  
(Act)**

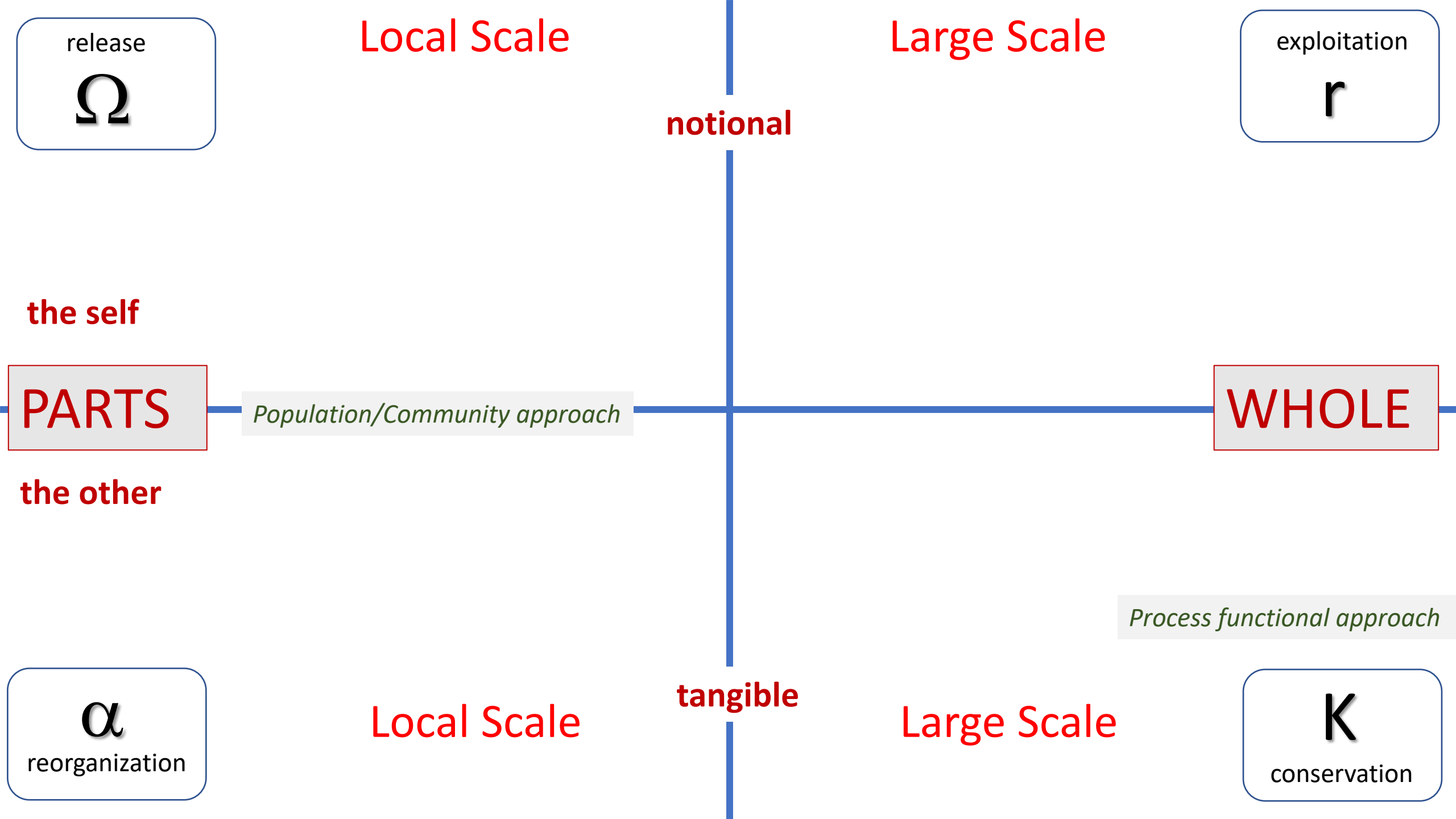
**TANGIBLE  
(Act)**

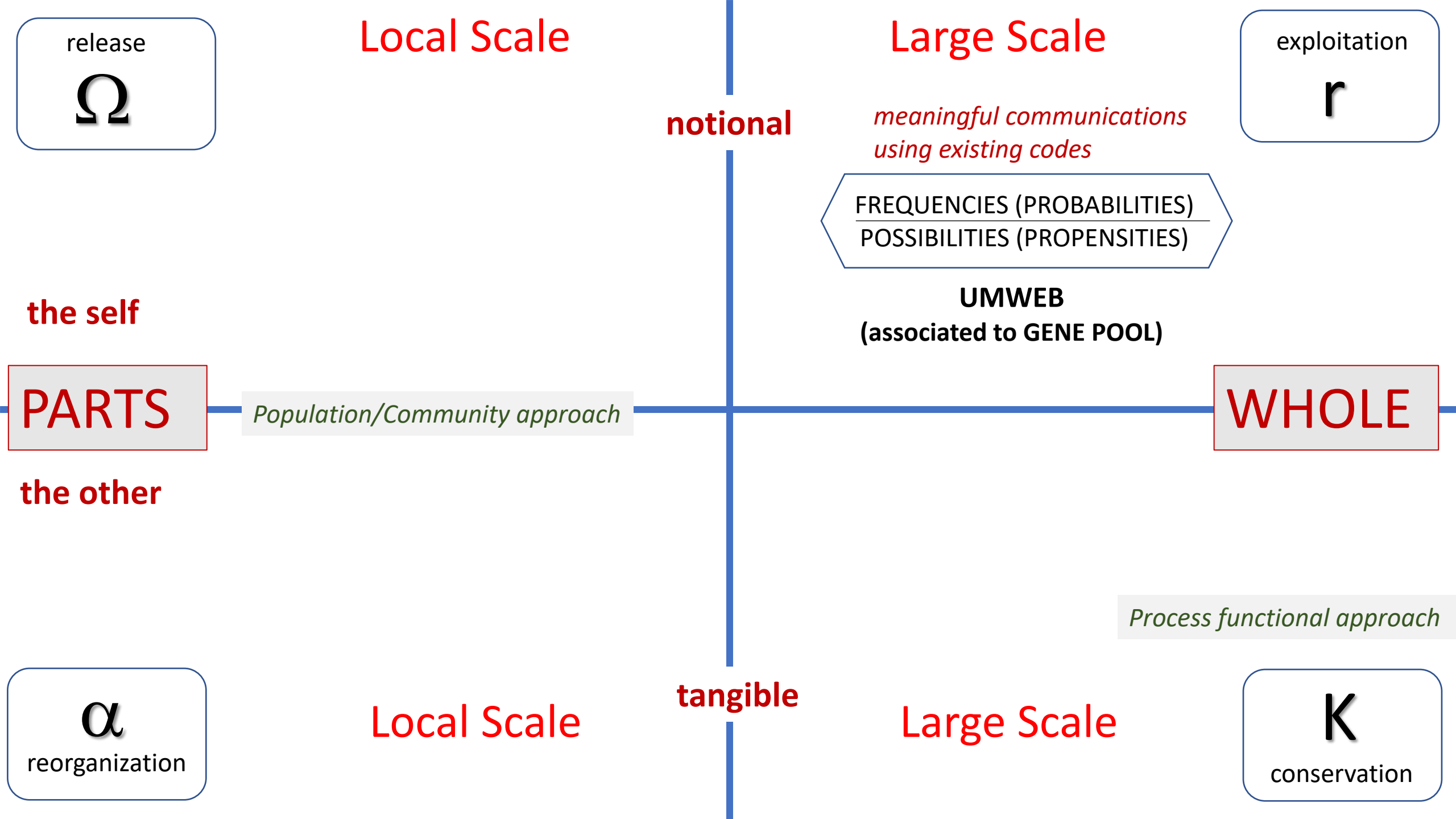
Self-reproducing PARTS

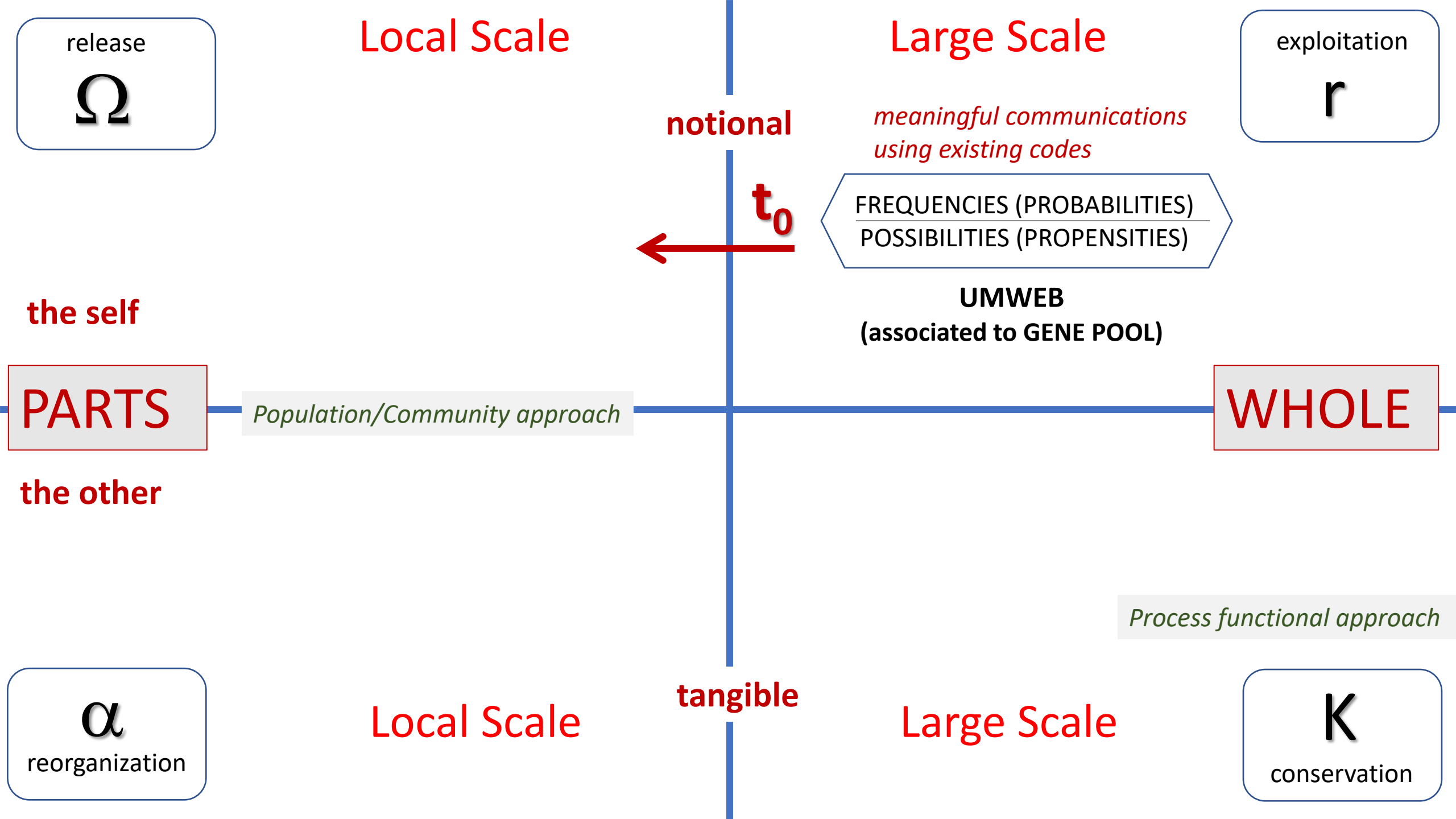
Self-reproducing WHOLE

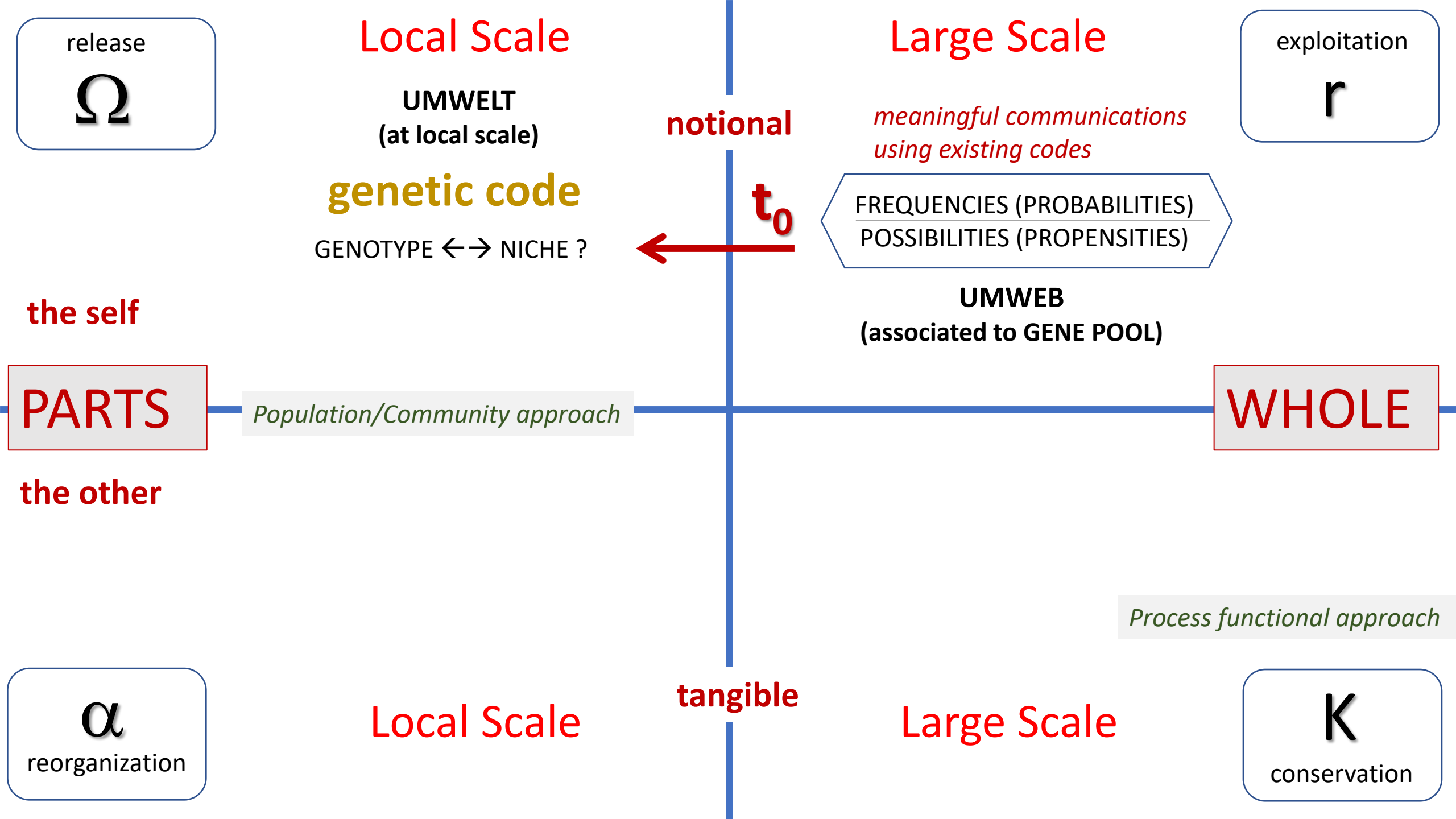
vertical coupling

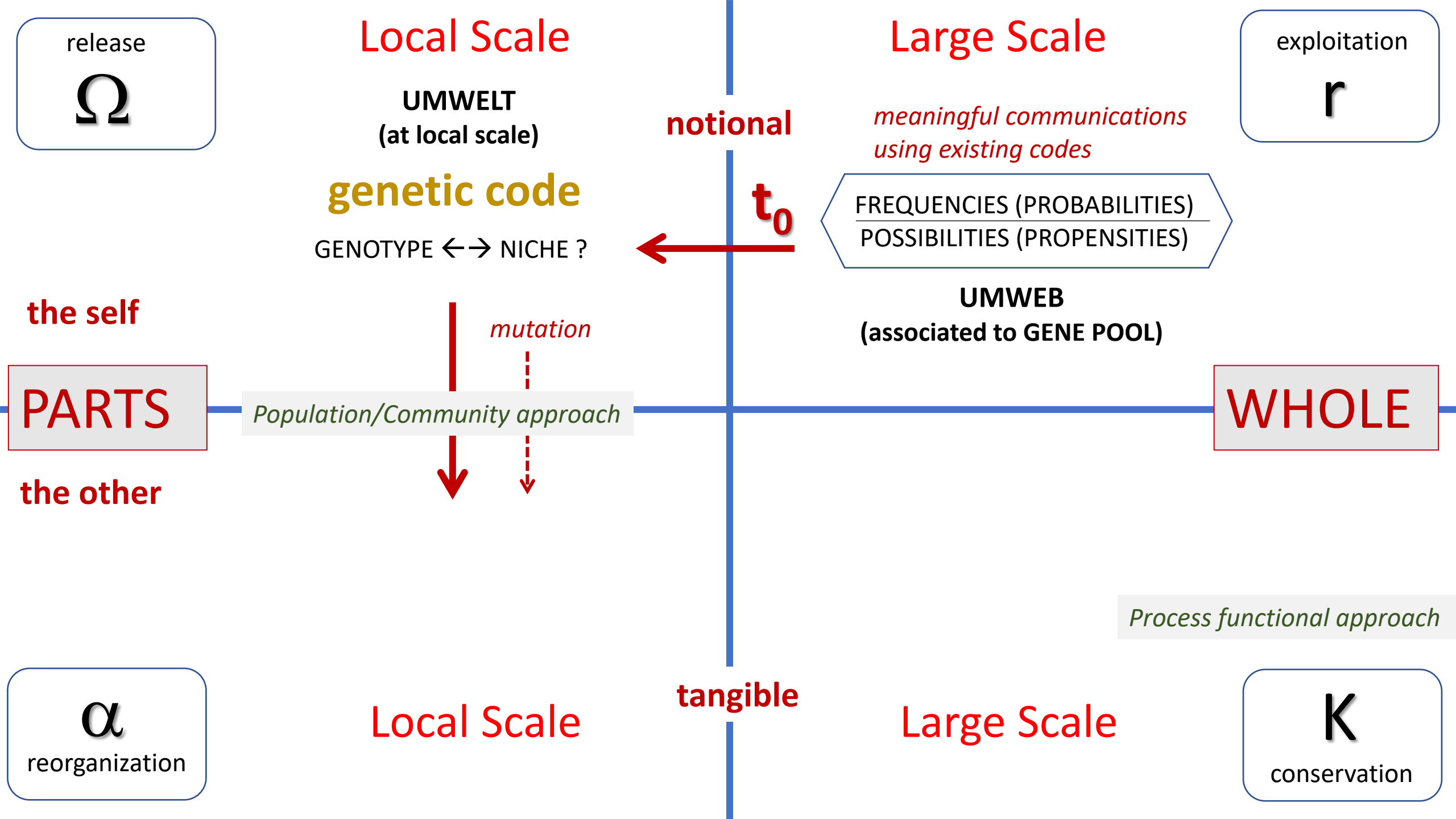
structural coupling











release

$\Omega$

Local Scale

UMWELT  
(at local scale)

genetic code

GENOTYPE  $\leftrightarrow$  NICHE ?

notional

$t_0$

Large Scale

*meaningful communications  
using existing codes*

FREQUENCIES (PROBABILITIES)  
POSSIBILITIES (PROPENSITIES)

exploitation

$r$

the self

PARTS

*Population/Community approach*

*mutation*

UMWEB

(associated to GENE POOL)

WHOLE

the other

*Process functional approach*

$\alpha$

reorganization

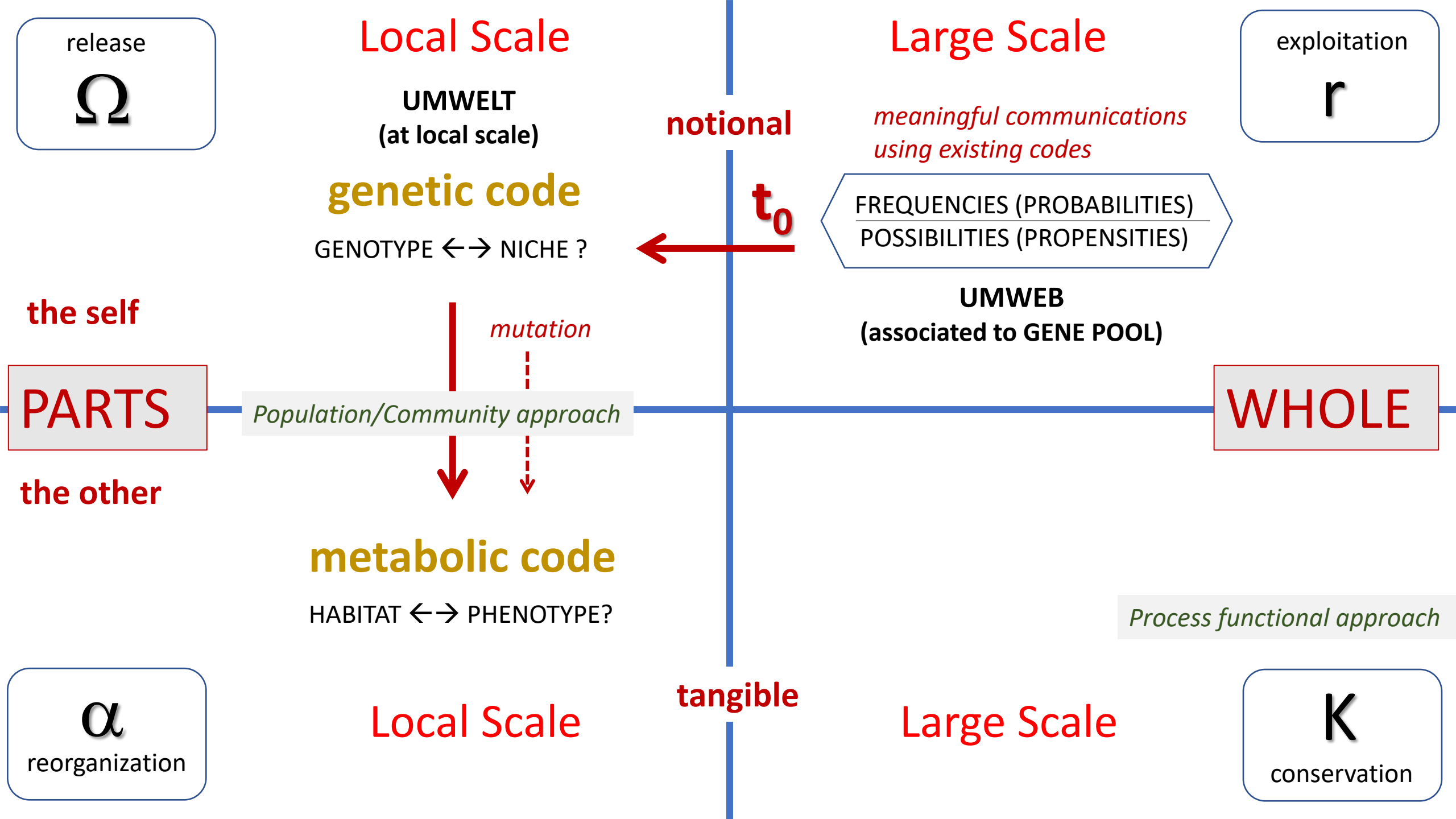
Local Scale

tangible

Large Scale

$K$

conservation



release

Ω

Local Scale

UMWELT  
(at local scale)

genetic code

GENOTYPE ↔ NICHE?

Large Scale

exploitation

r

*meaningful communications  
using existing codes*

FREQUENCIES (PROBABILITIES)  
POSSIBILITIES (PROPENSITIES)

UMWEB  
(associated to GENE POOL)

the self

PARTS

the other

*Population/Community approach*

*mutation*

notional

t<sub>0</sub>

WHOLE

metabolic code

HABITAT ↔ PHENOTYPE?

*Process functional approach*

tangible

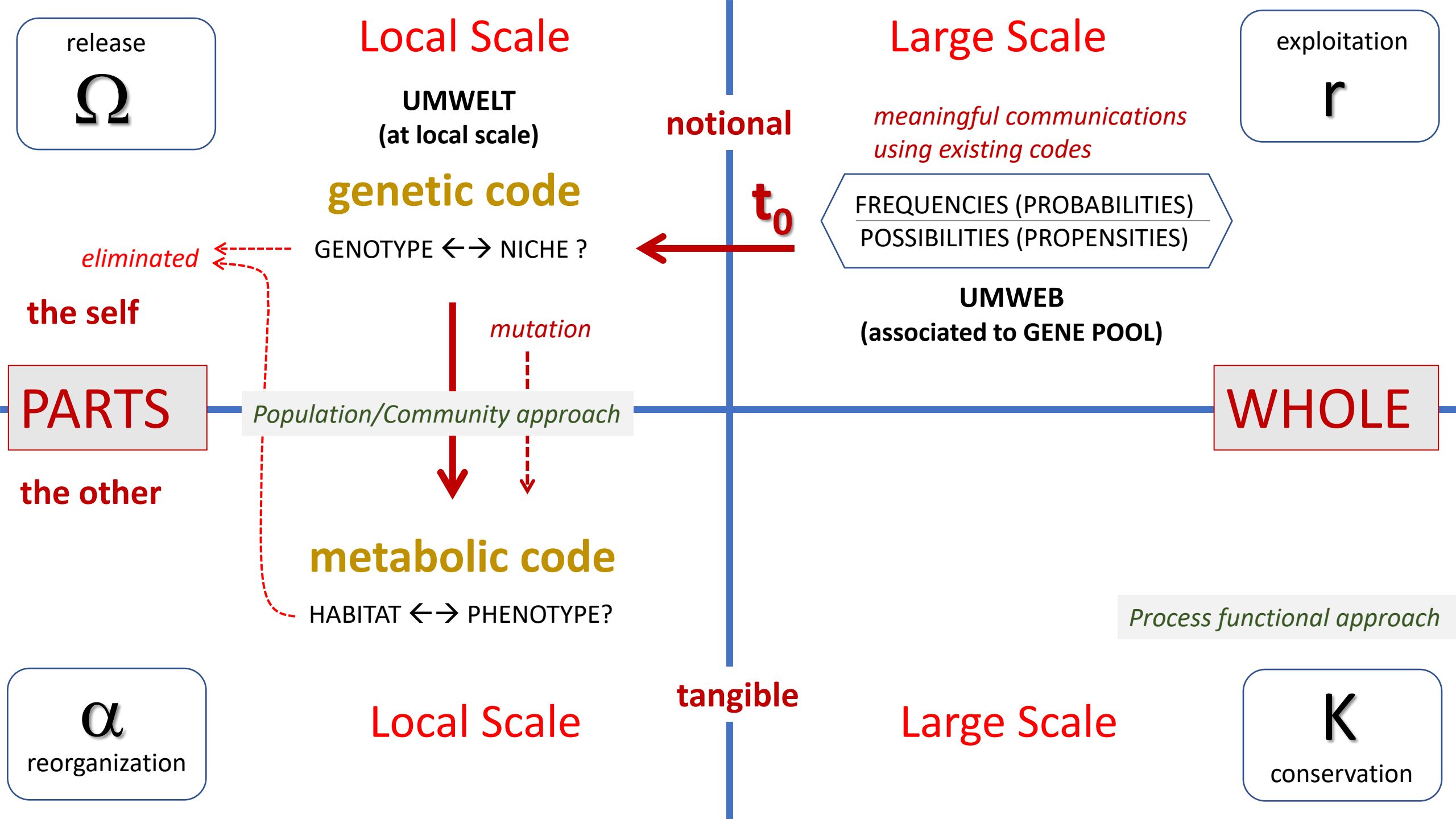
Local Scale

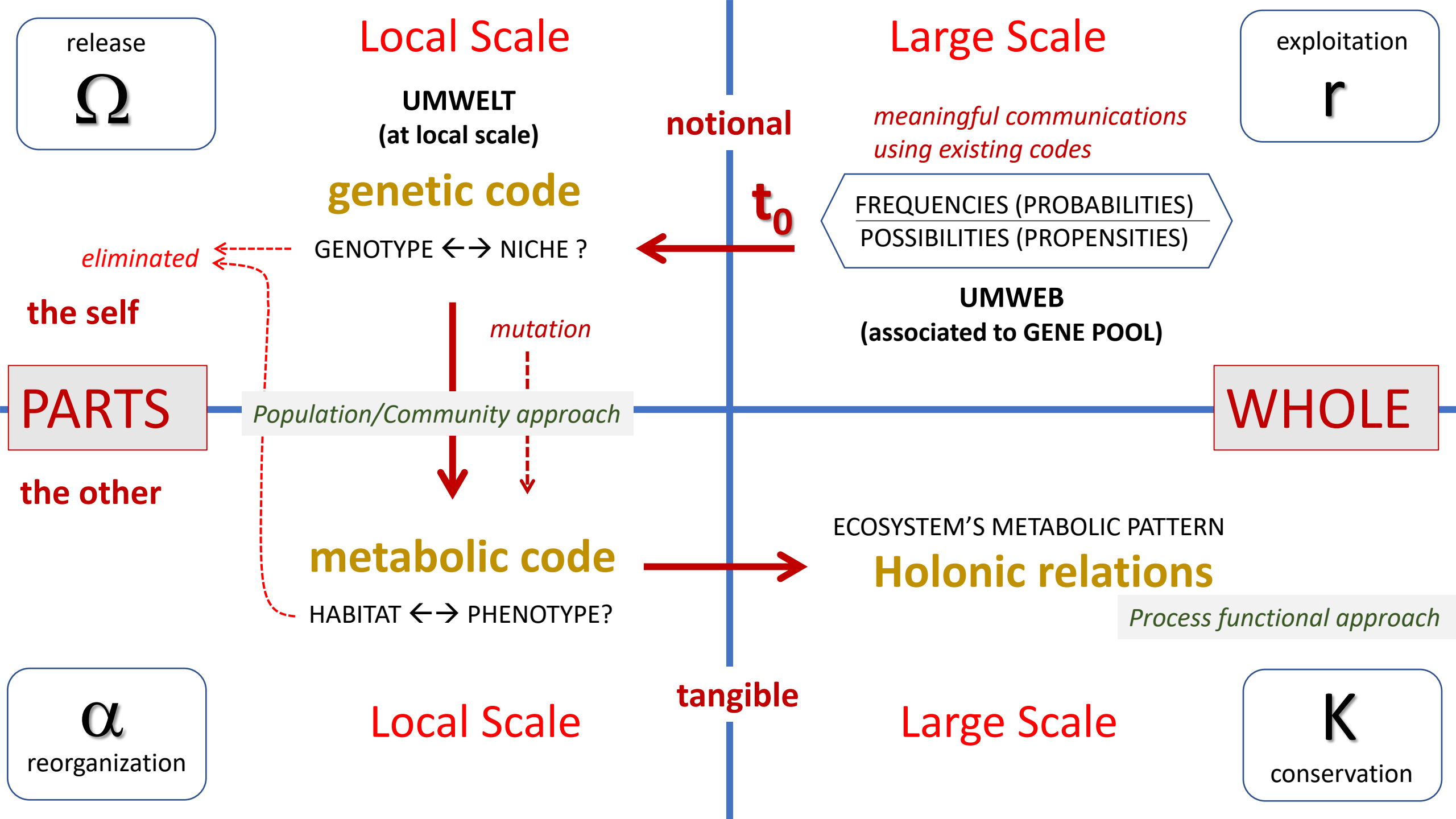
α  
reorganization

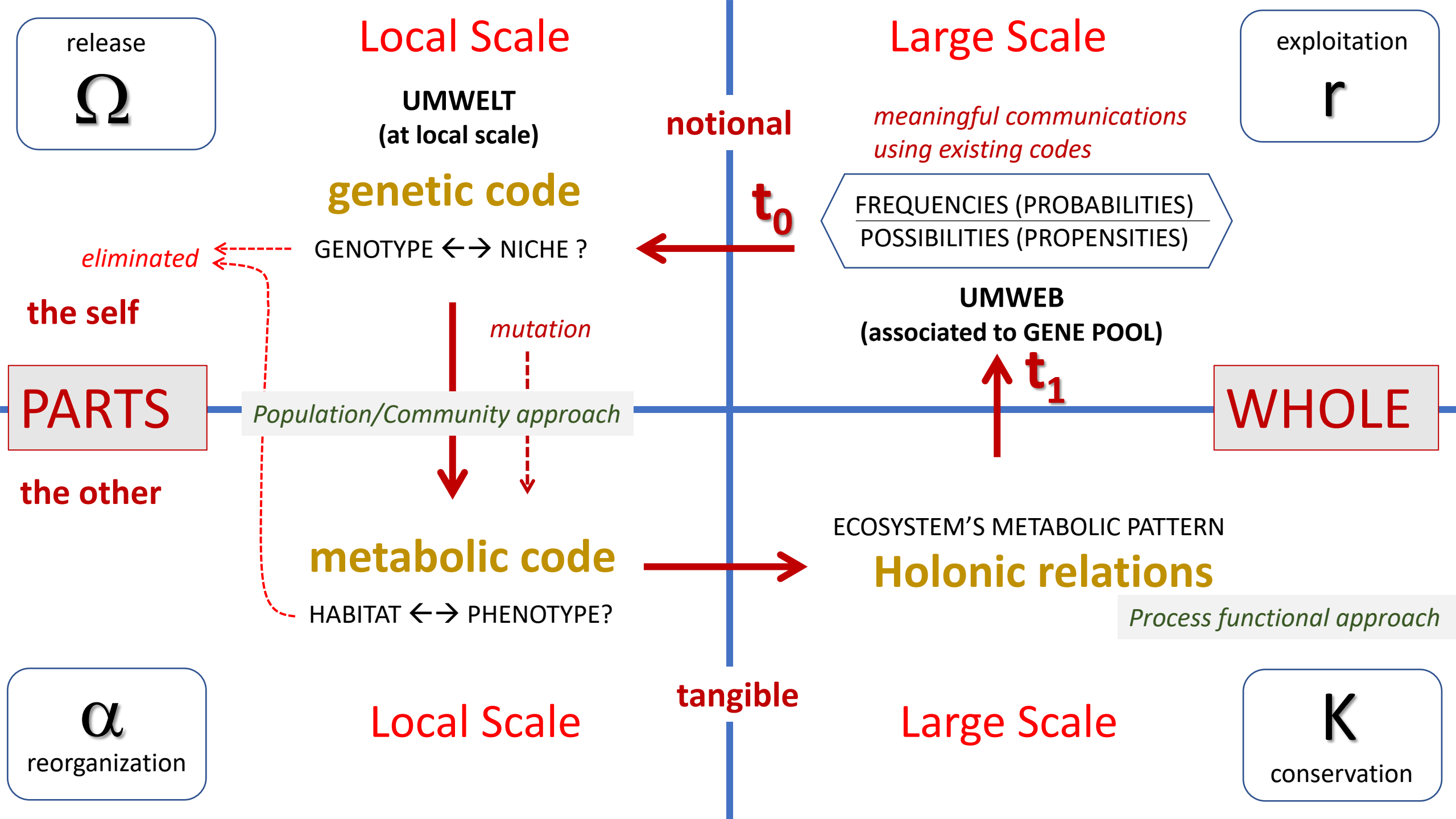
Large Scale

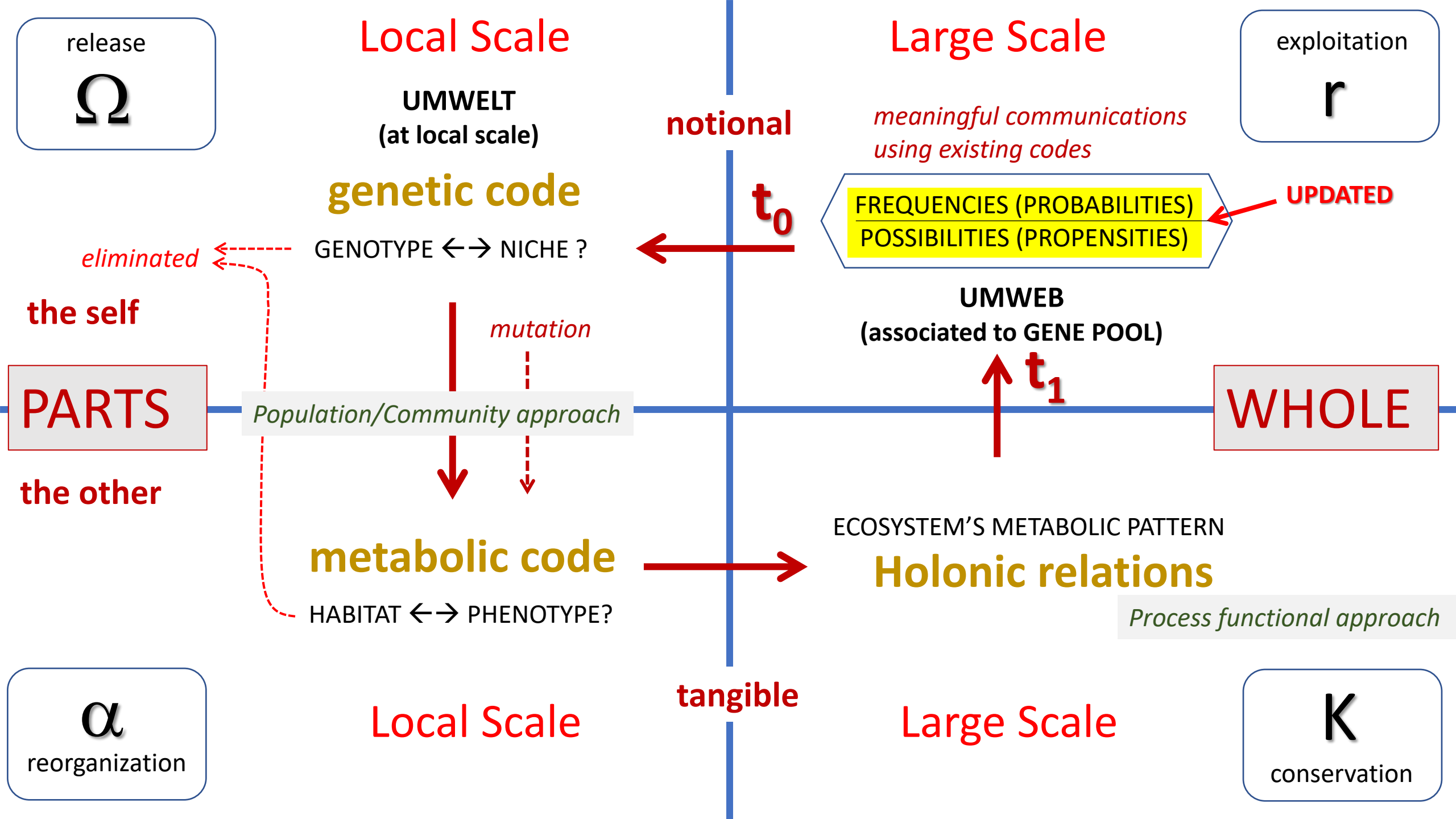
K  
conservation











release

$\Omega$

Local Scale

UMWELT  
(at local scale)

genetic code

GENOTYPE  $\leftrightarrow$  NICHE ?

*eliminated*

the self

PARTS

the other

*Population/Community approach*

*mutation*

metabolic code

HABITAT  $\leftrightarrow$  PHENOTYPE ?

notional

$t_0$

Large Scale

exploitation

$r$

*meaningful communications  
using existing codes*

FREQUENCIES (PROBABILITIES)  
POSSIBILITIES (PROPENSITIES)

UPDATED

UMWEB  
(associated to GENE POOL)

$t_1$

WHOLE

ECOSYSTEM'S METABOLIC PATTERN

Holonic relations

*Process functional approach*

tangible

Local Scale

Large Scale

$\alpha$   
reorganization

$K$   
conservation

**LOWER LEVEL**

**HIGHER LEVEL**


**COMMUNICATIONS**

*Notional definition  
of societal identity*

**INTERACTIONS**

*Tangible realization  
of societal identity*

## LOWER LEVEL

## HIGHER LEVEL

	<p>Validated representations of EXPECTED relations based on types</p> <p><b>Institutions</b></p> <p>Narratives, Models, Data Knowledge claims, Targets Lower-level final causes</p>

## COMMUNICATIONS

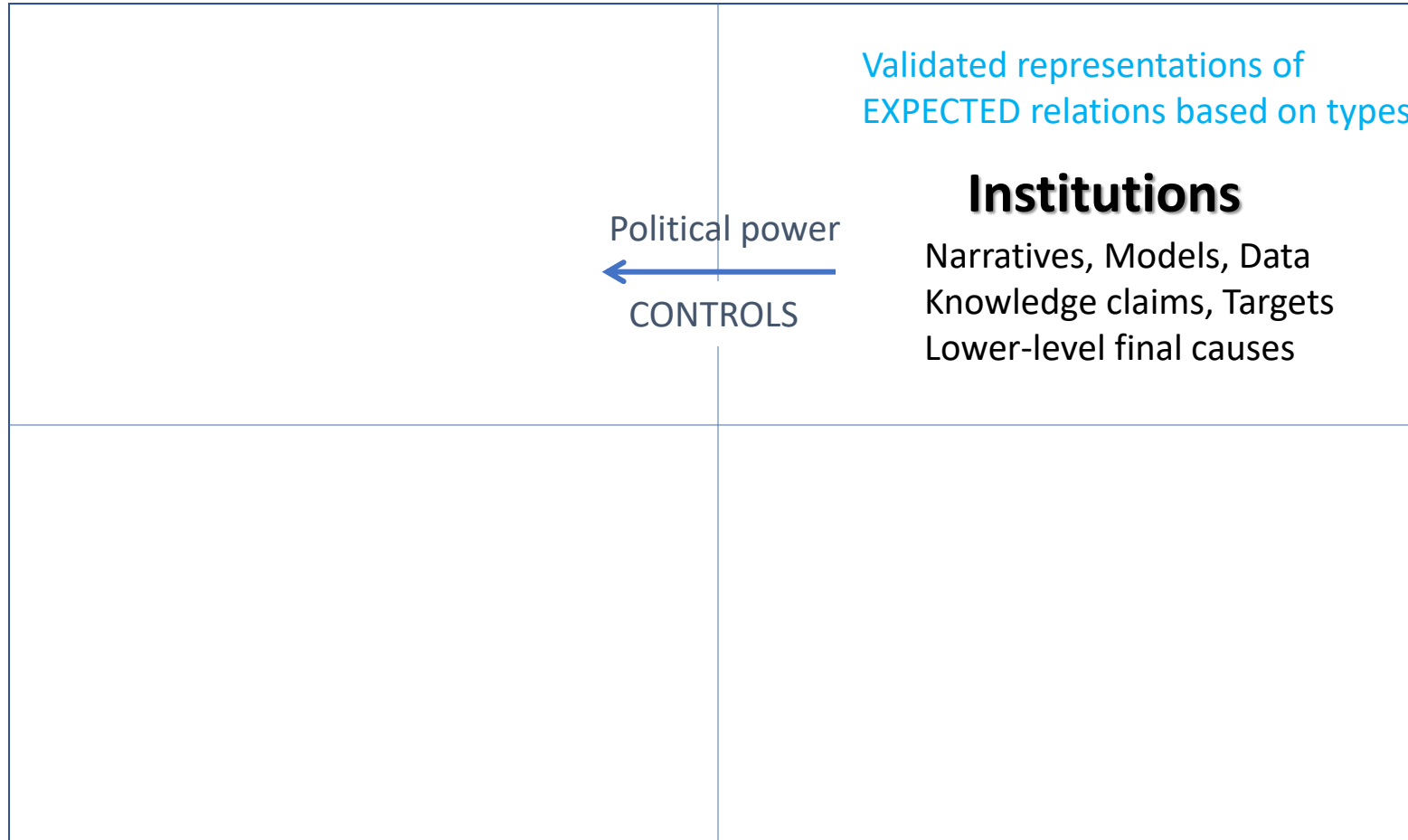
*Notional definition  
of societal identity*

## INTERACTIONS

*Tangible realization  
of societal identity*

## LOWER LEVEL

## HIGHER LEVEL



## COMMUNICATIONS

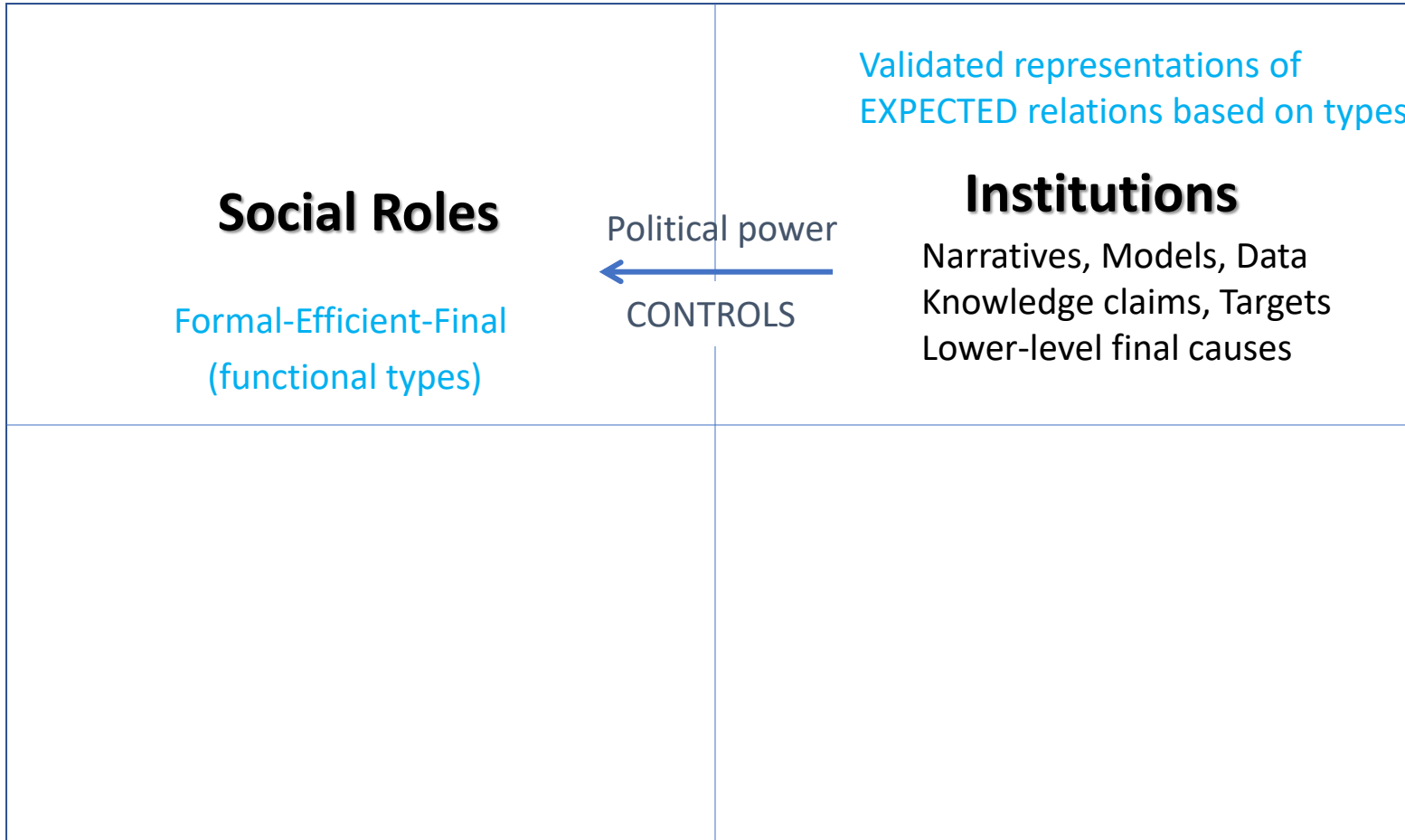
*Notional definition  
of societal identity*

## INTERACTIONS

*Tangible realization  
of societal identity*

## LOWER LEVEL

## HIGHER LEVEL



## COMMUNICATIONS

*Notional definition  
of societal identity*

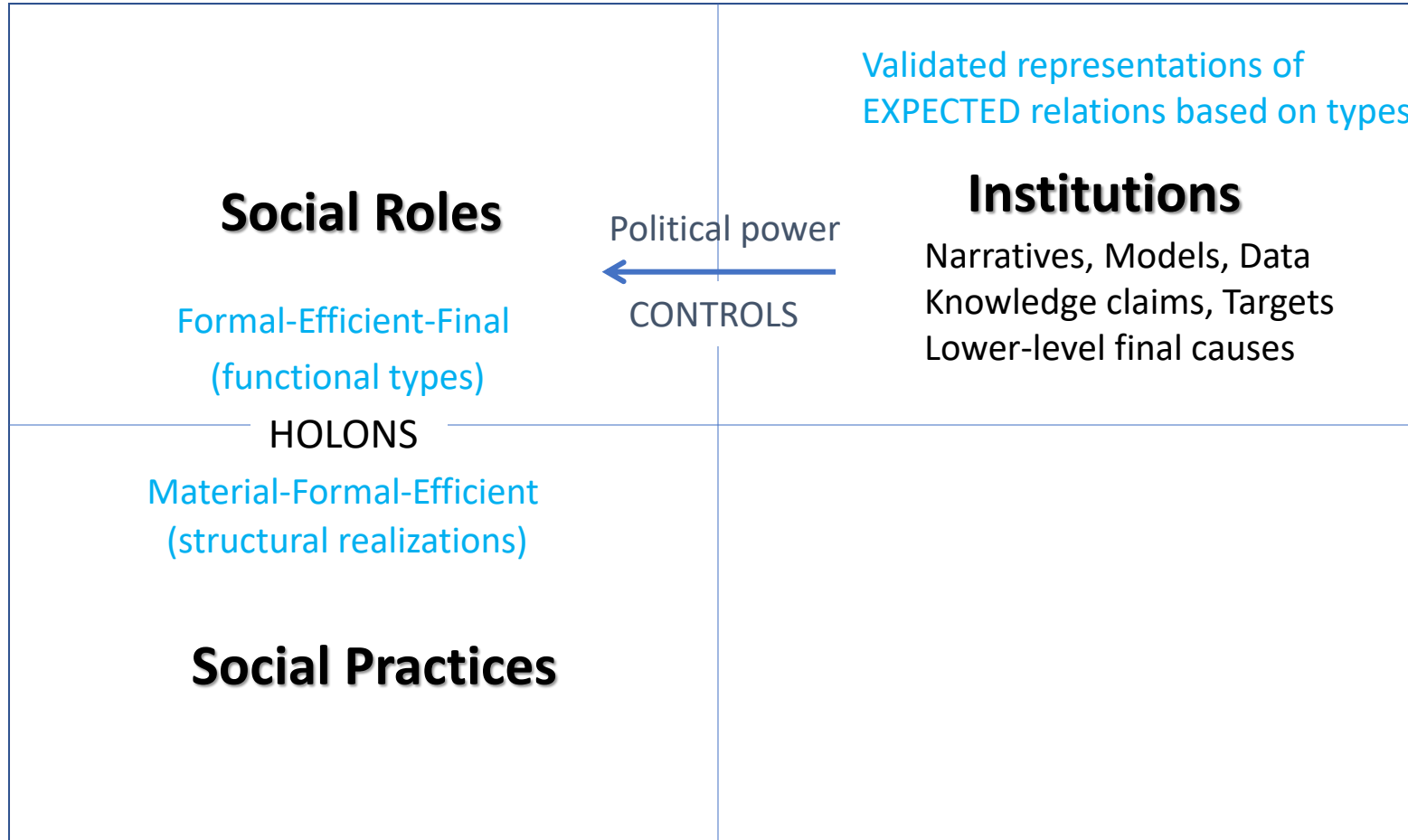
## INTERACTIONS

*Tangible realization  
of societal identity*



## LOWER LEVEL

## HIGHER LEVEL



## COMMUNICATIONS

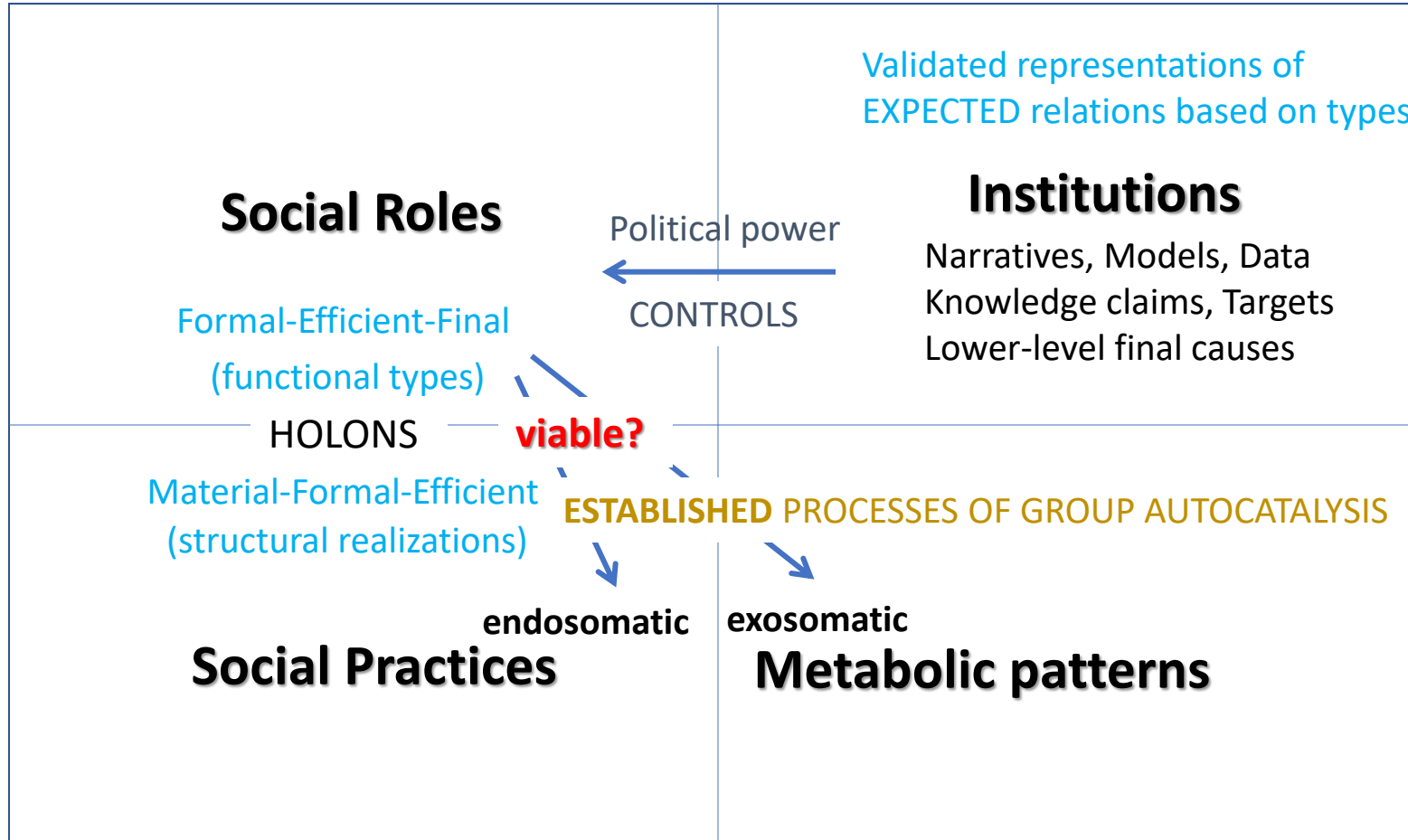
*Notional definition  
of societal identity*

## INTERACTIONS

*Tangible realization  
of societal identity*

## LOWER LEVEL

## HIGHER LEVEL



## COMMUNICATIONS

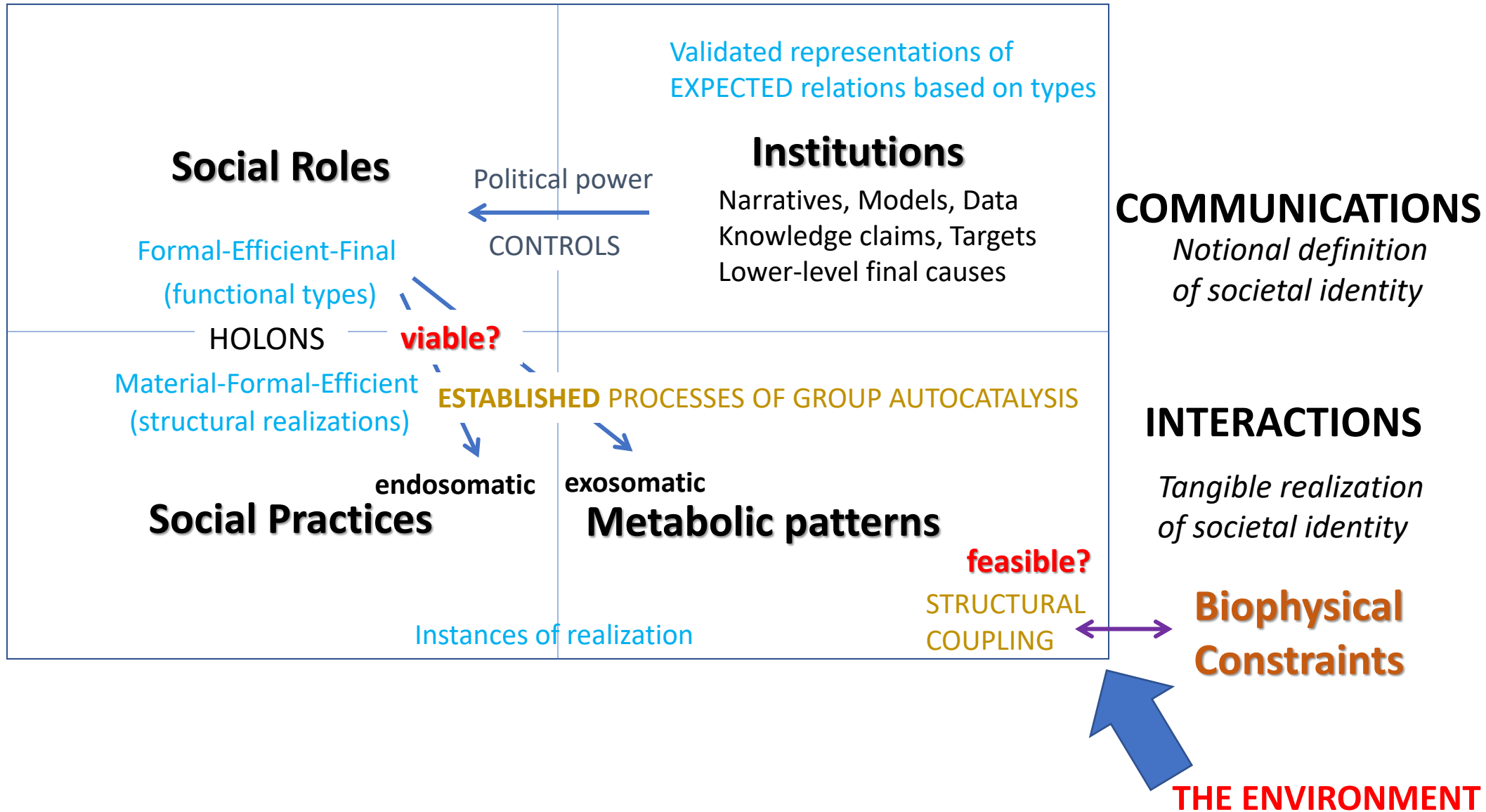
*Notional definition  
of societal identity*

## INTERACTIONS

*Tangible realization  
of societal identity*

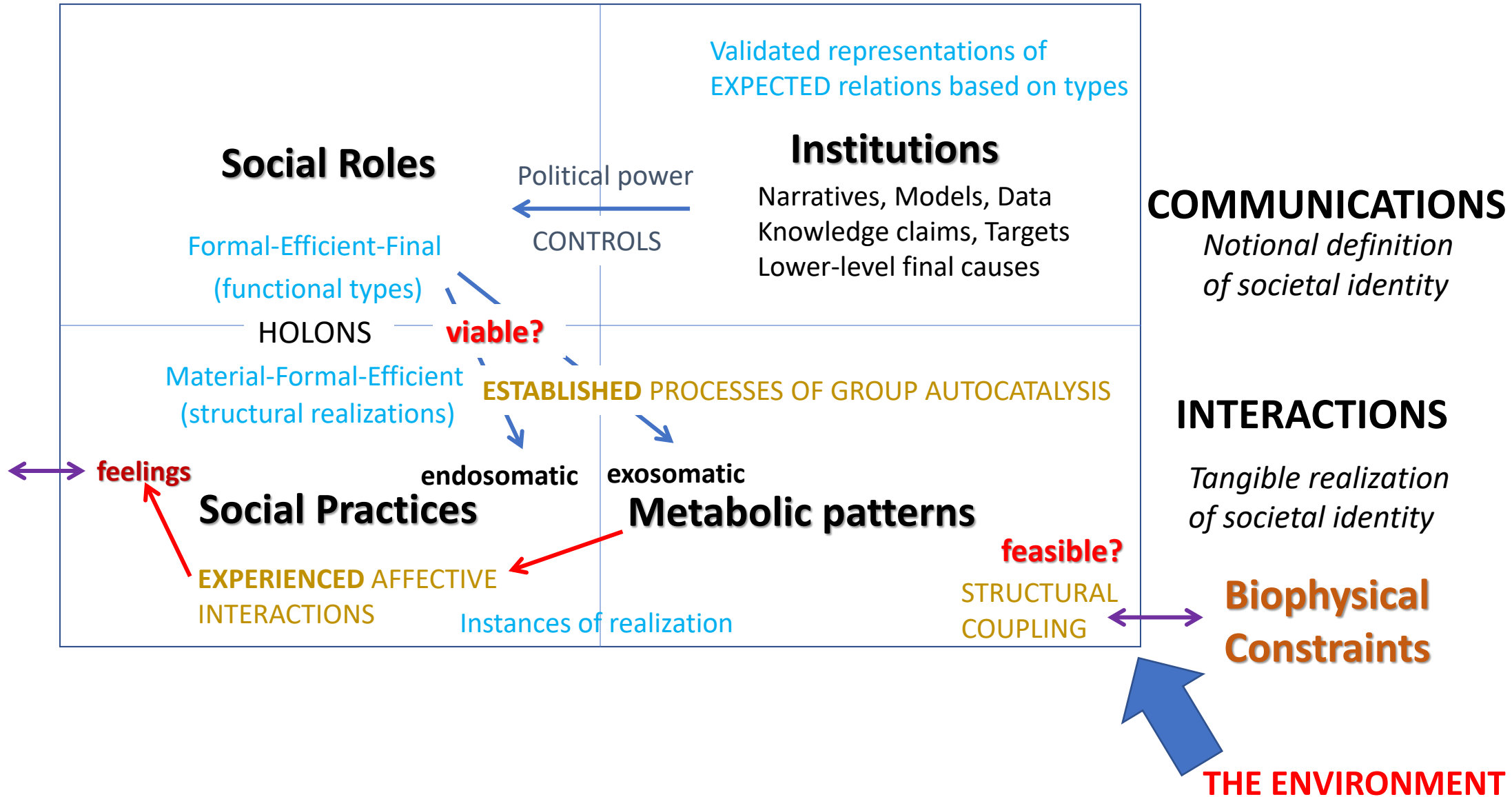
## LOWER LEVEL

## HIGHER LEVEL



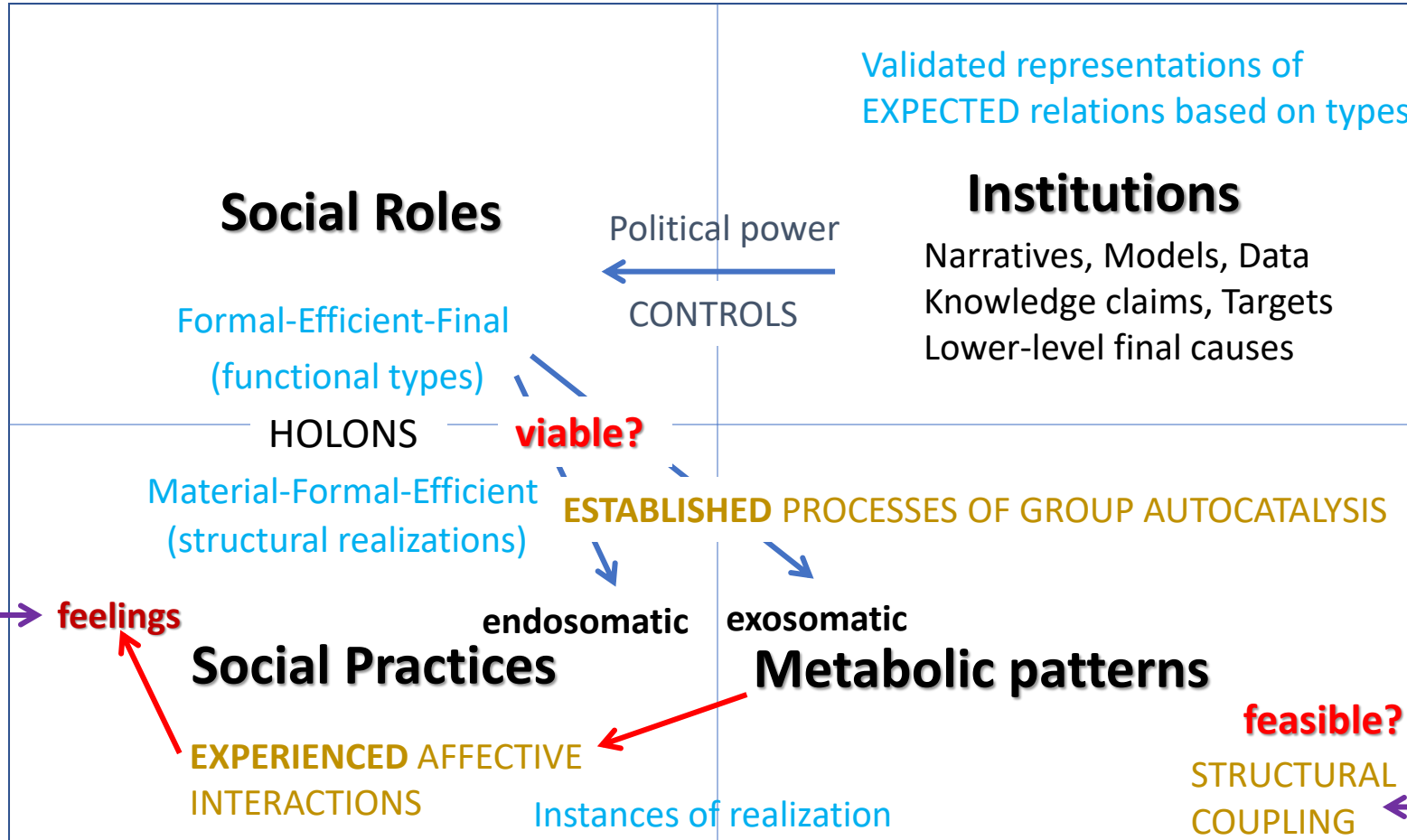
## LOWER LEVEL

## HIGHER LEVEL



## LOWER LEVEL

## HIGHER LEVEL



## COMMUNICATIONS

*Notional definition  
of societal identity*

## INTERACTIONS

*Tangible realization  
of societal identity*

## Biophysical Constraints

EXPECTED LEVEL  
OF PROTECTION

EMOTIONAL  
SCHEMAS

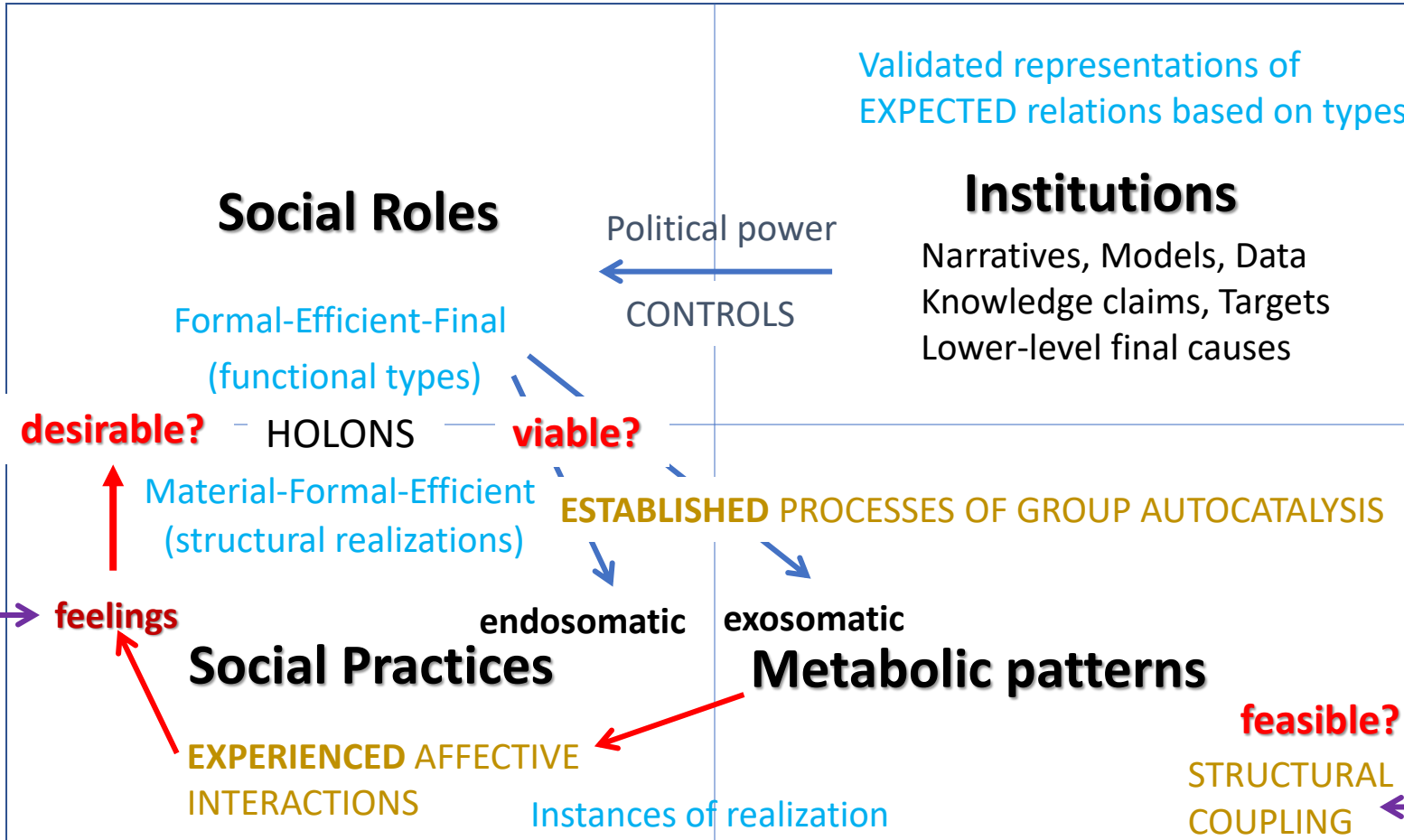
Emotions

THE "IDs"

THE ENVIRONMENT

# LOWER LEVEL

# HIGHER LEVEL



**COMMUNICATIONS**  
*Notional definition  
of societal identity*

**INTERACTIONS**  
*Tangible realization  
of societal identity*

**Biophysical  
Constraints**

ACCEPTABLE LEVELS  
OF EMOTIONAL STRESS



EXPECTED LEVEL  
OF PROTECTION



feelings

EMOTIONAL  
SCHEMAS

**Emotions**



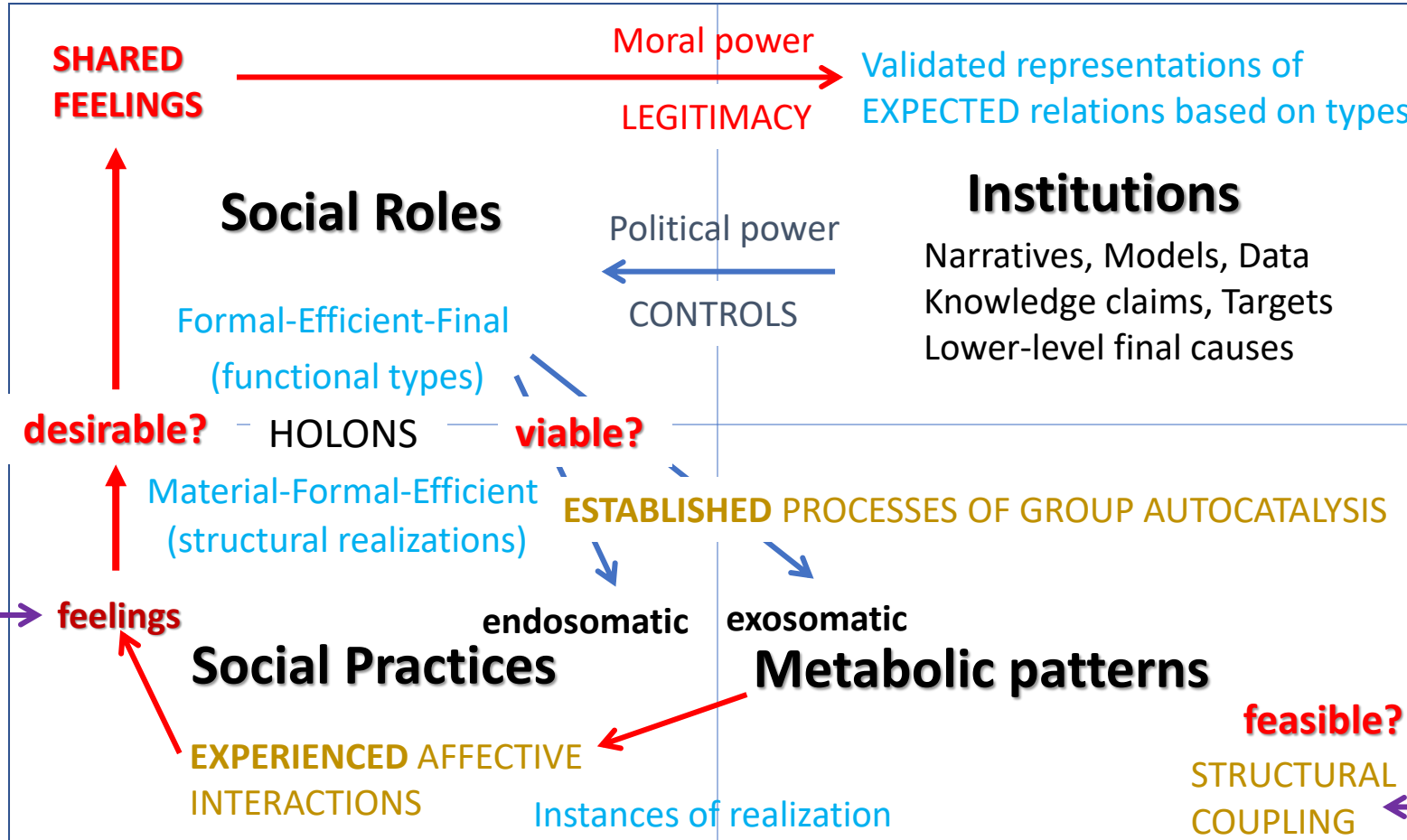
**THE "IDs"**



**THE ENVIRONMENT**

# LOWER LEVEL

# HIGHER LEVEL



**COMMUNICATIONS**  
*Notional definition of societal identity*

**INTERACTIONS**  
*Tangible realization of societal identity*

**Biophysical Constraints**

ACCEPTABLE LEVELS OF EMOTIONAL STRESS

EXPECTED LEVEL OF PROTECTION

EMOTIONAL SCHEMAS

Emotions

THE "IDs"

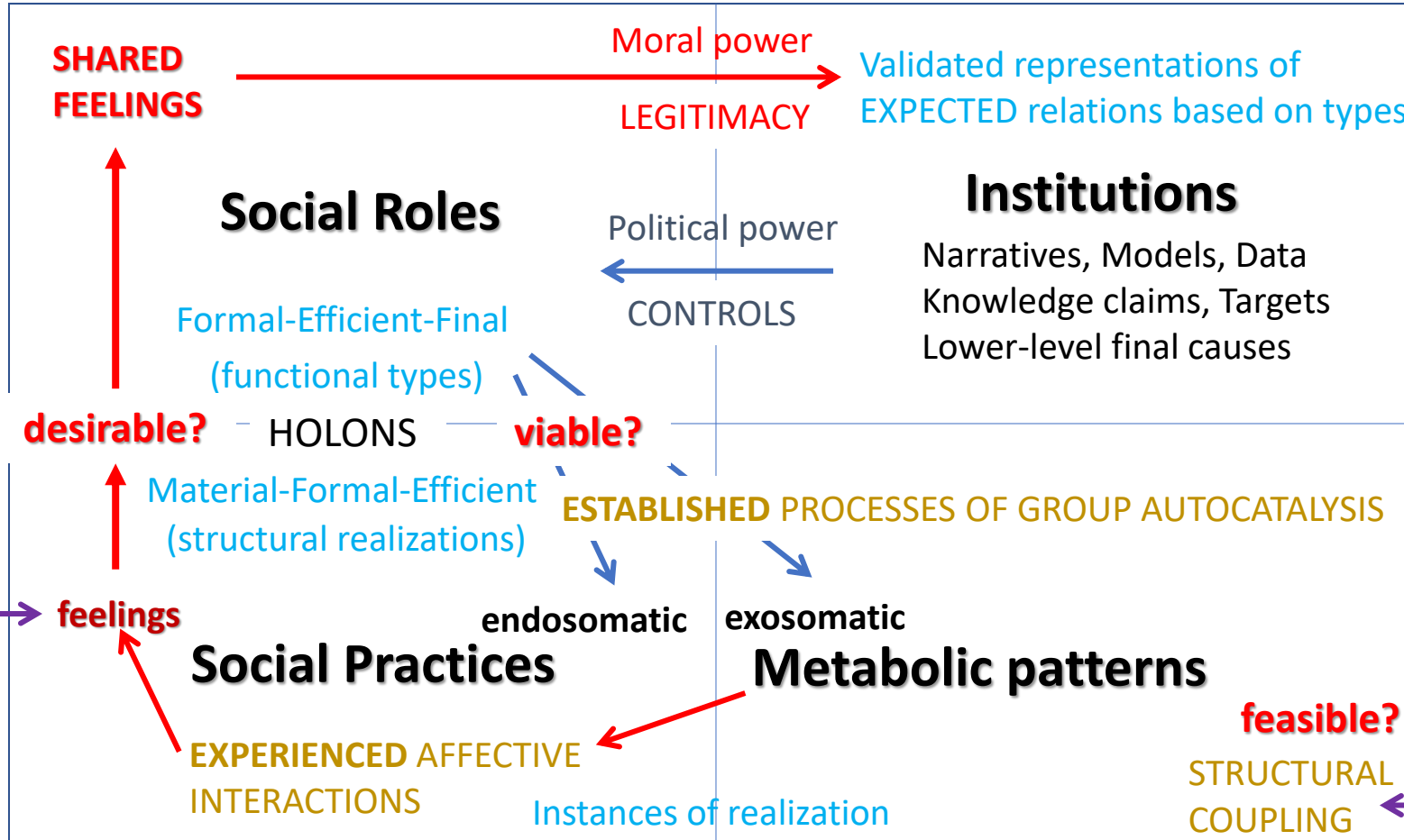
THE ENVIRONMENT

# THE MYTH



## LOWER LEVEL

## HIGHER LEVEL



## COMMUNICATIONS

*Notional definition of societal identity*

## INTERACTIONS

*Tangible realization of societal identity*

## Biophysical Constraints

## Justifications

*FINAL CAUSES*

SHARED GROUP IDENTITY  
Why do we want to belong to the society

ACCEPTABLE LEVELS OF EMOTIONAL STRESS



EXPECTED LEVEL OF PROTECTION

EMOTIONAL SCHEMAS

## Emotions



THE "IDs"

THE ENVIRONMENT





**THE MYTH**

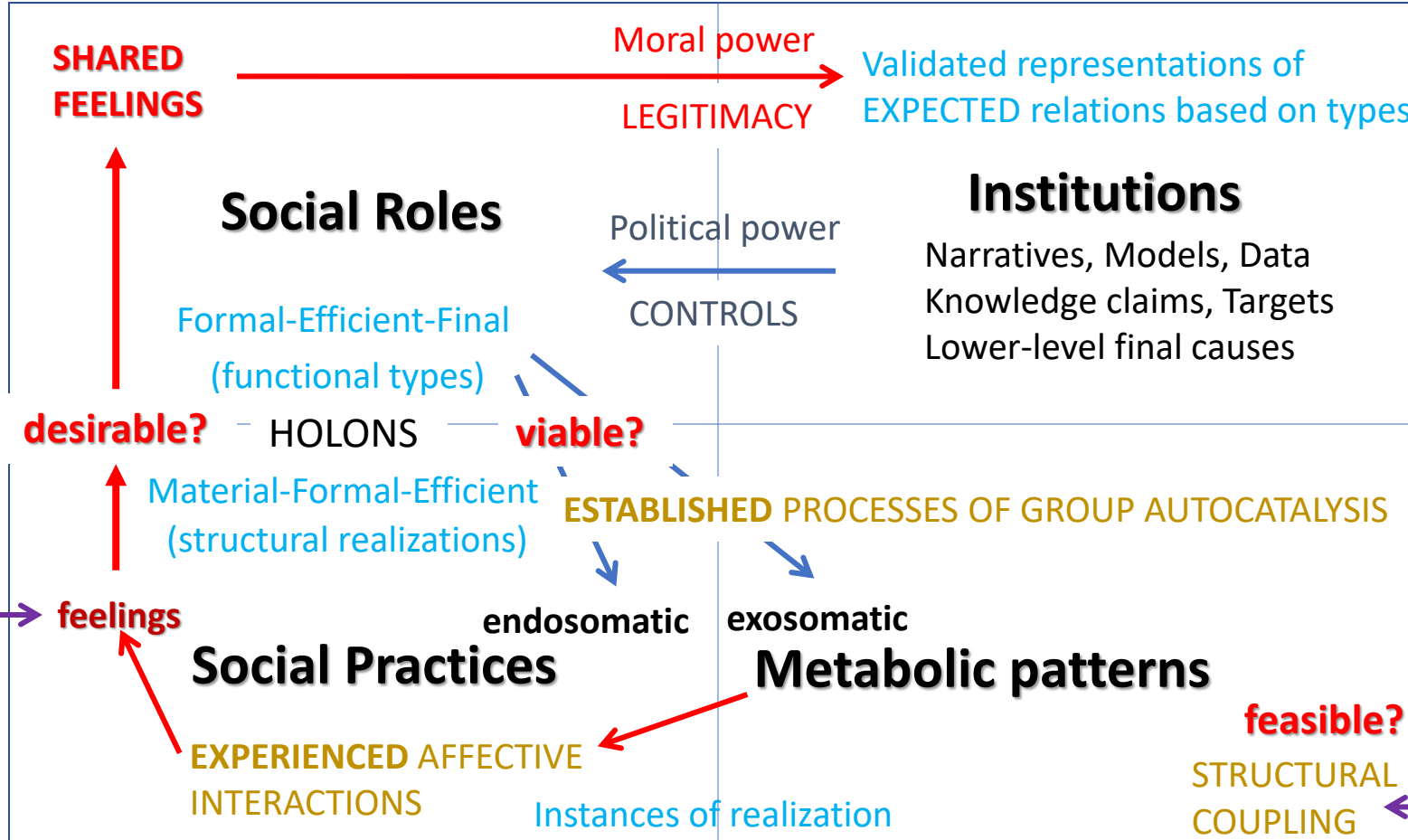


**THE MEANING WITHIN THE WHOLE**



**LOWER LEVEL**

**HIGHER LEVEL**



Does this identity make sense?

COGNITIVE SCHEMAS

**Uncertainty**

**COMMUNICATIONS**

*Notional definition of societal identity*

**INTERACTIONS**

*Tangible realization of societal identity*

**Biophysical Constraints**

**THE ENVIRONMENT**



**Justifications**

*FINAL CAUSES*

SHARED GROUP IDENTITY  
Why do we want to belong to the society

ACCEPTABLE LEVELS OF EMOTIONAL STRESS



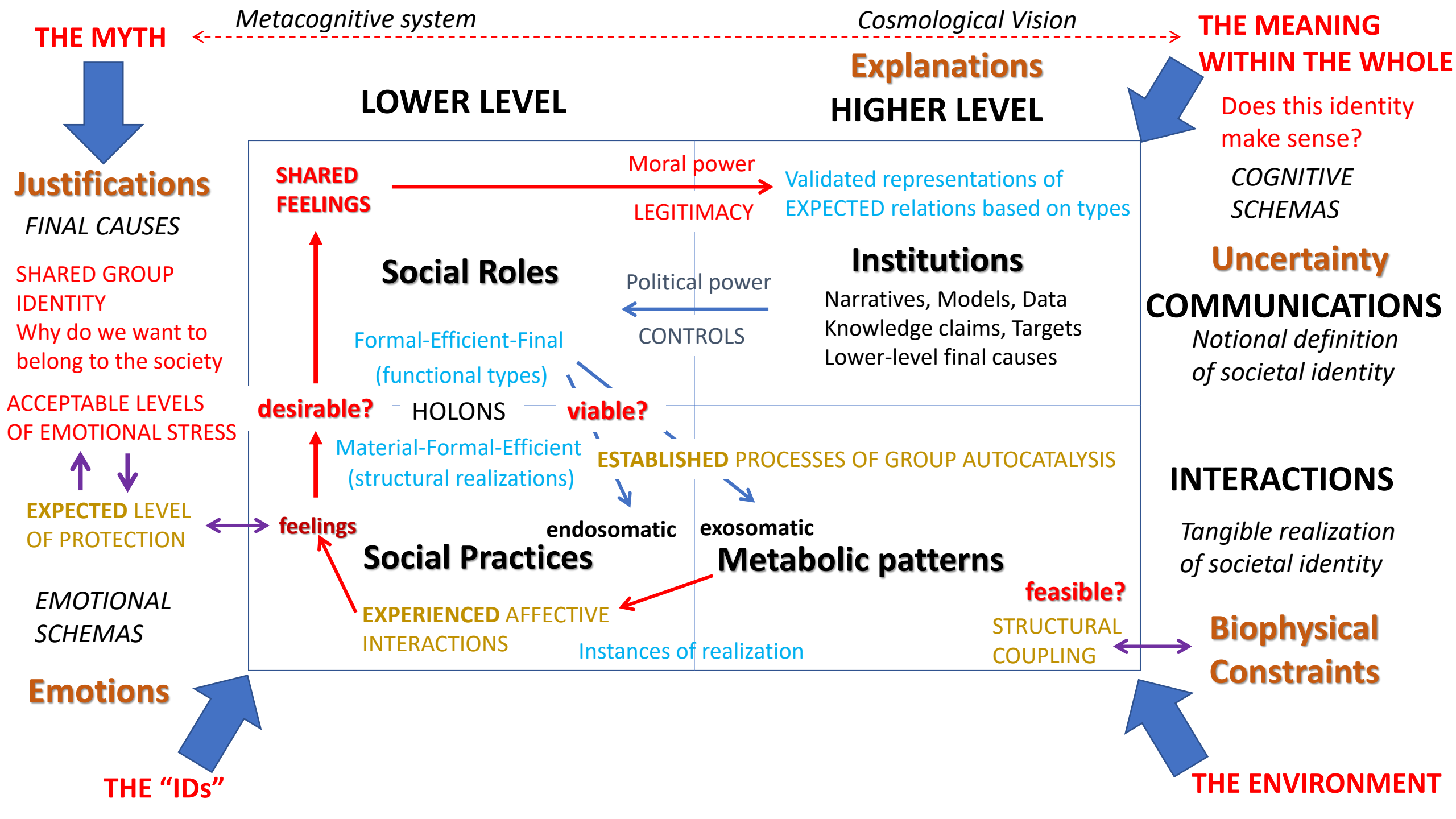
EXPECTED LEVEL OF PROTECTION

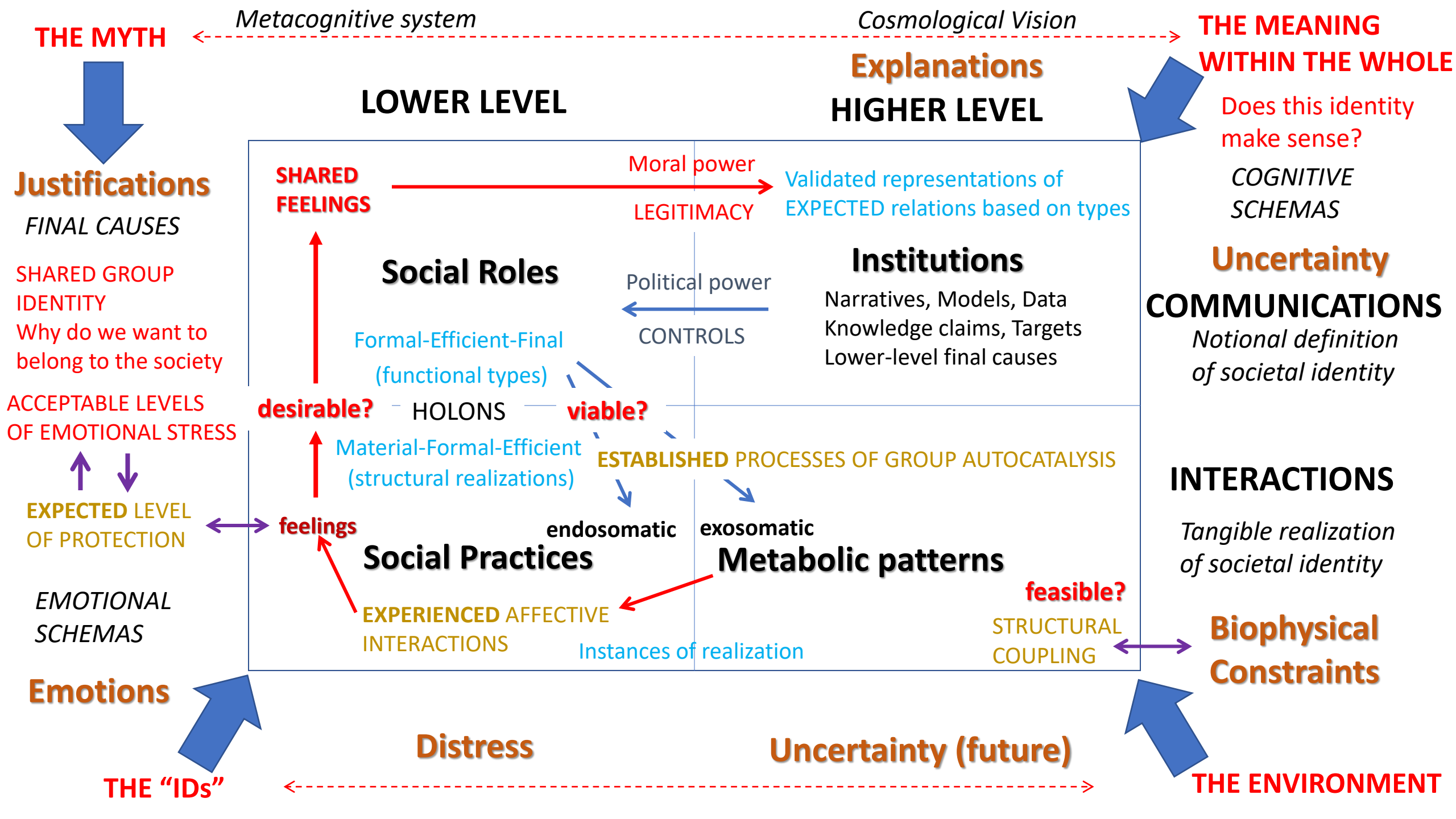
EMOTIONAL SCHEMAS

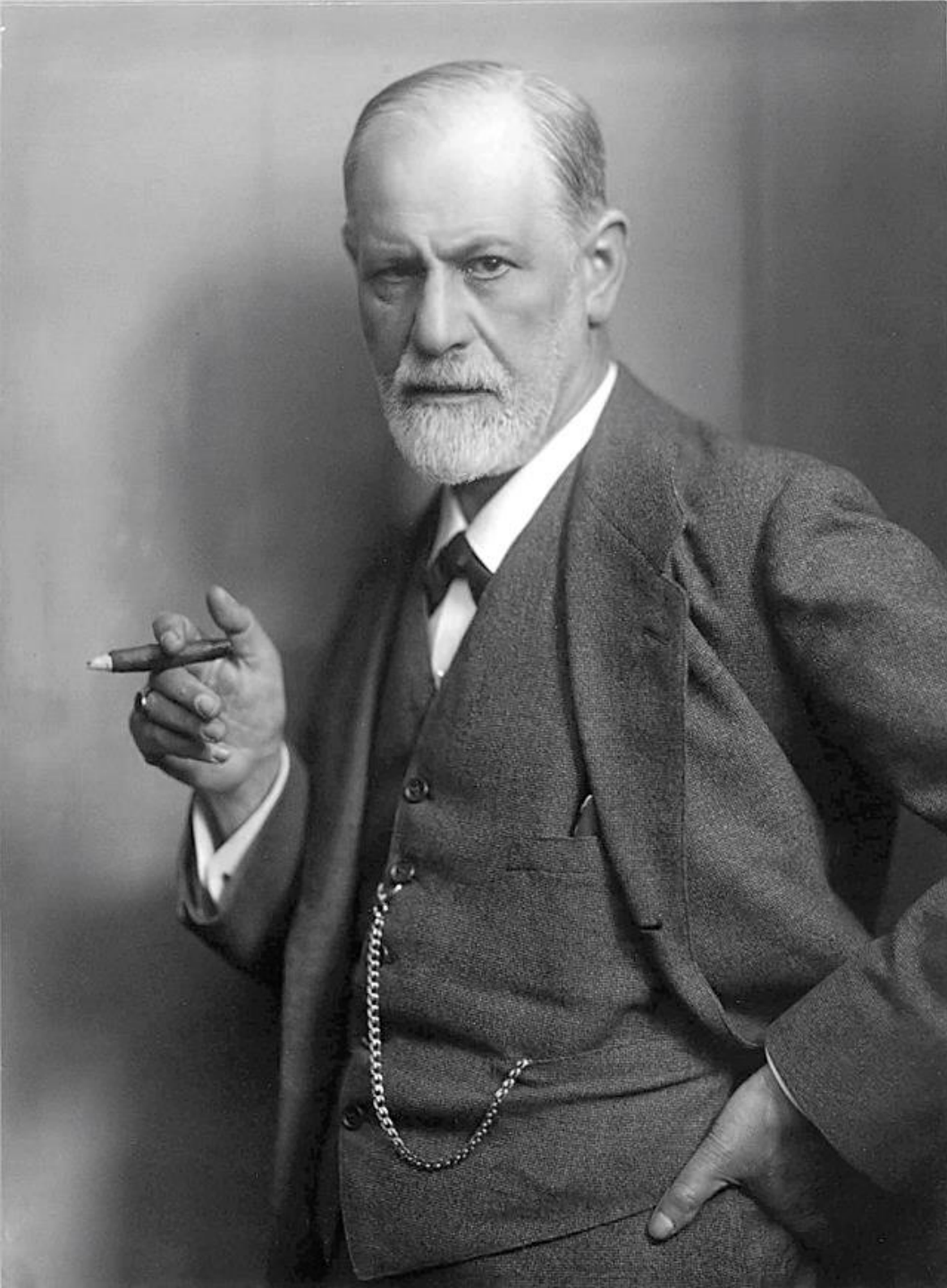
**Emotions**



**THE "IDs"**







CONCLUSION

# The biosemiotic process in ecological systems

# The biosemiotic process in ecological systems

stable metabolic pattern = meaningful information



**BIOPHYSICALLY  
FEASIBLE and VIABLE**

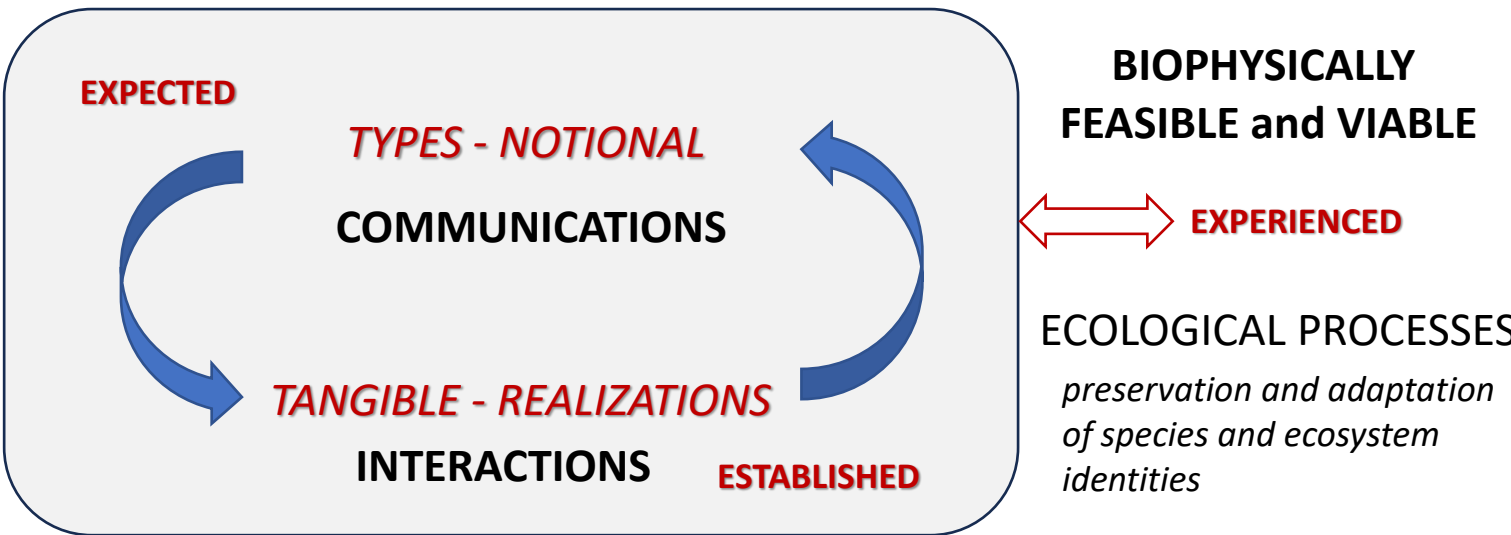
↔ **EXPERIENCED**

**ECOLOGICAL PROCESSES**  
*preservation and adaptation  
of species and ecosystem  
identities*

# The biosemiotic process in ecological systems

stable metabolic pattern = meaningful information

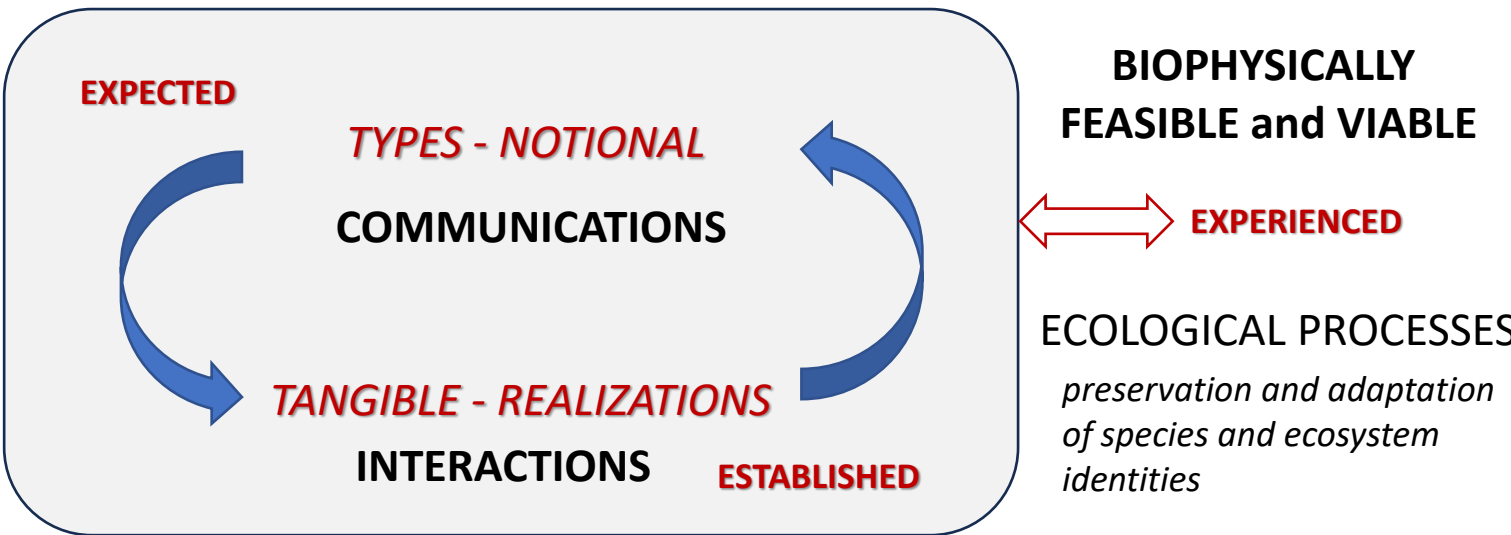
GAIA, the experience done in the TAO, gives meaning to the process and its components



# The biosemiotic process in ecological systems

GAIA, the experience done in the TAO, gives meaning to the process and its components

stable metabolic pattern = meaningful information



# The biosemiotic process in social-ecological systems



# The biosemiotic process in ecological systems

GAIA, the experience done in the TAO, gives meaning to the process and its components

stable metabolic pattern = meaningful information



**BIOPHYSICALLY FEASIBLE and VIABLE**

↔ **EXPERIENCED**

**ECOLOGICAL PROCESSES**  
*preservation and adaptation of species and ecosystem identities*

# The biosemiotic process in social-ecological systems

feelings of belonging = desirable identity = stable identity



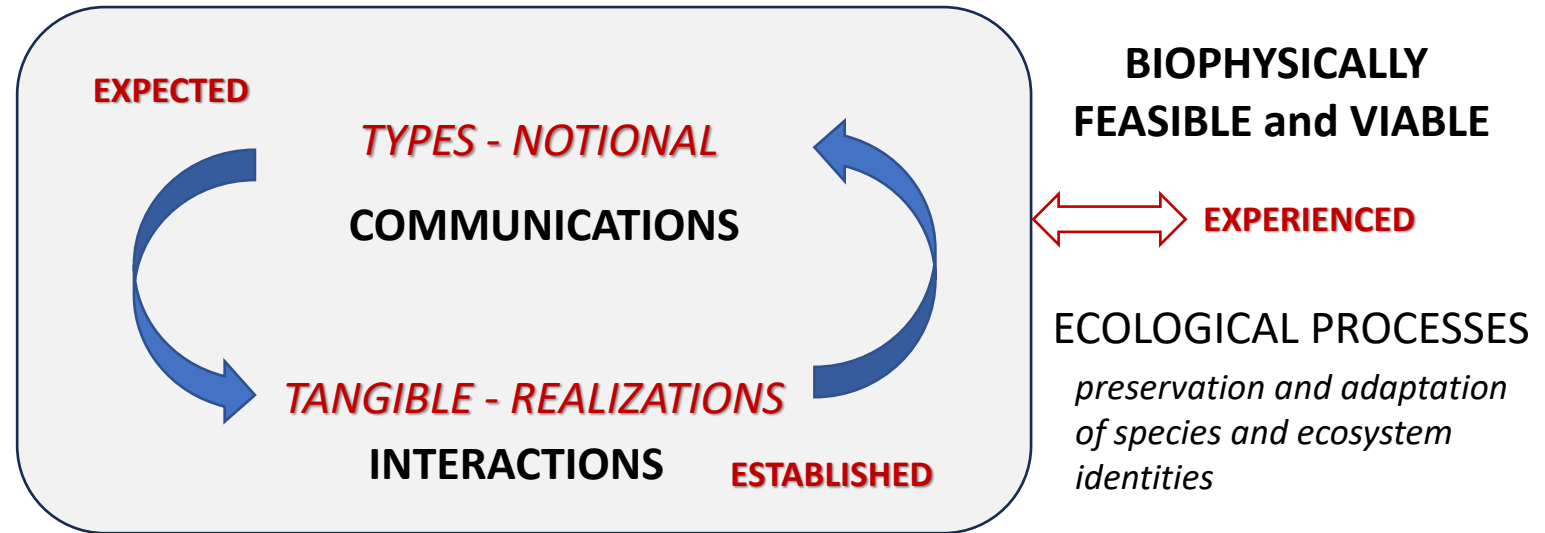
**PSYCHIC STRUCTURE**  
**"IT IS WORTH IT"**

↔ **EXPERIENCED**

**SOCIAL PRACTICES**  
*preservation and adaptation of a shared social identity*

# The biosemiotic process in ecological systems

GAIA, the experience done in the TAO, gives meaning to the process and its components

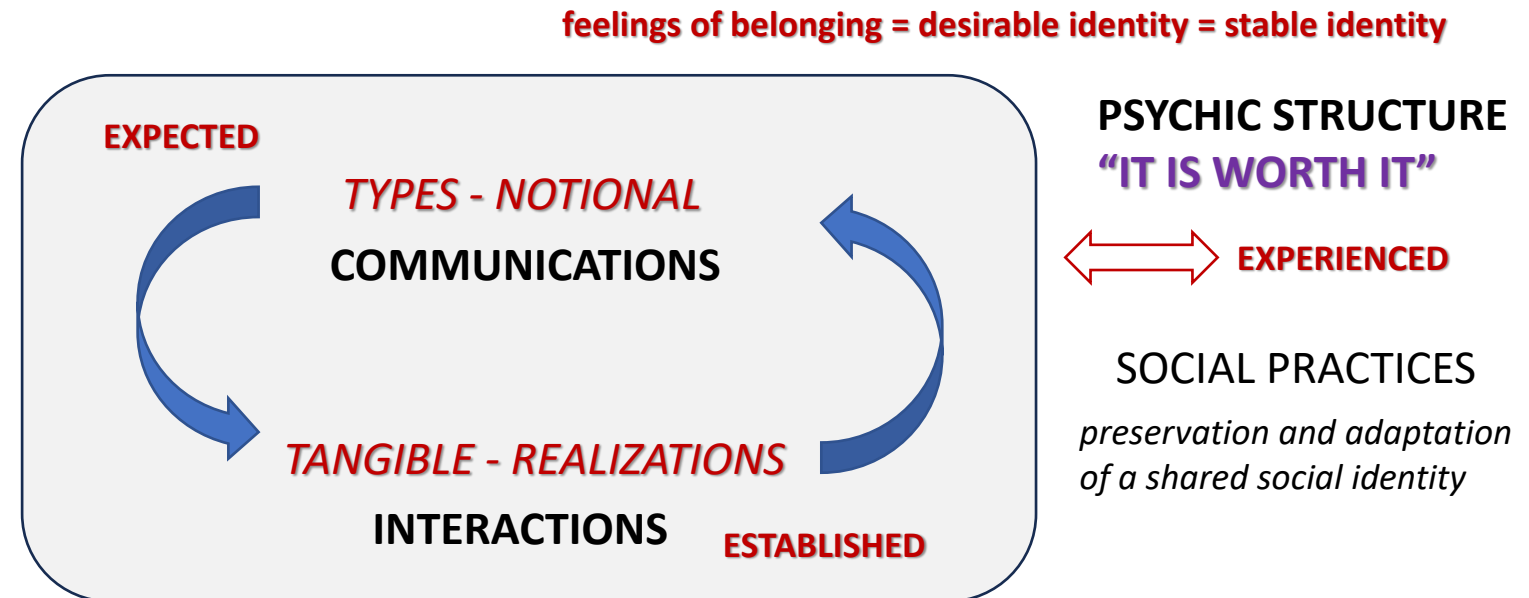


# The biosemiotic process in social-ecological systems

The ability to generate a bundle of “feelings of belonging” to a chosen identity, giving meaning to communications taking place inside the process

SELF-REFERENTIALITY: they use a language to communicate to themselves:

- (i) “who they are”; and
- (ii) “why they do what they do”



Validated knowledge based on narratives/taxonomies referring to types

Shared purpose giving justification to the chosen identity

# COMMUNICATIONS

*knowledge claims*  
institutions  
rules/controls  
data/models

## INTERPRETATION



*POLITICAL POWER*

GUIDING ACTION  
MONITORING AND CONTROL



IDENTITY

## REPRESENT

Validating knowledge

**NOTIONAL SIDE**

**TANGIBLE SIDE**

IDENTITY

LEGITIMIZING  
UPDATING

Sociotechnical  
imaginaries

*MORAL POWER*



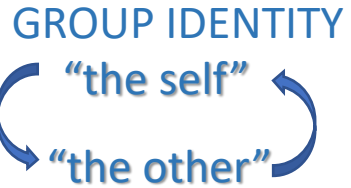
## INTERPRETATION

*affective interactions*

feelings

fears/dreams

archetypes



# INTERACTIONS

## ACT

Using knowledge

## Social Practices



Psychic Structure made of instances of humans feeling the effect of affective interactions

## EMBEDDING ECOSYSTEMS



Metabolic pattern of biophysical interactions

Validated knowledge based on narratives/taxonomies referring to types

Shared purpose giving justification to the chosen identity

# COMMUNICATIONS

*knowledge claims*  
institutions  
rules/controls  
data/models

**INTERPRETATION**



*POLITICAL POWER*

GUIDING ACTION  
MONITORING AND CONTROL

**Ecological Collapse!**

~~EMBEDDING ECOSYSTEMS~~



Metabolic pattern of biophysical interactions

**REPRESENT**

Validating knowledge

**NOTIONAL SIDE**

**TANGIBLE SIDE**

IDENTITY

IDENTITY

# INTERACTIONS

**ACT**

Using knowledge

**Social Practices**



LEGITIMIZING  
UPDATING

Sociotechnical imaginaries

*MORAL POWER*



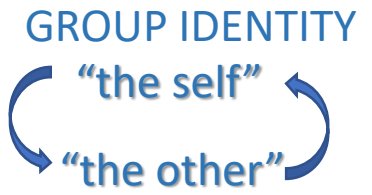
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# COMMUNICATIONS

*knowledge claims*  
institutions  
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data/models

INTERPRETATION



POLITICAL POWER

GUIDING ACTION  
MONITORING AND CONTROL

**Ecological Collapse!**

~~EMBEDDING ECOSYSTEMS~~



Metabolic pattern of biophysical interactions

REPRESENT  
Validating knowledge

NOTIONAL SIDE

TANGIBLE SIDE

IDENTITY

IDENTITY

# INTERACTIONS

ACT  
Using knowledge

Social Practices



LEGITIMIZING  
UPDATING

Sociotechnical imaginaries

MORAL POWER



INTERPRETATION

*affective interactions*

feelings

fears/dreams

archetypes

**Loss of purpose**



Psychic Structure made of instances of humans feeling the effect of affective interactions

~~Validated knowledge based on narratives, taxonomies referring to types~~

**Policy legends!**

Shared purpose giving justification to the chosen identity

# COMMUNICATIONS

*knowledge claims*  
institutions  
rules/controls  
data/models

**REPRESENT**  
Validating knowledge

LEGITIMIZING  
UPDATING  
Sociotechnical imaginaries

**INTERPRETATION**

IDENTITY

**NOTIONAL SIDE**

IDENTITY

**INTERPRETATION**

**TANGIBLE SIDE**

*MORAL POWER*

*POLITICAL POWER*

*affective interactions*

GUIDING ACTION  
MONITORING AND CONTROL

**Ecological Collapse!**

**Loss of purpose**

# INTERACTIONS

**ACT**

feelings  
fears/dreams  
archetypes

~~GROUP IDENTITY  
the self  
the other~~

Using knowledge

**Social Practices**



Psychic Structure made of instances of humans feeling the effect of affective interactions

~~EMBEDDING ECOSYSTEMS~~

*outside*  
Metabolic pattern of biophysical interactions

~~Validated knowledge based on narratives, taxonomies referring to types~~

**Policy legends!**

**Delirium** ← ~~Shared purpose giving justification to the chosen identity~~

# COMMUNICATIONS

*knowledge claims*  
institutions  
rules/controls  
data/models

**REPRESENT**  
Validating knowledge

LEGITIMIZING  
UPDATING  
**Sociotechnical imaginaries**

**INTERPRETATION**

IDENTITY

**NOTIONAL SIDE**

IDENTITY

**INTERPRETATION**

**TANGIBLE SIDE**

*POLITICAL POWER*

*MORAL POWER*

*affective interactions*

GUIDING ACTION  
MONITORING AND CONTROL

**Ecological Collapse!**

# INTERACTIONS

**ACT**

feelings  
fears/dreams  
archetypes  
~~GROUP IDENTITY  
the self  
the other~~

Using knowledge

**Psychic Structure made of instances of humans feeling the effect of affective interactions**

~~EMBEDDING ECOSYSTEMS~~

*outside* → **Metabolic pattern of biophysical interactions** ← *inside*

**Social Practices** *inside*

~~Validated knowledge based on narratives/taxonomies referring to types~~

**Policy legends!**

**Delirium**

~~Shared purpose giving justification to the chosen identity~~

knowledge claims

rules/c

data/mo

INTERPRETATION



POLITICAL POWER

GUIDING ACTION

MONITORING AND COM

**Ecological Collapse!**

~~EMBEDDING ECOSYSTEMS~~

outside

Metabolic pattern of biophysical interactions

**Social Practices**

inside

instances of humans feeling the effect of affective interactions



Sociotechnical imaginaries

POLITICAL POWER

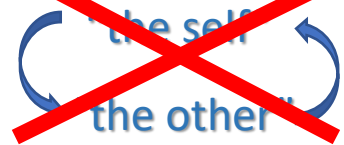


INTERPRETATION

interactions

**Loss of purpose**

~~GROUP IDENTITY~~



structure made of



If you can read this slide, then you are still alive!

CONGRATULATIONS!

Thanks for your heroic attention

<Mario.Giampietro1@gmail.com>

ADDITIONAL MATERIAL  
FOR FURTHER DISCUSSIONS

**The process of validation of the identity of the lower-level holon as a useful component of the functional cycle can be defined by using the 4 Aristotelian causes introduced in relational biology.**

The process of validation of the identity of the lower-level holon as a useful component of the functional cycle can be defined by using the 4 Aristotelian causes introduced in relational biology.

**TANGIBLE**

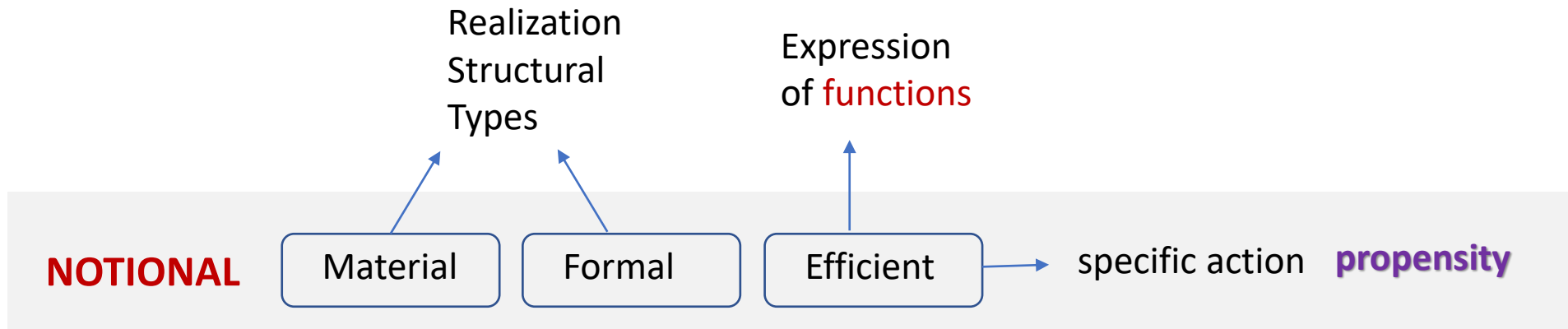
Realization  
Structural  
Types

**NOTIONAL**



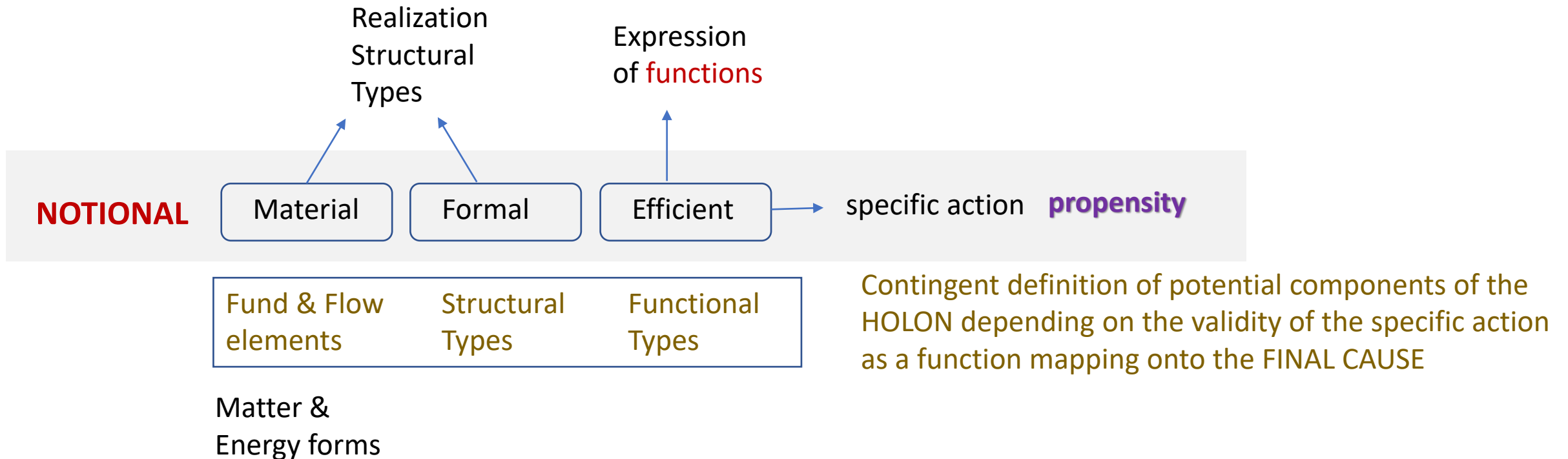
The process of validation of the identity of the lower-level holon as a useful component of the functional cycle can be defined by using the 4 Aristotelian causes introduced in relational biology.

## TANGIBLE

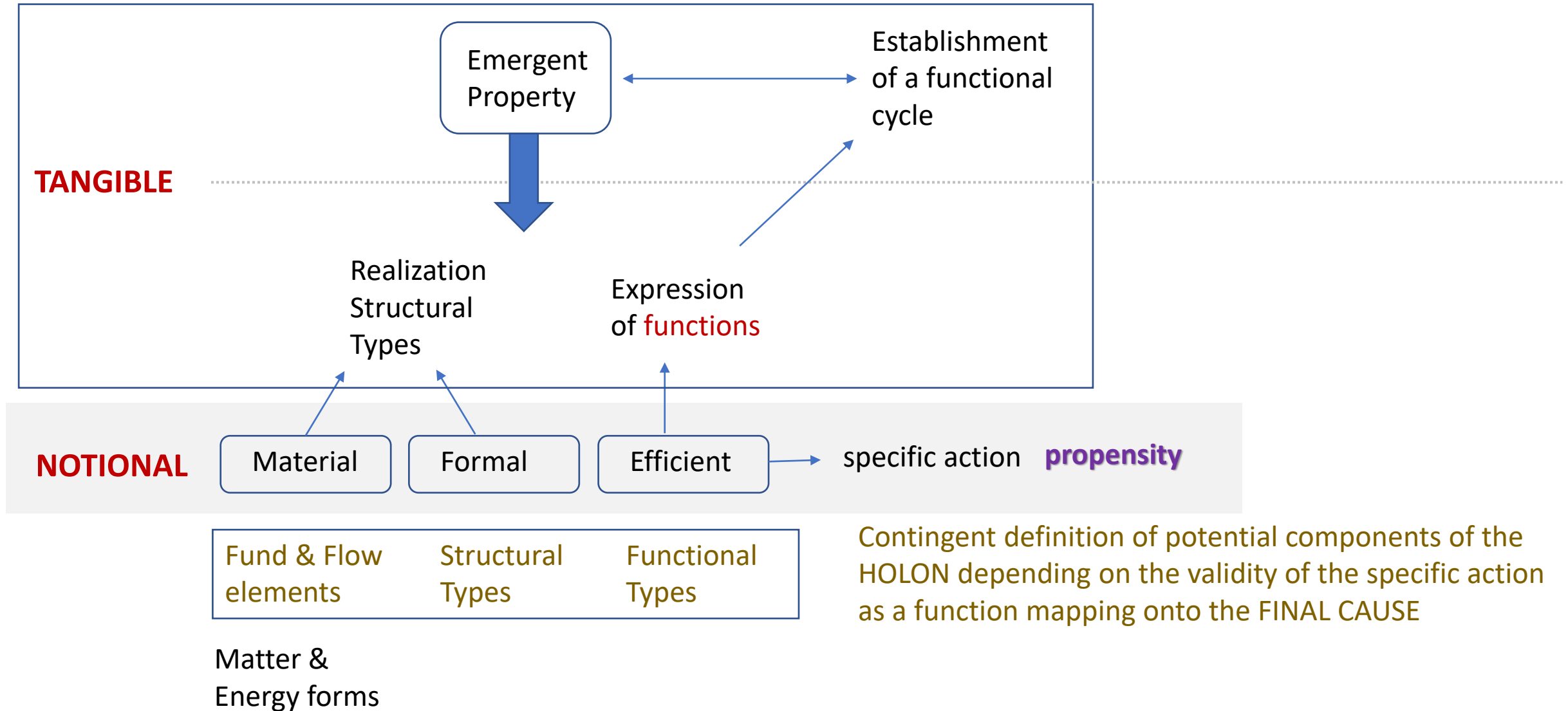


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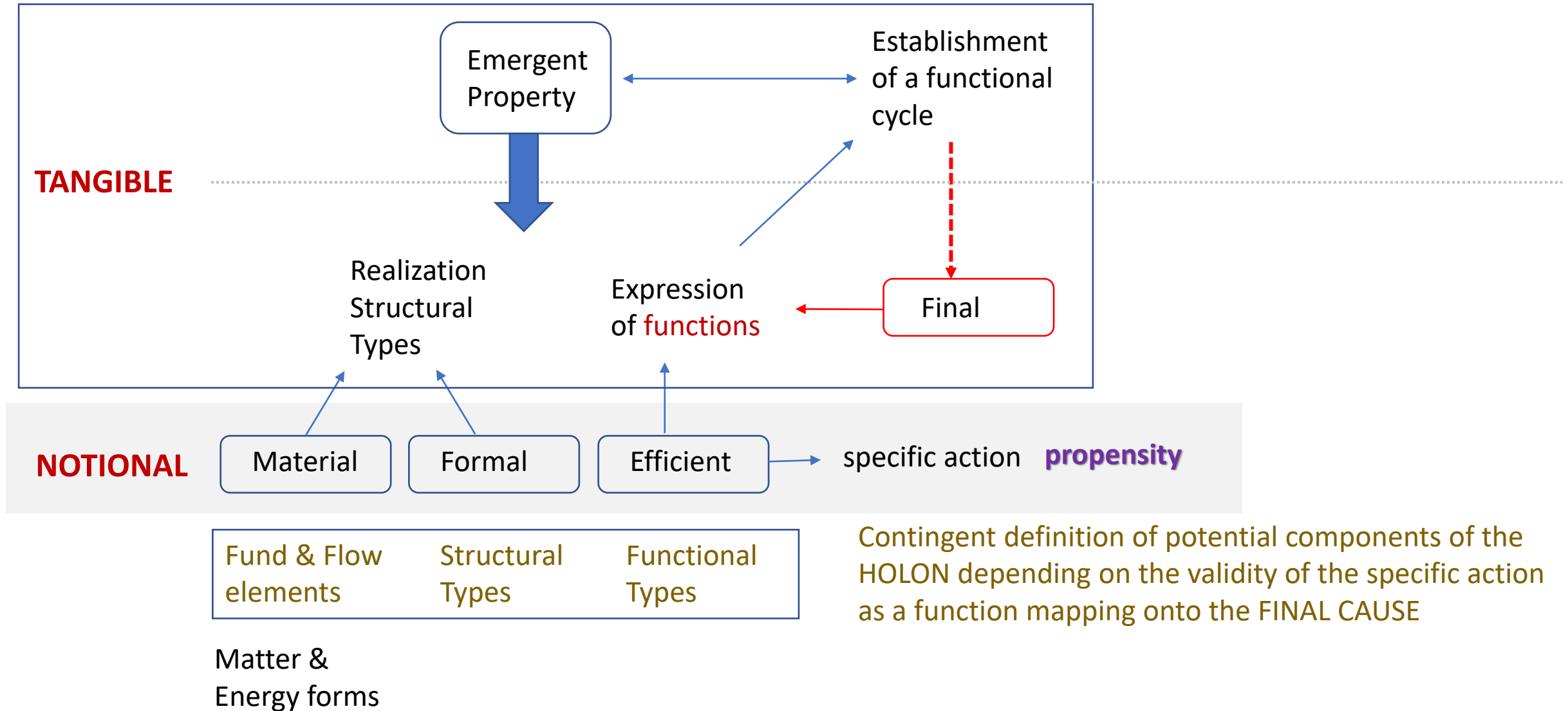
## TANGIBLE



The process of validation of the identity of the lower-level holon as a useful component of the functional cycle can be defined by using the 4 Aristotelian causes introduced in relational biology.

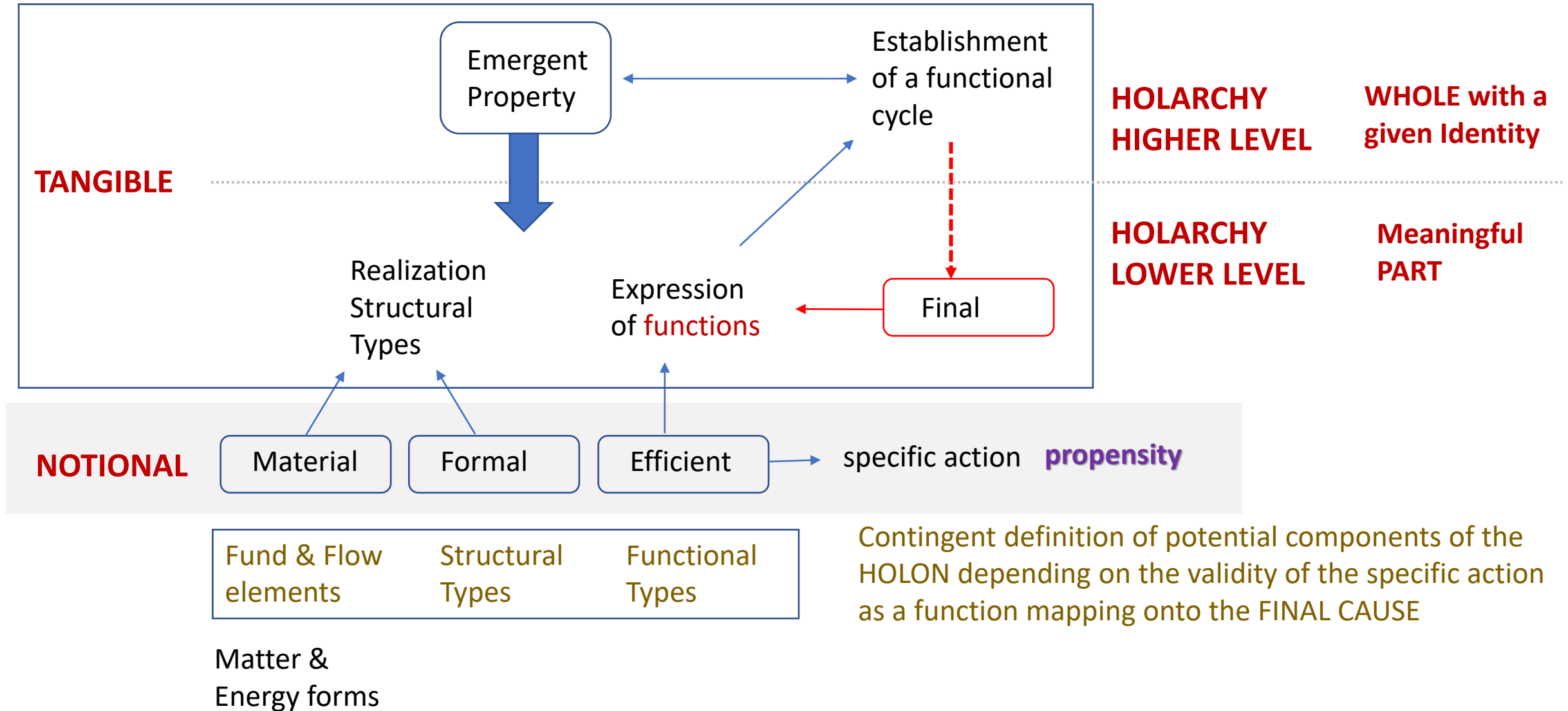


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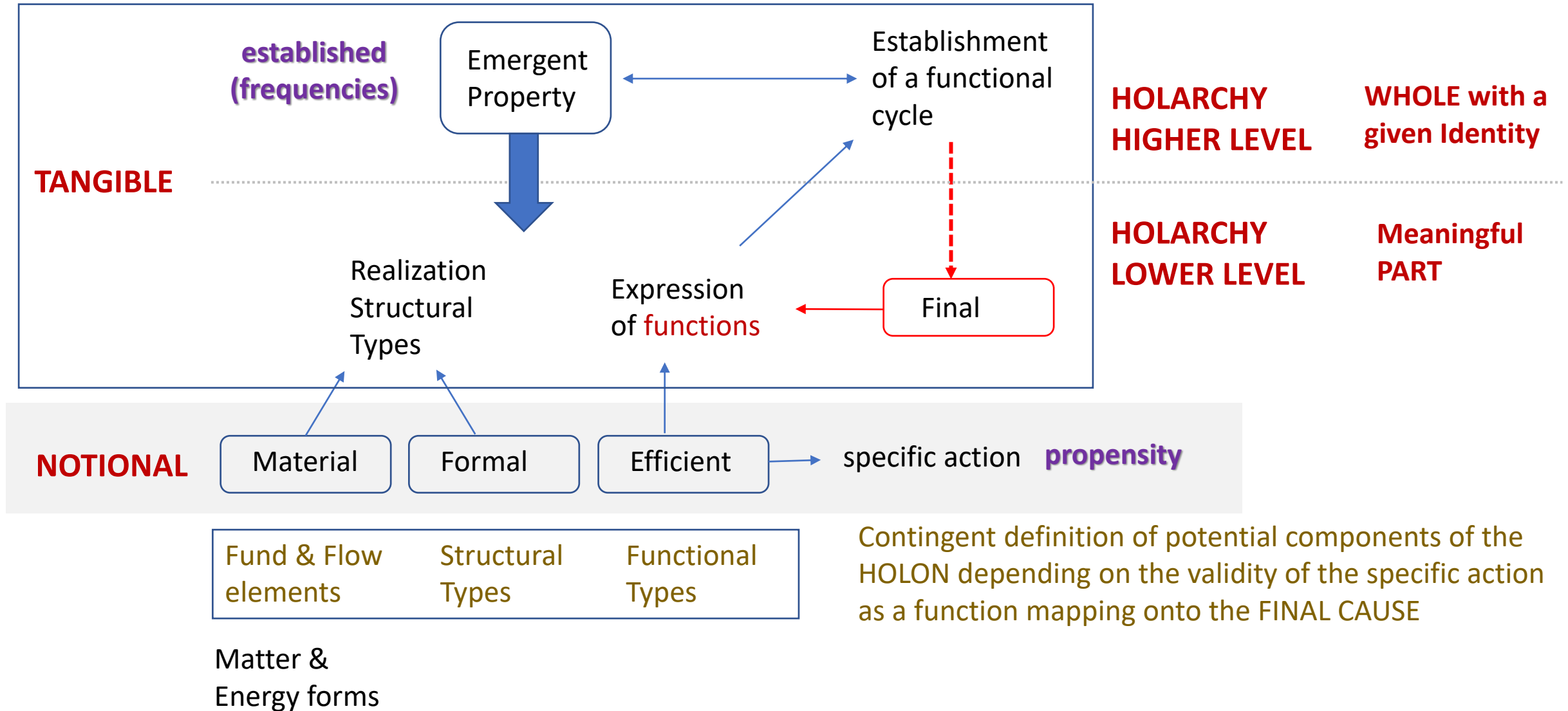




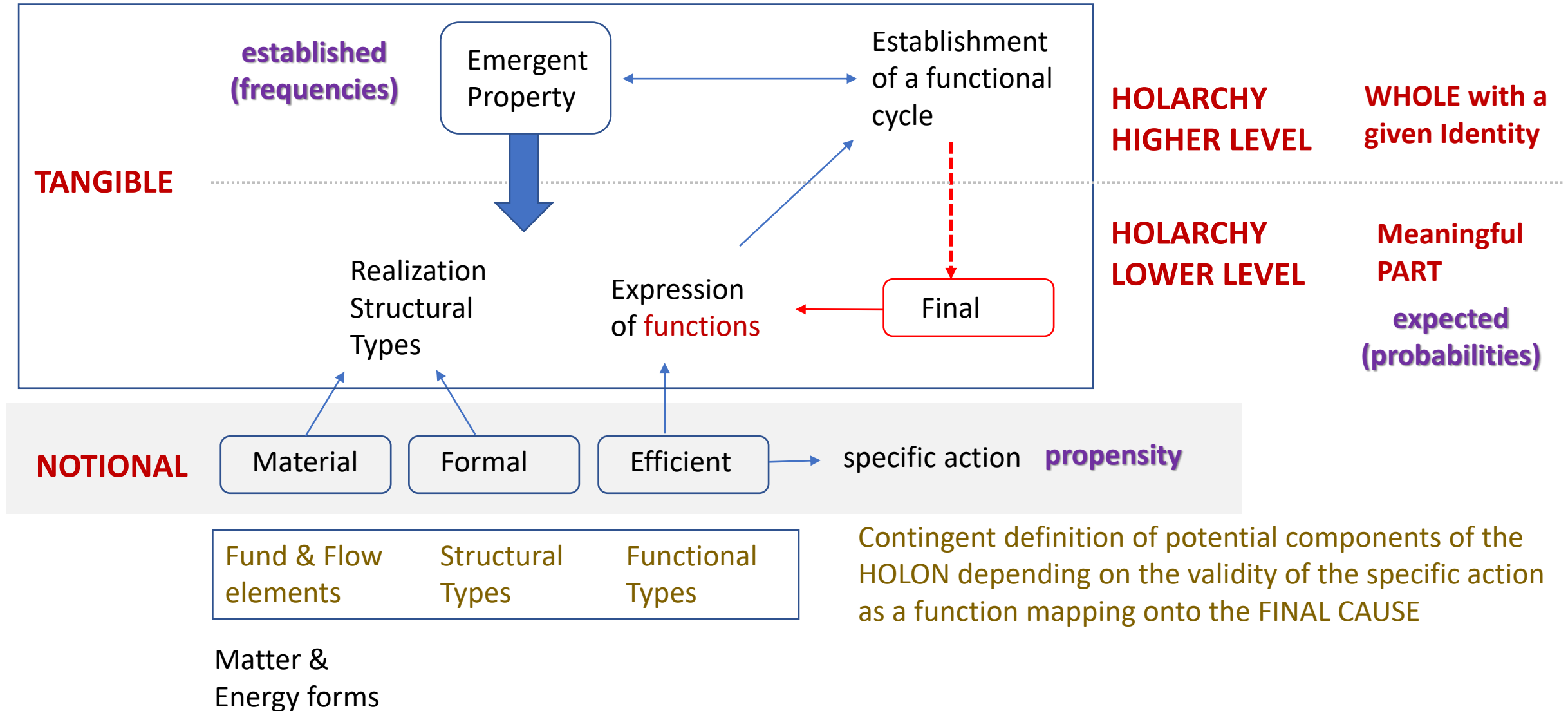
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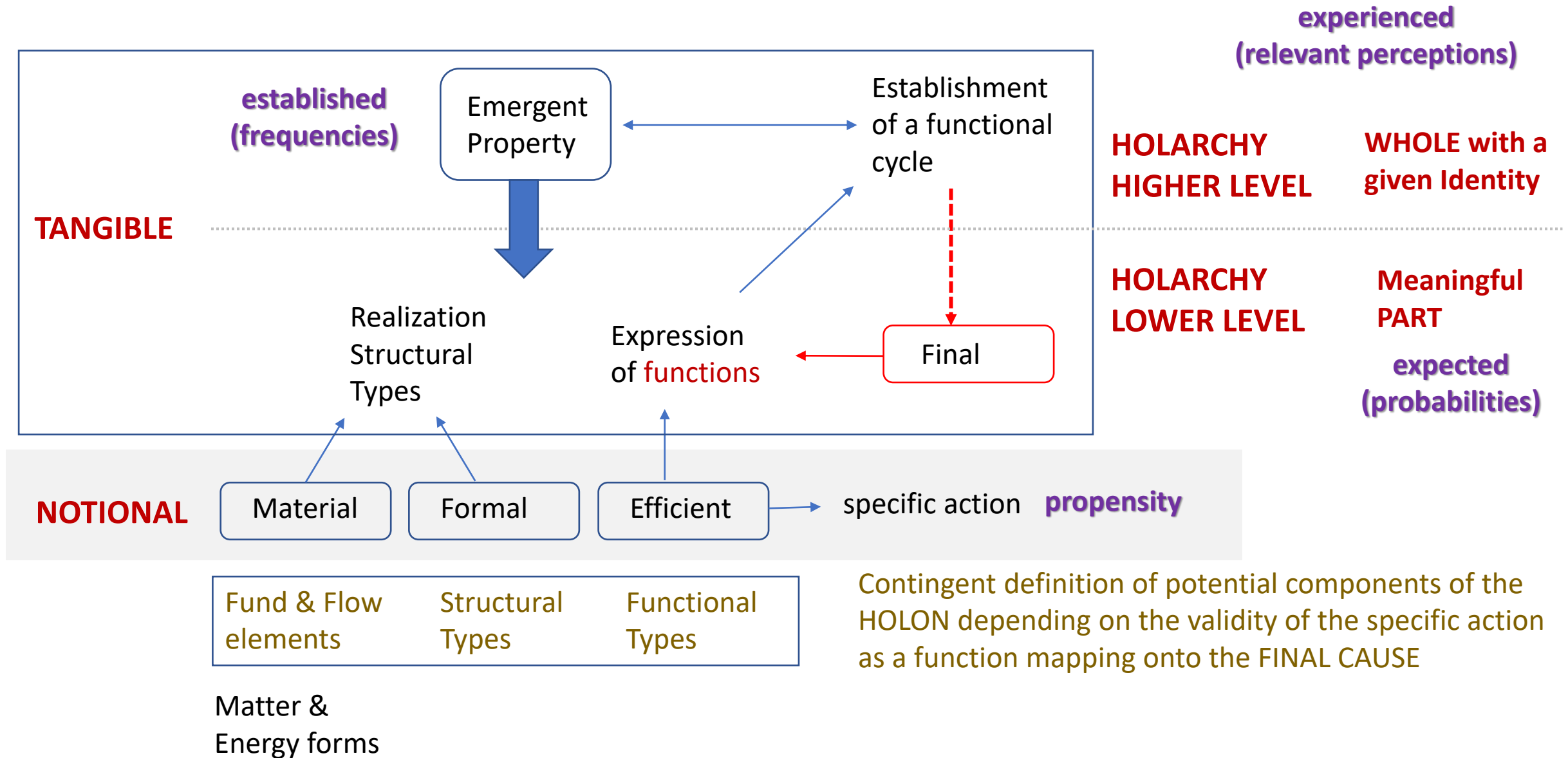
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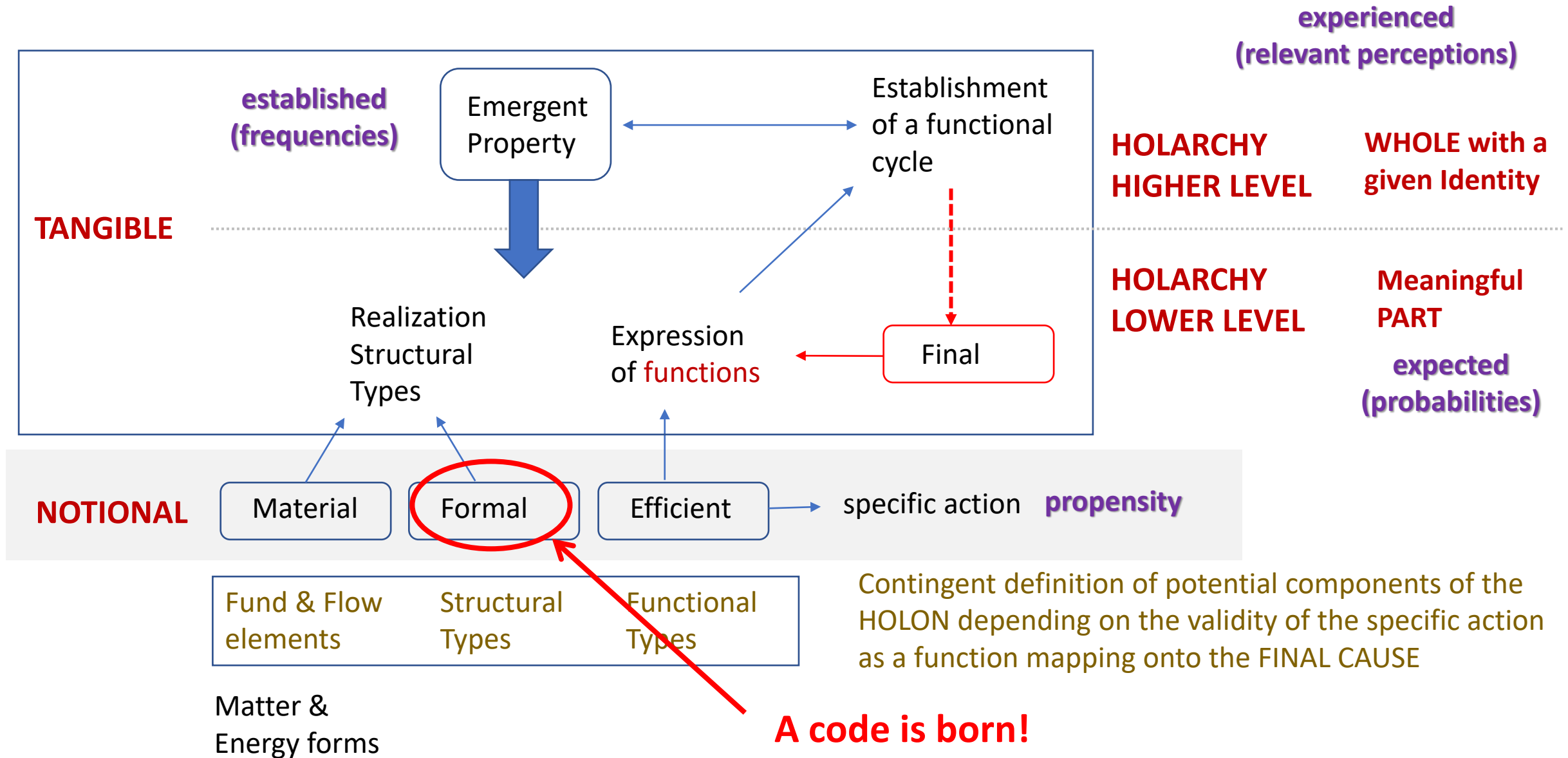
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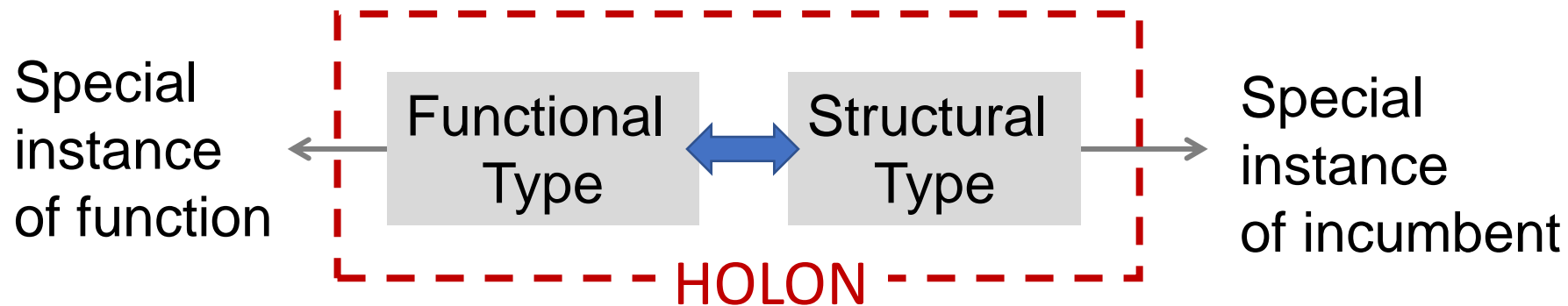


A holon is a unit of meaning that we use to identify a relevant agent recognized as a pertinent combination of a functional and a structural type.

However, when we are observing the external world we are observing **entities** that we perceive as being **special instances** of holons – ***a realization of a given combination of functional and structural types!***

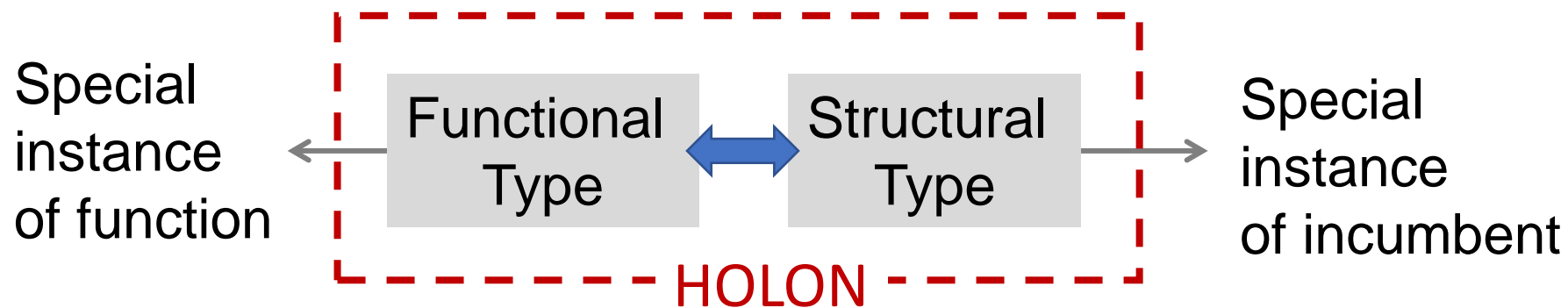
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A holon is a unit of meaning that we use to identify a relevant agent recognized as a pertinent combination of a functional and a structural type.

However, when we are observing the external world we are observing **entities** that we perceive as being **special instances** of holons – ***a realization of a given combination of functional and structural types!***



*US Presidency in 1817*  
*vs*  
*US Presidency in 2017*

*U.S. President*

*Trump*  
*vs*  
*Biden*



# MANY-TO-ONE and ONE-TO-MANY mappings when dealing with HOLONs



*A spectre is haunting  
Reductionism . . .*

# MANY-TO-ONE and ONE-TO-MANY mappings when dealing with HOLONs

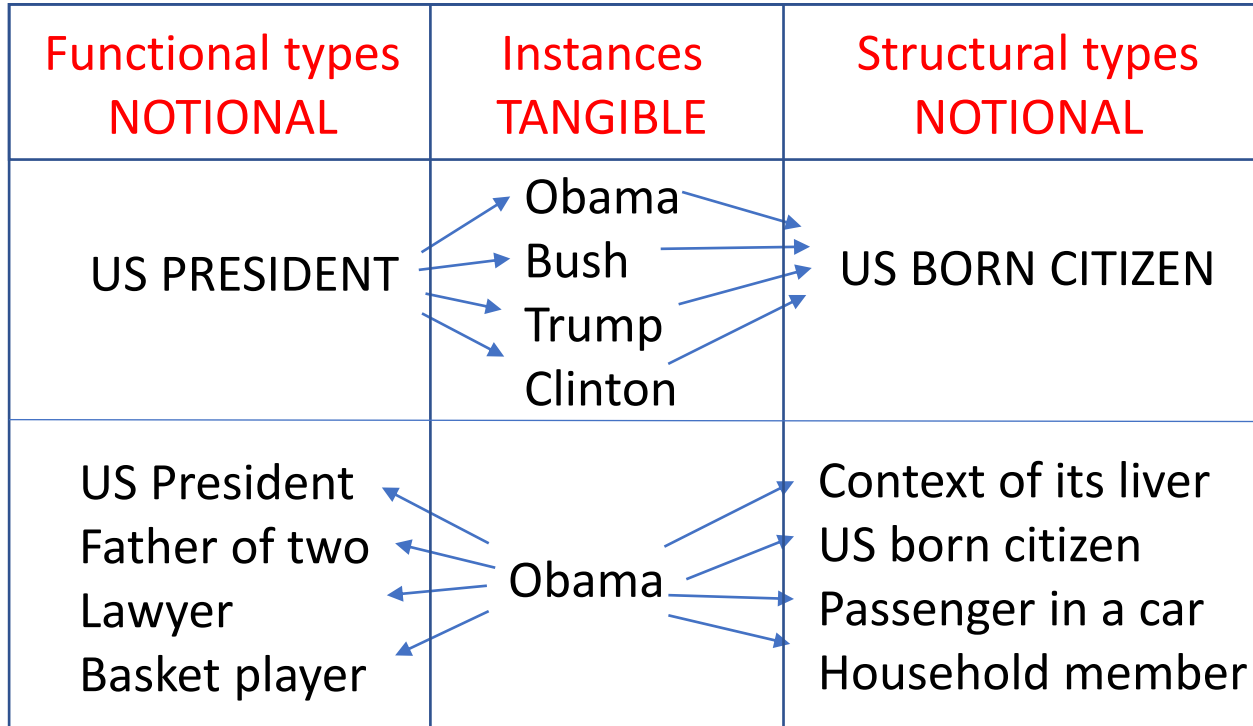
Functional types NOTIONAL	Instances TANGIBLE	Structural types NOTIONAL
US PRESIDENT	Obama Bush Trump Clinton	US BORN CITIZEN
US President Father of two Lawyer Basket player	Obama	Context of its liver US born citizen Passenger in a car Household member

**SYNCHRONIC**



*A spectre is haunting  
Reductionism . . .*

# MANY-TO-ONE and ONE-TO-MANY mappings when dealing with HOLONs

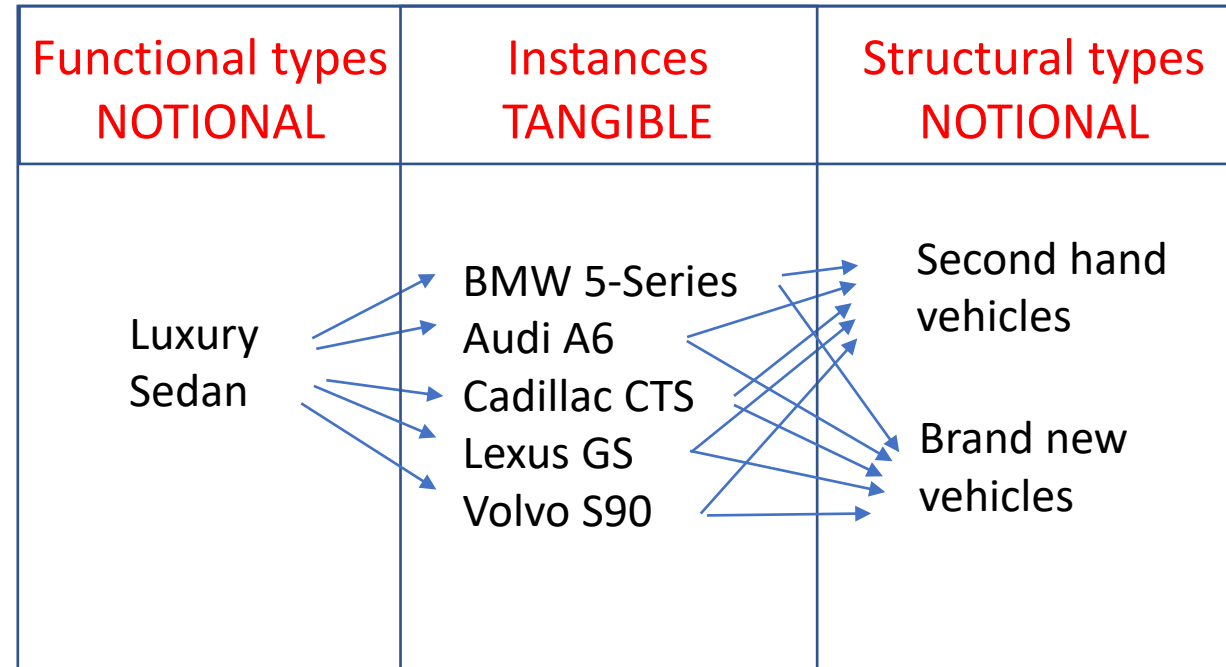


**SYNCHRONIC**

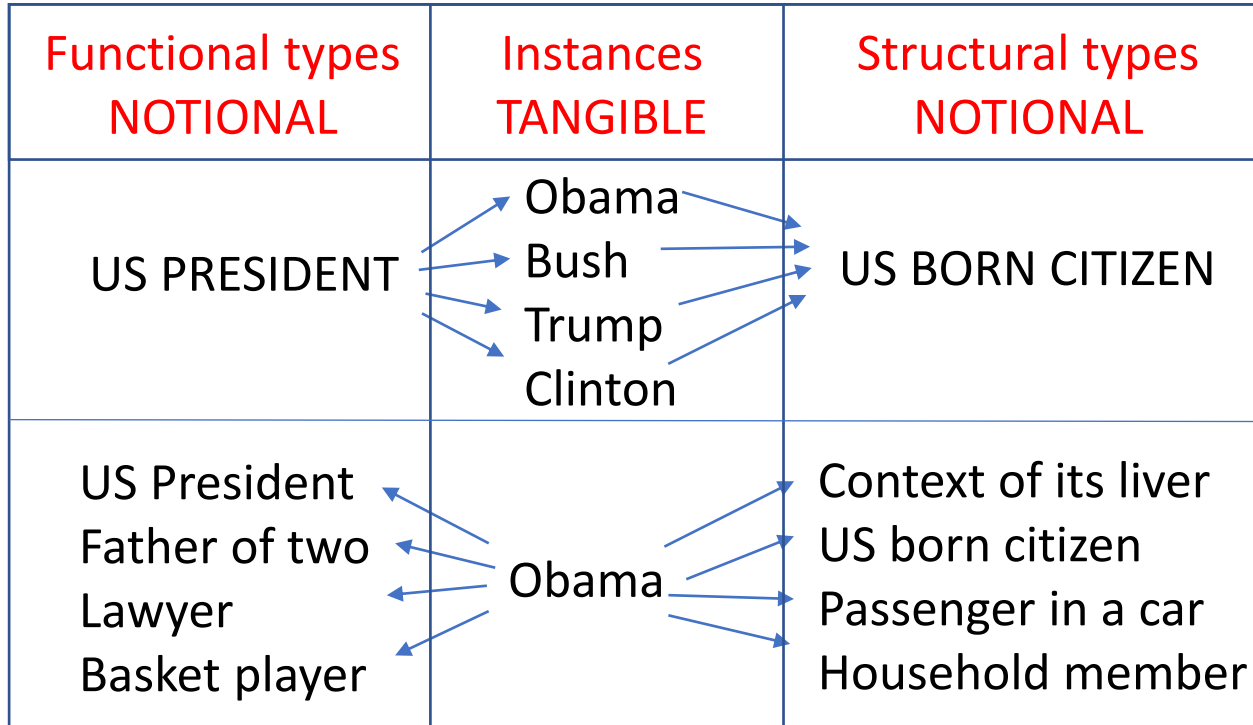


*A spectre is haunting  
Reductionism . . .*

**DIACHRONIC**



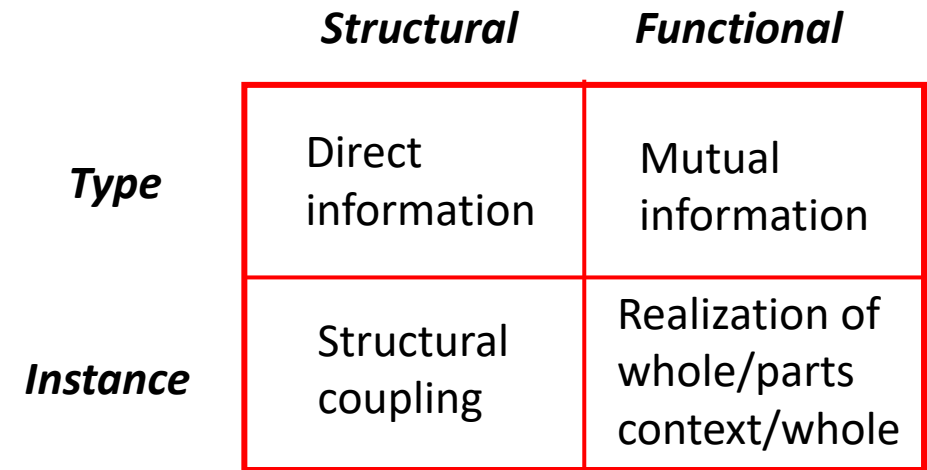
# MANY-TO-ONE and ONE-TO-MANY mappings when dealing with HOLONs



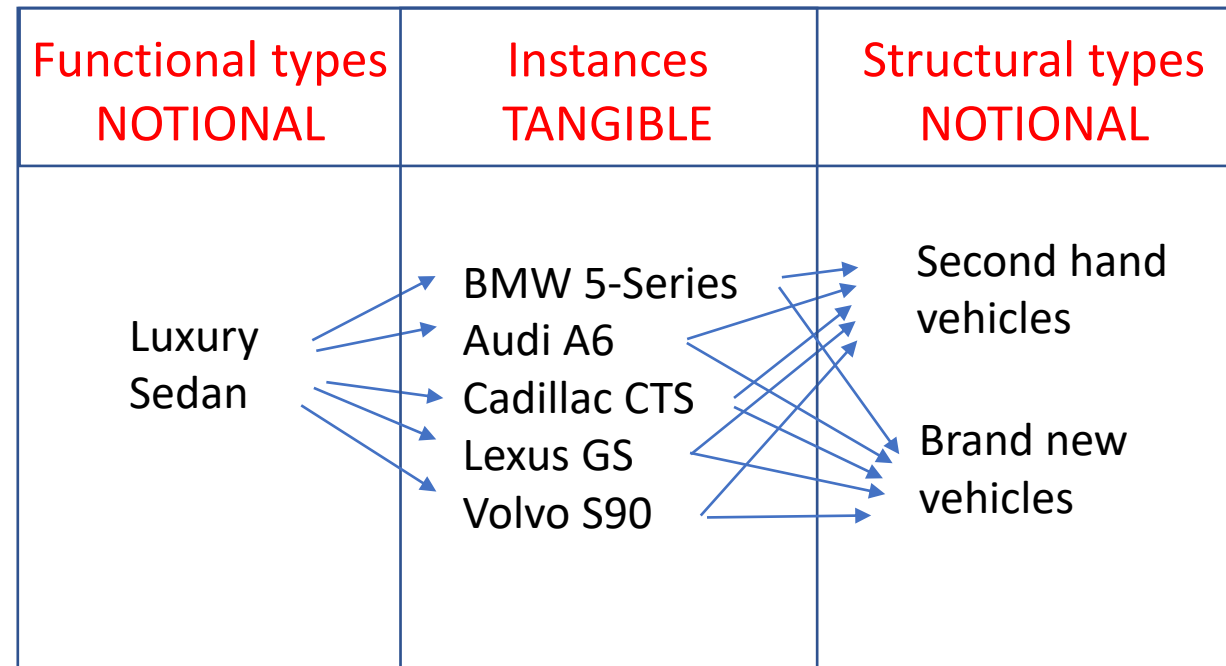
**SYNCHRONIC**



*A spectre is haunting  
Reductionism . . .*



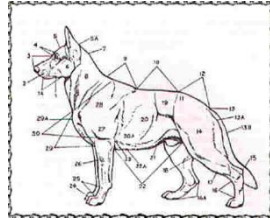
**DIACHRONIC**





“Thor” (a dog) on the  
Golden Beach of  
Istanbul

observer's knowledge  
about dogs



*Notional*



“Thor” (a dog) on the  
Golden Beach of  
Istanbul

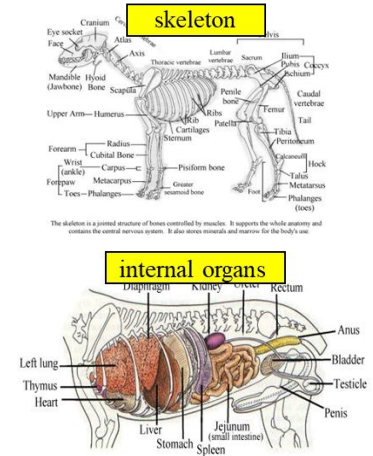
**ONTOLOGY** allowing a representation of  
the relations over attributes, types, categories



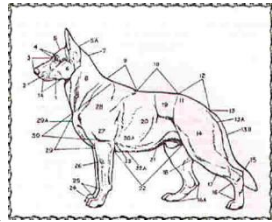
the 4 varieties of  
Belgian shepherd



face pattern



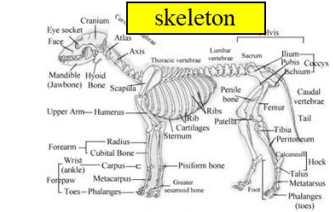
observer's knowledge about dogs



**ONTOLOGY** allowing a representation of the relations over attributes, types, categories



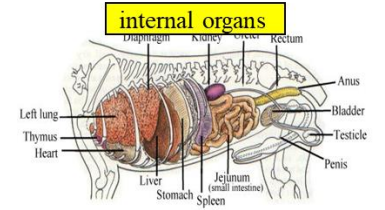
the 4 varieties of Belgian shepherd



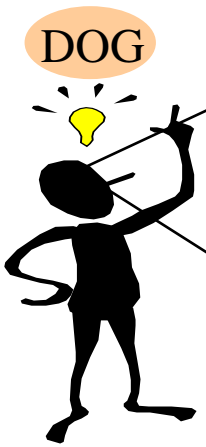
skeleton



face pattern



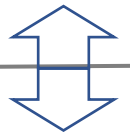
internal organs



**EPISTEMIC CUT**

LOCAL SCALE

*Notional*



LARGE SCALE



“Thor” (a dog) on the Golden Beach of Istanbul

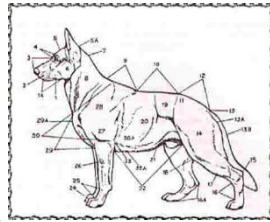
PERRO

CANE

CHIEN

DOG

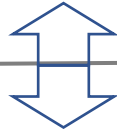
observer's knowledge about dogs



Notional

EPISTEMIC CUT

LOCAL SCALE



LARGE SCALE

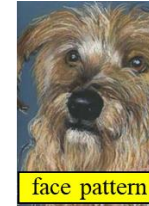


"Thor" (a dog) on the Golden Beach of Istanbul

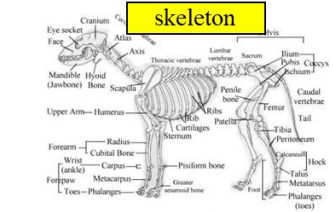
ONTOLOGY allowing a representation of the relations over attributes, types, categories



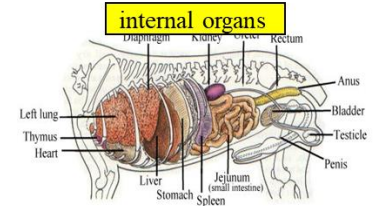
the 4 varieties of Belgian shepherd



face pattern



skeleton



internal organs



HUND

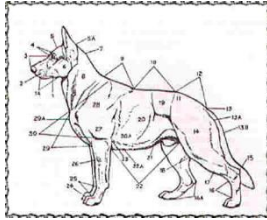
PERRO

CANE

CHIEN

DOG

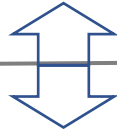
observer's knowledge about dogs



Notional

EPISTEMIC CUT

LOCAL SCALE



LARGE SCALE



“Thor” (a dog) on the Golden Beach of Istanbul

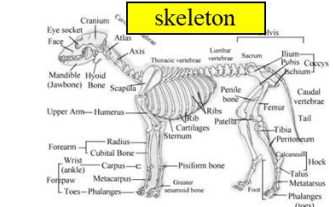
ONTOLOGY allowing a representation of the relations over attributes, types, categories



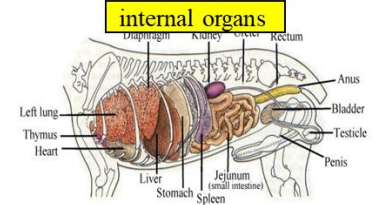
the 4 varieties of Belgian shepherd



face pattern



skeleton



internal organs

...

HUND

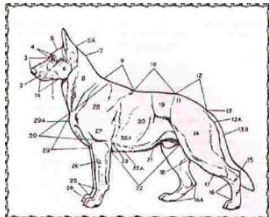
PERRO

CANE

CHIEN

DOG

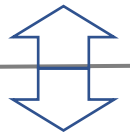
observer's knowledge about dogs



Notional

EPISTEMIC CUT

LOCAL SCALE



LARGE SCALE



"Thor" (a dog) on the Golden Beach of Istanbul

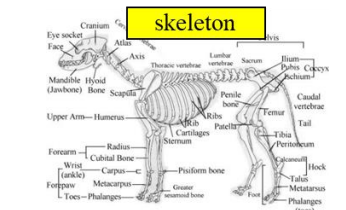
ONTOLOGY allowing a representation of the relations over attributes, types, categories



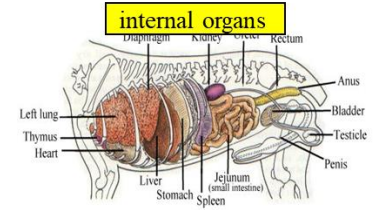
the 4 varieties of Belgian shepherd



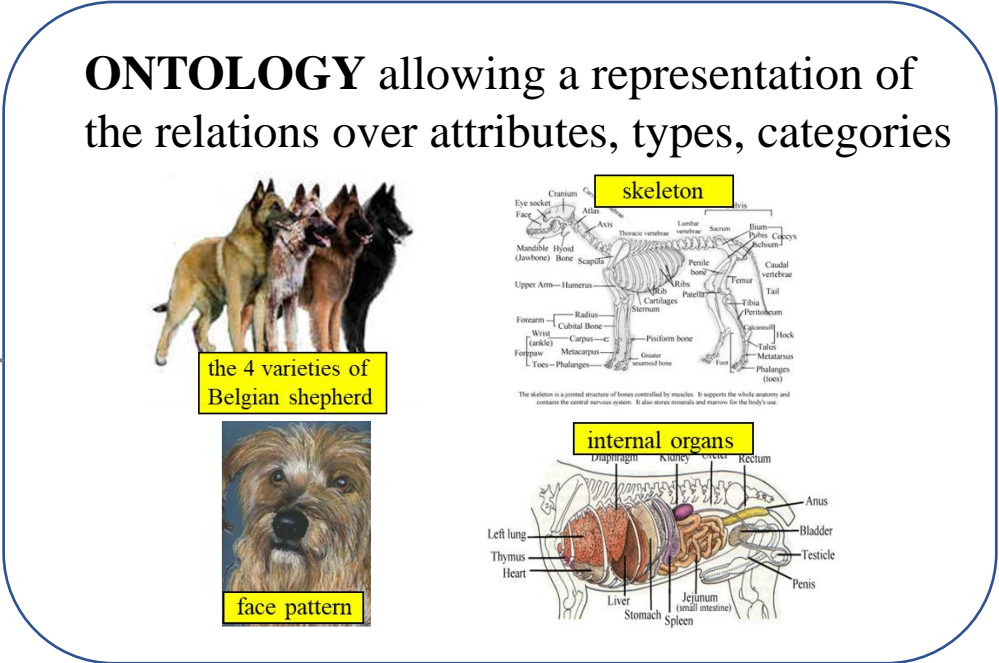
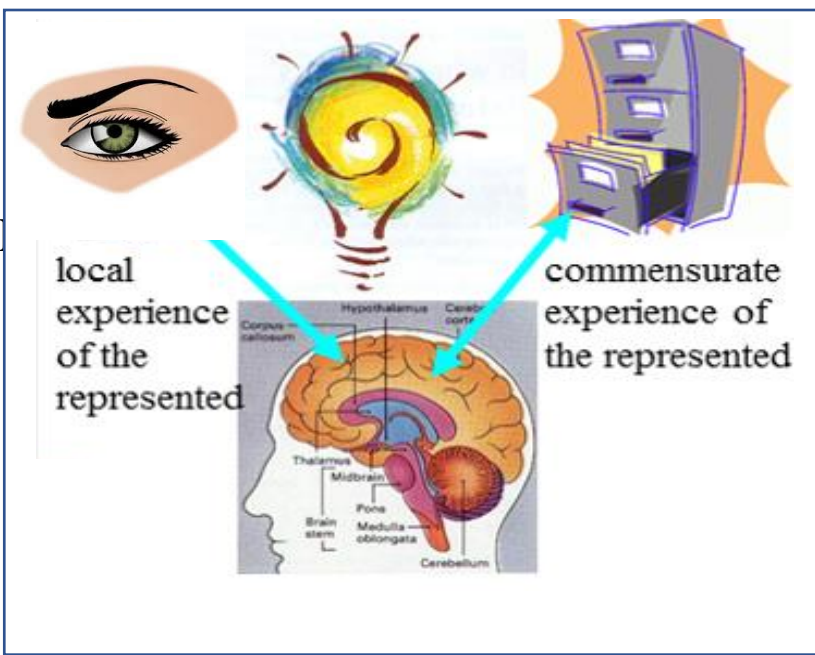
face pattern



skeleton



internal organs



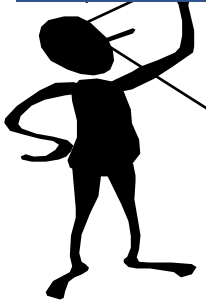
*Notional*

**EPISTEMIC CUT**

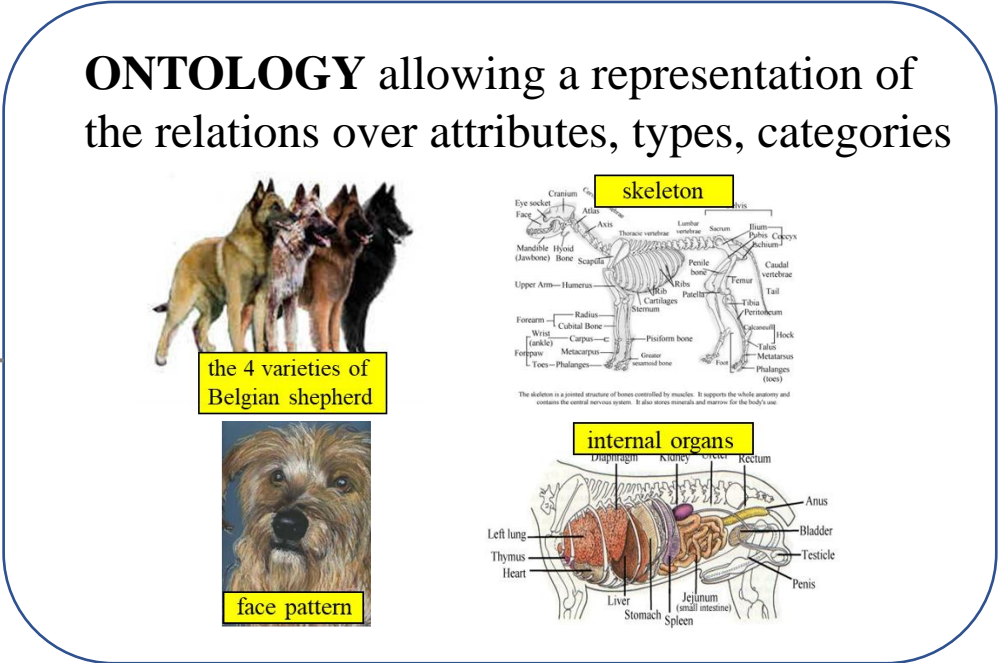
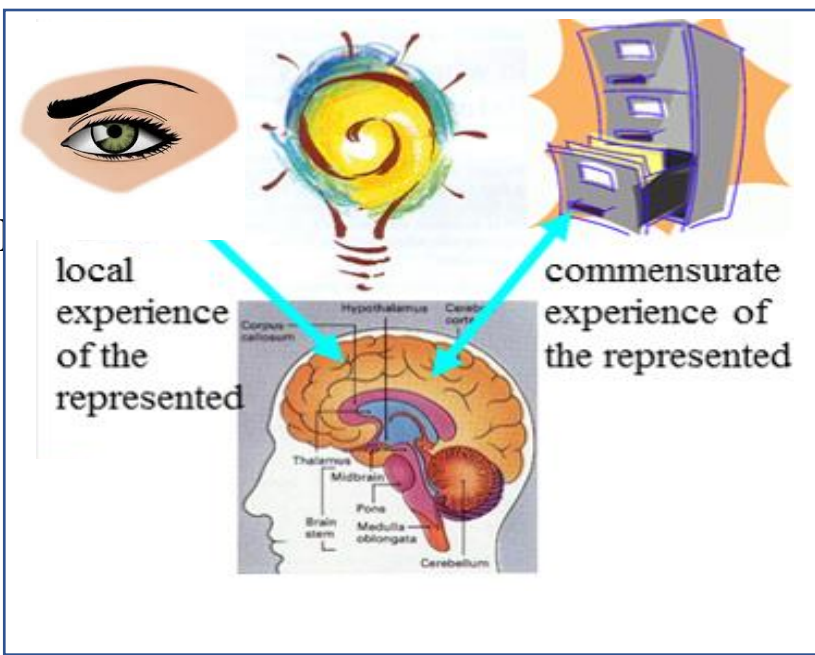
LOCAL SCALE



LARGE SCALE



“Thor” (a dog) on the Golden Beach of Istanbul



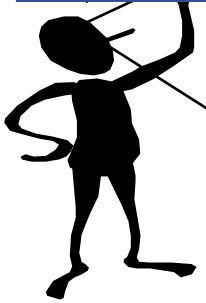
*Notional*

**EPISTEMIC CUT**

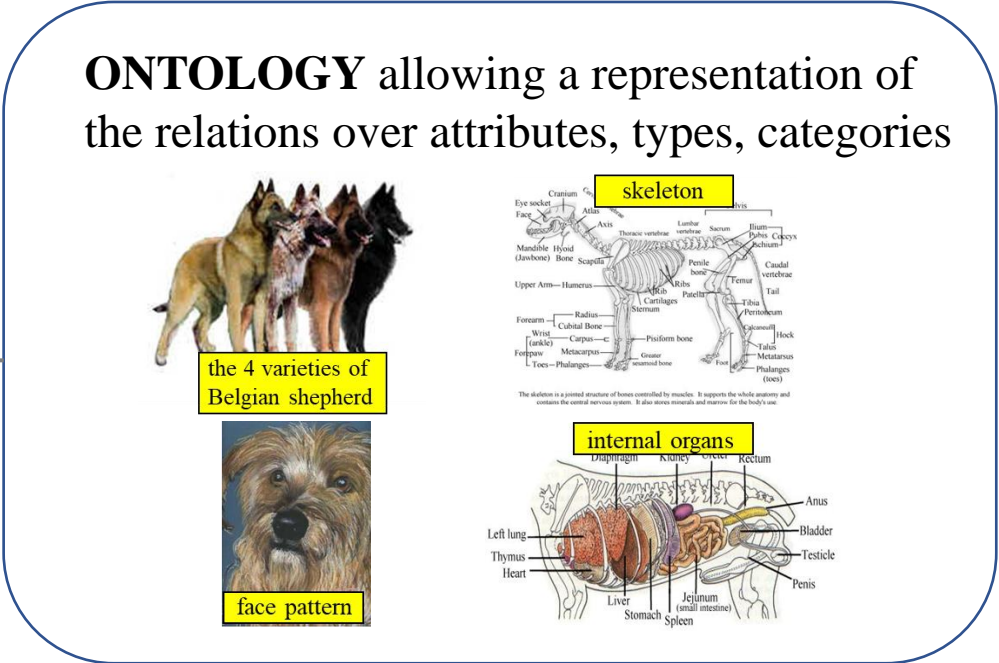
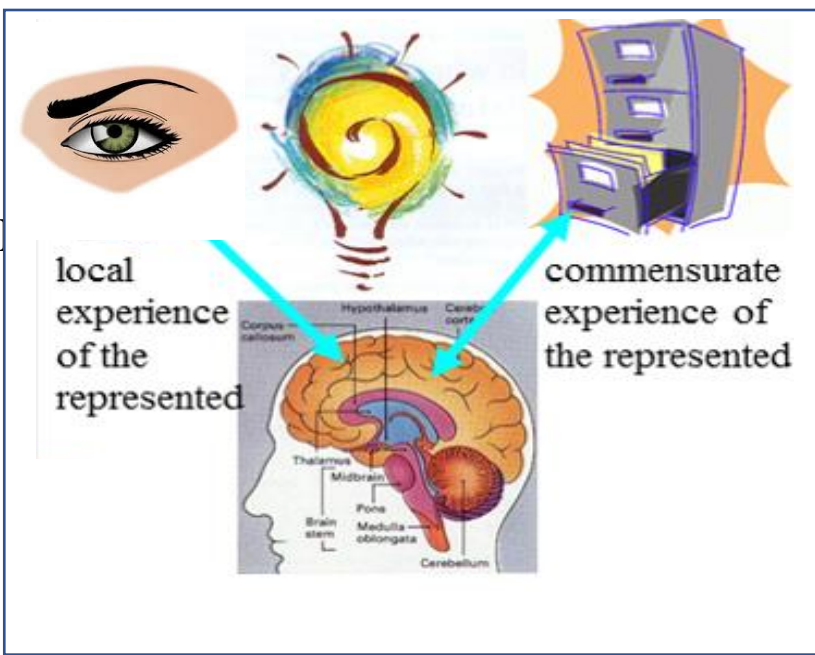
LOCAL SCALE



LARGE SCALE



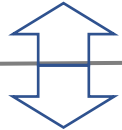
“Thor” (a dog) on the Golden Beach of Istanbul



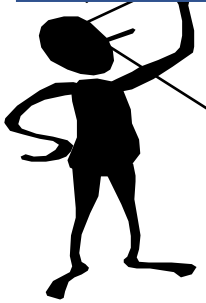
*Notional*

**EPISTEMIC CUT**

LOCAL SCALE



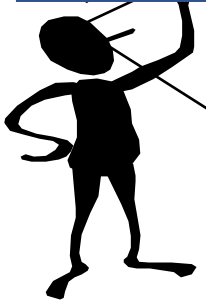
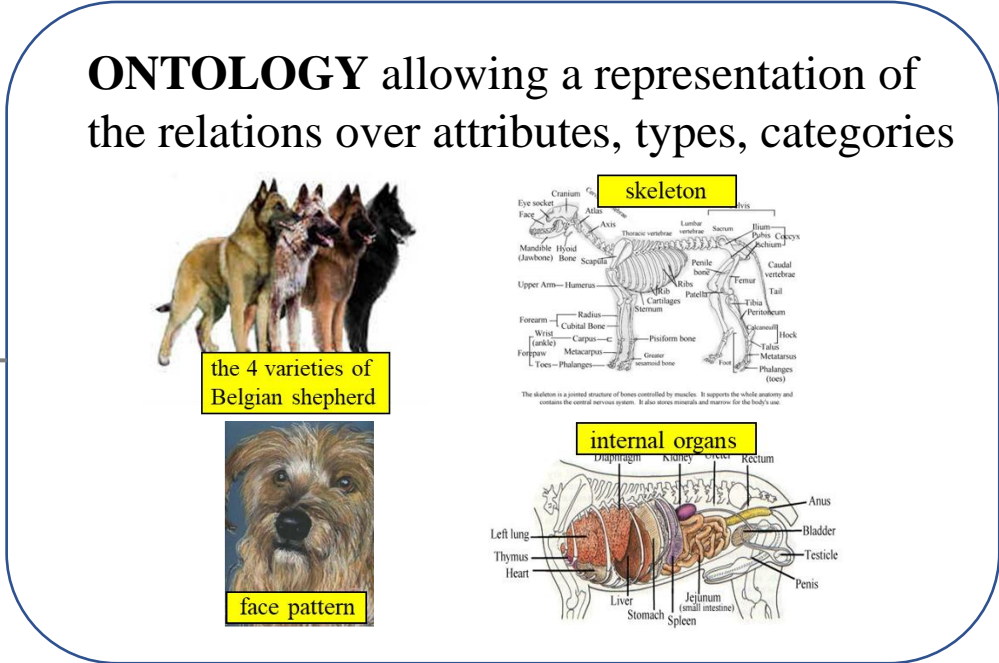
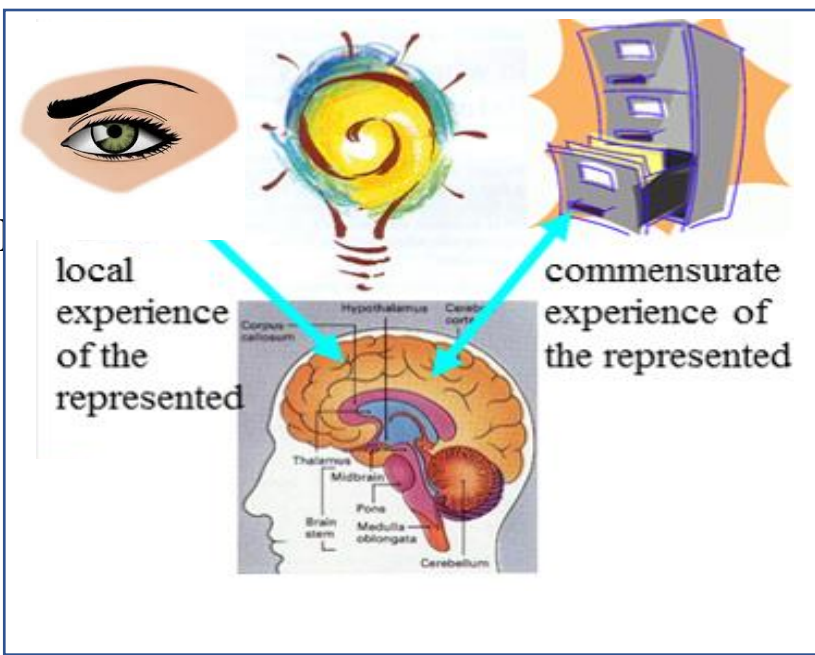
LARGE SCALE



Instance of organism belonging to the species *Canis Familiaris*



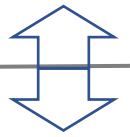
“Thor” (a dog) on the Golden Beach of Istanbul



**EPISTEMIC CUT**

LOCAL SCALE

Notional



LARGE SCALE

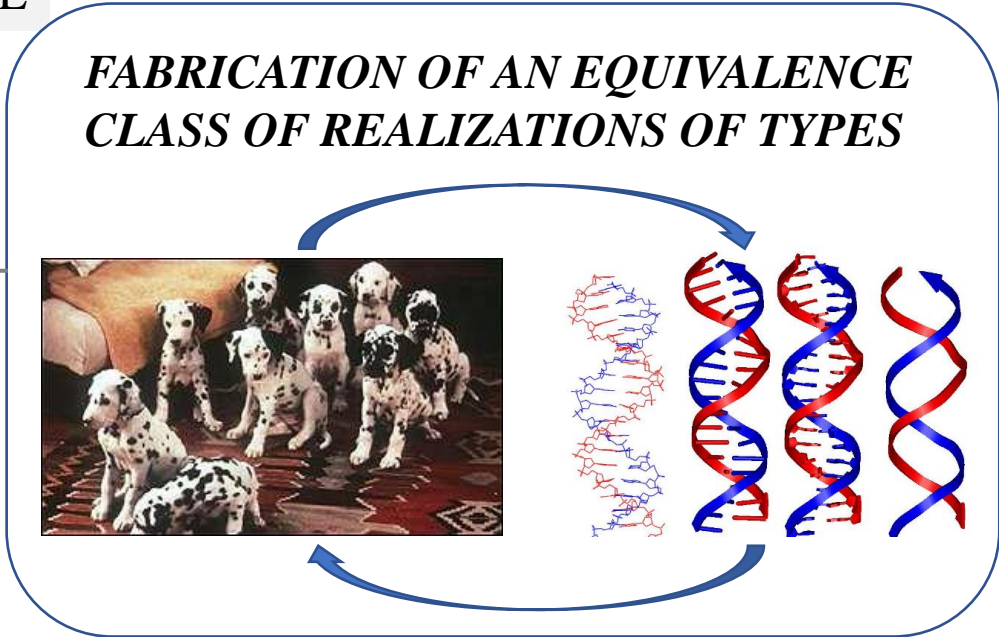
Tangible

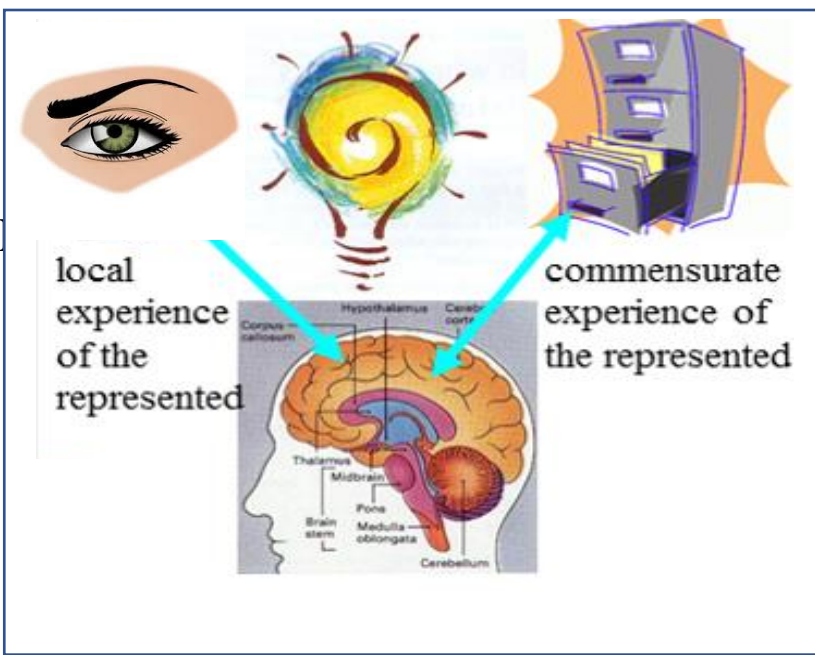
Instance of organism belonging to the species *Canis Familiaris*



“Thor” (a dog) on the Golden Beach of Istanbul

**LARGER SCALE!**



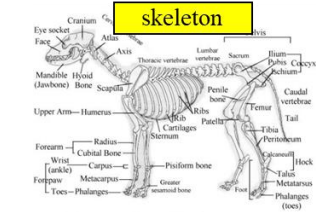


**Expected**

**ONTOLOGY** allowing a representation of the relations over attributes, types, categories



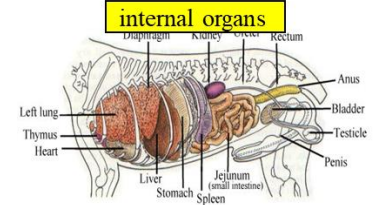
the 4 varieties of Belgian shepherd



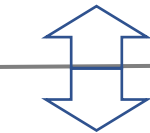
The skeleton is a general structure of bones controlled by muscles. It supports the whole anatomy and contains the central nervous system. It also stores minerals and reserves for the body's use.



face pattern



*Notional*

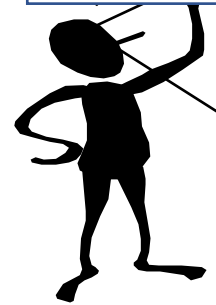


*Tangible*

**EPISTEMIC CUT**

LOCAL SCALE

LARGE SCALE



**Experiences**

Instance of organism belonging to the species *Canis Familiaris*

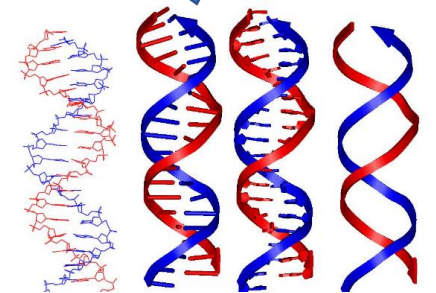


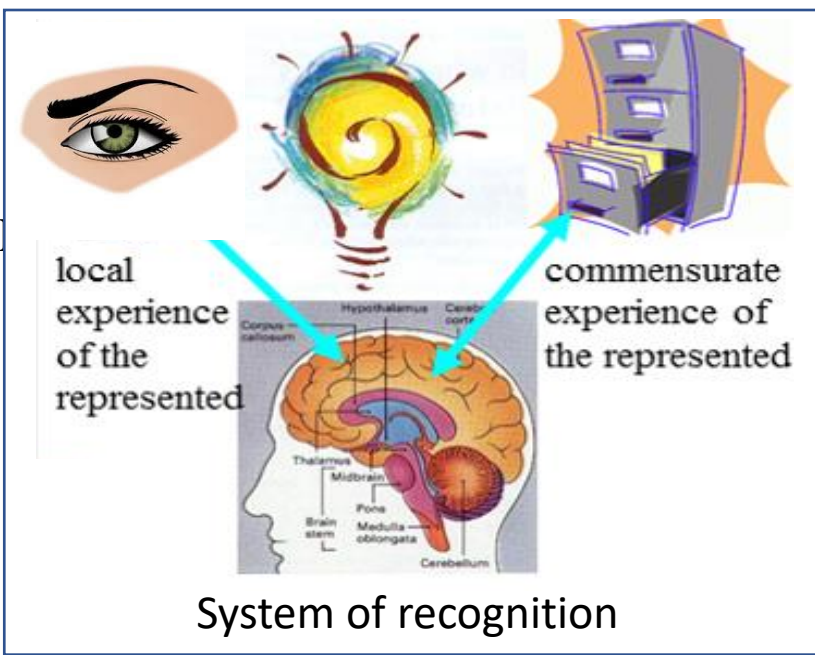
"Thor" (a dog) on the Golden Beach of Istanbul

**LARGER SCALE!**

**Established**

**FABRICATION OF AN EQUIVALENCE CLASS OF REALIZATIONS OF TYPES**

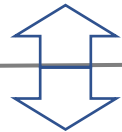




**Expected**

System of representations

*Notional*



*Tangible*

System of realizations

**LARGER SCALE!**

**Established**

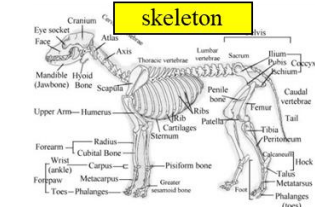
**ONTOLOGY** allowing a representation of the relations over attributes, types, categories



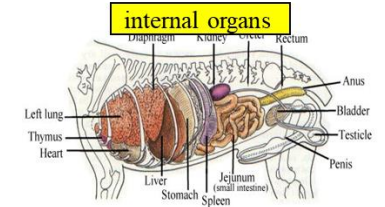
the 4 varieties of Belgian shepherd



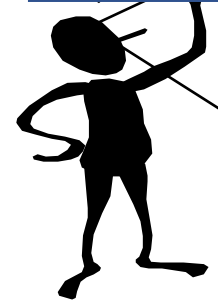
face pattern



skeleton



internal organs



**EPISTEMIC CUT**

LOCAL SCALE

LARGE SCALE

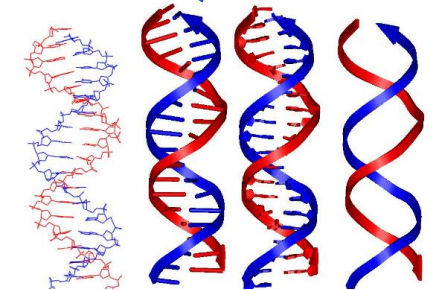
**Experiences**

Instance of organism belonging to the species *Canis Familiaris*

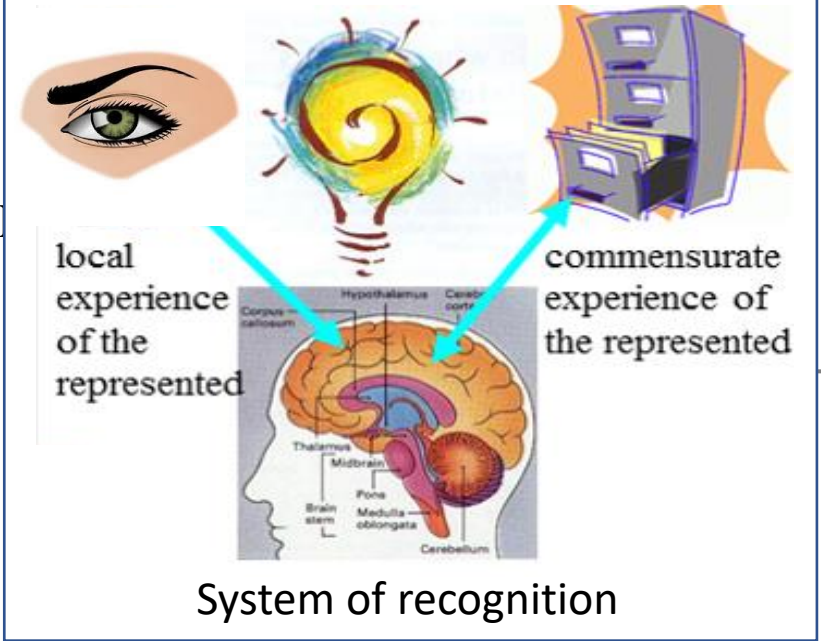


“Thor” (a dog) on the Golden Beach of Istanbul

**FABRICATION OF AN EQUIVALENCE CLASS OF REALIZATIONS OF TYPES**



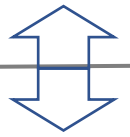




**Expected**

System of representations

*Notional*



LOCAL SCALE

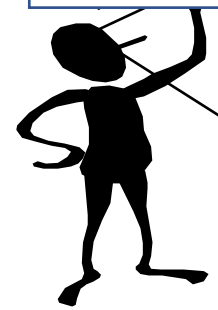
LARGE SCALE

*Tangible*

System of realizations

**LARGER SCALE!**

**Established**



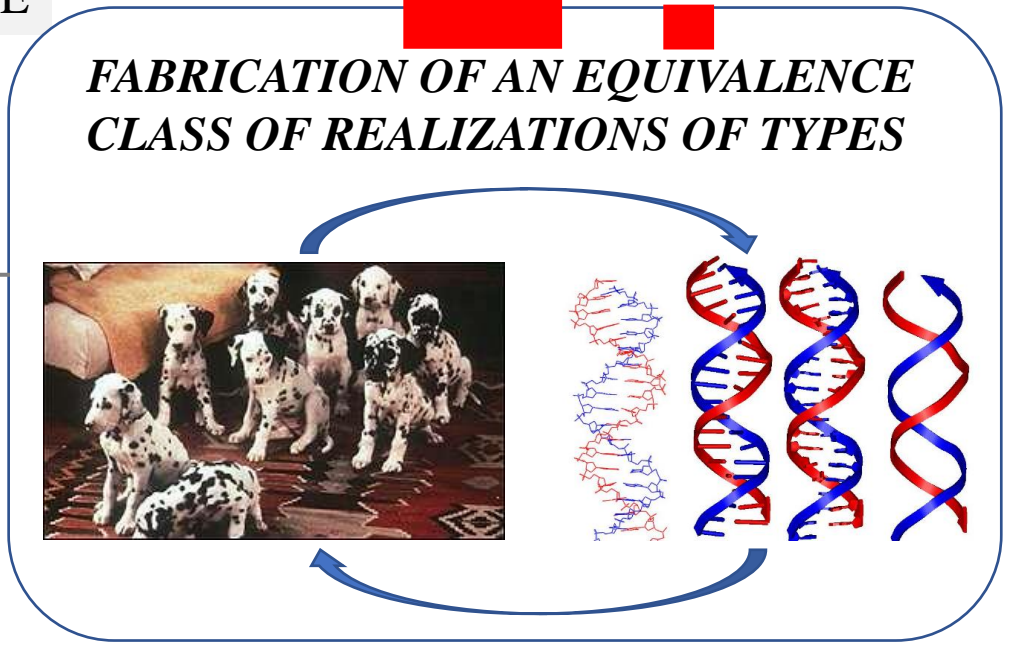
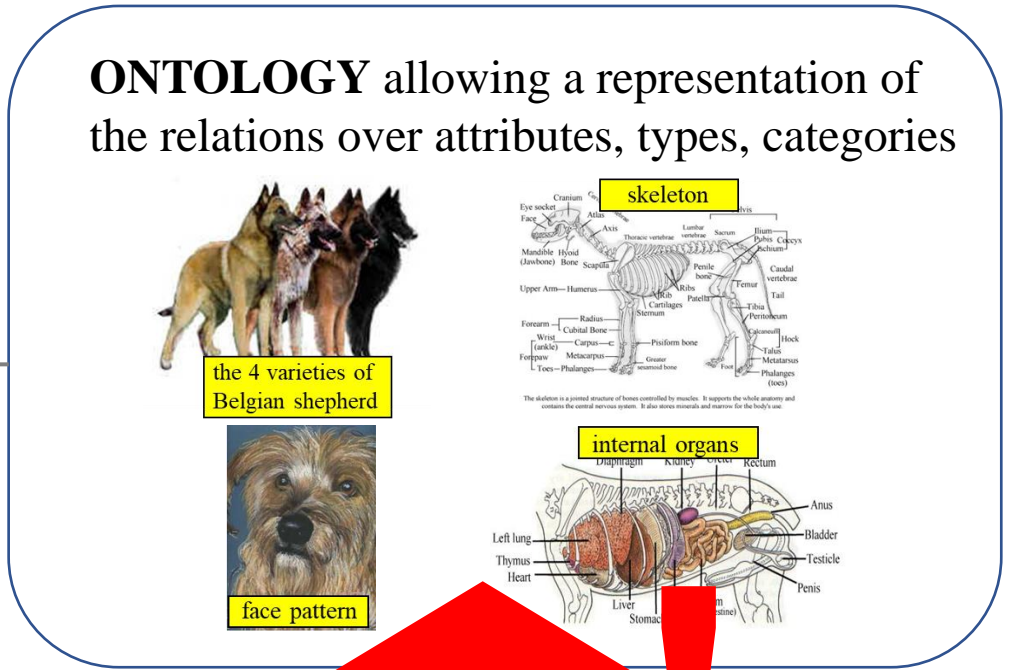
**EPISTEMIC CUT**

**Experience**



Instance of organism belonging to the species *Canis Familiaris*

“Thor” (a dog) on the Golden Beach of Istanbul



# THE OTHER

# THE OTHER



# THE OTHER

“token”  
realization

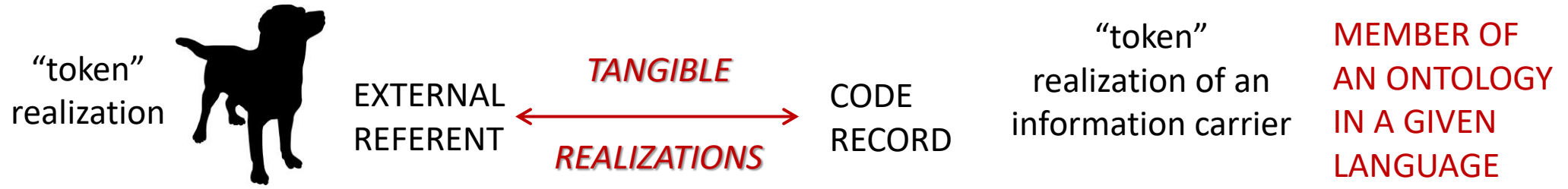


EXTERNAL  
REFERENT



CODE  
RECORD

# THE OTHER



# THE OTHER

“token”  
realization



EXTERNAL  
REFERENT



CODE  
RECORD

“token”  
realization of an  
information carrier

MEMBER OF  
AN ONTOLOGY  
IN A GIVEN  
LANGUAGE

*NOTIONAL*

# THE OTHER



EXTERNAL REFERENT

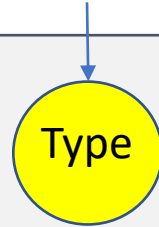


CODE RECORD

“token” realization of an information carrier

MEMBER OF AN ONTOLOGY IN A GIVEN LANGUAGE

Representation of expected attributes



*NOTIONAL*

# THE OTHER



EXTERNAL REFERENT

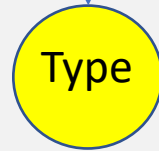


CODE RECORD

“token” realization of an information carrier

MEMBER OF AN ONTOLOGY IN A GIVEN LANGUAGE

Representation of expected attributes



- \* Dog
- \* Chien
- \* Perro
- \* Cane
- \* 甘蔗 Gānzhe

**Names of the code**

*NOTIONAL*



# THE OTHER



EXTERNAL REFERENT

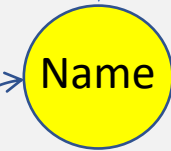
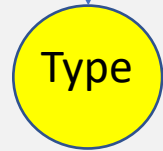
*TANGIBLE REALIZATIONS*

CODE RECORD

“token” realization of an information carrier

MEMBER OF AN ONTOLOGY IN A GIVEN LANGUAGE

Representation of expected attributes



- \* ICONS
- \* INDEXES
- \* EMONS

*NOTIONAL*

- \* Dog
- \* Chien
- \* Perro
- \* Cane
- \* 甘蔗 Gānzhè

Names of the code

# THE OTHER



EXTERNAL REFERENT

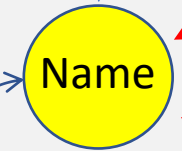
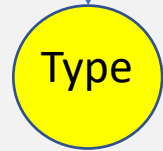


CODE RECORD

“token” realization of an information carrier

MEMBER OF AN ONTOLOGY IN A GIVEN LANGUAGE

Representation of expected attributes



- \* Dog
- \* Chien
- \* Perro
- \* Cane
- \* 甘蔗 Gānzhe

Names of the code

shared information useful for action



shared meaning of the name

*NOTIONAL*

# THE OTHER



EXTERNAL REFERENT

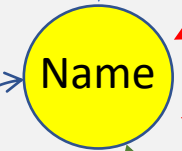
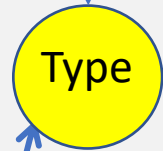
*TANGIBLE REALIZATIONS*

CODE RECORD

“token” realization of an information carrier

MEMBER OF AN ONTOLOGY IN A GIVEN LANGUAGE

Representation of expected attributes



- \* Dog
- \* Chien
- \* Perro
- \* Cane
- \* 甘蔗 Gānzhe

Names of the code

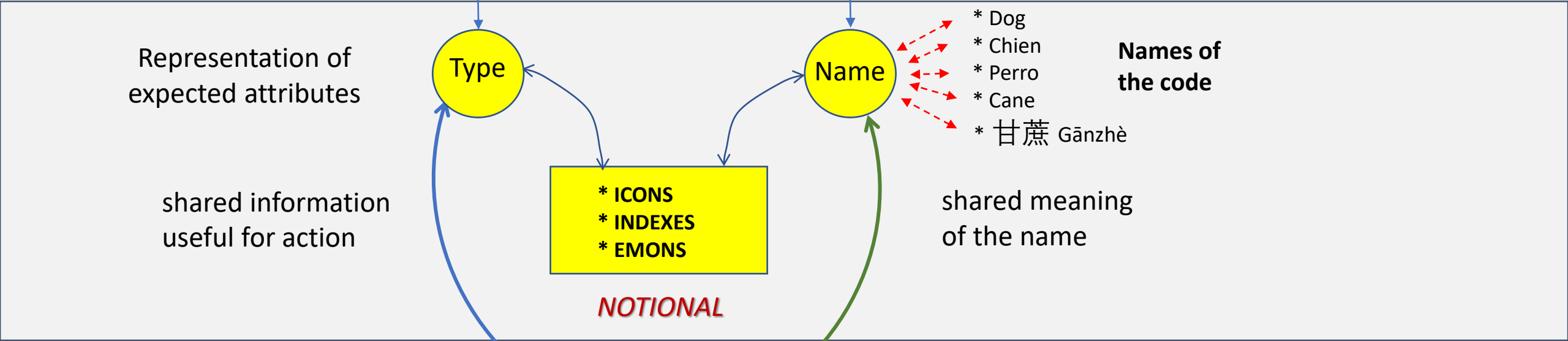
shared information useful for action



*NOTIONAL*

shared meaning of the name

# THE SELF



# THE OTHER



EXTERNAL REFERENT

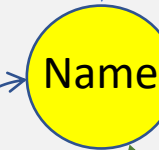
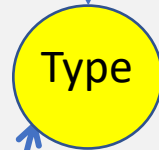
*TANGIBLE REALIZATIONS*

CODE RECORD

“token” realization of an information carrier

MEMBER OF AN ONTOLOGY IN A GIVEN LANGUAGE

Representation of expected attributes



- \* Dog
- \* Chien
- \* Perro
- \* Cane
- \* 甘蔗 Gānzhè

Names of the code

shared information useful for action



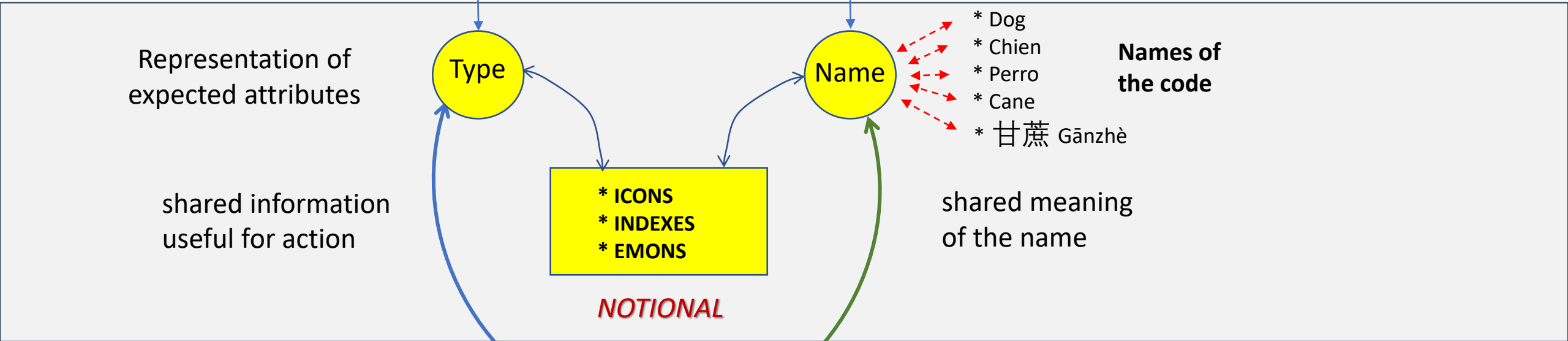
*NOTIONAL*

shared meaning of the name

FOR INTERACTION

- Identify a relevant ontology:
- \* Identifying external referents to be used
  - \* Using available knowledge claims before acting
  - \* Checking the validity of knowledge claims

# THE SELF



# THE OTHER



EXTERNAL REFERENT

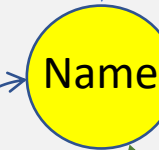
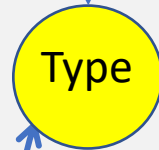
*TANGIBLE REALIZATIONS*

CODE RECORD

“token” realization of an information carrier

MEMBER OF AN ONTOLOGY IN A GIVEN LANGUAGE

Representation of expected attributes



- Names of the code
- \* Dog
  - \* Chien
  - \* Perro
  - \* Cane
  - \* 甘蔗 Gānzhè

shared information useful for action



shared meaning of the name

*NOTIONAL*

FOR INTERACTION

FOR COMMUNICATION

- Identify a relevant ontology:
- \* Identifying external referents to be used
  - \* Using available knowledge claims before acting
  - \* Checking the validity of knowledge claims

# THE SELF

- Share experiences:
- \* Updating the quality of the information
  - \* Correcting and expanding knowledge claims
  - \* Updating and expanding purposes and taboos

# THE OTHER



EXTERNAL REFERENT

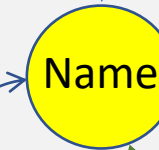
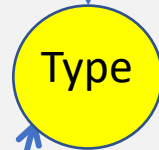
*TANGIBLE REALIZATIONS*

CODE RECORD

“token” realization of an information carrier

MEMBER OF AN ONTOLOGY IN A GIVEN LANGUAGE

Representation of expected attributes



- Names of the code
- \* Dog
  - \* Chien
  - \* Perro
  - \* Cane
  - \* 甘蔗 Gānzhè

shared information useful for action



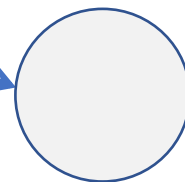
*NOTIONAL*

shared meaning of the name

FOR INTERACTION

FOR COMMUNICATION

- Identify a relevant ontology:
- \* Identifying external referents to be used
  - \* Using available knowledge claims before acting
  - \* Checking the validity of knowledge claims



- Share experiences:
- \* Updating the quality of the information
  - \* Correcting and expanding knowledge claims
  - \* Updating and expanding purposes and taboos

# THE SELF

STABLE METABOLIC NETWORK?



*LARGER SCALE TANGIBLE REALIZATION*



STABLE IDENTITY OF THE SOCIAL SYSTEM?

*Tangible*

**INTERACTIONS**

**COMMUNICATIONS**

*Notional*

# Exosomatic Metabolism

**signified** (instances)

**PRAGMATIC**

**APPLY**

**METABOLIC NETWORK**  
(established societal identity)

***Technical interactions***

***Tangible***

**INTERACTIONS**

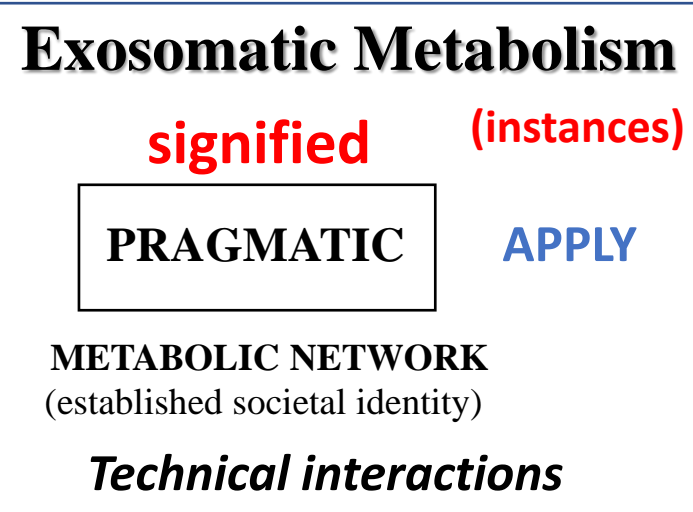
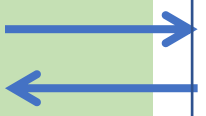
**COMMUNICATIONS**

***Notional***



**ENVIRONMENT**

*biophysical interactions*



**ECOLOGICAL METABOLISM**

*Tangible*

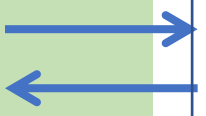
**INTERACTIONS**

**COMMUNICATIONS**

*Notional*

# ENVIRONMENT

*biophysical interactions*



**Exosomatic Metabolism**  
**signified** (instances)  
**PRAGMATIC** **APPLY**  
METABOLIC NETWORK  
(established societal identity)  
*Technical interactions*



**Endosomatic Metabolism**  
**interpretant** (holons)  
**SEMANTIC** **TRANSDUCE**  
PSYCHIC STRUCTURE  
(feelings personal identity) **CONCERNS**  
SOCIAL PRACTICES **PURPOSES**  
(semiotic fitting group identity)  
*Affective Interactions*

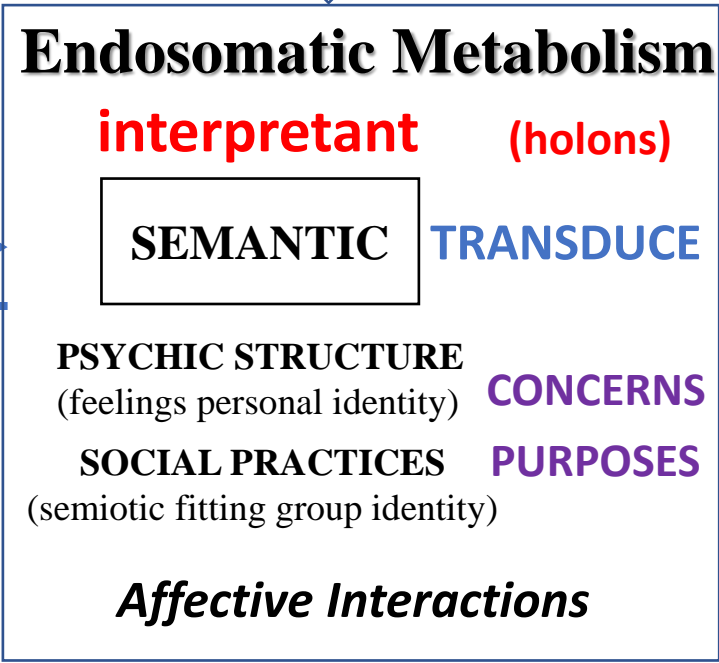
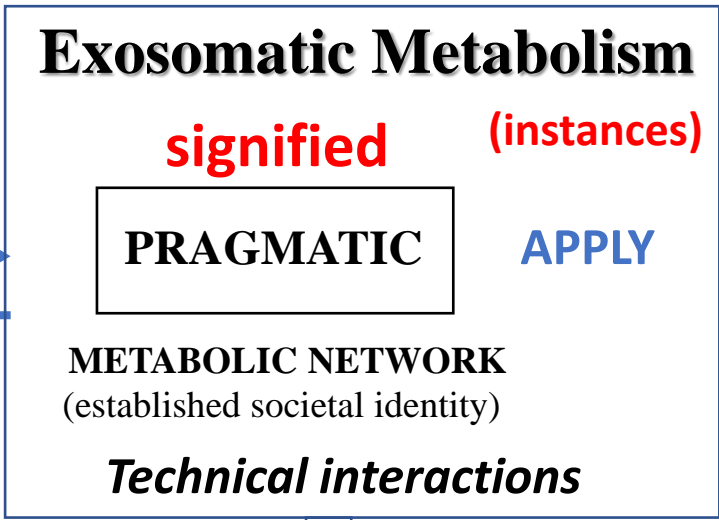
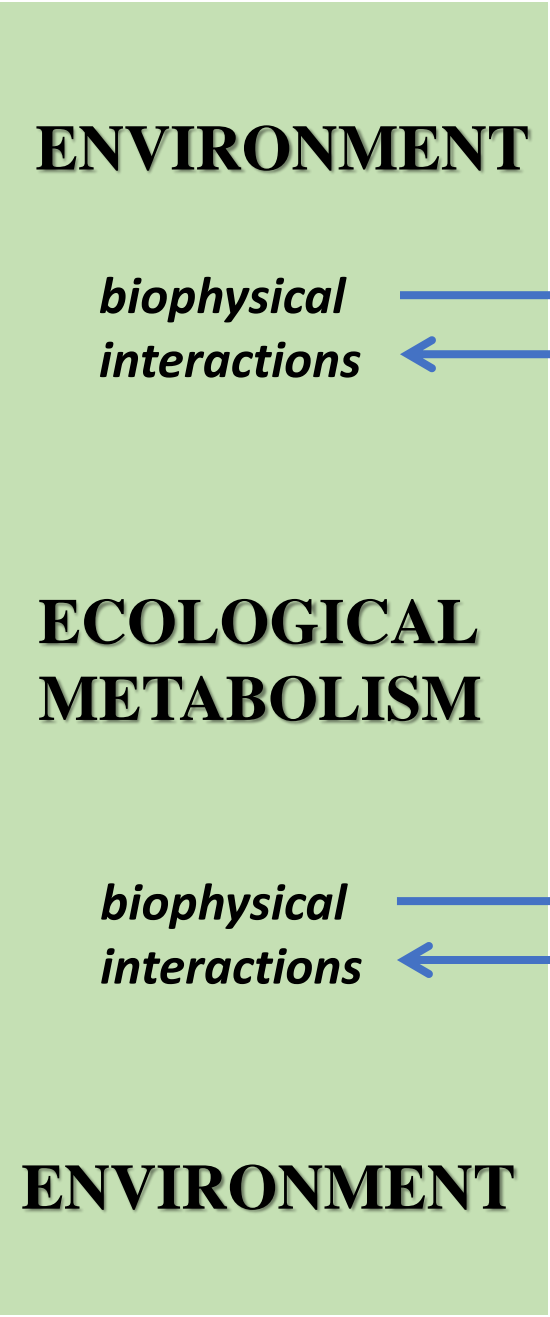
# ECOLOGICAL METABOLISM

*Tangible*

**INTERACTIONS**

**COMMUNICATIONS**

*Notional*

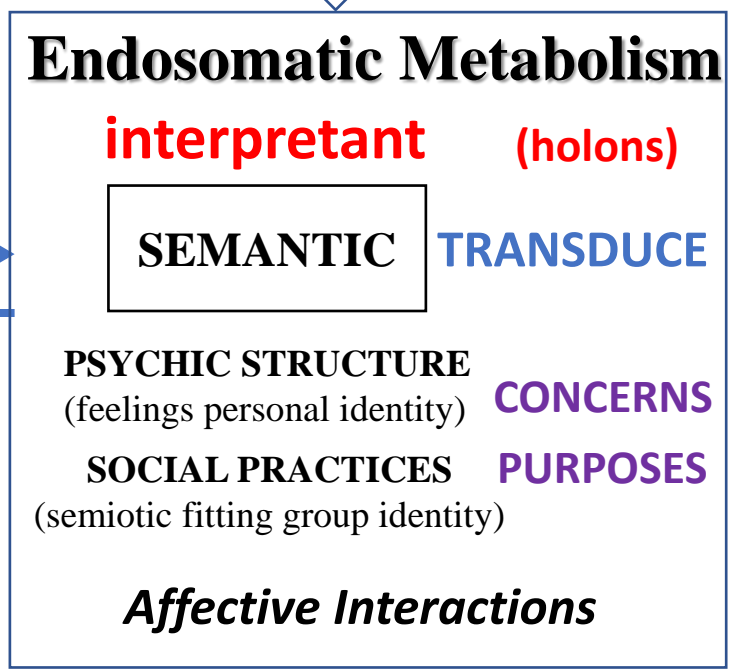
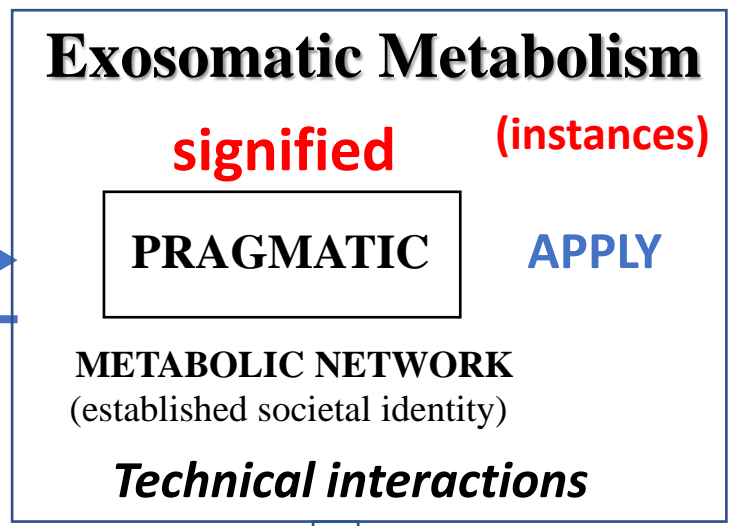
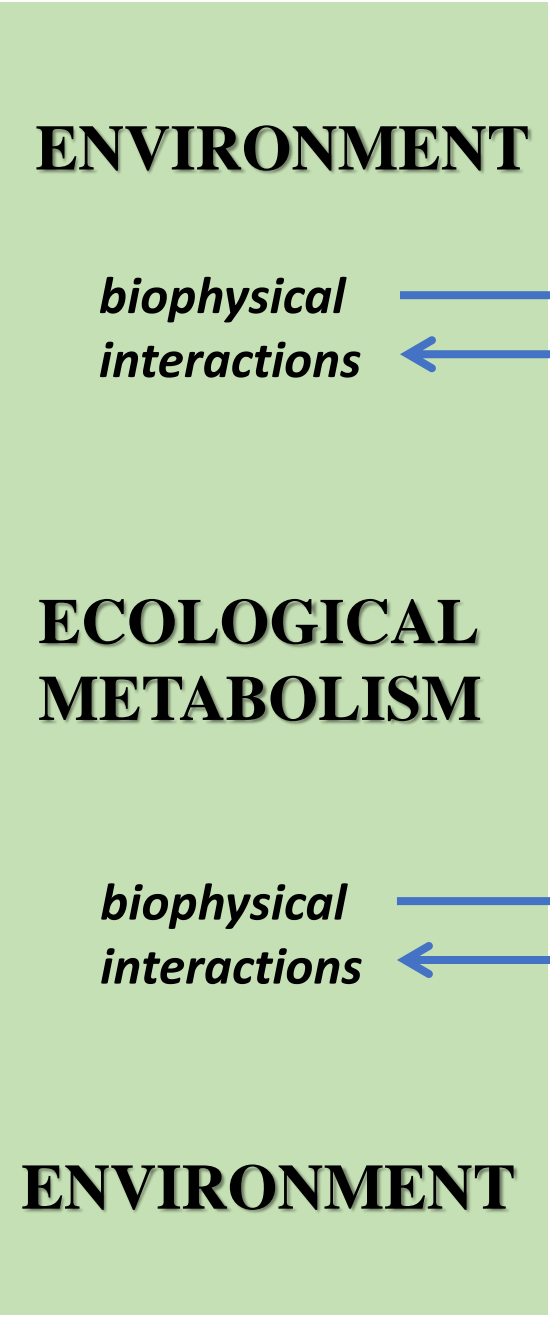


*Tangible*

**INTERACTIONS**

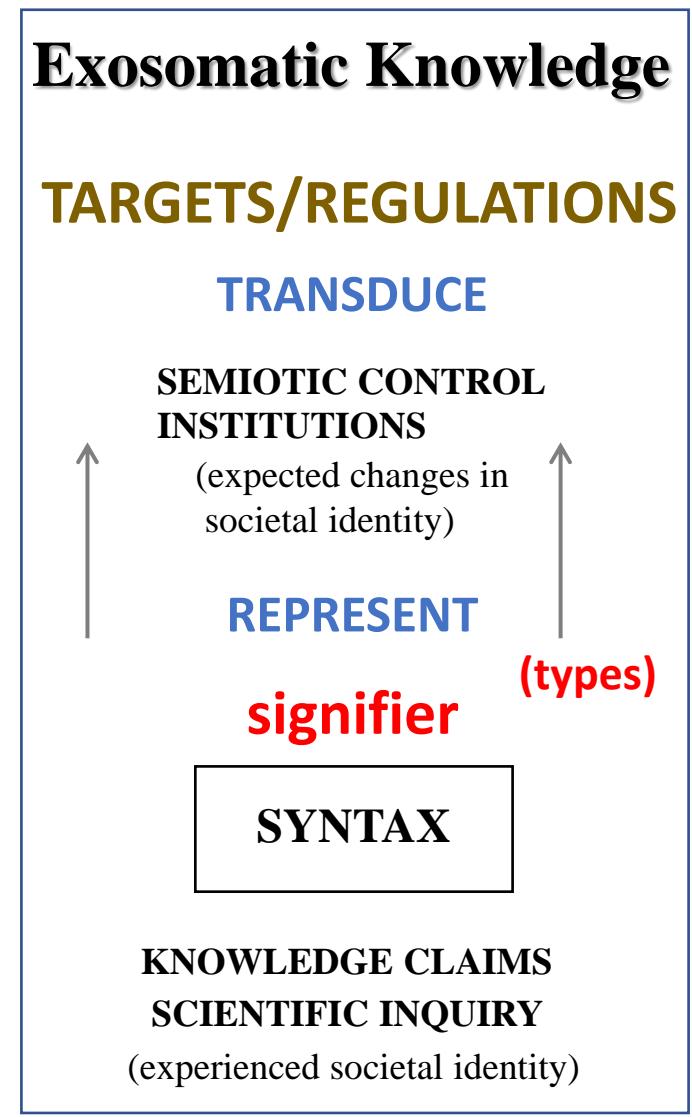
**COMMUNICATIONS**

*Notional*



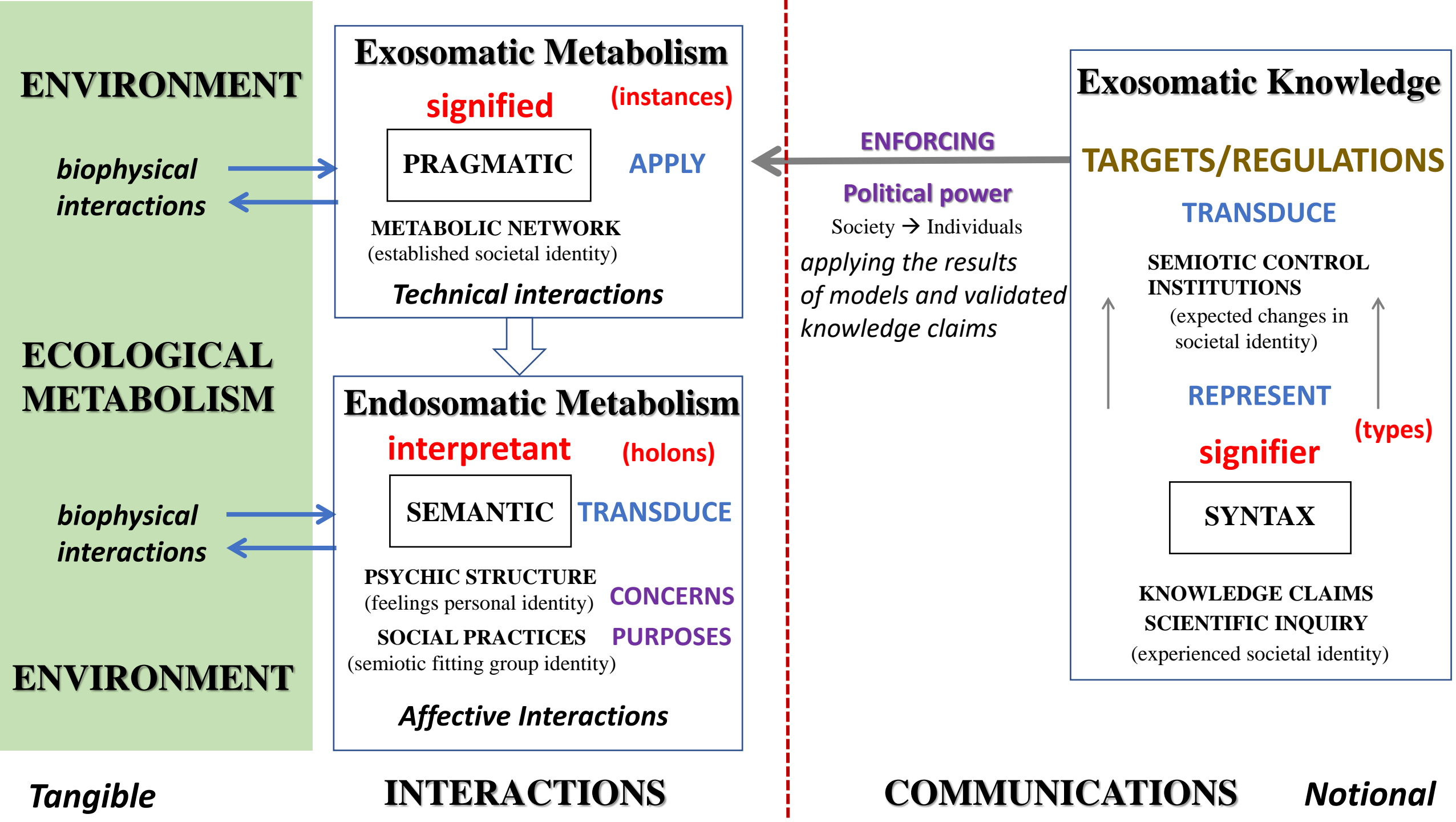
**INTERACTIONS**

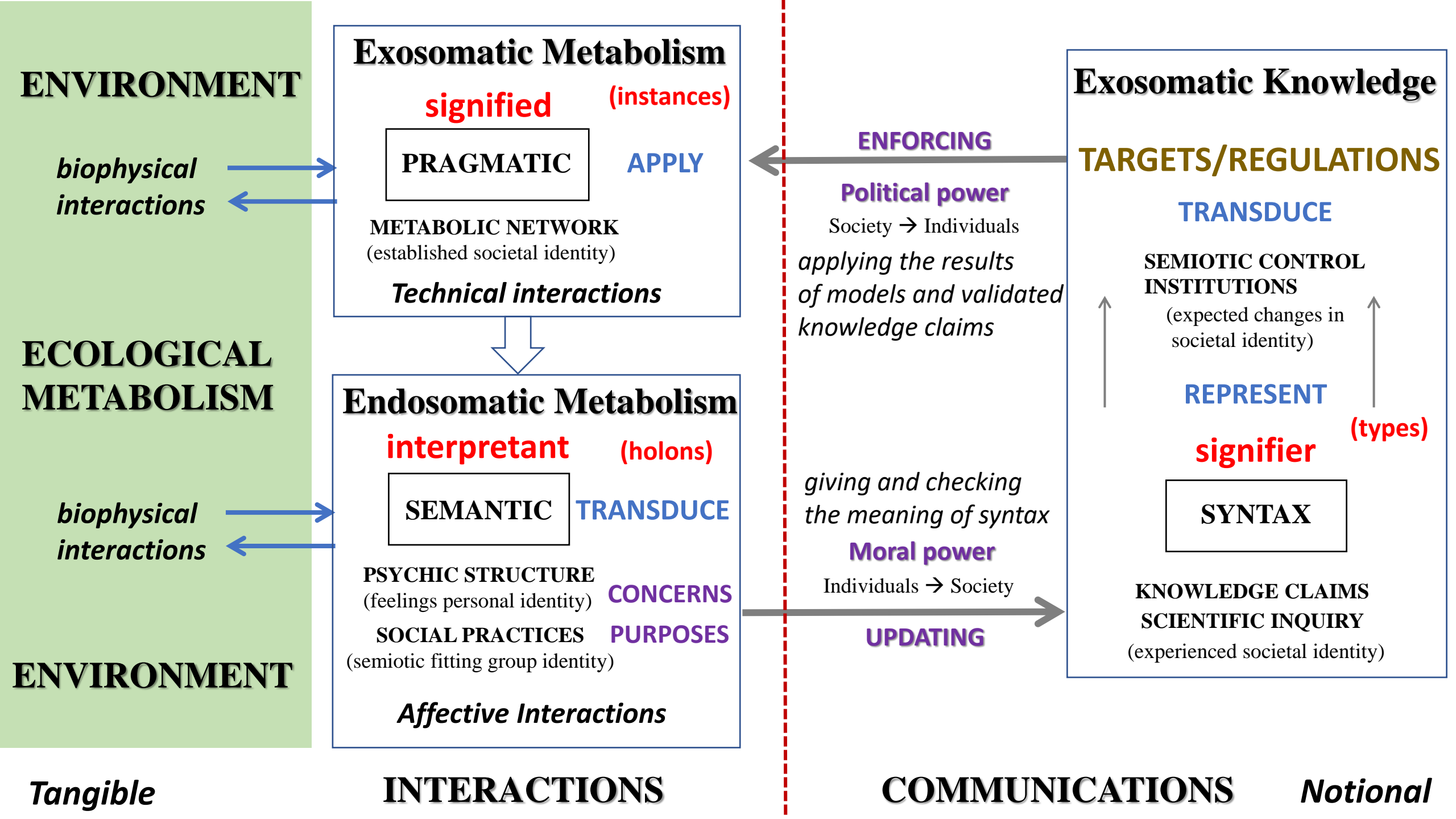
*Tangible*



**COMMUNICATIONS**

*Notional*

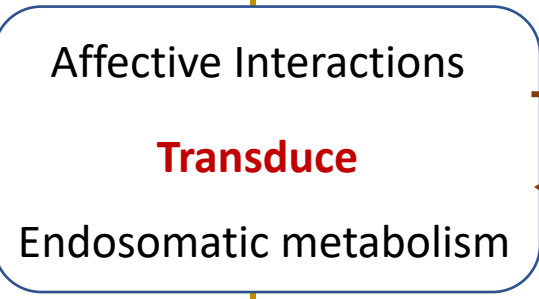




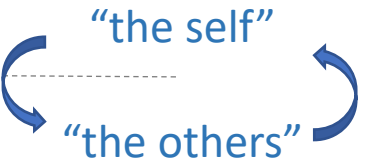
tangible ← → notional

**BODY**

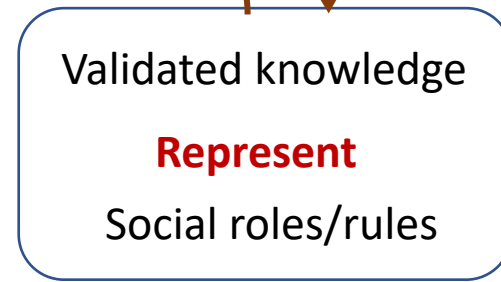
PSYCHIC STRUCTURE



GROUP IDENTITY

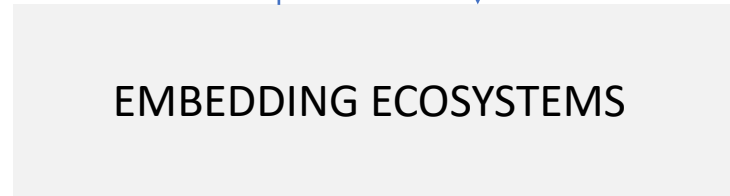


**MIND**

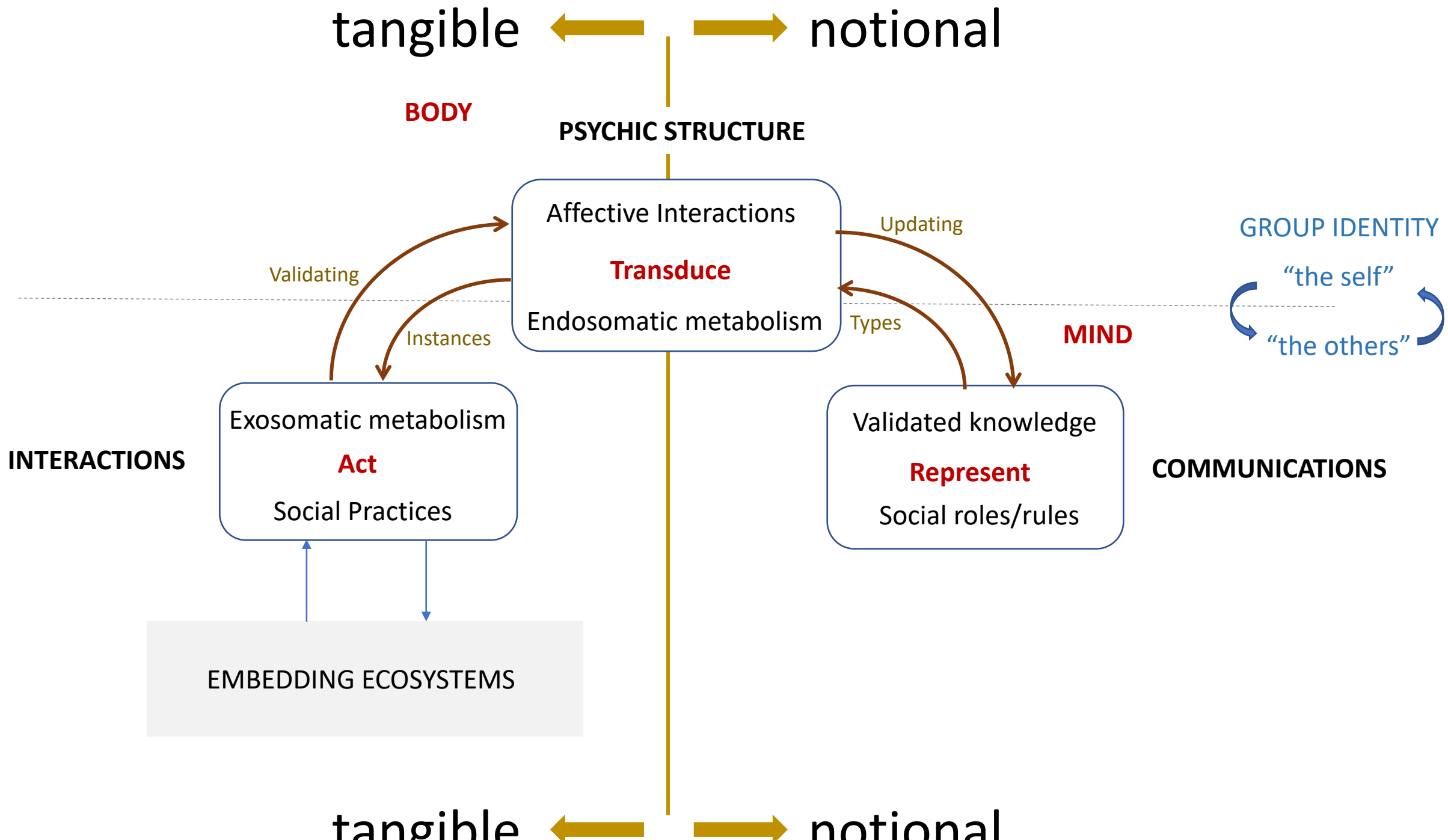


COMMUNICATIONS

INTERACTIONS



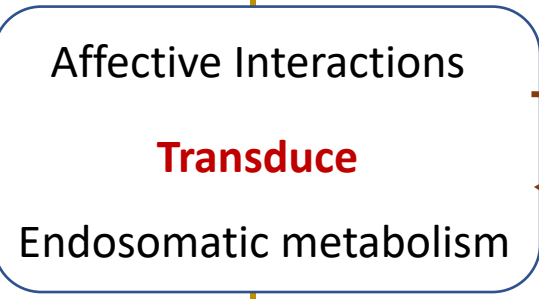
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tangible ← → notional

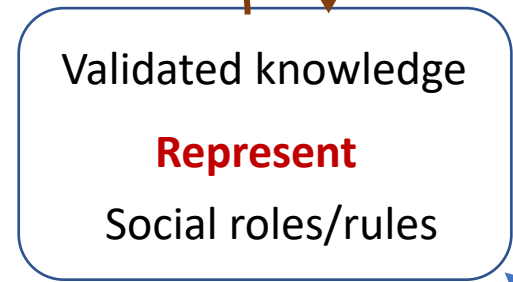
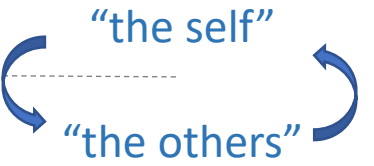
**BODY**

PSYCHIC STRUCTURE



**MIND**

GROUP IDENTITY



COMMUNICATIONS

**The SUPEREGO**

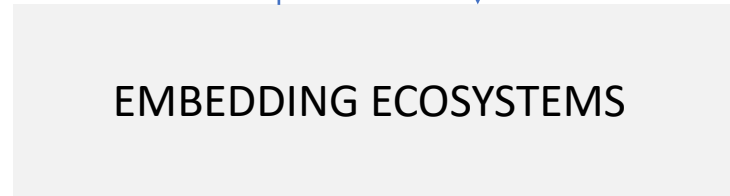
Validating

Instances

Updating

Types

INTERACTIONS



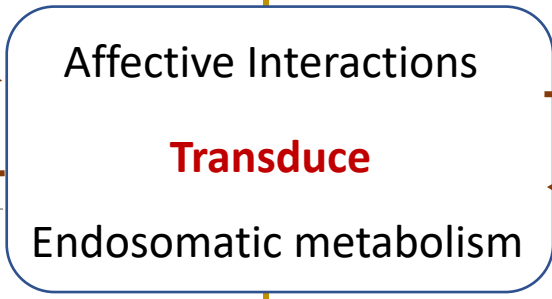
tangible ← → notional



tangible ← → notional

**BODY**

PSYCHIC STRUCTURE



Validating

Instances

Updating

Types

**MIND**

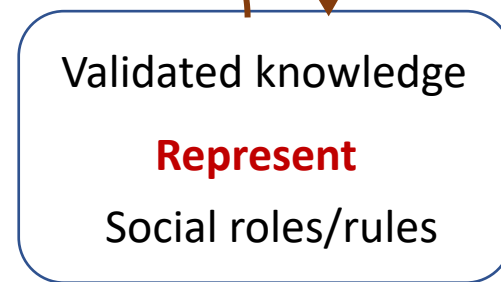
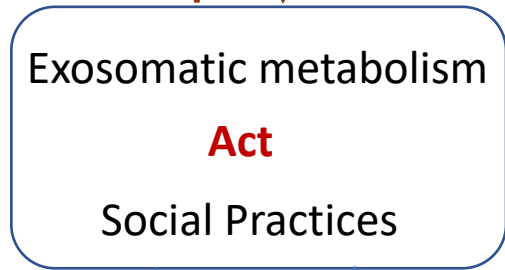
GROUP IDENTITY

“the self”

“the others”

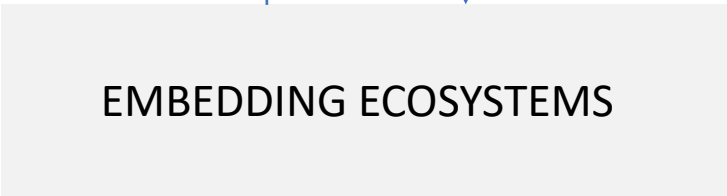
**The EGO**

INTERACTIONS



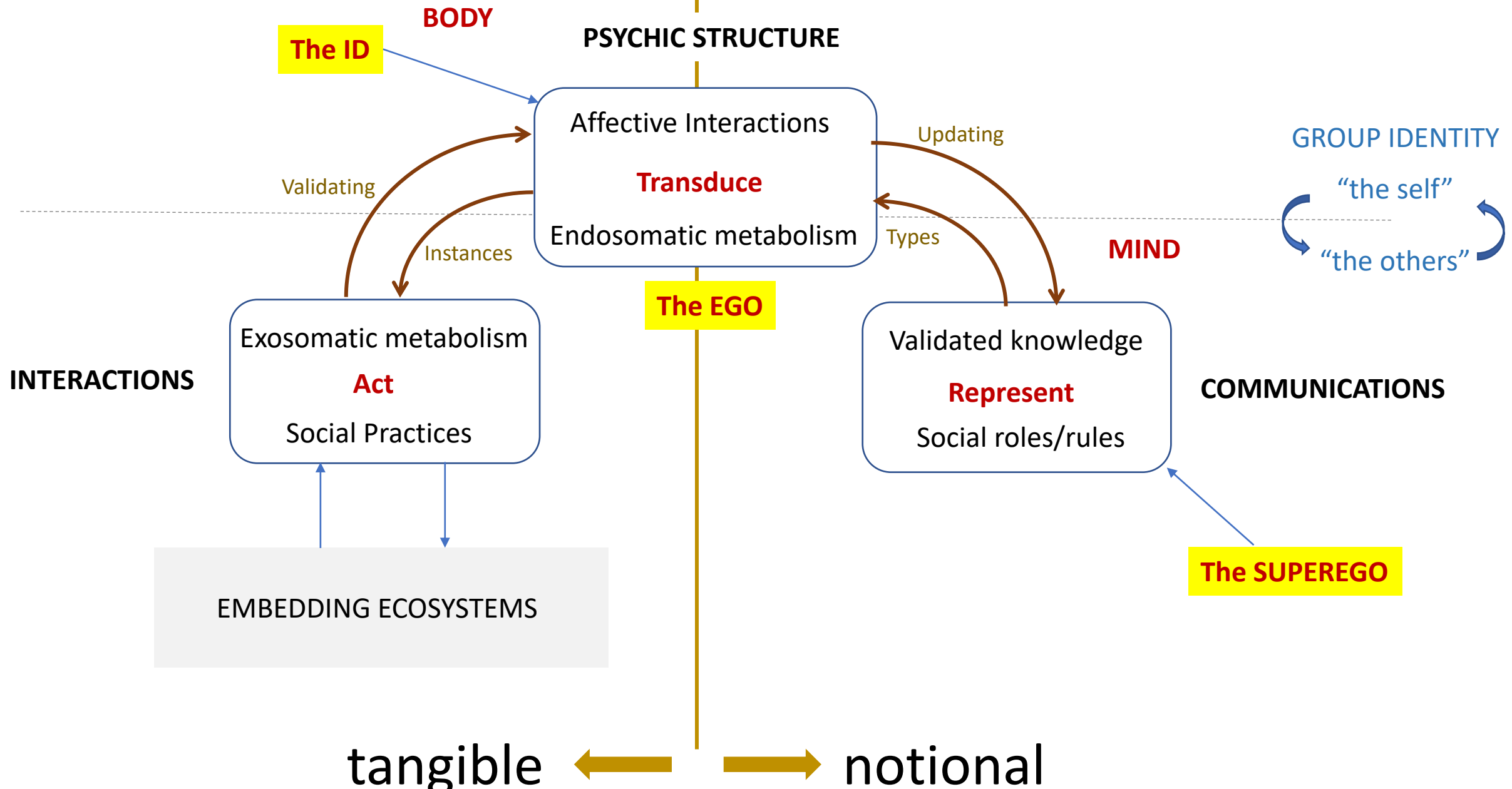
COMMUNICATIONS

**The SUPEREGO**

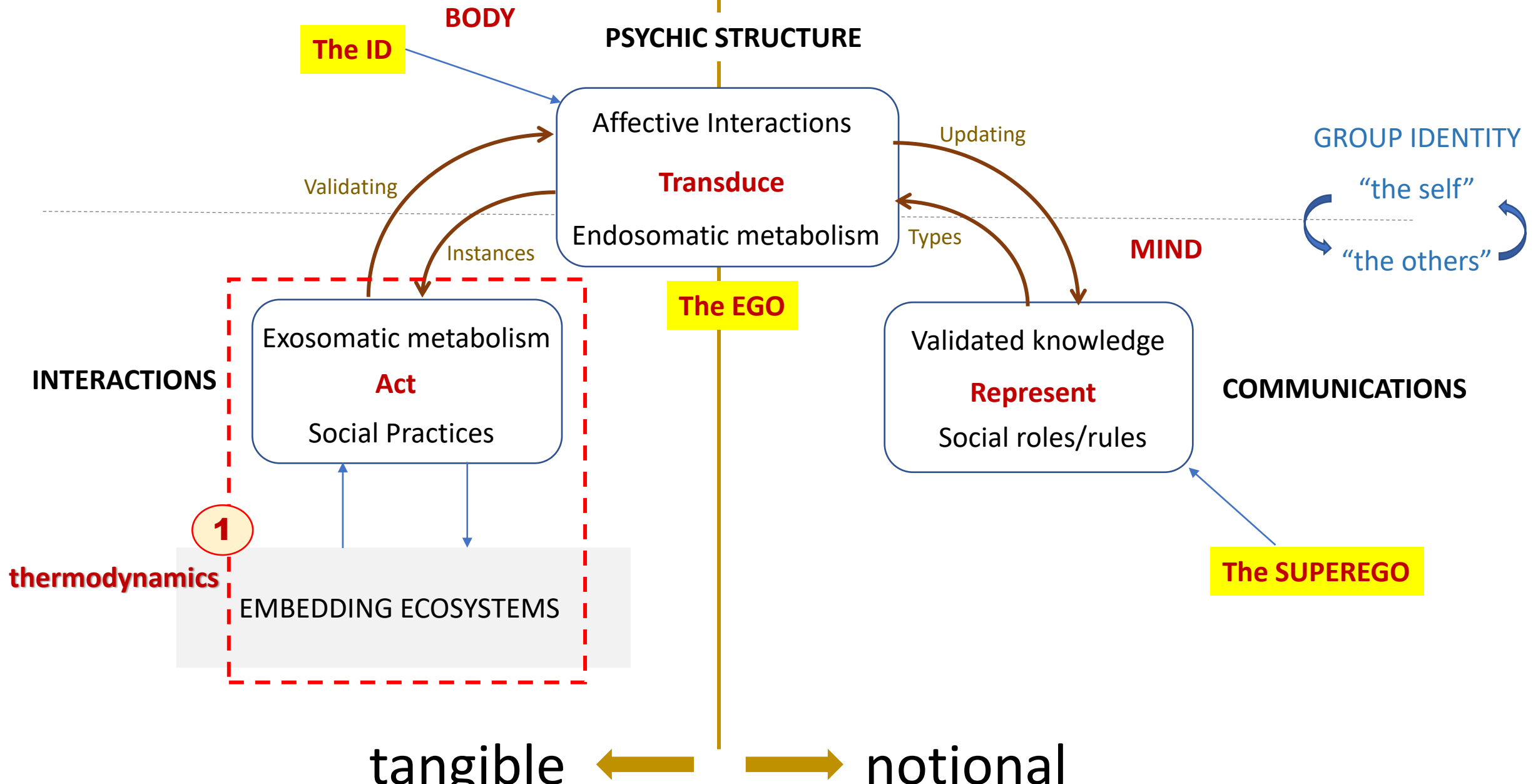


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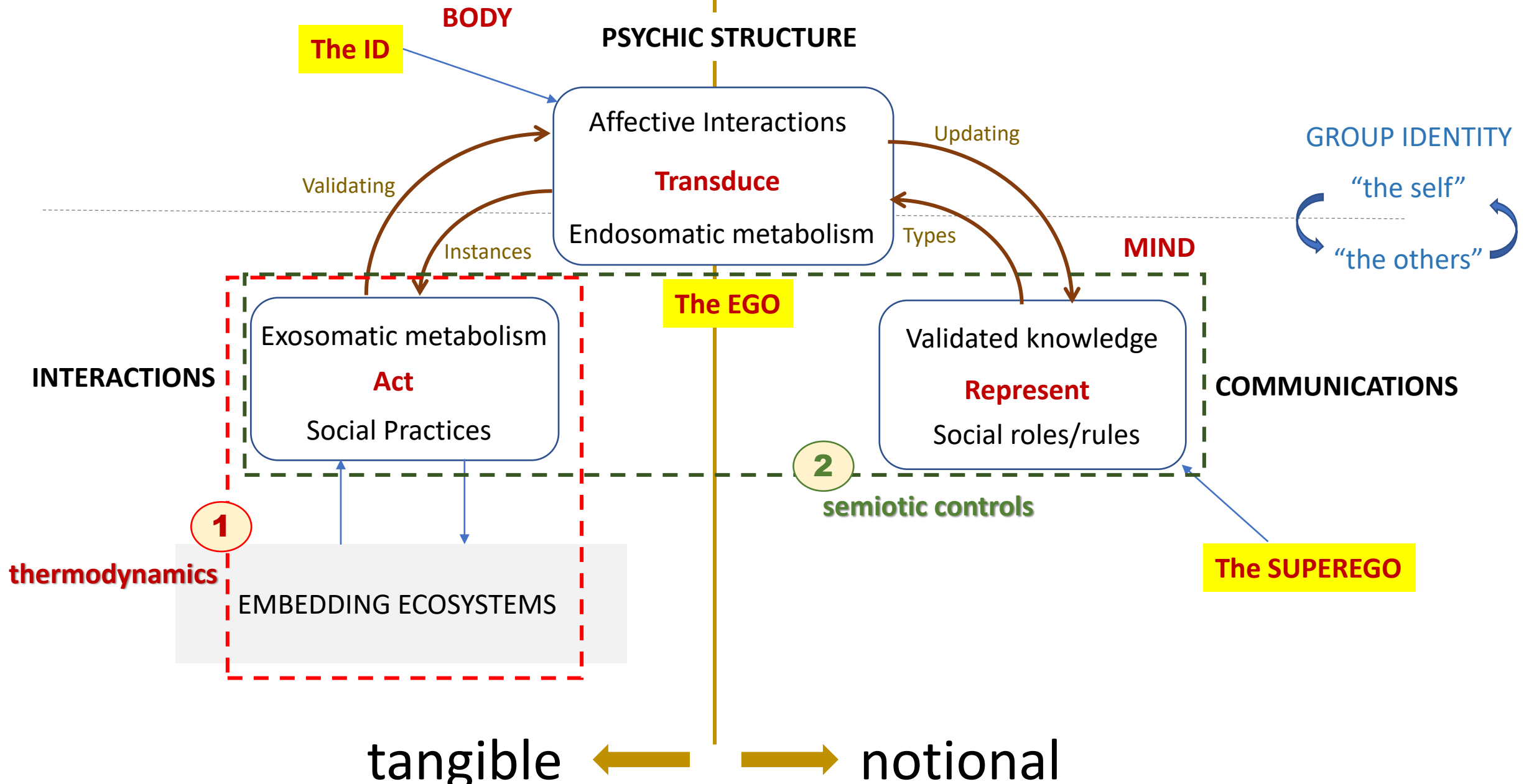
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tangible ← → notional



tangible ← → notional



tangible ← → notional

