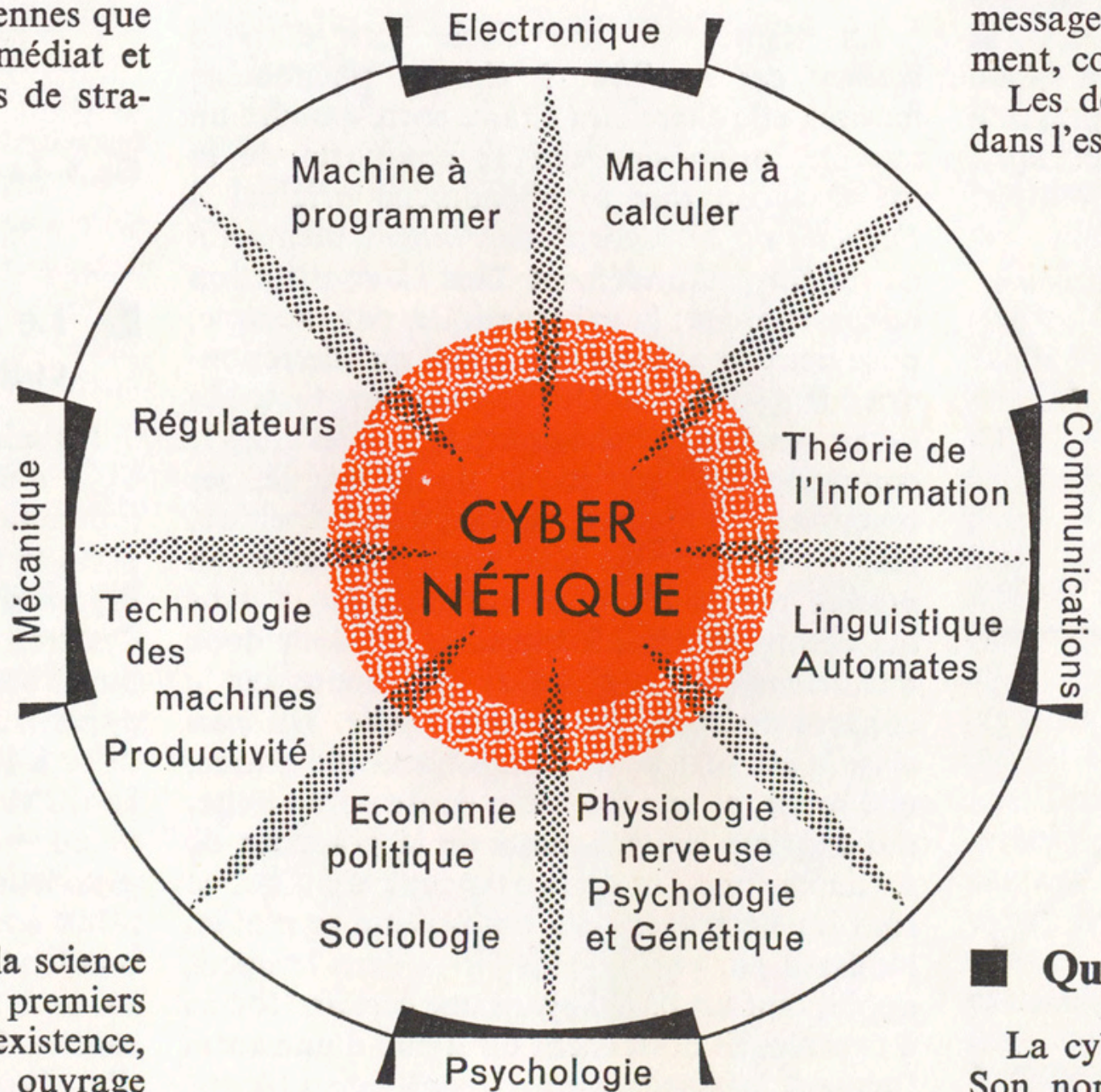
ficiel est plus
tidiennes que
immédiat et
aines de stra-

ua-
ber
ec-
la
to-
le
ont
on
no-
lux
tre
ou-
ire
era
our
ec-
ce
ous

de la science
les premiers
tre existence,
cet ouvrage



teur et sa *co*
messages qui
ment, constit
Les découv
dans l'esprit
de
la
sic
Pr
qu
sci
tro
m
cel
Fr
so
et
qu
no
à
l'o
de

■ Qu'est-

La cyberné
Son nom pl

interaction cybernetics design

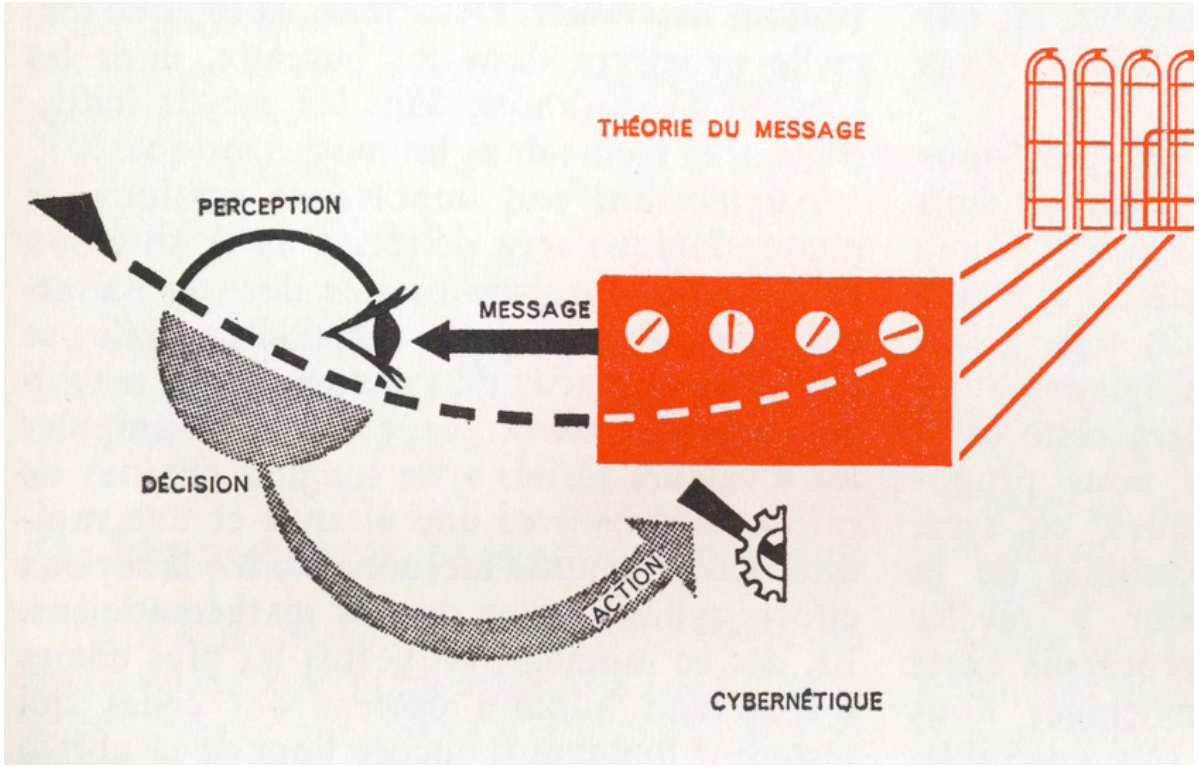
Dr. Paul Pangaro
CyberneticLifestyles.com
New York City

École Nationale Supérieure des Mines de Paris
2 October 2009

interaction

cybernetics

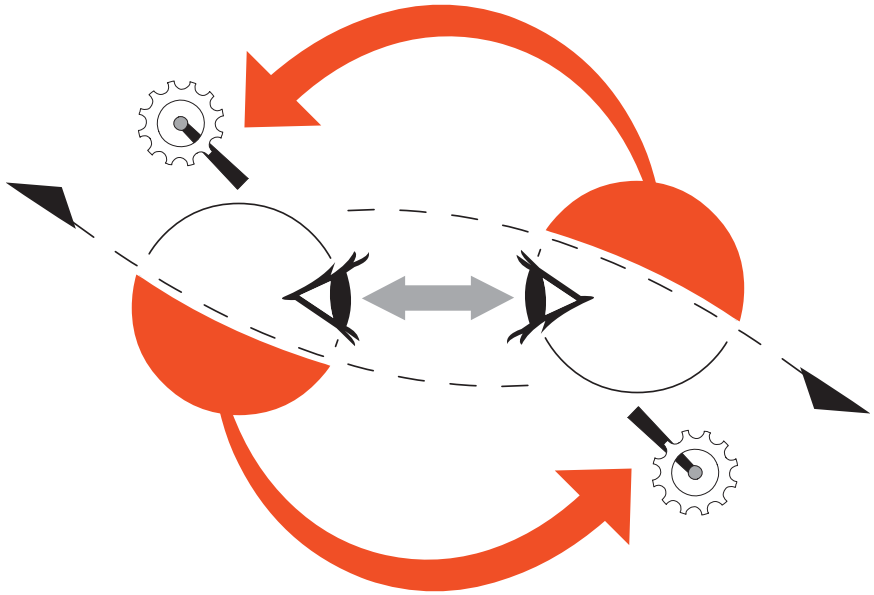
design



interaction

cybernetics

design



interaction

cybernetics

design

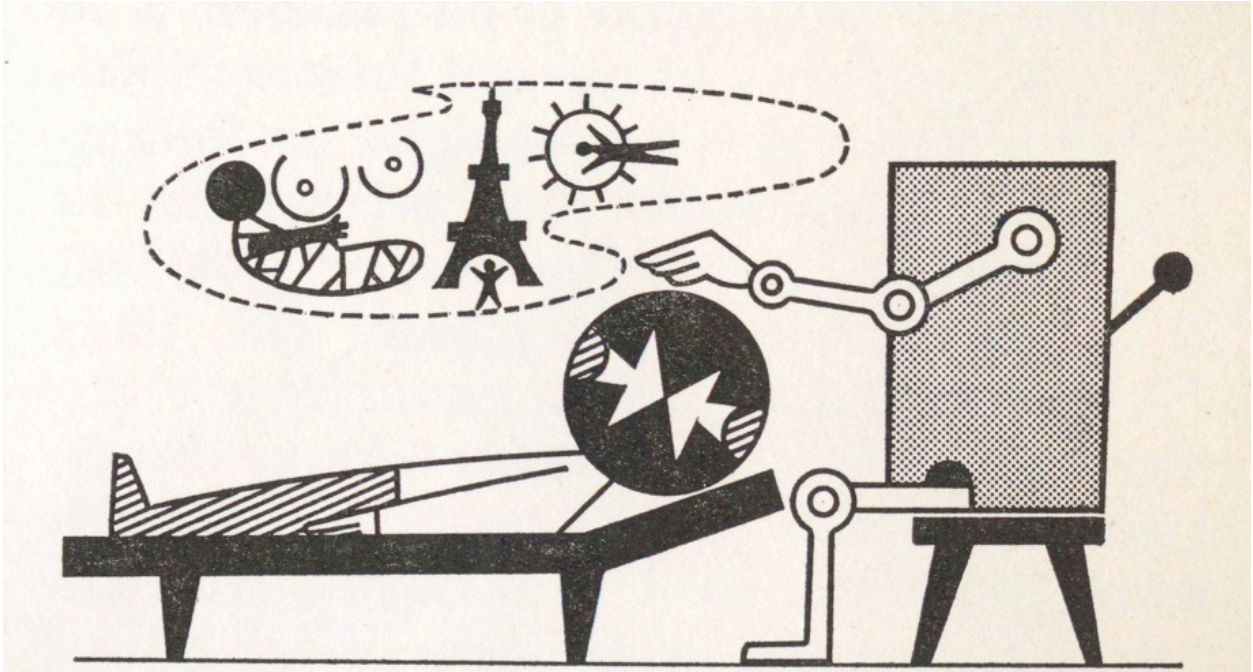
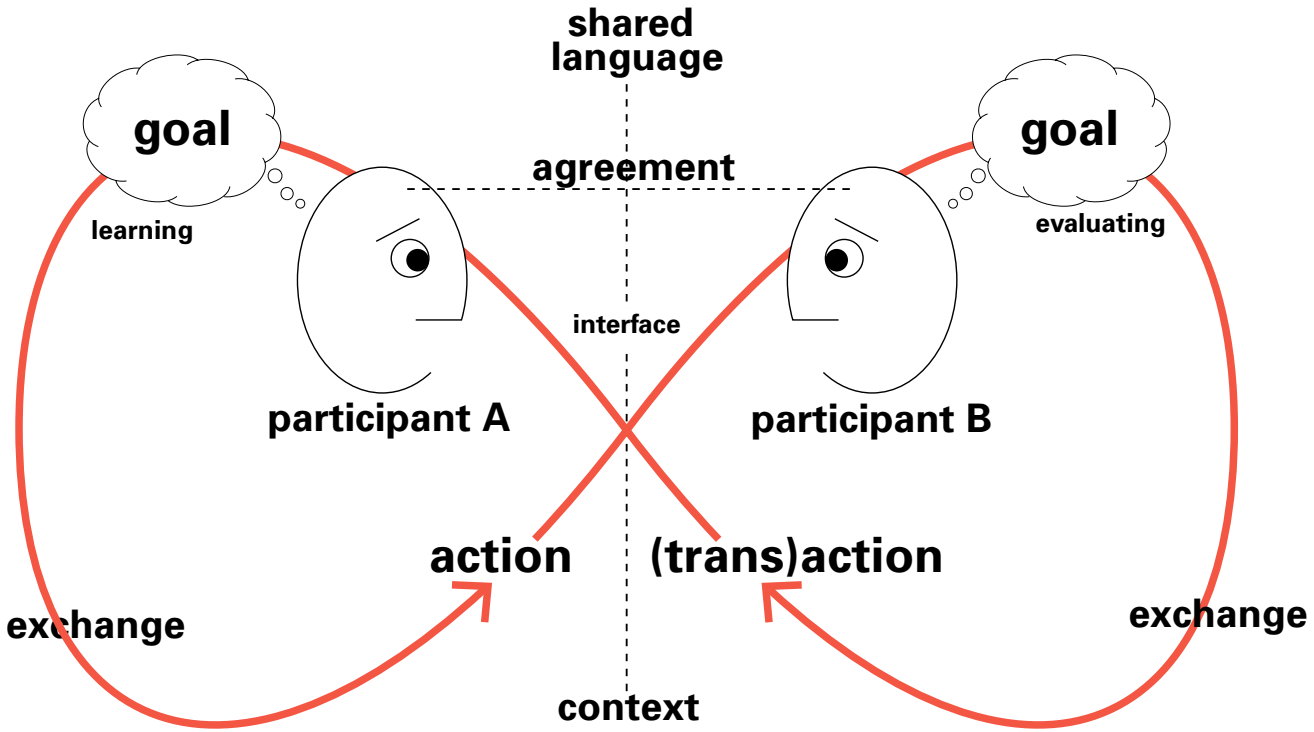


Fig. 2. Verrons-nous un jour la machine à psychanalyser ?

interaction
cybernetics
design



what has changed for designers—complexity

new knowledge in biology, medicine, physics...

the internet

“big data”

sensor explosion...

what has not changed for designers—human needs

fundamental desire to “get what we want”

need to formulate and agree on goals

to coordinate actions

to expand choices...

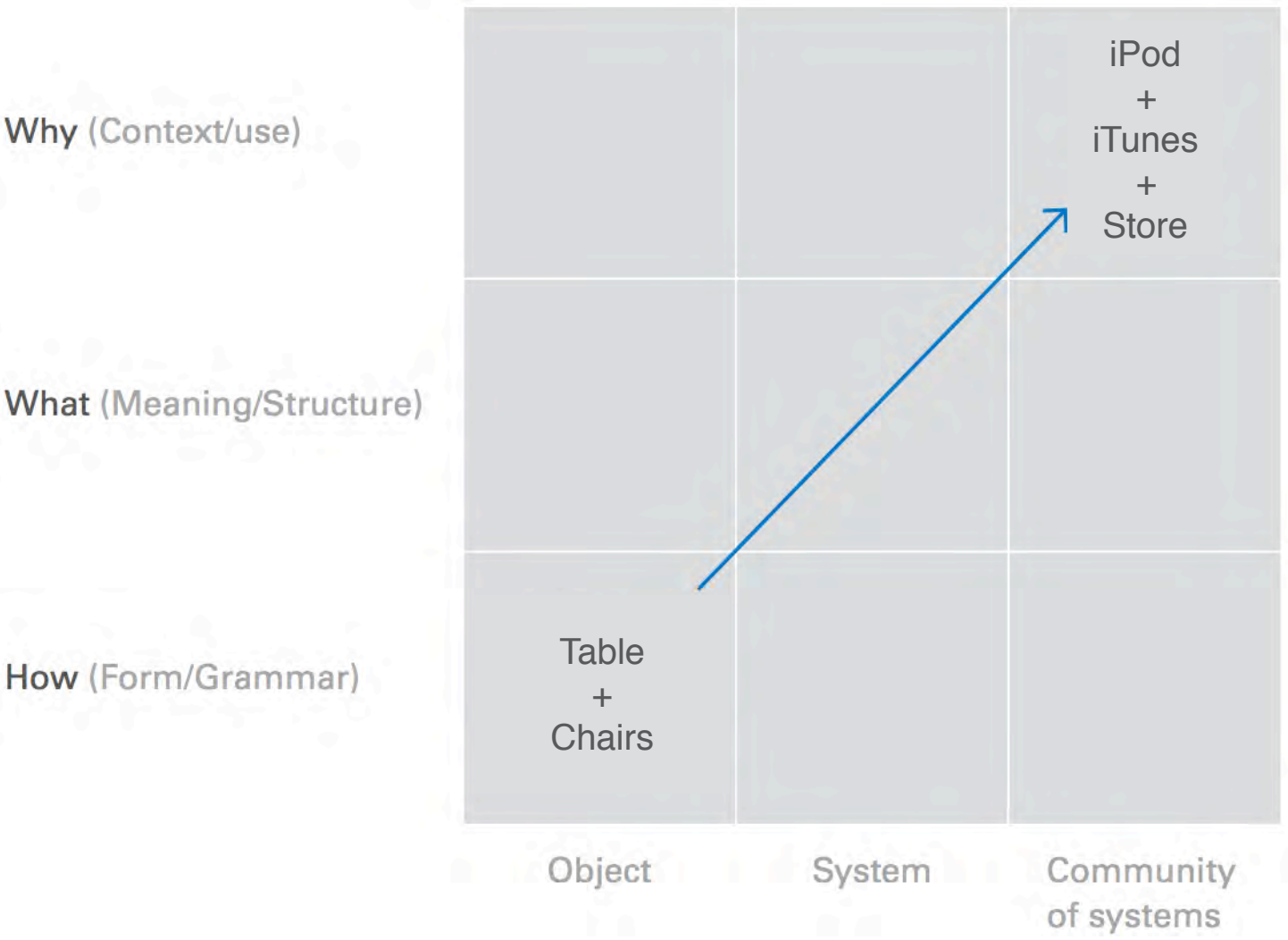
so, how do designers

understand...

design for...

manage all this?

design processes must change



design processes must change

We are in a new era of technology, where the sensor + mobility + video webs are being added to the “text web”.

Designers will have new tools and media, which will change the way they work, which suggests changes in design education.

Designers will focus on systems not objects, embrace complexity, and move from form-giving to conversation-managing.

Hugh Dubberly

design processes must change

We are in a new era of technology, where the sensor + mobility + video webs are being added to the “text web”.

Designers will have new tools and media, which will change the way they work, which suggests changes in design education.

Design = will focus on systems not objects, embrace complexity, and move from form-giving to conversation-managing.

Hugh Dubberly

design processes must change

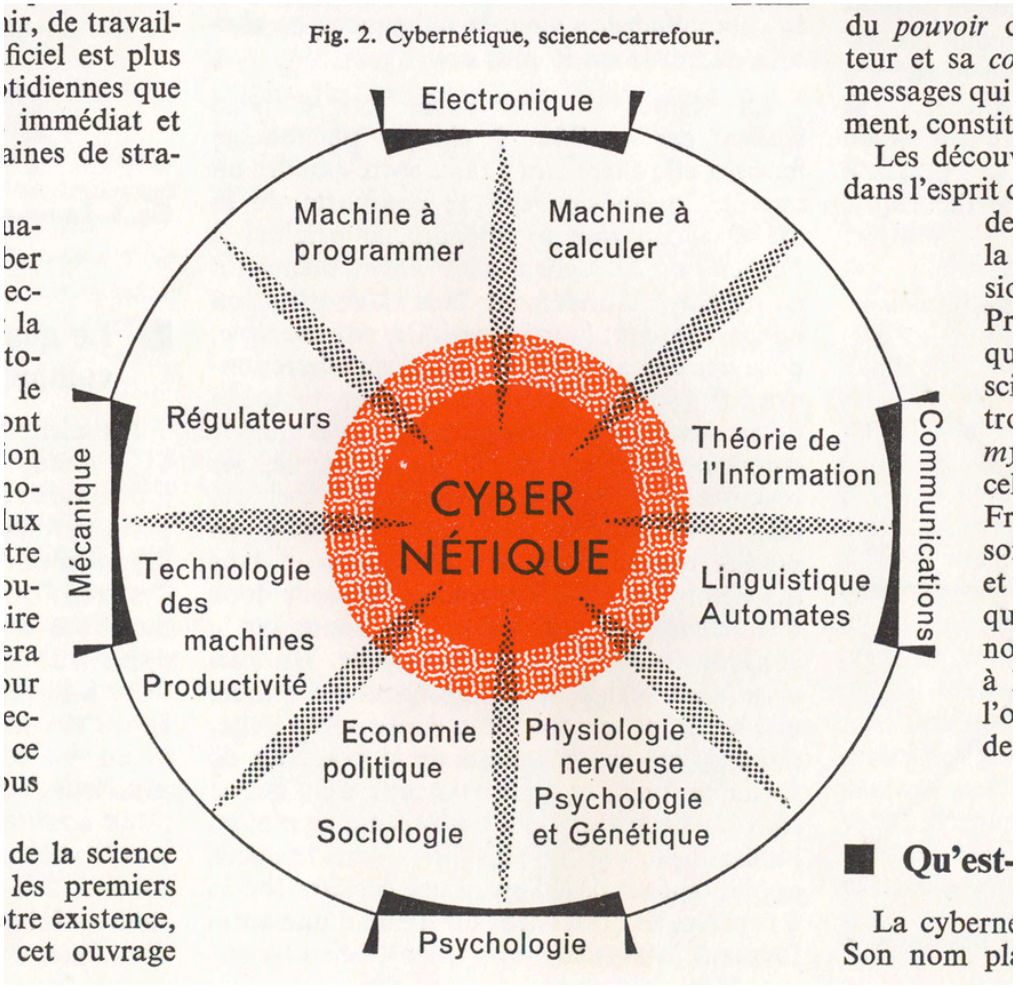
Design = systems
+ complexity
+ conversation

interaction

cybernetics

design

Design = systems
+ complexity
+ conversation



CYBERNETICS

what is cybernetics?

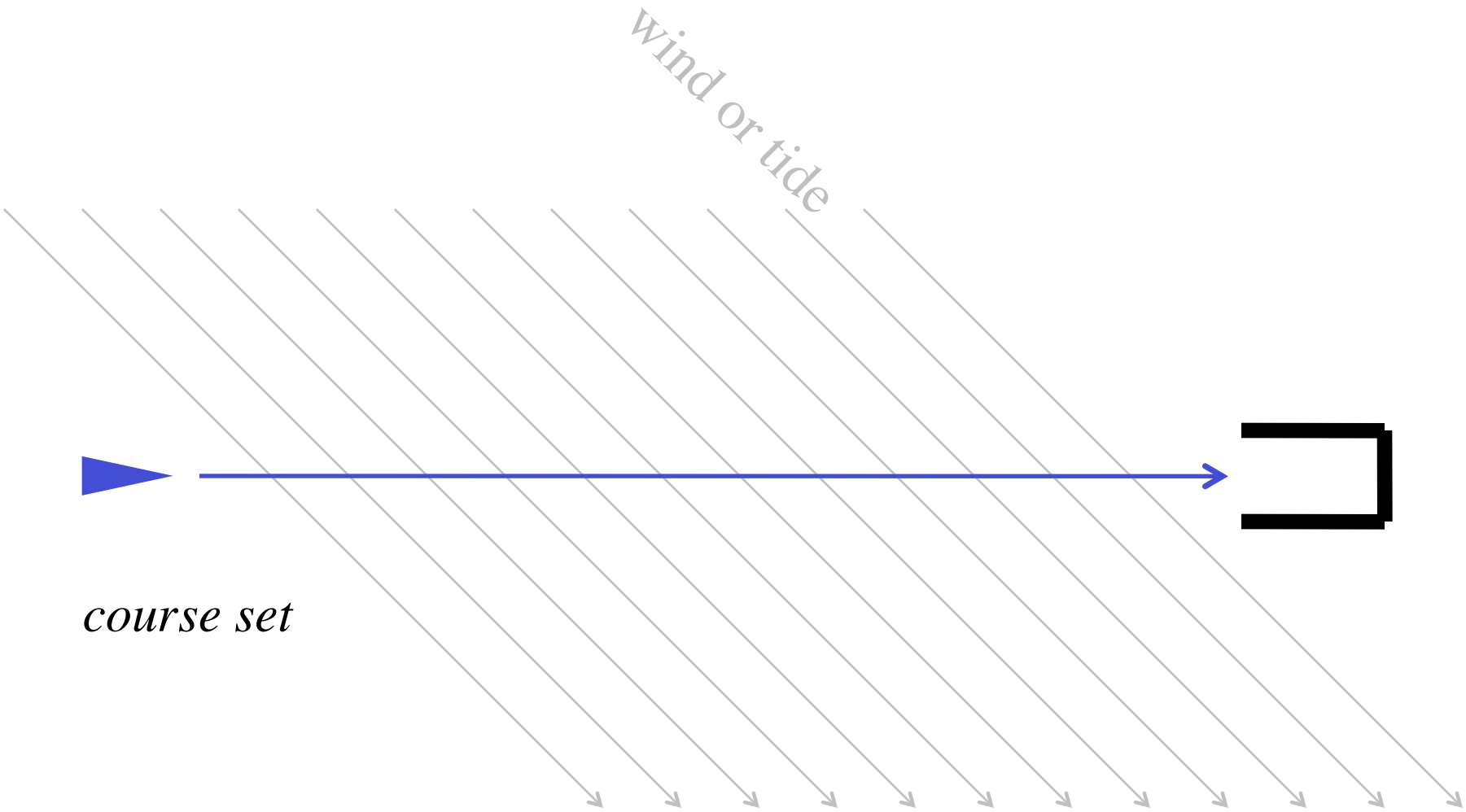
why is cybernetics a science for design?

discussion

CYBERNETICS

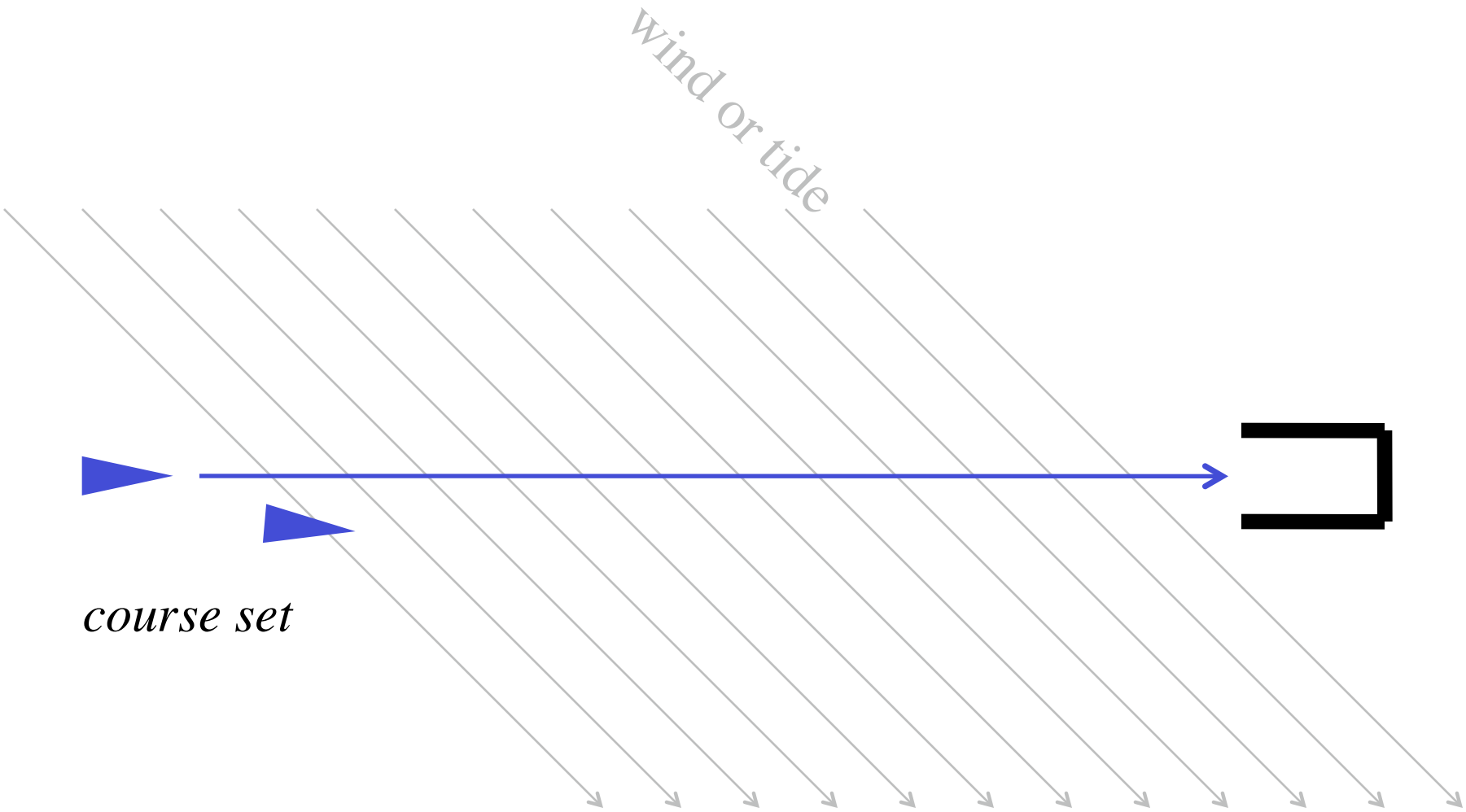
from Greek ‘kybernetes’—the art of steering

the art of steering

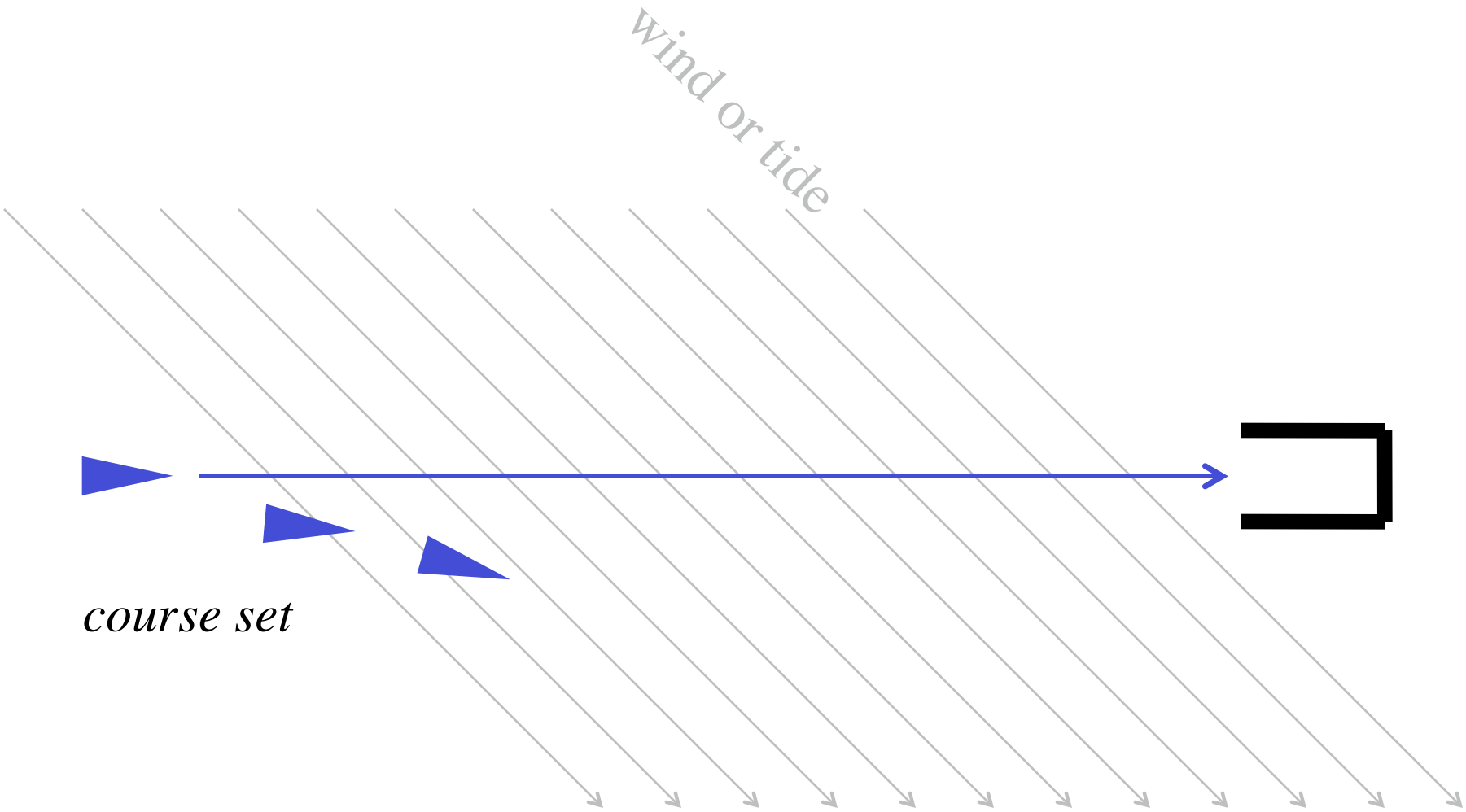


course set

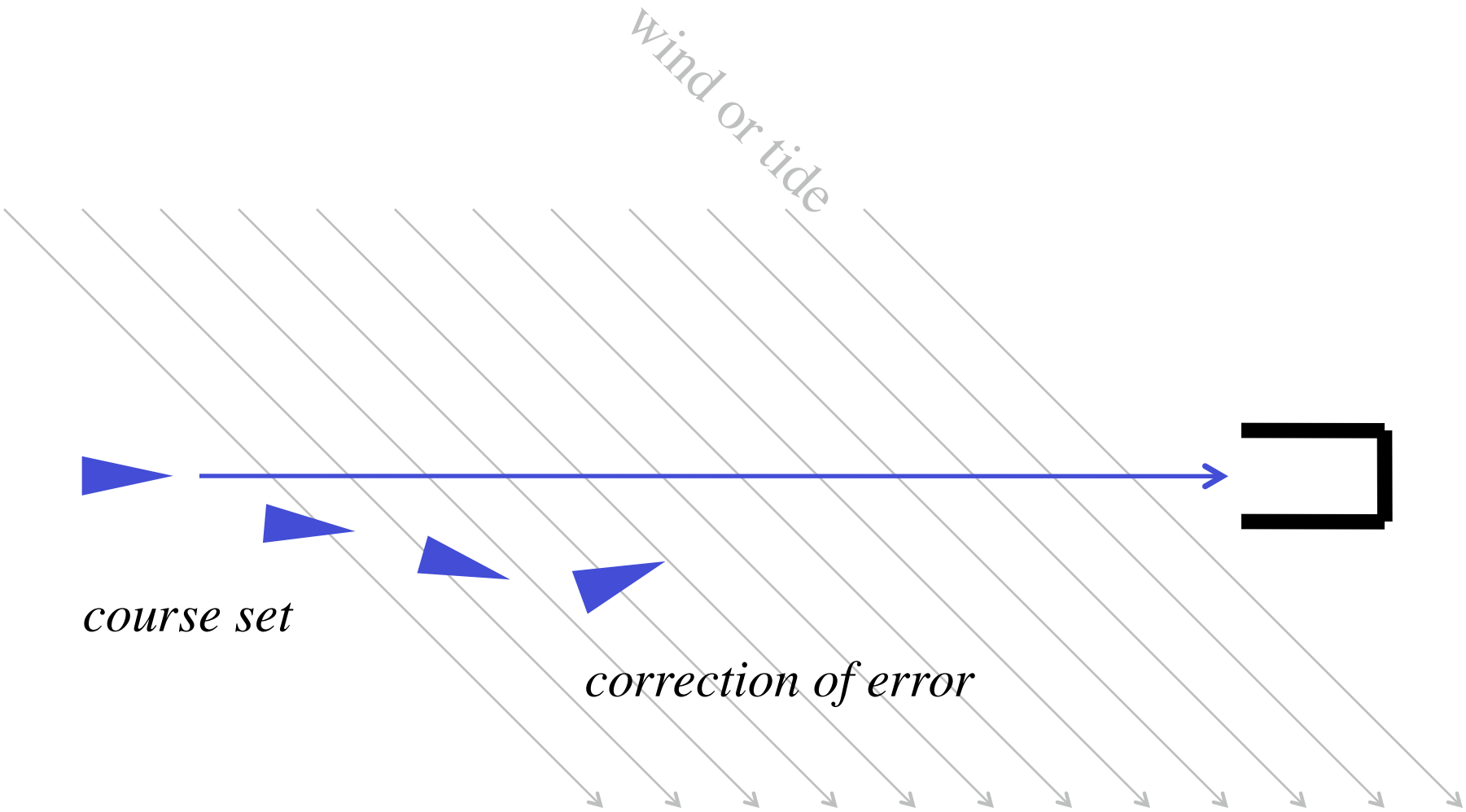
the art of steering



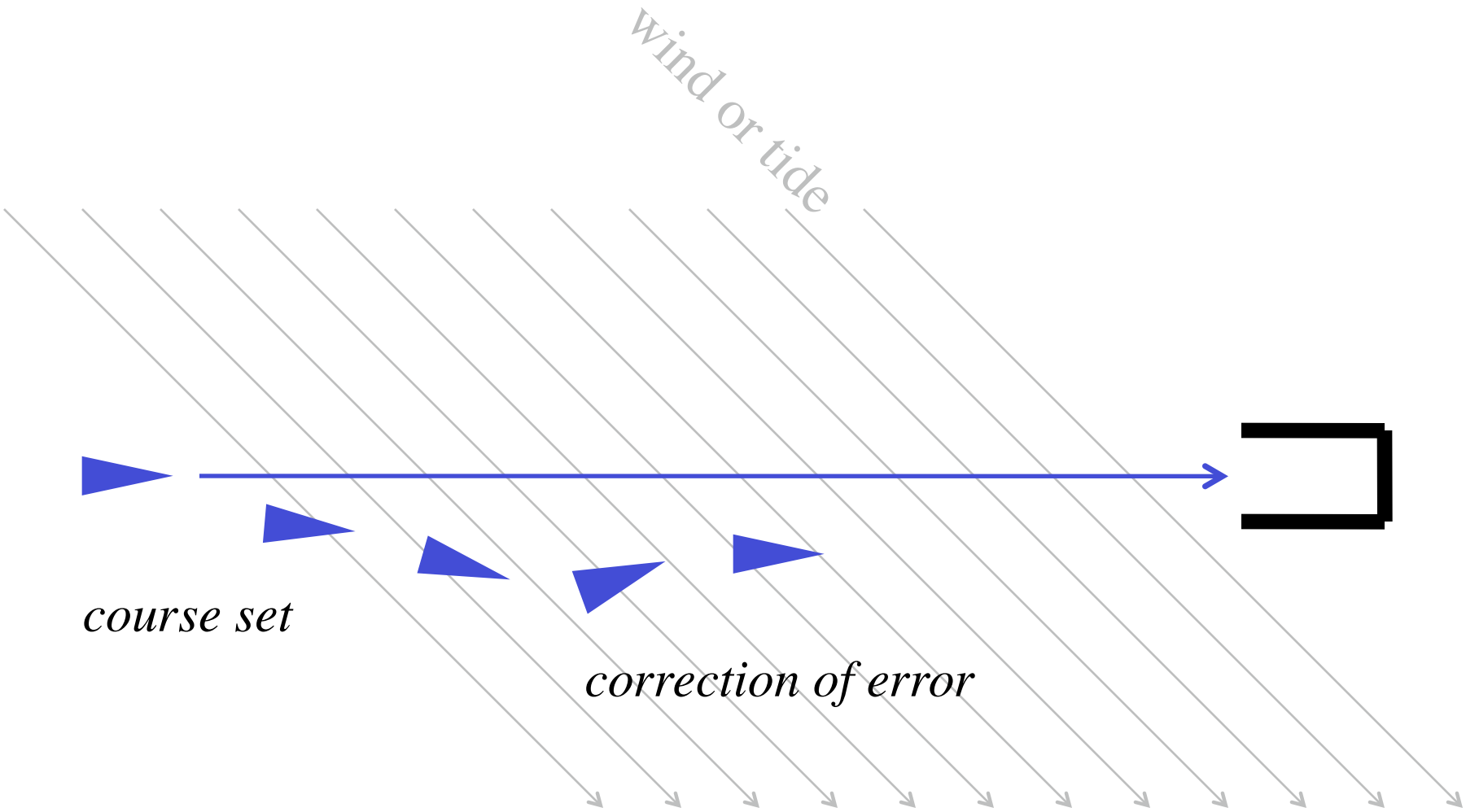
the art of steering



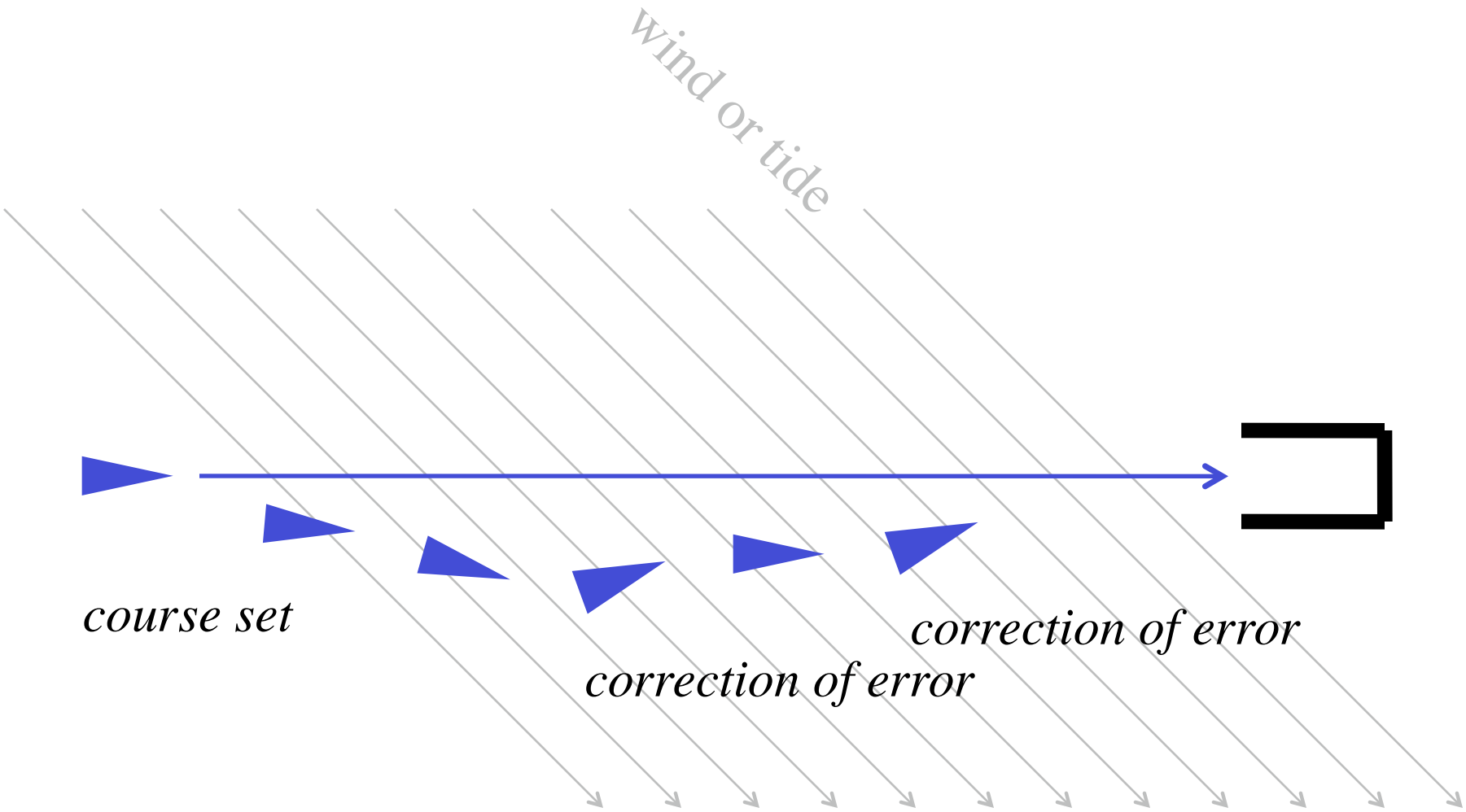
the art of steering



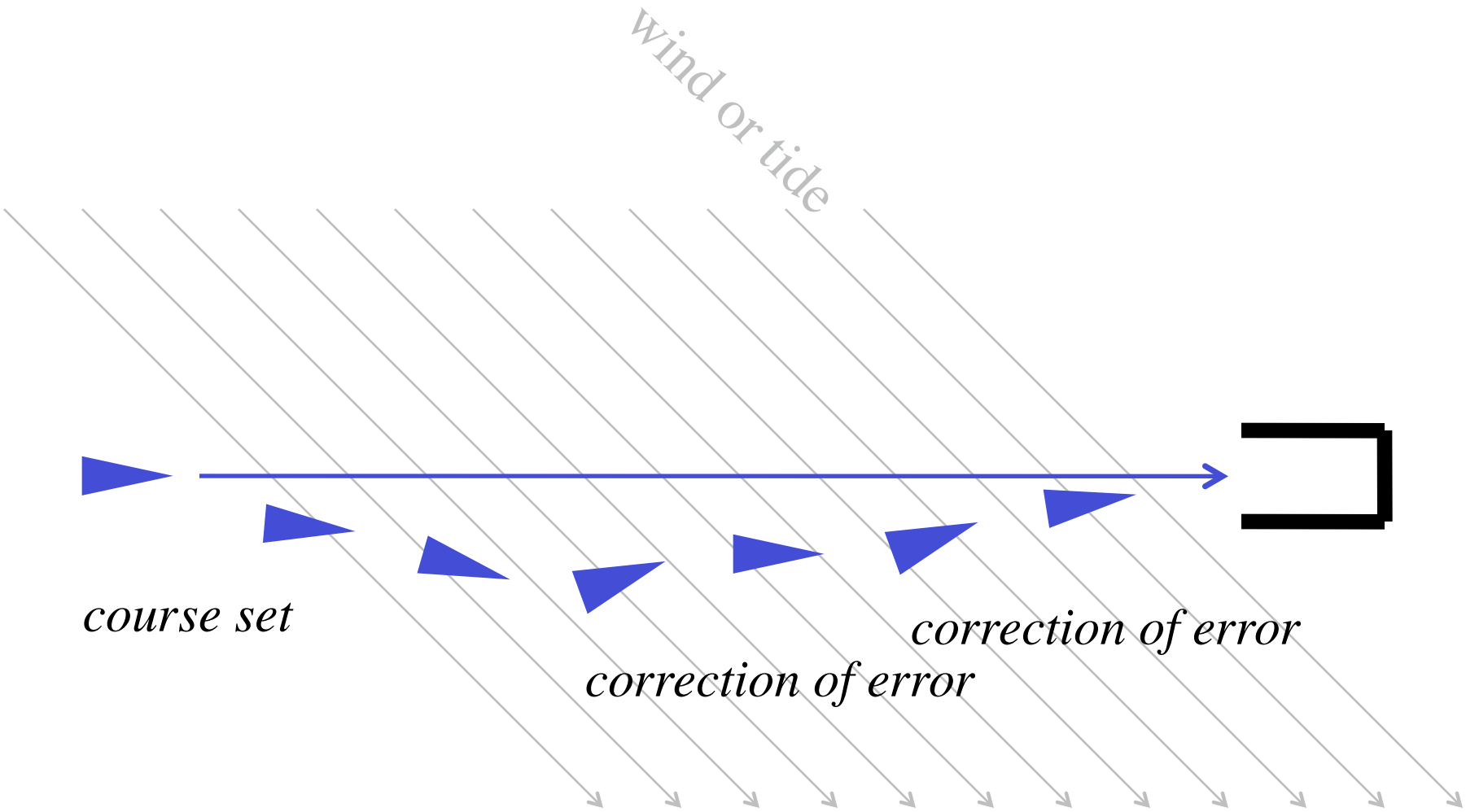
the art of steering



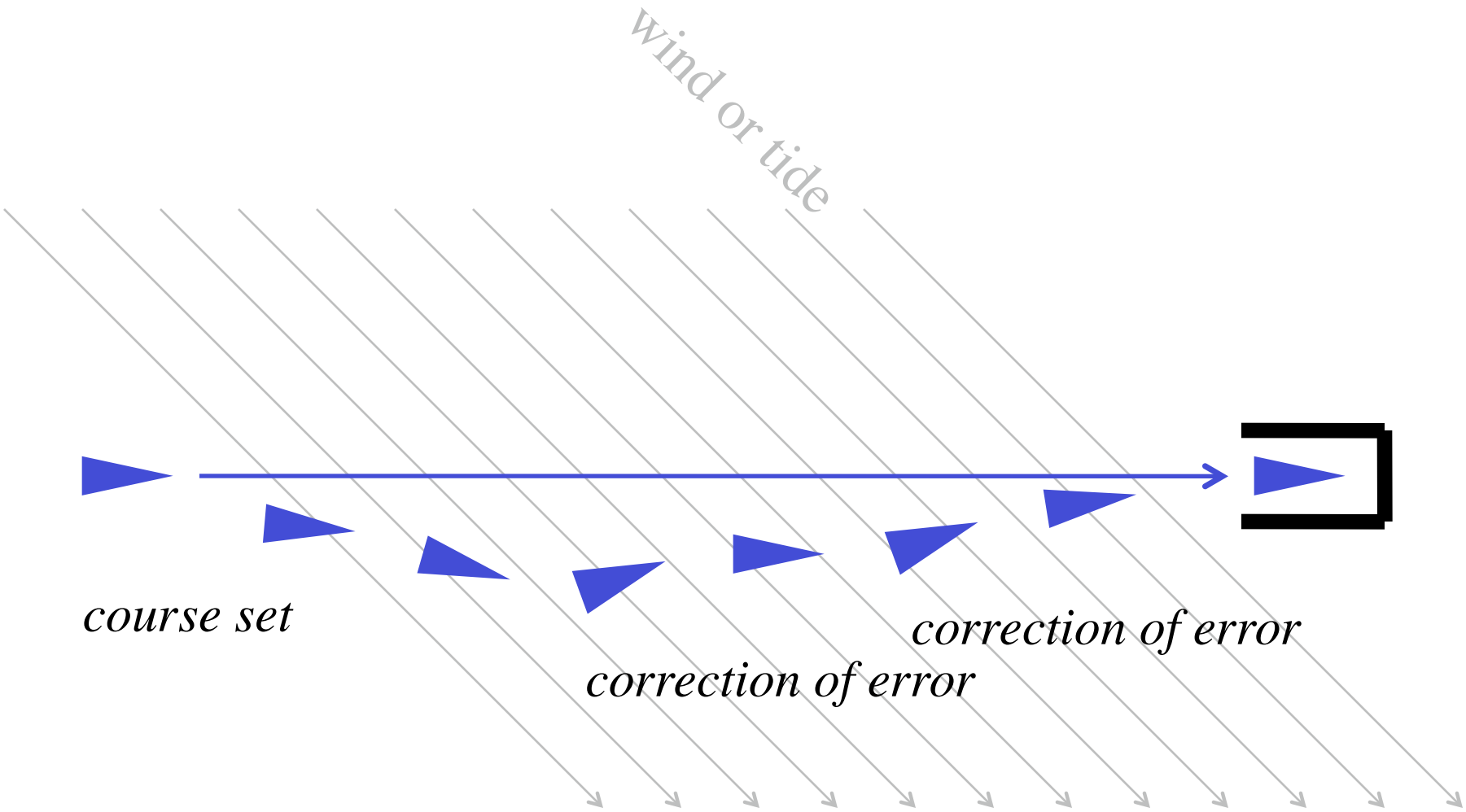
the art of steering



the art of steering



the art of steering



CYBERNETICS

system has goal

system aims toward goal

environment affects aim

information returns to system—'feedback'

system measures difference between state and goal
—detects 'error'

system acts to correct the error, to achieve its goal

CYBERNETICS

from Greek ‘kybernetes’—the art of steering

in Latin, the same term becomes ‘governing’

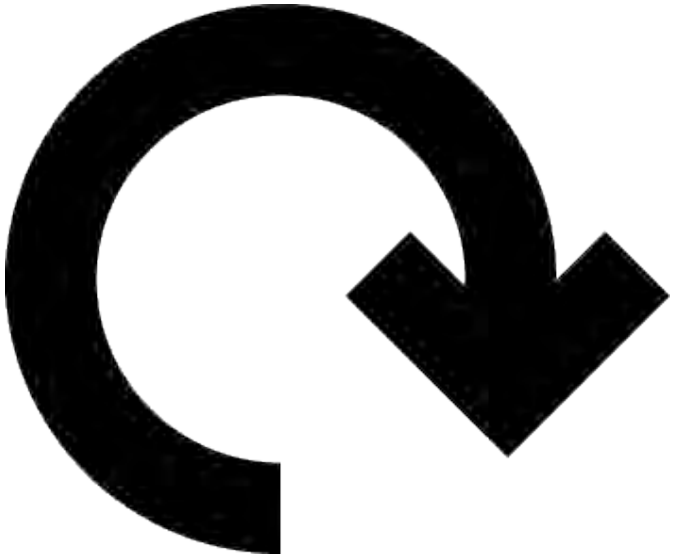
– regulation by law or person

– government *means* regulation

CYBERNETICS

"... introduces for the first time —
and not only by saying it, but methodologically —
the notion of circularity, circular causal systems."

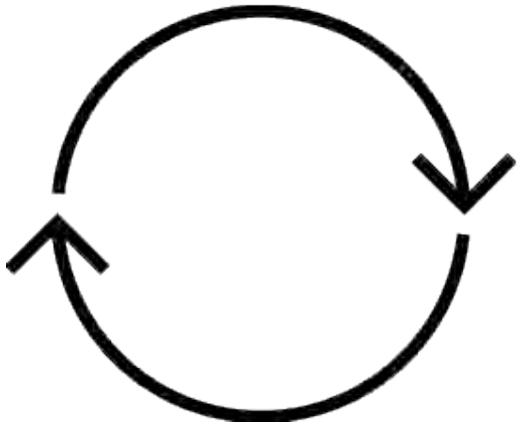
Heinz von Foerster



the art of regulation

detection of error

compares heading with
goal of reaching port



adjusts rudder
to correct heading

correction of error

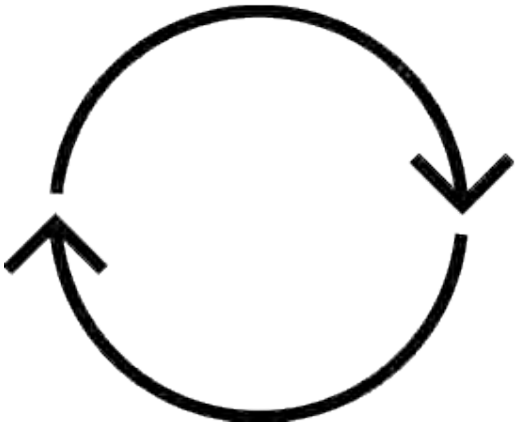
feedback

ship's heading

the art of regulation

comparing

compares heading with
goal of reaching port



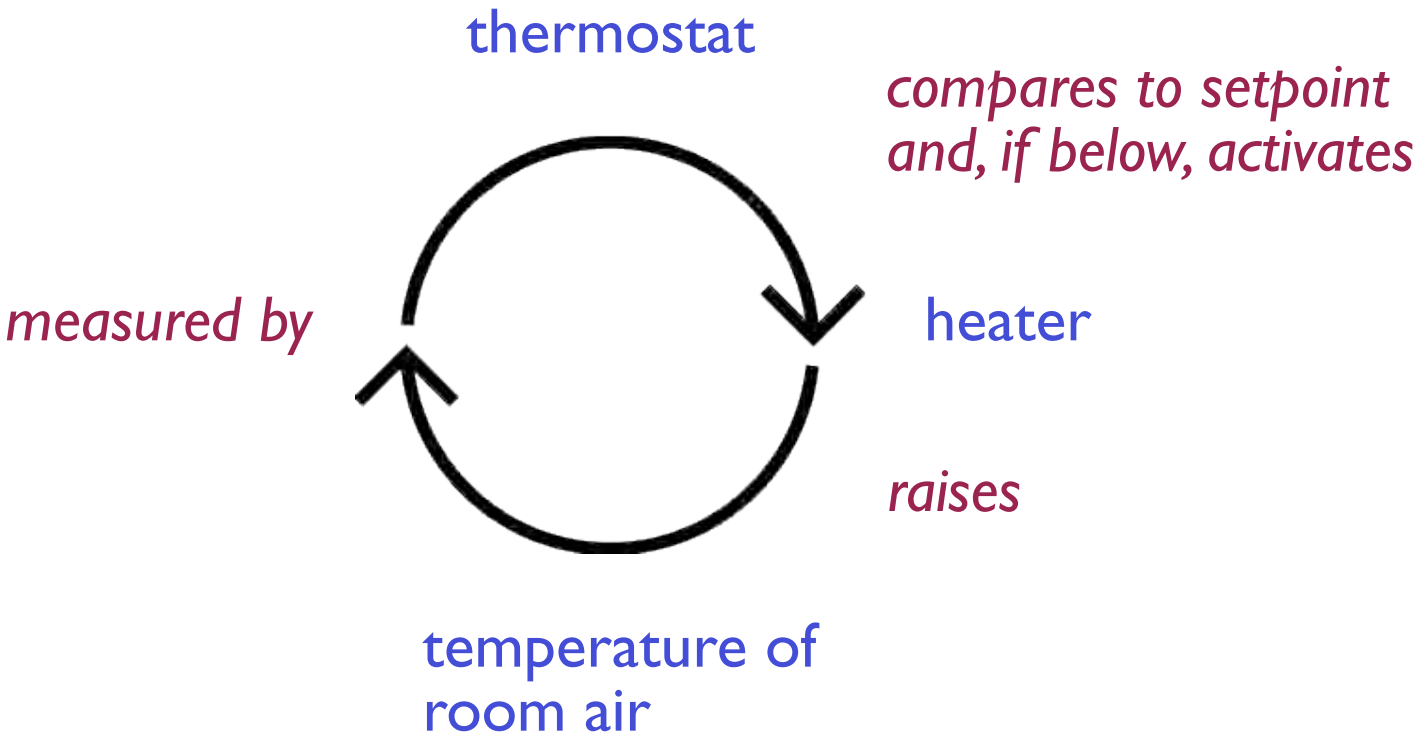
sensing

adjusts rudder
to correct heading

acting

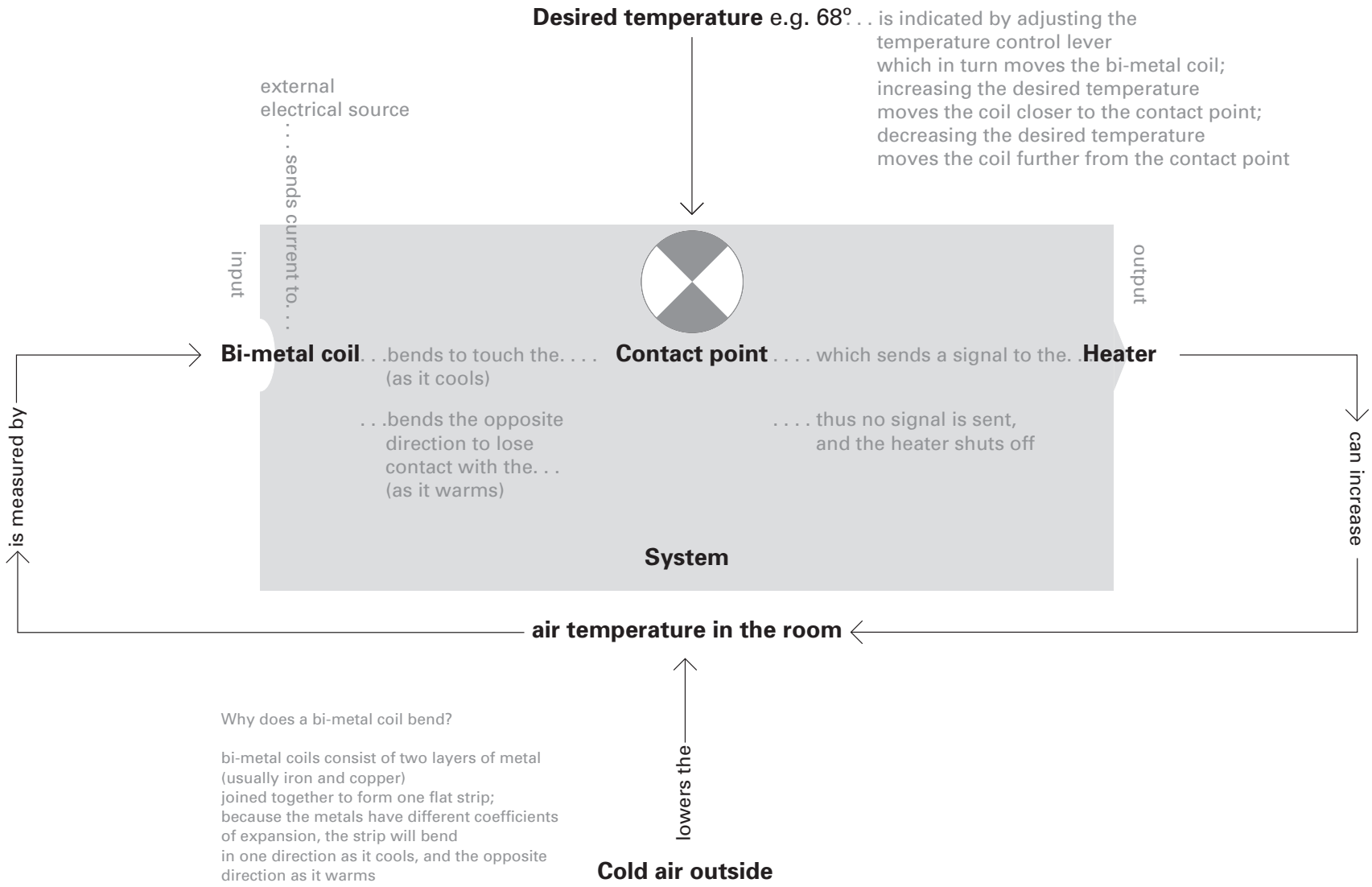
ship's heading

automation of regulation



Feedback: Classic Example

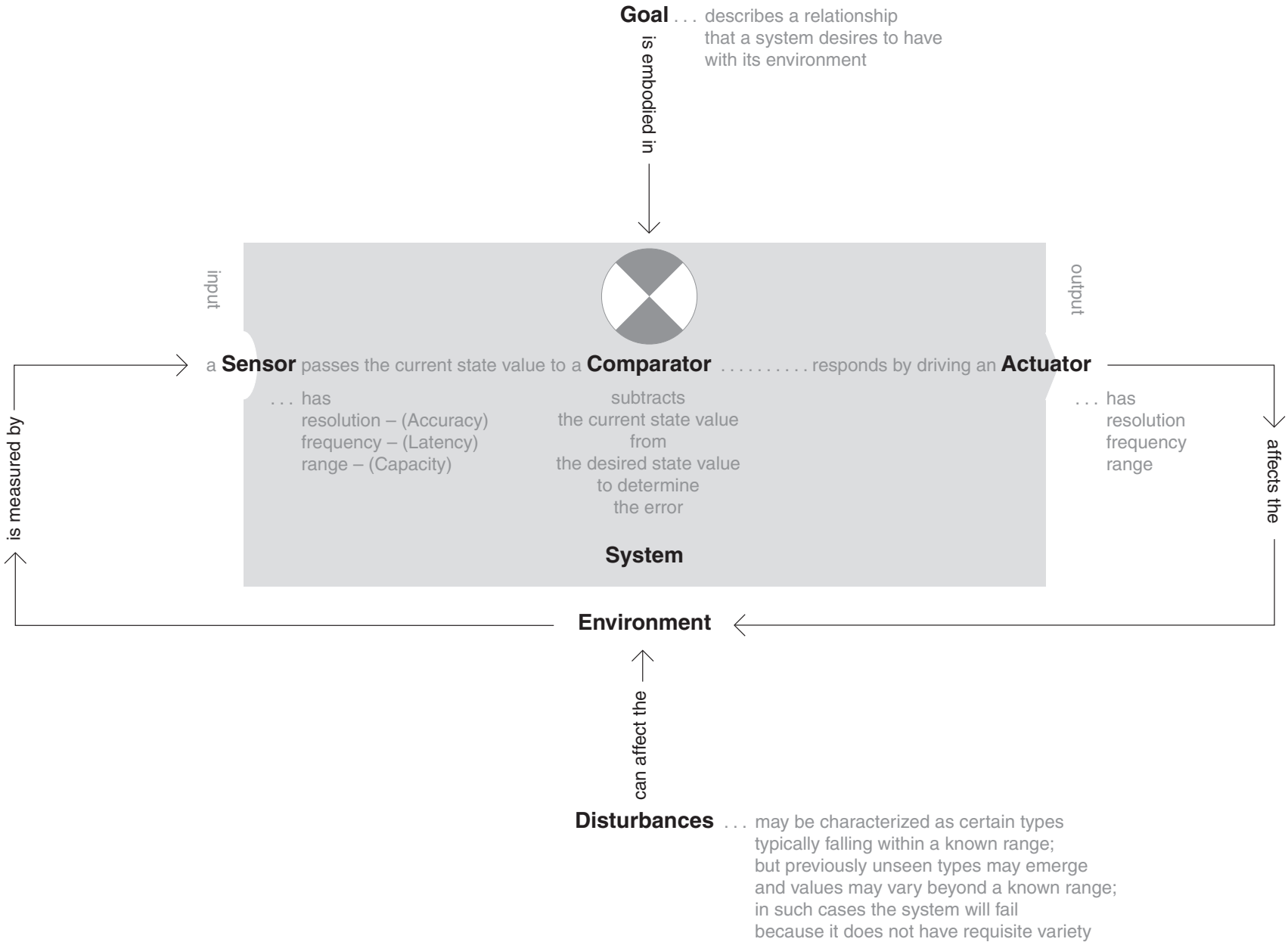
Thermostat regulating room temperature
(via a heater)



Why does a bi-metal coil bend?

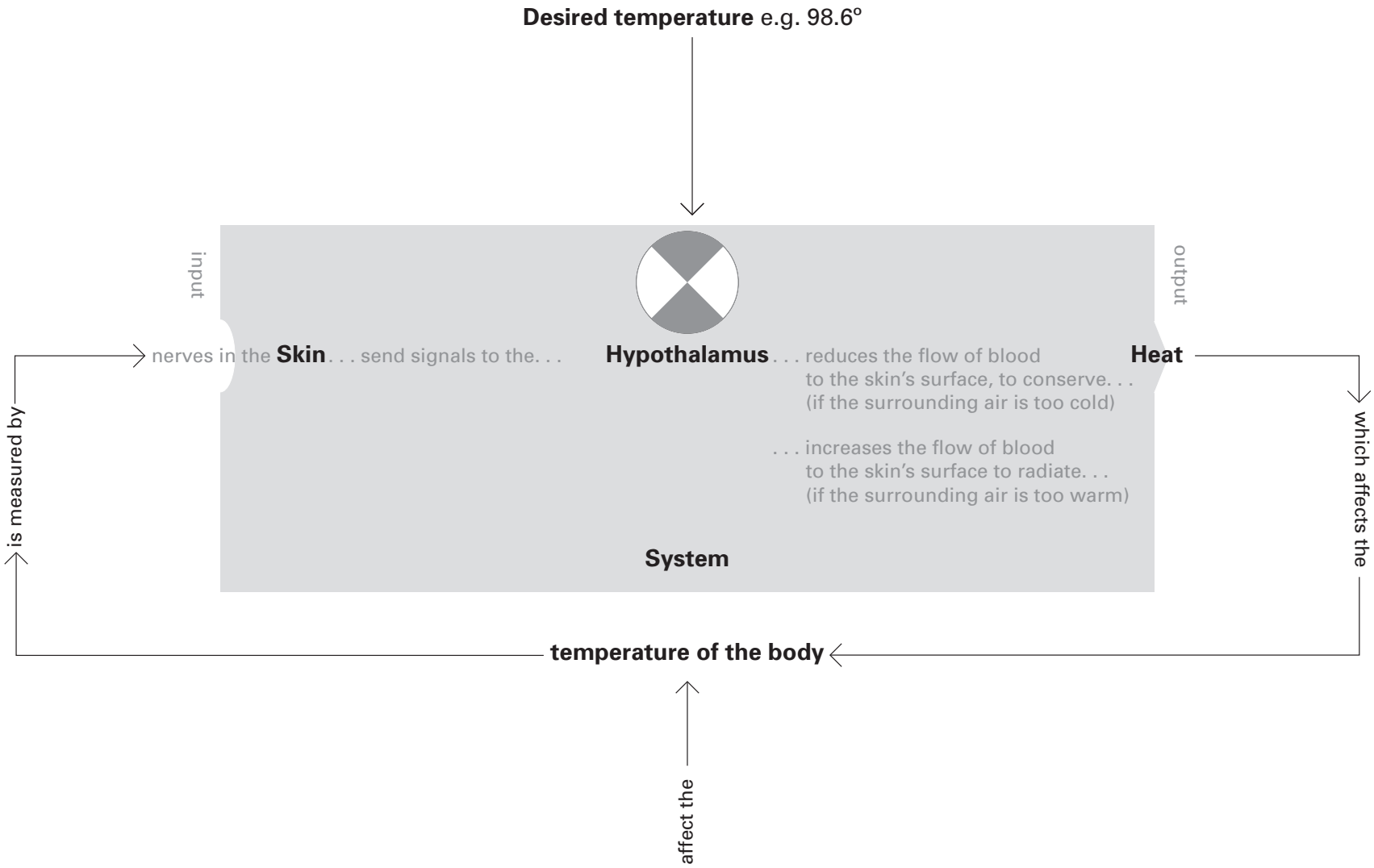
bi-metal coils consist of two layers of metal (usually iron and copper) joined together to form one flat strip; because the metals have different coefficients of expansion, the strip will bend in one direction as it cools, and the opposite direction as it warms

Feedback: Formal Mechanism

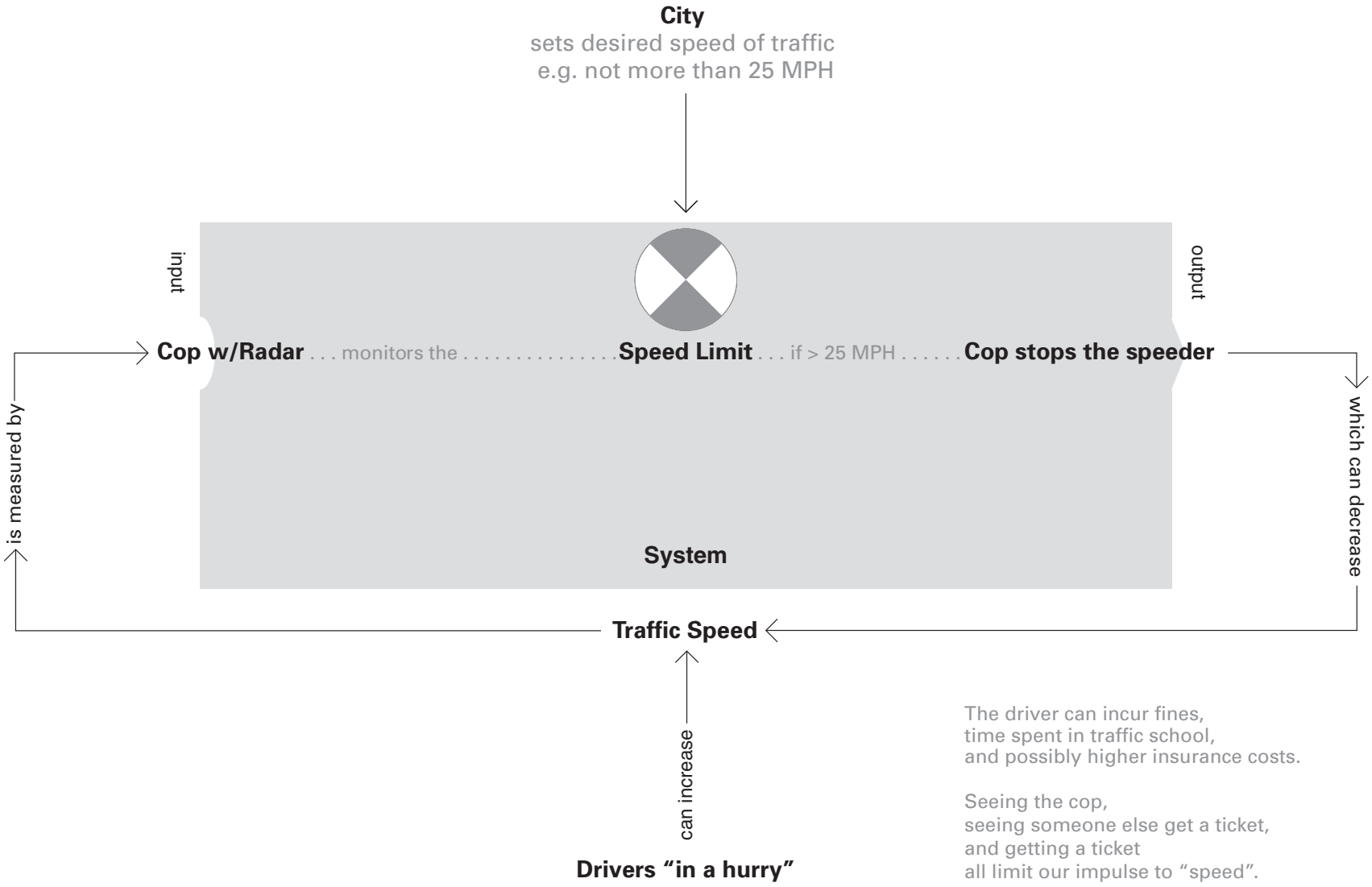


Feedback: Biological Example

Regulating temperature in the human body



Feedback: Social Example
Regulating traffic speed



CYBERNETICS

CYBERNETICS

OR CONTROL AND COMMUNICATION IN THE ANIMAL AND THE MACHINE

Norbert Wiener

PROFESSOR OF MATHEMATICS
THE MASSACHUSETTS INSTITUTE
OF TECHNOLOGY

THE TECHNOLOGY PRESS

JOHN WILEY & SONS, INC., NEW YORK

HERMANN et CIE, PARIS

historical views of cybernetics

Cybernetics saves the souls, bodies, and material possessions from the gravest dangers.

– *Socrates according to Plato, c. 400 B.C.E.*

The future science of government should be called "la cybernetique."

– *André-Marie Ampere, 1843*

Until recently, there was no existing word for this complex of ideas, and... I felt constrained to invent one...

– *Norbert Wiener, 1954*

many views of cybernetics

La Cybernetique est l'art d'assurer l'efficacite de l'action.

– *Louis Couffignal*

The science of effective organization.

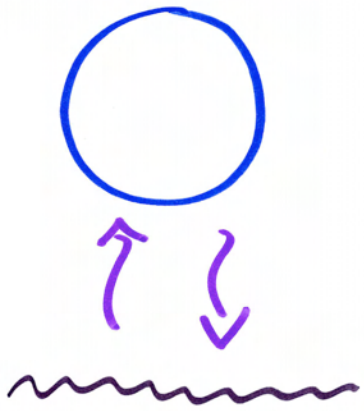
– *Stafford Beer*

The science of observed systems.

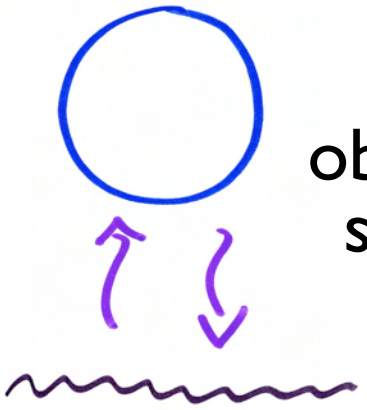
– *Heinz von Foerster*

The study of the immaterial aspects of systems.

– *W. Ross Ashby*



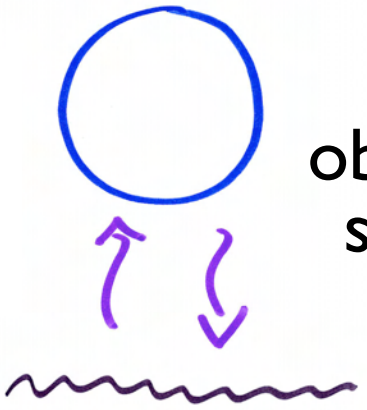
after Maturana



observed
system

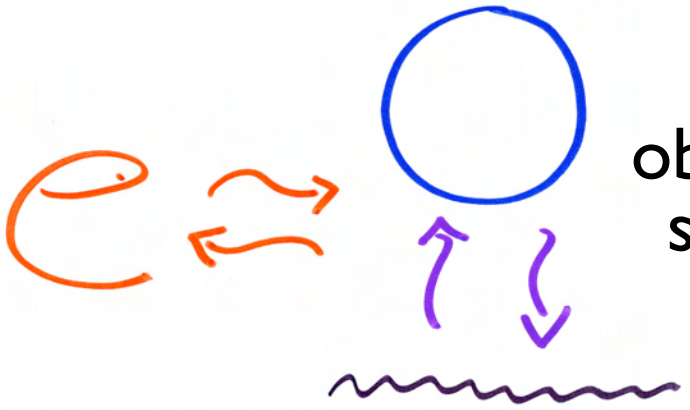
after Maturana

first-order cybernetics



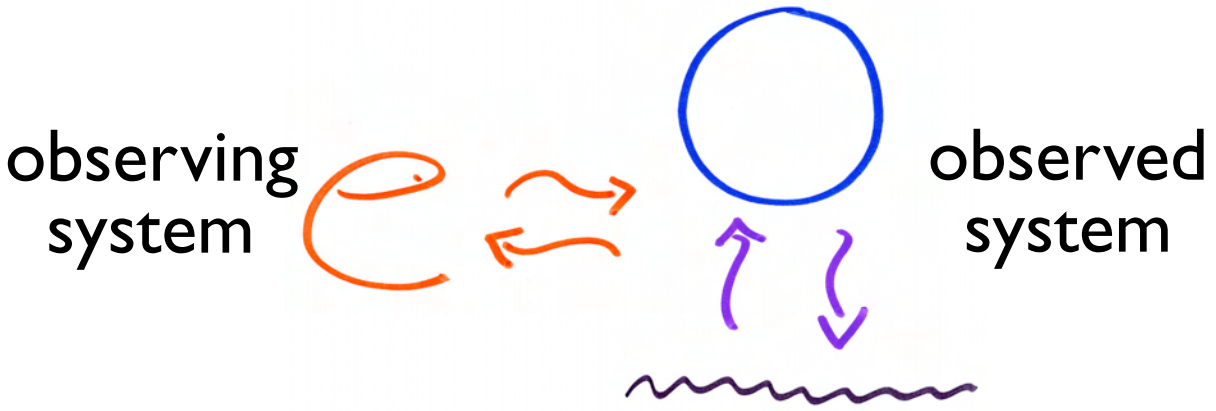
observed system

first-order cybernetics



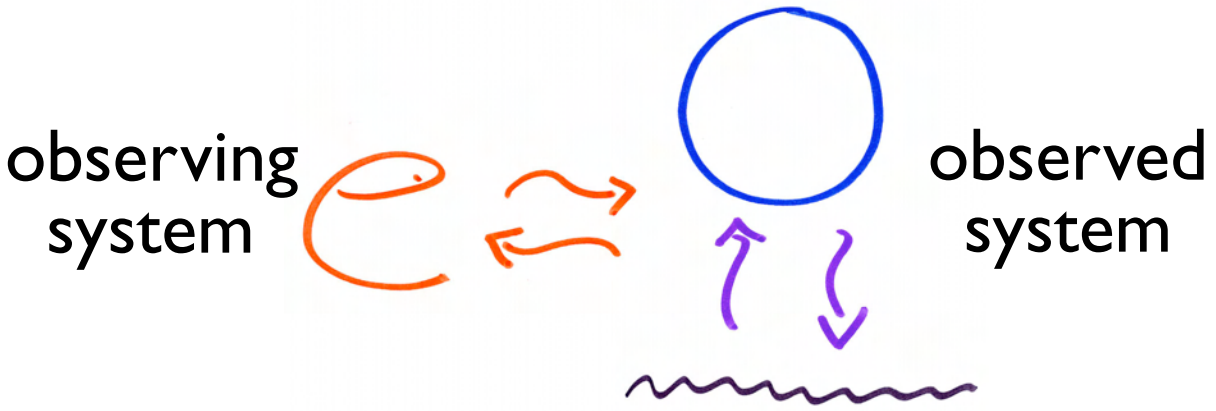
observed system

first-order cybernetics

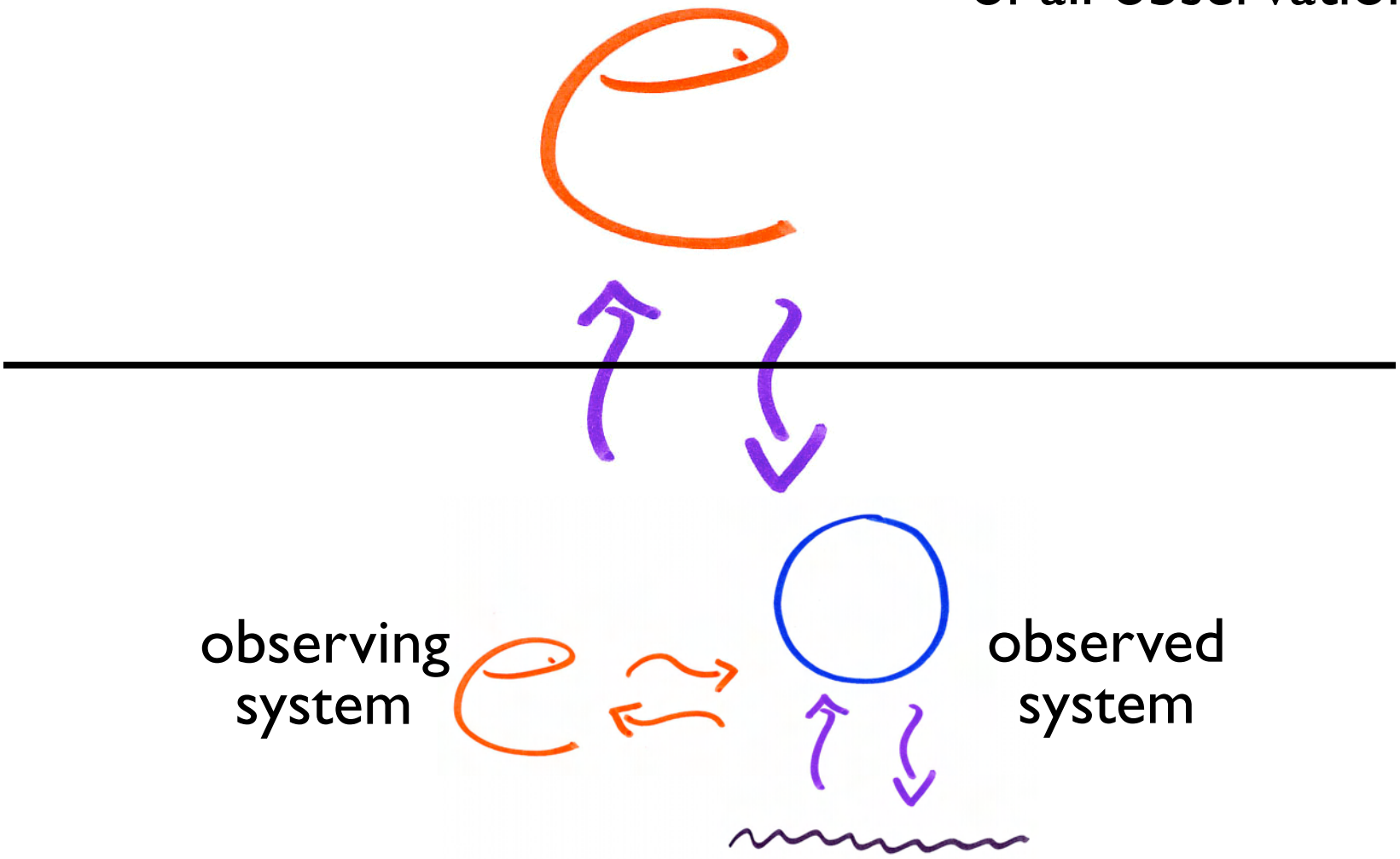


second-order cybernetics

first-order cybernetics

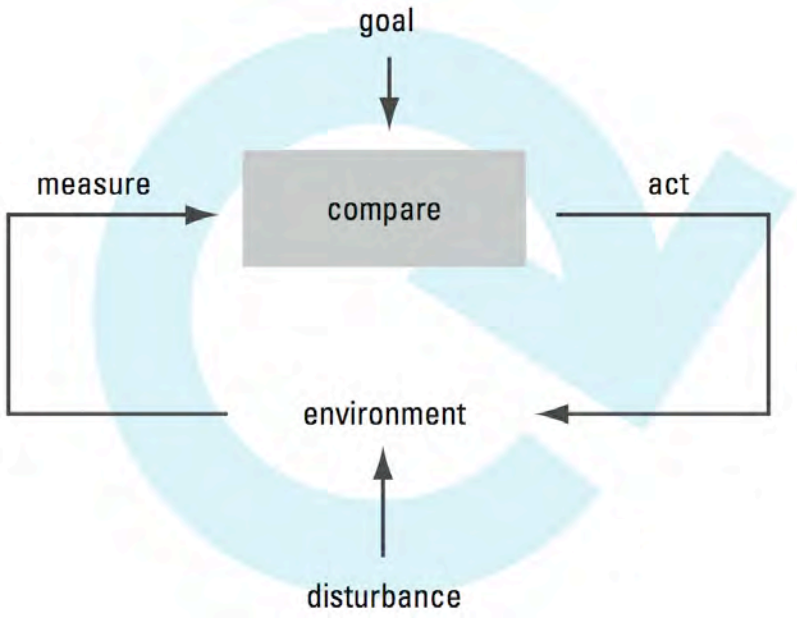


recognizing
the subjectivity
of all observation



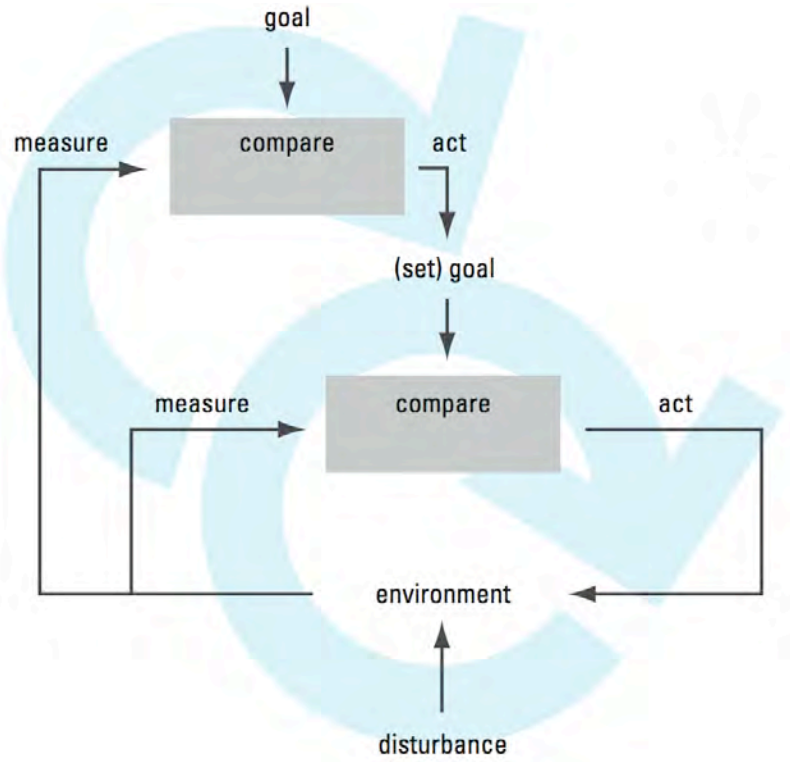
second-order cybernetics

cybernetics explains how
circular causal systems work



second-order cybernetics

cybernetics explains how
circular causal systems work—
even when they self-regulate and modify their goals



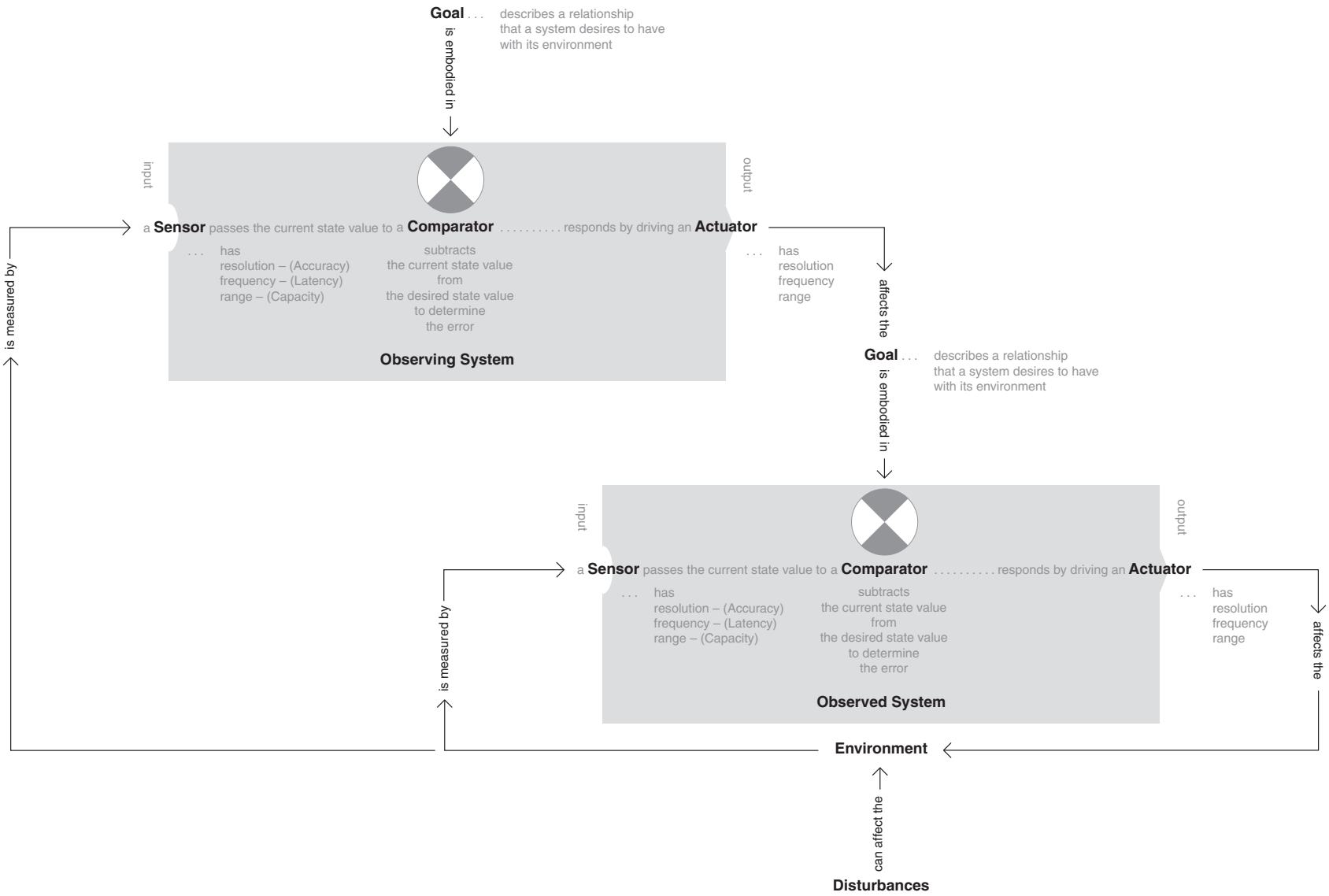
software services engage users in circular causal loops.

these loops involve actions to achieve goals as well as modification of goals.

cybernetic models are well suited to the process of designing user interaction.

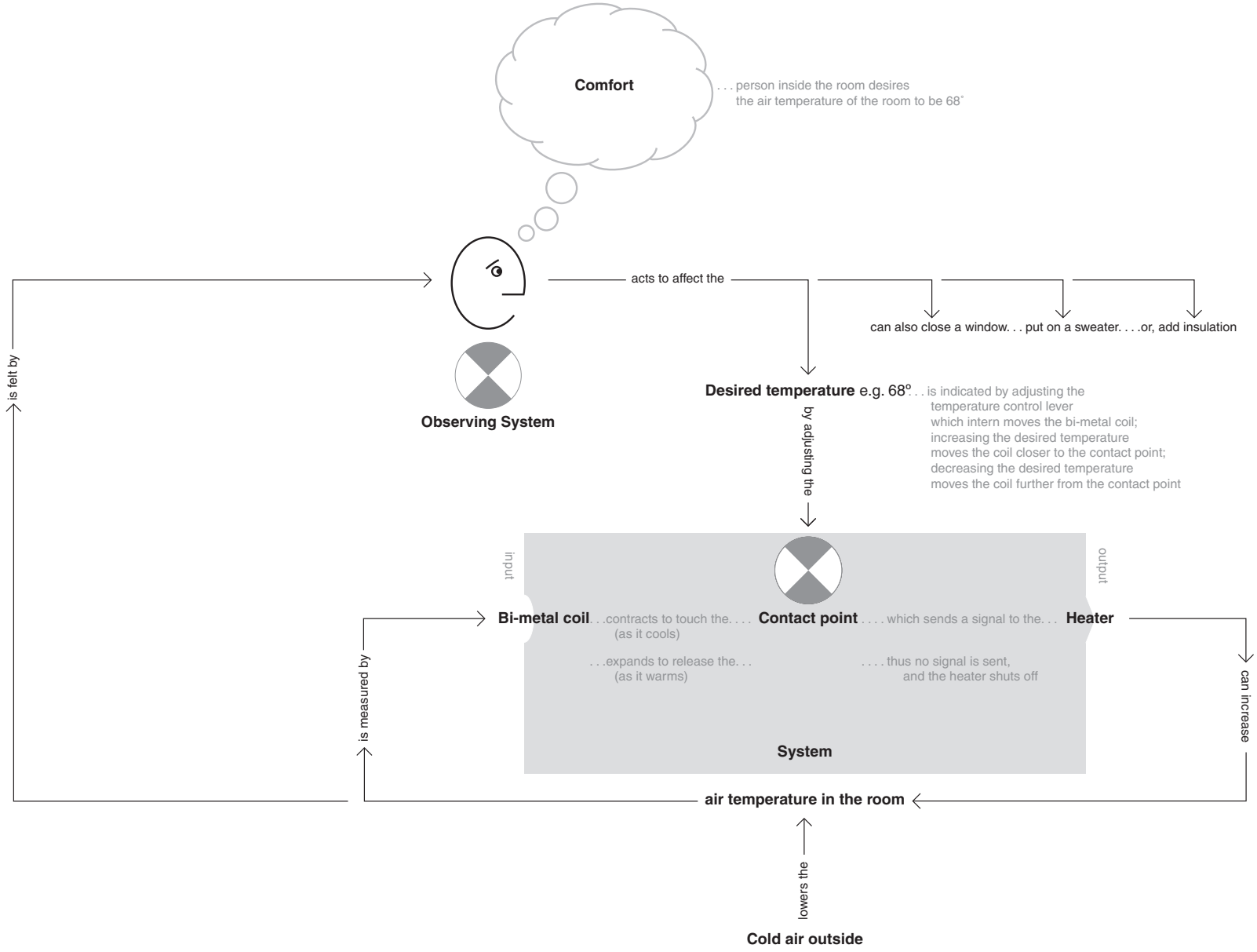
Second-order Feedback: Formal Mechanism

An automatic feedback system (first-order) is controlled by another automatic feedback system (second-order). The first system is 'nested' inside the second.



Second-order Feedback: Classic Example

Person controlling a thermostat (regulating a regulator)

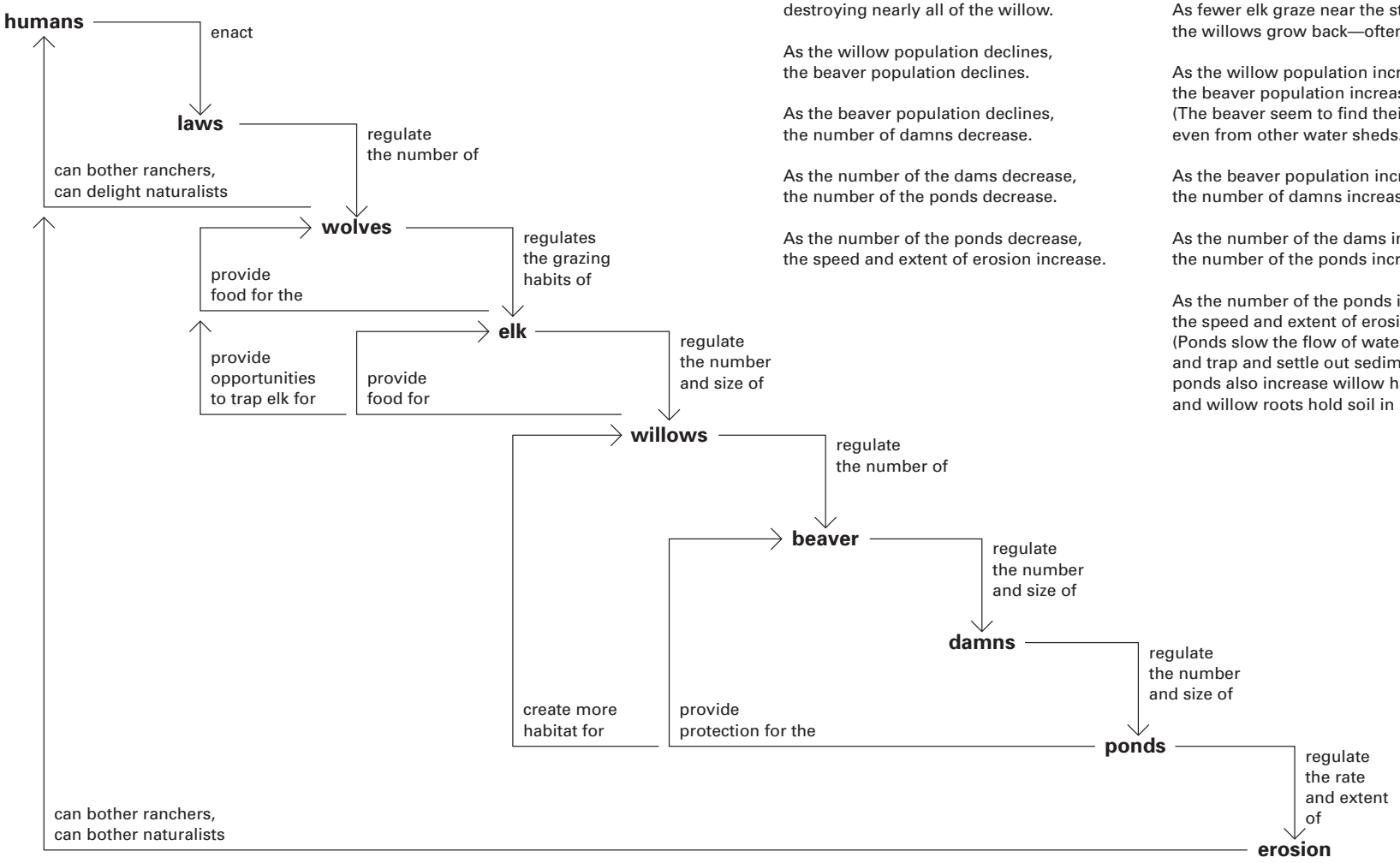


Second-order Feedback: Biological Example

The Role of Wolves in Regulating the Yellowstone Ecosystem

Decreasing the wolf population seemed to increase erosion (and created a more desert-like environment).

Conversely, restoring wolves seemed to reduce erosion (and restored much of the environment's diversity).



Increasing Erosion

As the number of wolves drops, the level of elk grazing around streams (and the nearby willows) rises (an unexpected outcome).

As more elk graze near the streams, they destroy more and more willows—eventually (over many years) destroying nearly all of the willow.

As the willow population declines, the beaver population declines.

As the beaver population declines, the number of damns decrease.

As the number of the dams decrease, the number of the ponds decrease.

As the number of the ponds decrease, the speed and extent of erosion increase.

Decreasing Erosion

As the number of wolves increases (after reintroduction), the level of elk grazing around streams (and the nearby willows) drops—presumably because the elk "sense" the increased danger in these areas where wolves can more easily trap them.

As fewer elk graze near the streams, the willows grow back—often quite rapidly.

As the willow population increases, the beaver population increases. (The beaver seem to find their way back even from other water sheds.)

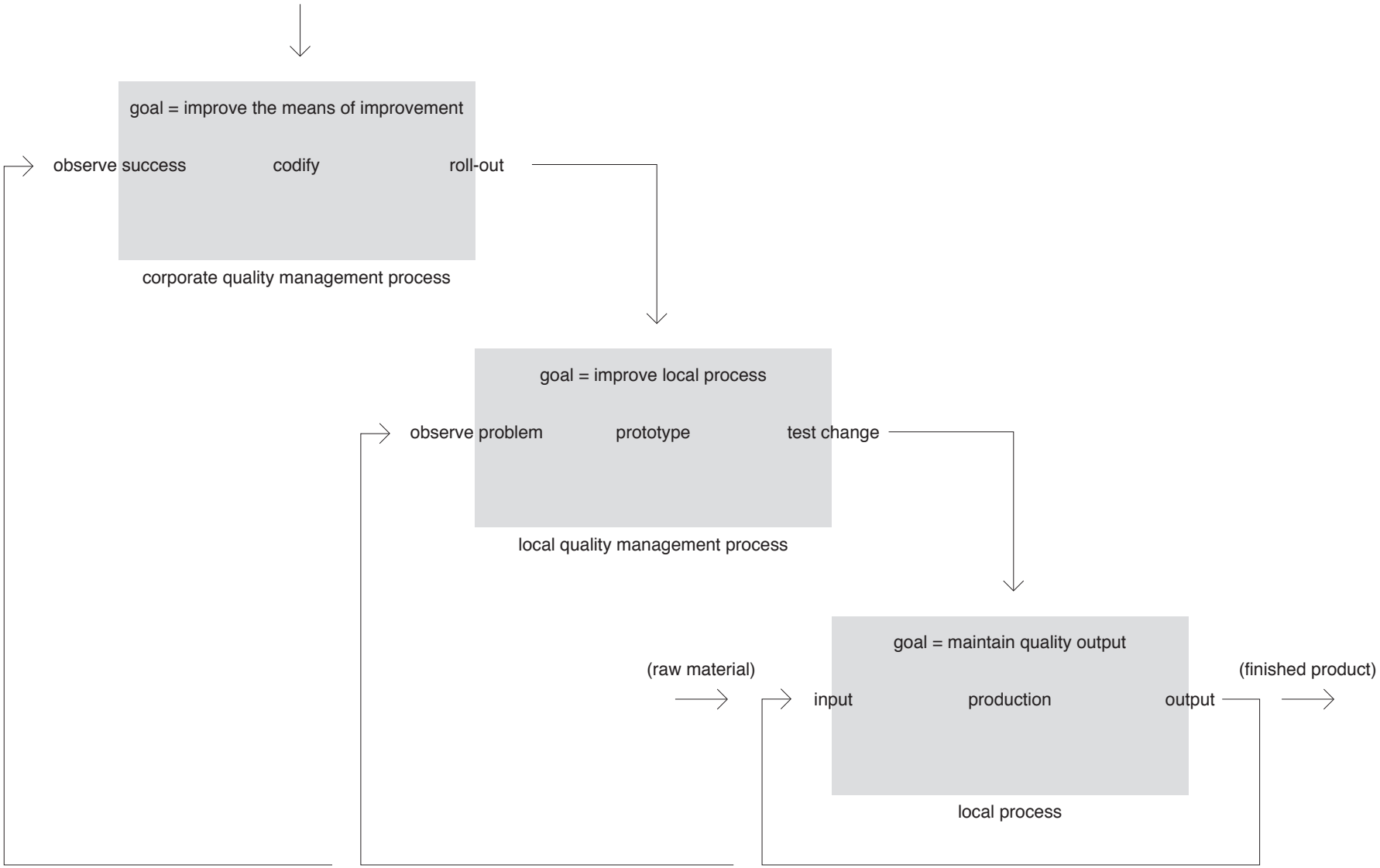
As the beaver population increases, the number of damns increase.

As the number of the dams increase, the number of the ponds increase.

As the number of the ponds increase, the speed and extent of erosion decrease. (Ponds slow the flow of water and trap and settle out sediment; ponds also increase willow habitat; and willow roots hold soil in place.)

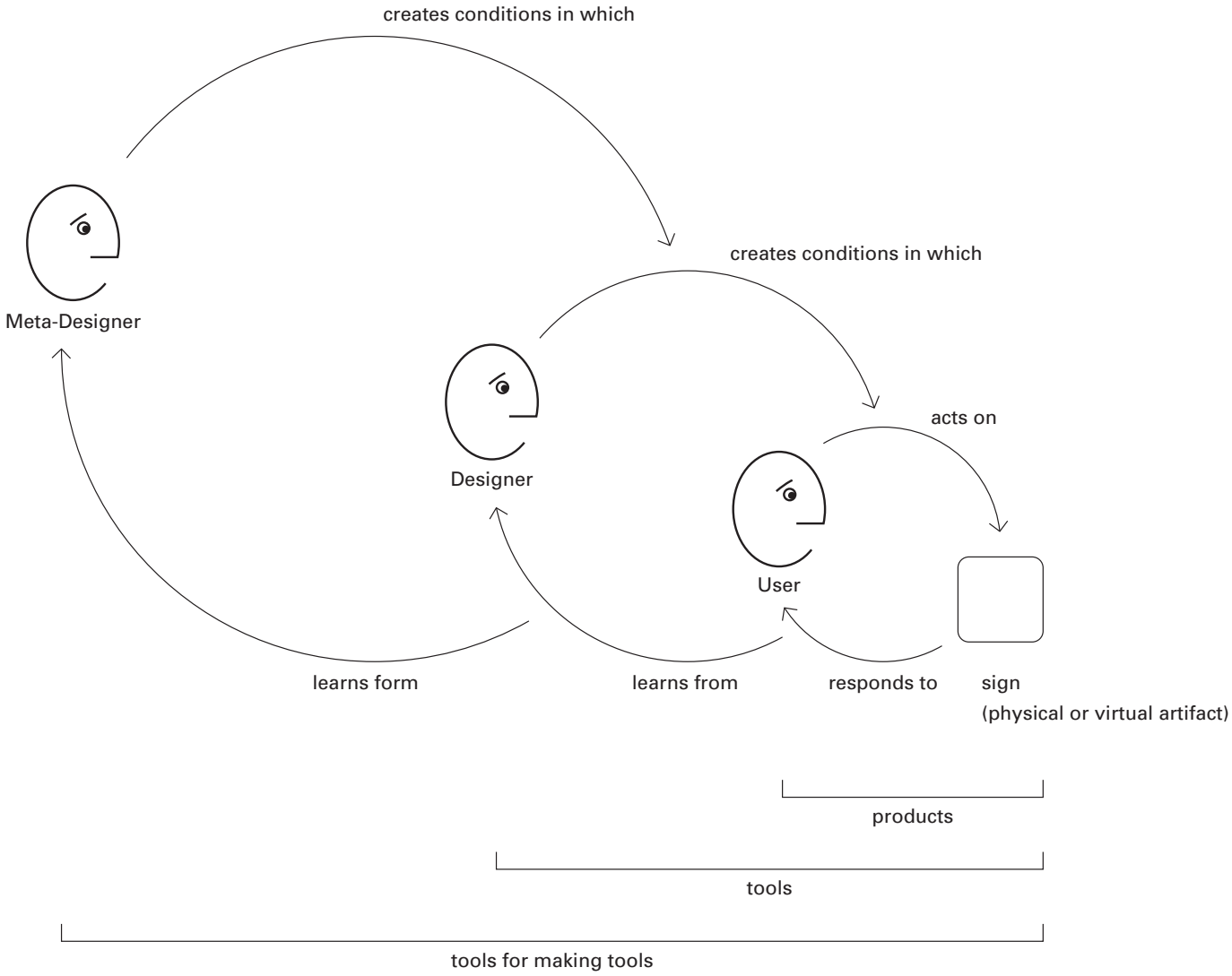
Second-order Feedback: Social Example
after Douglas Englebart

Organizational 'boot-strapping' process relies on nested feedback loops.



Second-order Feedback: Social Example

Levels of feedback in design processes



CYBERNETICS

CYBERNETICS

OR CONTROL AND COMMUNICATION IN THE ANIMAL AND THE MACHINE

Norbert Wiener

PROFESSOR OF MATHEMATICS
THE MASSACHUSETTS INSTITUTE
OF TECHNOLOGY

THE TECHNOLOGY PRESS

JOHN WILEY & SONS, INC., NEW YORK

HERMANN et CIE, PARIS

CYBERNETICS

CIRCULAR CAUSAL AND FEEDBACK MECHANISMS IN BIOLOGICAL AND SOCIAL SYSTEMS

Transactions of the Tenth Conference
April 22, 23, and 24, 1953, Princeton, N. J.

Edited by

HEINZ VON FOERSTER

DEPARTMENT OF ELECTRICAL ENGINEERING
UNIVERSITY OF ILLINOIS
CHAMPAIGN, ILL.

Assistant Editors

MARGARET MEAD

AMERICAN MUSEUM OF NATURAL HISTORY
NEW YORK, N. Y.

HANS LUKAS TEUBER

DEPARTMENT OF PSYCHIATRY AND NEUROLOGY
NEW YORK UNIVERSITY COLLEGE OF MEDICINE
NEW YORK, N. Y.

Sponsored by the

JOSIAH MACY, JR. FOUNDATION

NEW YORK, N. Y.

Heinz von Foerster

OBSERVING SYSTEMS

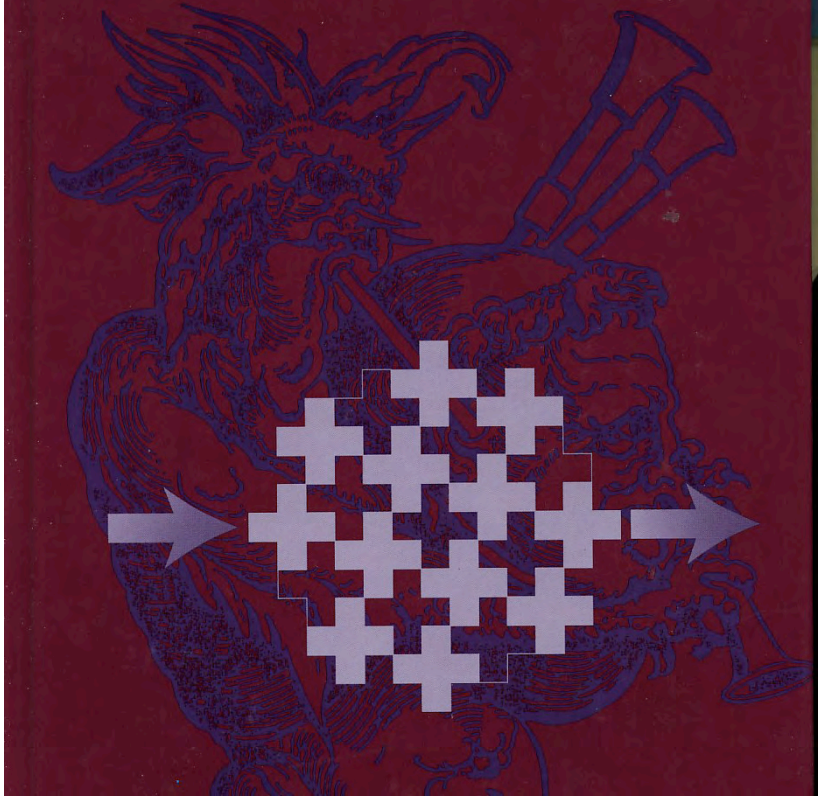
THE SYSTEMS INQUIRY SERIES

PUBLISHED BY INTERSYSTEMS PUBLICATIONS

Understanding Understanding

Essays on Cybernetics and Cognition

Heinz von Foerster



PARTICIPANTS

*Tenth Conference on Cybernetics**

MEMBERS

WARREN S. McCULLOCH, *Chairman*
Research Laboratory of Electronics, Massachusetts Institute of Technology
Cambridge, Mass.

HEINZ VON FOERSTER, *Secretary*
Department of Electrical Engineering, University of Illinois
Champaign, Ill.

GREGORY BATESON
Veterans Administration Hospital
Palo Alto, Cal.

ALEX BAVELAS†
Department of Economics and Social Science, Massachusetts Institute of Technology
Cambridge, Mass.

JULIAN H. BIGELOW
Department of Mathematics, Institute for Advanced Study
Princeton, N. J.

HENRY W. BROSIN
Department of Psychiatry, University of Pittsburgh School of Medicine
Pittsburgh, Pa.

LAWRENCE K. FRANK
72 Perry St., New York, N. Y.

RALPH W. GERARD†
Departments of Psychiatry and Physiology, University of Illinois College of Medicine
Chicago, Ill.

GEORGE EVELYN HUTCHINSON
Department of Zoology, Yale University
New Haven, Conn.

HEINRICH KLÜVER
Division of the Biological Sciences, University of Chicago
Chicago, Ill.

LAWRENCE S. KUBIE
Department of Psychiatry and Mental Hygiene, Yale University School of Medicine
New Haven, Conn.

RAFAEL LORENTE de NÓ†
Rockefeller Institute for Medical Research
New York, N. Y.

DONALD G. MARQUIS
Department of Psychology, University of Michigan
Ann Arbor, Mich.

MARGARET MEAD
American Museum of Natural History
New York, N. Y.

F. S. C. NORTHROP
Department of Philosophy, Yale University
New Haven, Conn.

* This is the final conference.
† Absent.

WALTER PITTS
Research Laboratory of Electronics, Massachusetts Institute of Technology
Cambridge, Mass.

ARTURO S. ROSENBLUETH†
Department of Physiology, Instituto Nacional de Cardiologia
Mexico City, D. F., Mexico

LEONARD J. SAVAGE
Committee on Statistics, University of Chicago
Chicago, Ill.

T. C. SCHNEIRLA
American Museum of Natural History
New York, N. Y.

HANS LUKAS TEUBER
Department of Psychiatry and Neurology, New York University College of Medicine
New York, N. Y.

GERHARDT VON BONIN
Department of Anatomy, University of Illinois College of Medicine
Chicago, Ill.

GUESTS

VAHE E. AMASSIAN
Department of Physiology and Biophysics, University of Washington
School of Medicine
Seattle, Wash.

Y. BAR-HILLEL
Department of Philosophy, Hebrew University
Jerusalem, Israel

JOHN R. BOWMAN
Department of Physical Chemistry
Mellon Institute of Industrial Research, University of Pittsburgh
Pittsburgh, Pa.

YUEN REN CHAO
Department of Oriental Languages, University of California
Berkeley, Cal.

JAN DROOGLEEVER-FORTUYN
Department of Neurology, University of Groningen
Groningen, Holland

W. GREY-WALTER
Burden Neurological Institute
Stapleton, Bristol, England

HENRY QUASTLER
Control Systems Laboratory, University of Illinois
Urbana, Ill.

CLAUDE SHANNON
Bell Telephone Laboratories, Inc., Murray Hill Laboratory
Murray Hill, N. J.

THE JOSIAH MACY, JR. FOUNDATION

FRANK FREMONT-SMITH, *Medical Director*
JANET FREED LYNCH, *Assistant for the Conference Program*

† Absent.

PARTICIPANTS

*Tenth Conference on Cybernetics**

MEMBERS

WARREN S. McCULLOCH, *Chairman*
Research Laboratory of Electronics, Massachusetts Institute of Technology
Cambridge, Mass.

HEINZ VON FOERSTER, *Secretary*
Department of Electrical Engineering, University of Illinois
Champaign, Ill.

GREGORY BATESON
Veterans Administration Hospital
Palo Alto, Cal.

ALEX BAVELAS†
Department of Economics and Social Science, Massachusetts Institute of Technology
Cambridge, Mass.

JULIAN H. BIGELOW
Department of Mathematics, Institute for Advanced Study
Princeton, N. J.

HENRY W. BROSIN
Department of Psychiatry, University of Pittsburgh School of Medicine
Pittsburgh, Pa.

LAWRENCE K. FRANK
72 Perry St., New York, N. Y.

RALPH W. GERARD†
Departments of Psychiatry and Physiology, University of Illinois College of Medicine
Chicago, Ill.

GEORGE EVELYN HUTCHINSON
Department of Zoology, Yale University
New Haven, Conn.

HEINRICH KLÜVER
Division of the Biological Sciences, University of Chicago
Chicago, Ill.

LAWRENCE S. KUBIE
Department of Psychiatry and Mental Hygiene, Yale University School of Medicine
New Haven, Conn.

RAFAEL LORENTE de NÓ†
Rockefeller Institute for Medical Research
New York, N. Y.

DONALD G. MARQUIS
Department of Psychology, University of Michigan
Ann Arbor, Mich.

MARGARET MEAD
American Museum of Natural History
New York, N. Y.

F. S. C. NORTHROP
Department of Philosophy, Yale University
New Haven, Conn.

* This is the final conference.
† Absent.

WALTER PITTS
Research Laboratory of Electronics, Massachusetts Institute of Technology
Cambridge, Mass.

ARTURO S. ROSENBLUETH†
Department of Physiology, Instituto Nacional de Cardiologia
Mexico City, D. F., Mexico

LEONARD J. SAVAGE
Committee on Statistics, University of Chicago
Chicago, Ill.

T. C. SCHNEIRLA
American Museum of Natural History
New York, N. Y.

HANS LUKAS TEUBER
Department of Psychiatry and Neurology, New York University College of Medicine
New York, N. Y.

GERHARDT VON BONIN
Department of Anatomy, University of Illinois College of Medicine
Chicago, Ill.

GUESTS

VAHE E. AMASSIAN
Department of Physiology and Biophysics, University of Washington
School of Medicine
Seattle, Wash.

Y. BAR-HILLEL
Department of Philosophy, Hebrew University
Jerusalem, Israel

JOHN R. BOWMAN
Department of Physical Chemistry
Mellon Institute of Industrial Research, University of Pittsburgh
Pittsburgh, Pa.

YUEN REN CHAO
Department of Oriental Languages, University of California
Berkeley, Cal.

JAN DROOGLEEVER-FORTUYN
Department of Neurology, University of Groningen
Groningen, Holland

W. GREY-WALTER
Burden Neurological Institute
Stapleton, Bristol, England

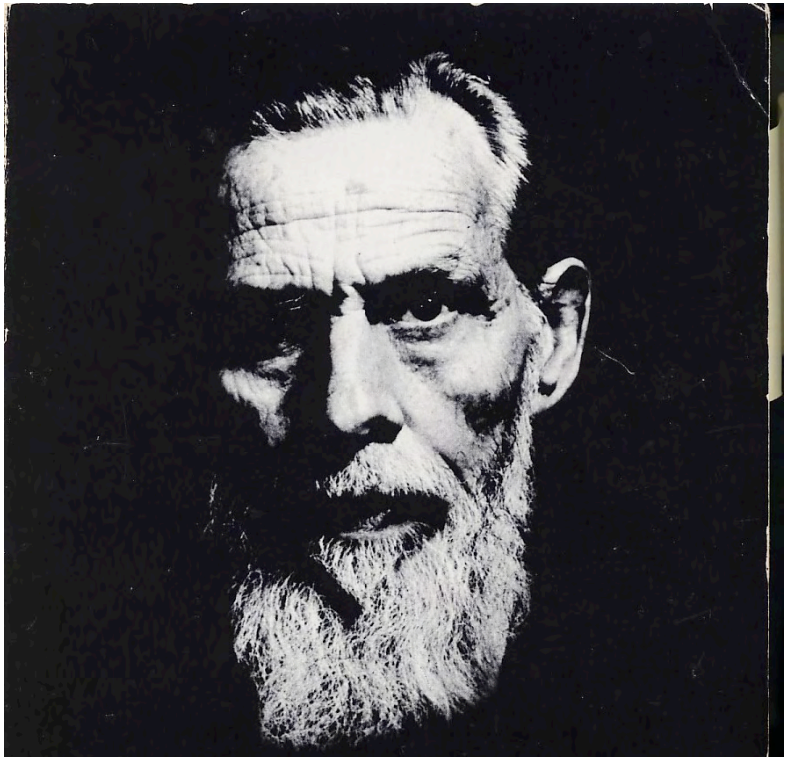
HENRY QUASTLER
Control Systems Laboratory, University of Illinois
Urbana, Ill.

CLAUDE SHANNON
Bell Telephone Laboratories, Inc., Murray Hill Laboratory
Murray Hill, N. J.

THE JOSIAH MACY, JR. FOUNDATION

FRANK FREMONT-SMITH, *Medical Director*
JANET FREED LYNCH, *Assistant for the Conference Program*

† Absent.



Warren S. McCulloch

EMBODIMENTS OF MIND

Introduction by Seymour Papert

New Foreword by Jerome Y. Lettvin

second-order views of cybernetics

The science of observing systems.

– *Heinz von Foerster*

Cybernetics of Cybernetics.

– *Margaret Mead*

The art of defensible metaphors.

– *Gordon Pask*

The science and art of human understanding.

– *Humberto Maturana*

how has cybernetics influenced design theory?

begins in complex problems early in 20th century—then...

Hochschule für Gestaltung in Ulm, Germany

- Norbert Wiener and Martin Heidegger lecture there
- Bucky Fuller and Charles Eames visit
- British and American design school faculty visit
- Christopher Alexander and Horst Rittel teach there, then at Berkeley

Venturi's "Learning from Las Vegas" in 1972 marks the symbolic end of Design Methods as a focus in architecture

About the same time, John Chris Jones and Chris Alexander repudiate Design Methods

In 1972, Rittel critiques the state of design methods, calls for a shift to design as rhetoric, echoing 2nd-order cybernetics

Rittel's Problems

1st-order cybernetics

simple problems

question is clear—we only need to provide an answer

most design problems given in school are like this

complex problems

we frame the current situation in order to show how it differs from a preferred situation

most design problems encountered in practice are li

2nd-order cybernetics

wicked problems

participants hold conflicting views of the problem

coming to agreement on the problem is impossible—without reframing

reframing is a process of construction and agreement

the most important problems of the 21st century are like this

why is cybernetics a science for design?

3 big reasons

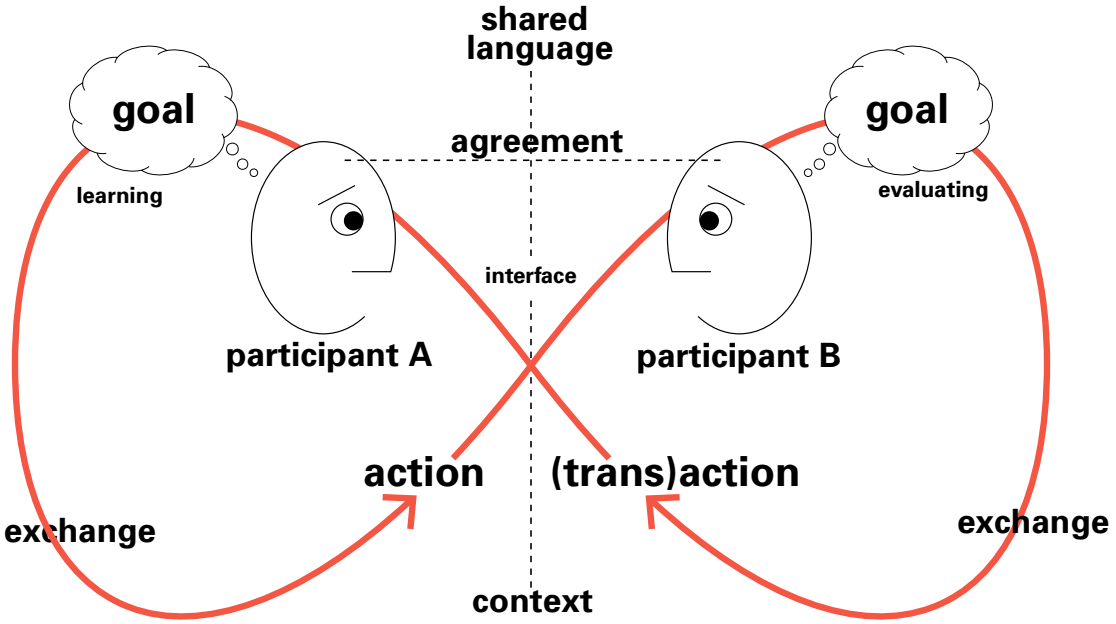
i. conversation

ii. requisite variety

iii. co-evolution

i. conversation models

cybernetics has a rigorous definition of conversation



GORDON PASK

CONVERSATION, COGNITION AND LEARNING

A CYBERNETIC THEORY AND METHODOLOGY

ELSEVIER

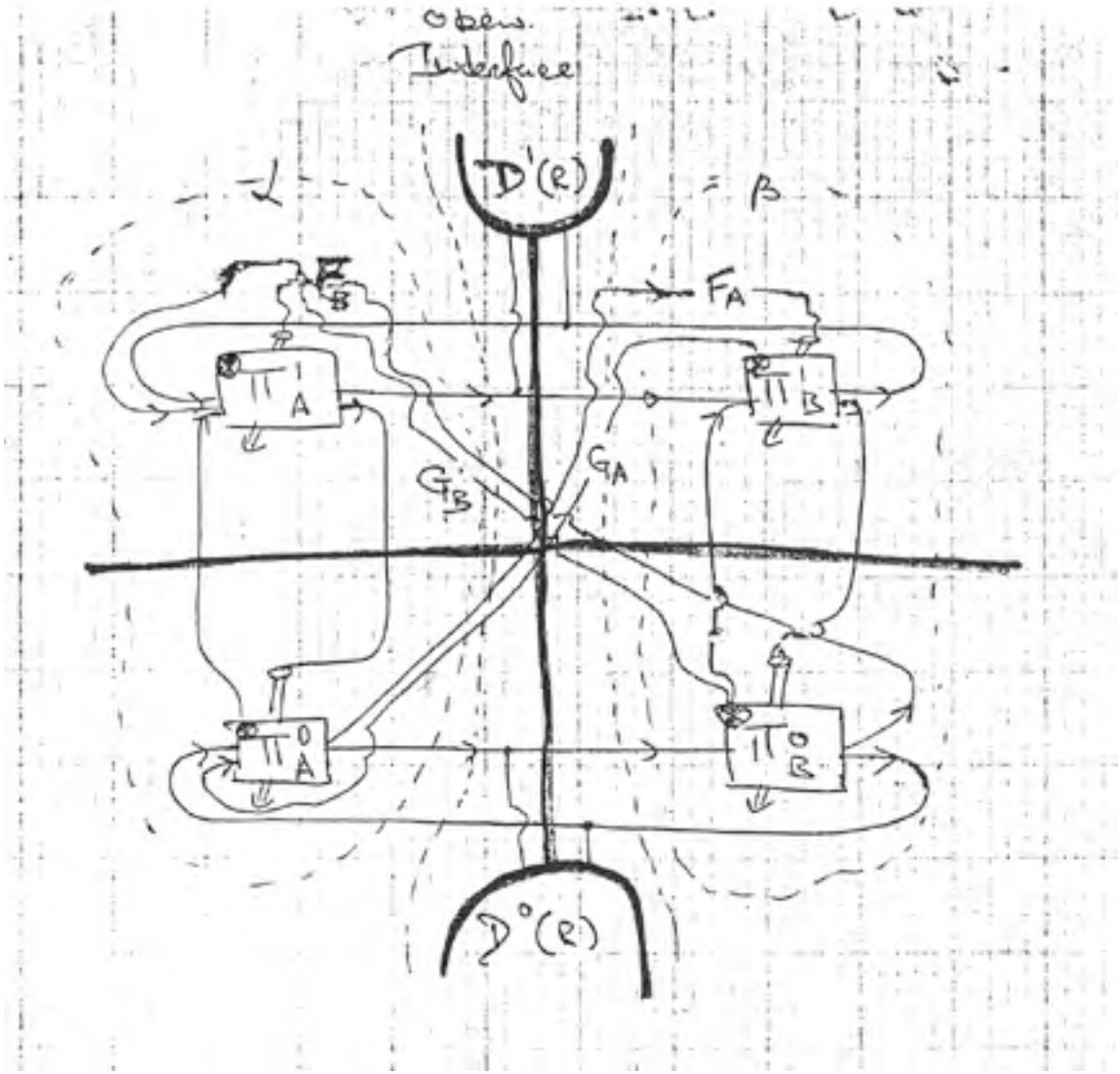
GORDON PASK

CONVERSATION THEORY

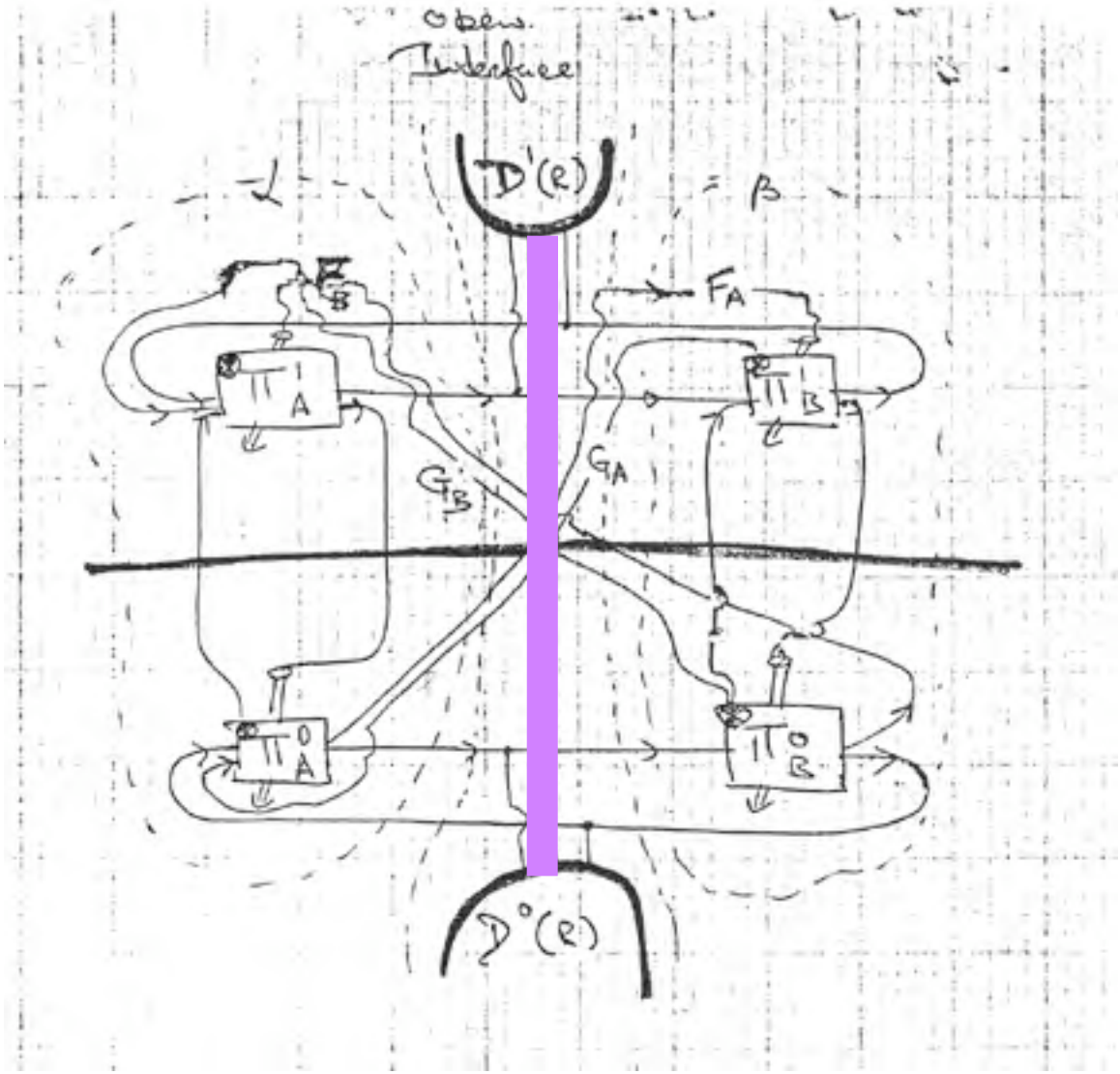
APPLICATIONS IN EDUCATION AND EPISTEMOLOGY

ELSEVIER

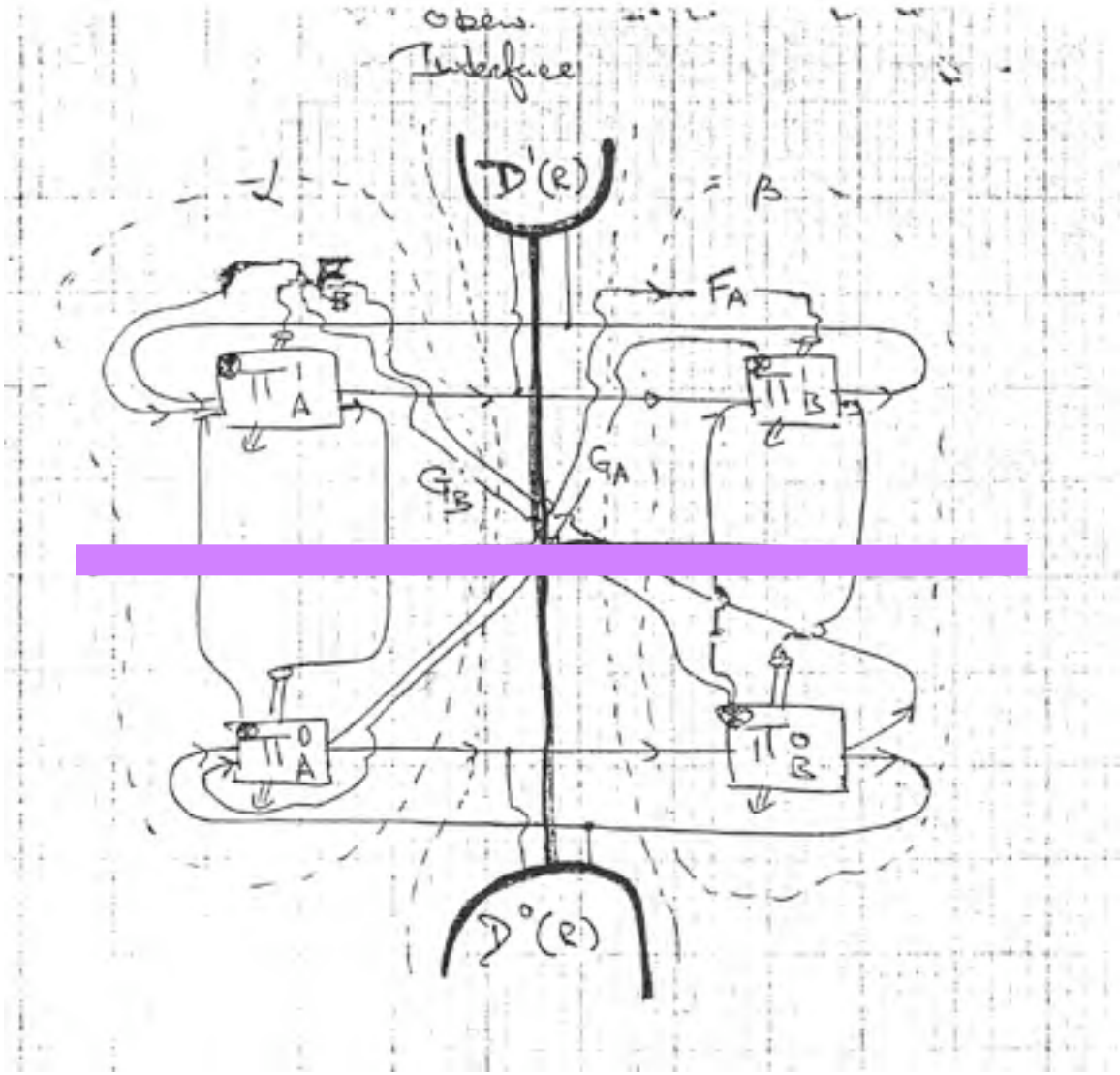
Pask's own rendering—in *Soft Architecture Machines*



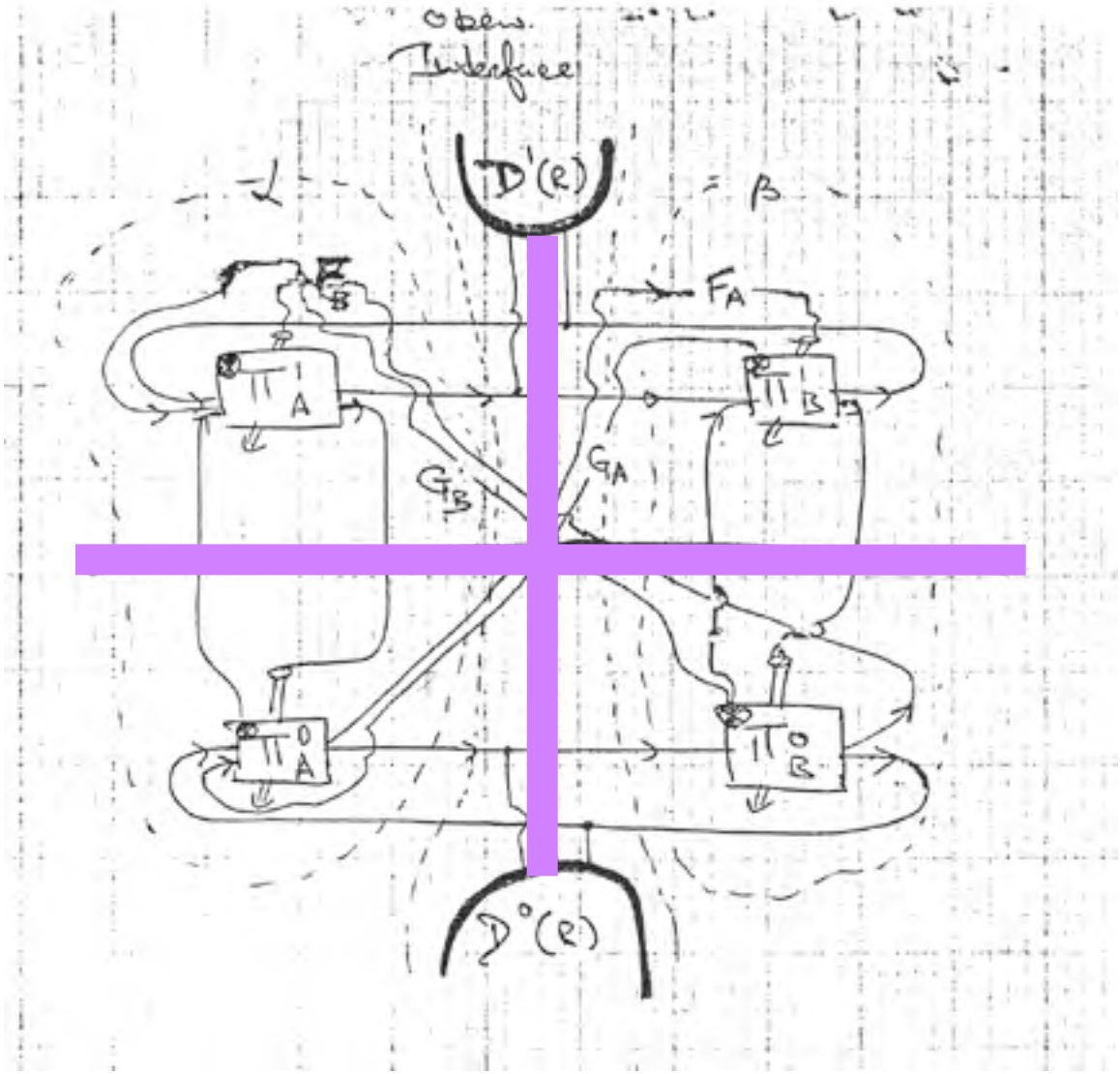
architecture—solitary action—individuals



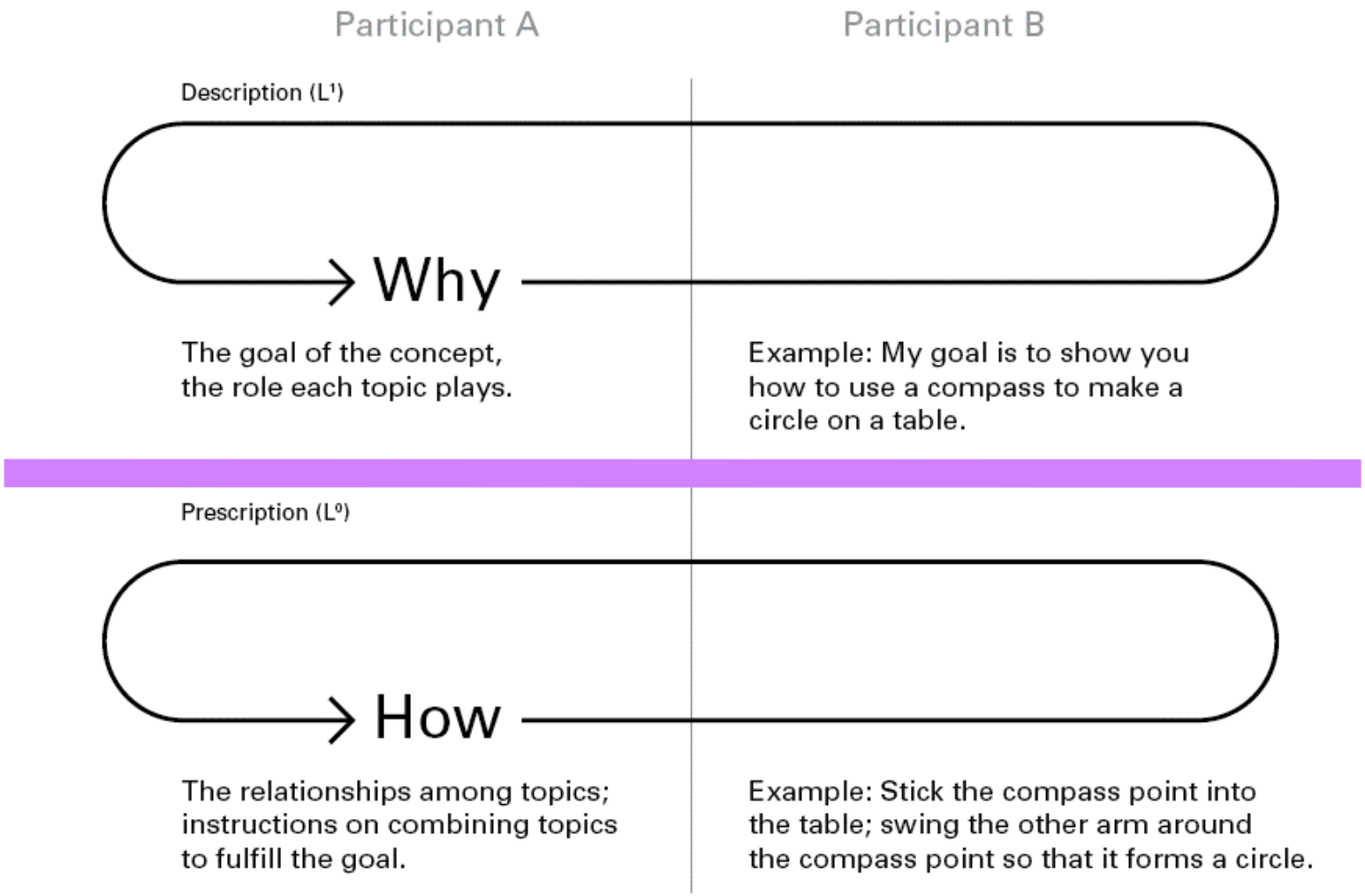
architecture—conversation—participants



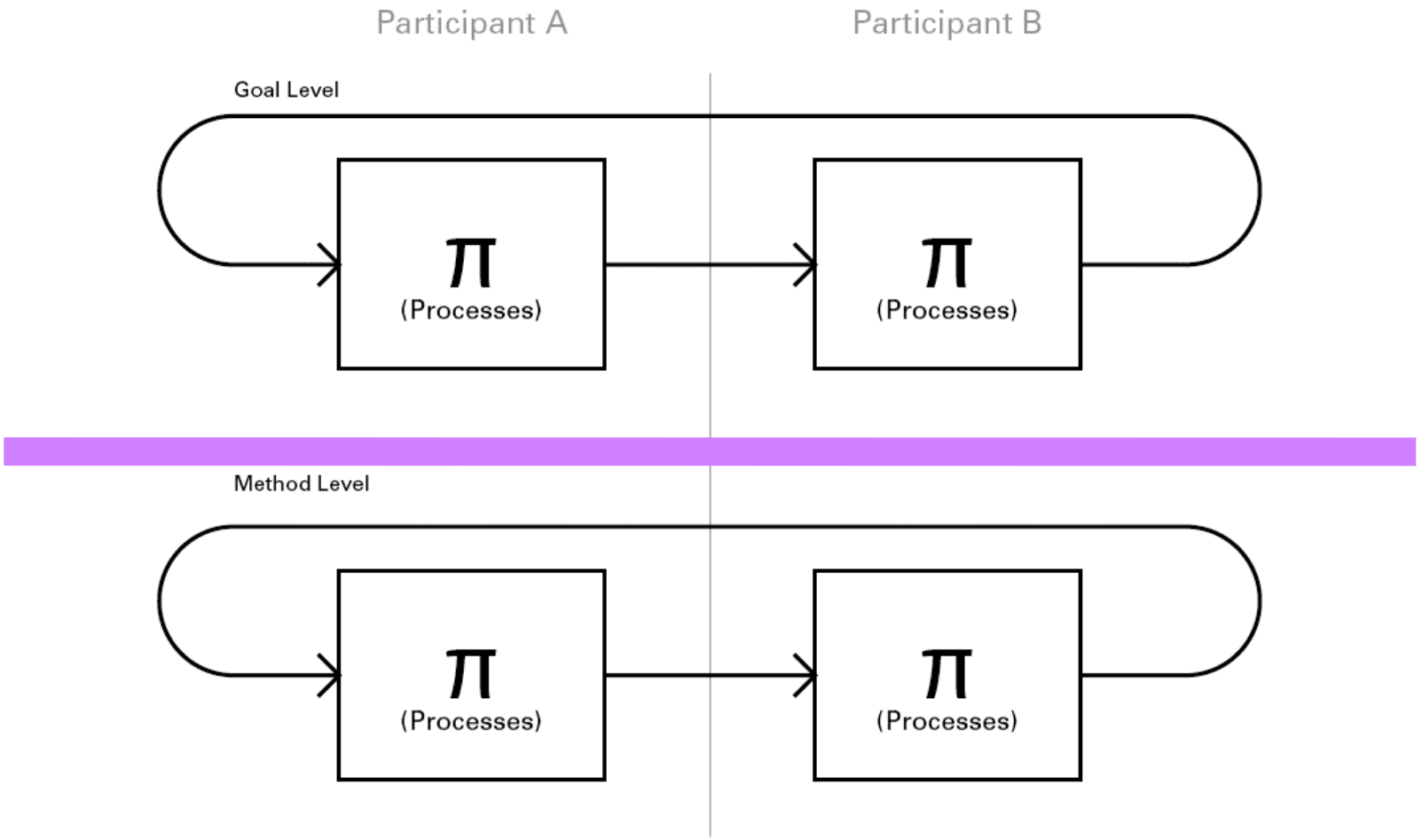
architecture—levels—conversation



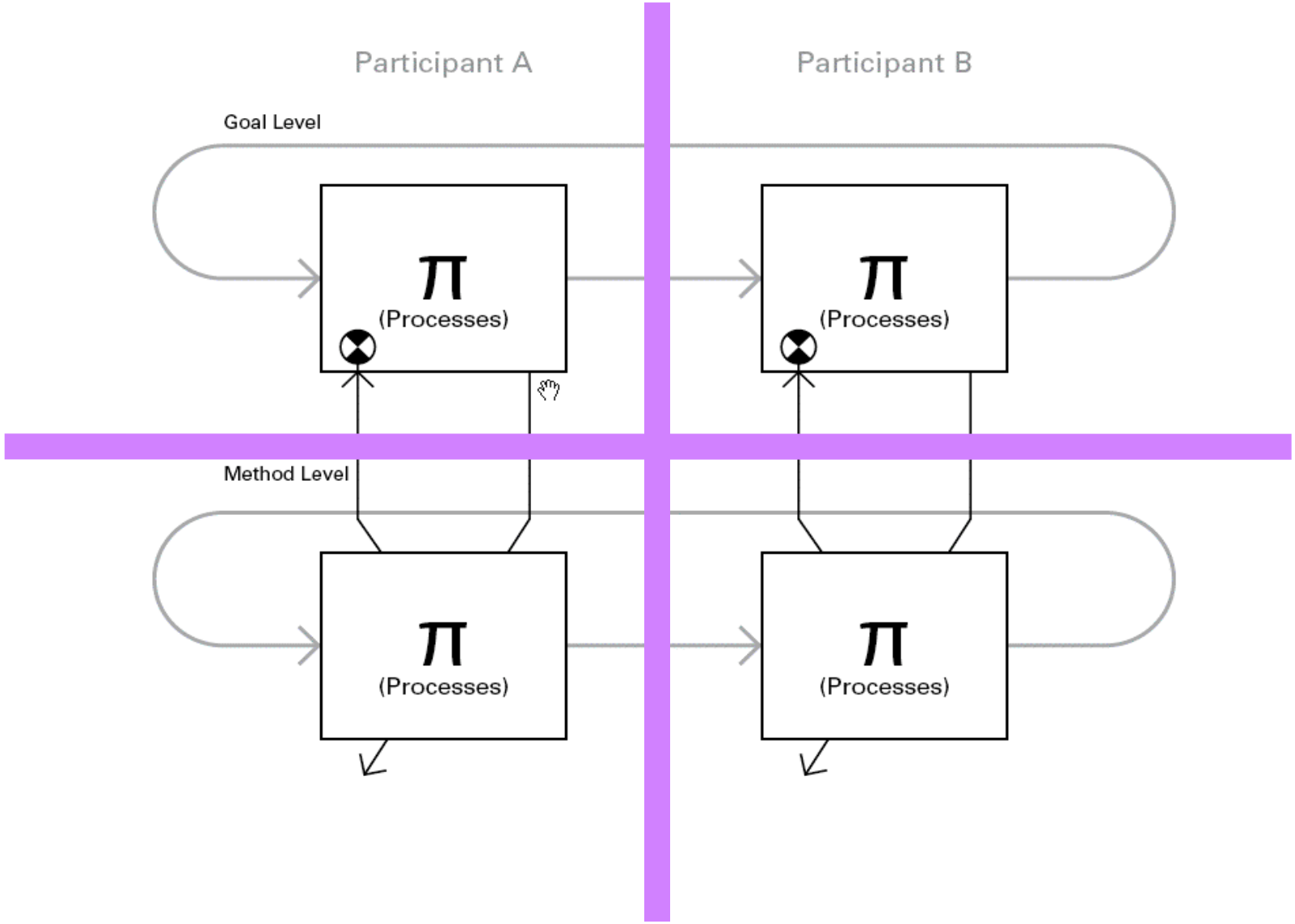
gordon pask—circular interactions—modeling



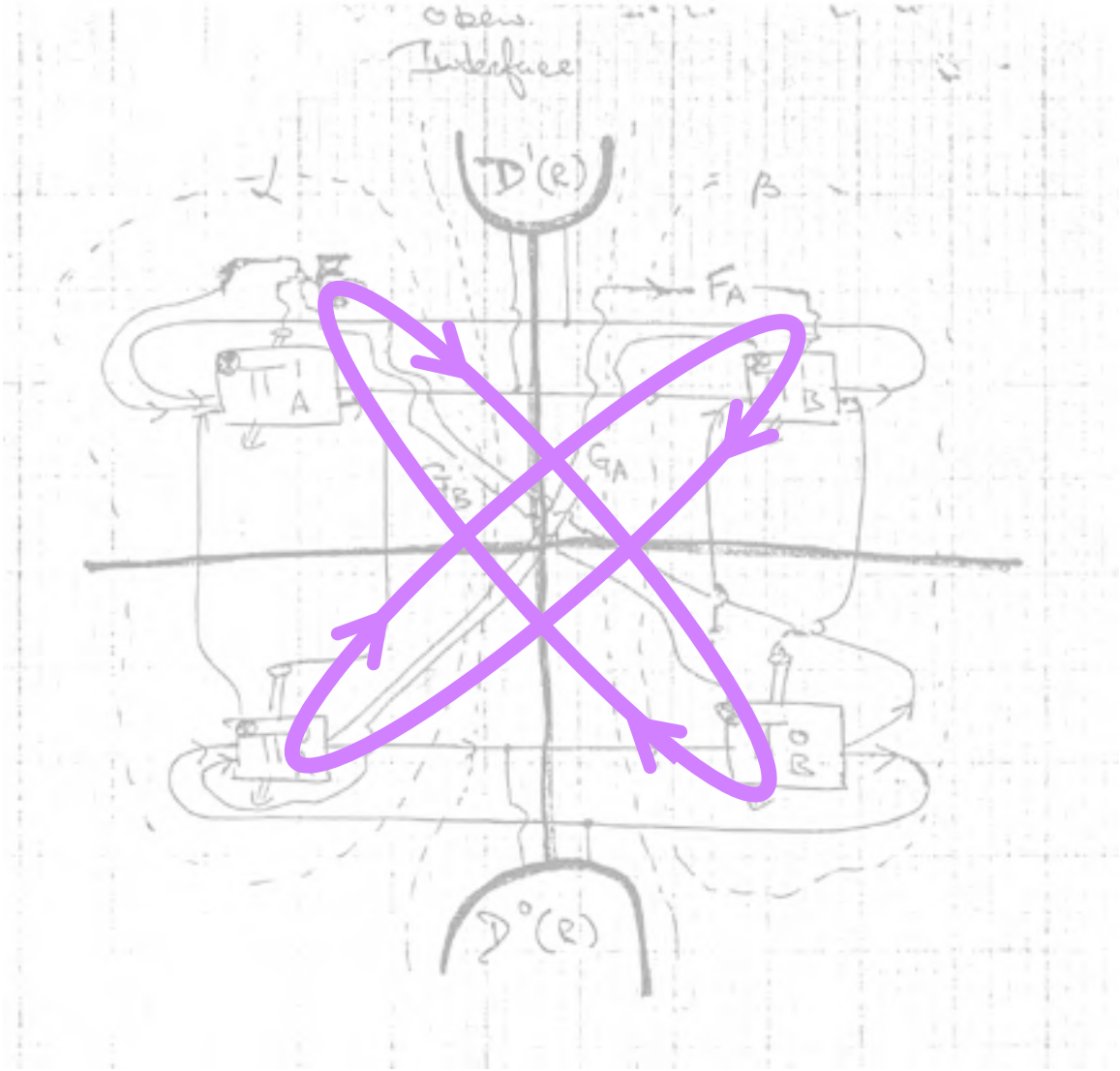
gordon pask—circular interactions—modeling



gordon pask—circular interactions—modeling



dance—contention—shared outcomes



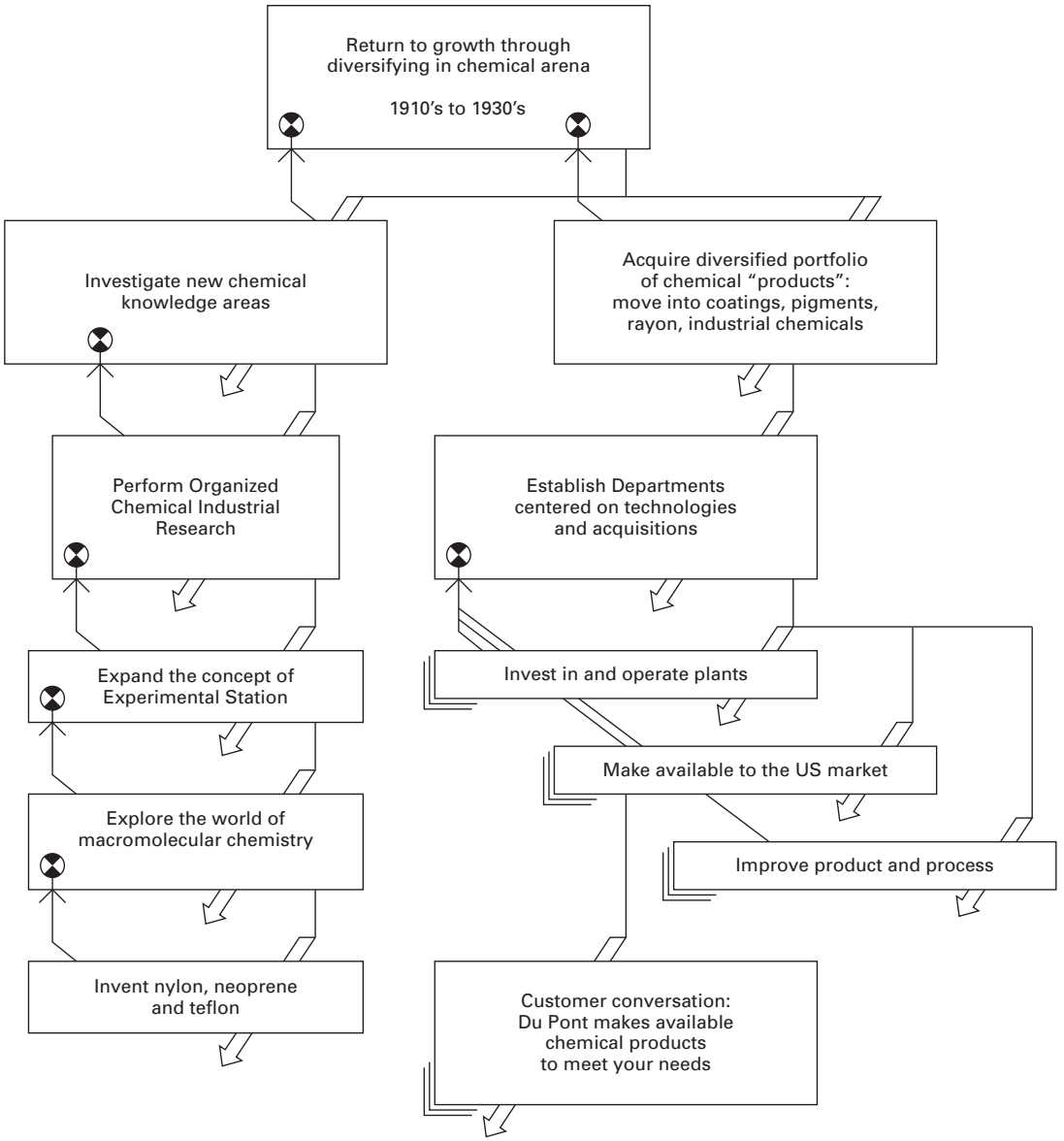
i. conversation models

cybernetics has a rigorous definition of conversation, making it practical to "design for conversation"

a. organizational interfaces

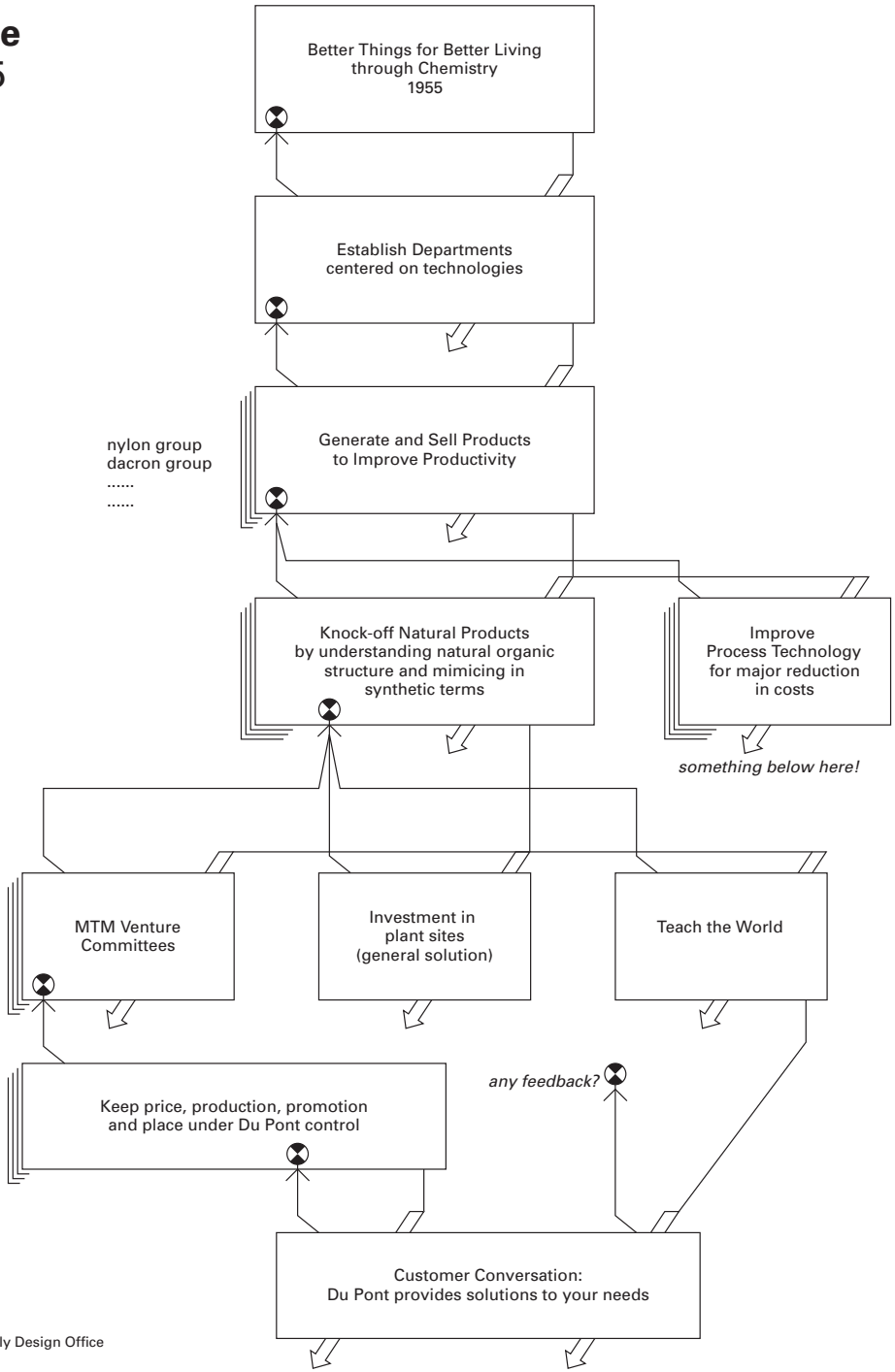
Du Pont Goal Structure
Snapshot 1910 to 1940

Laid the foundation for a new business—
"invention" phase.



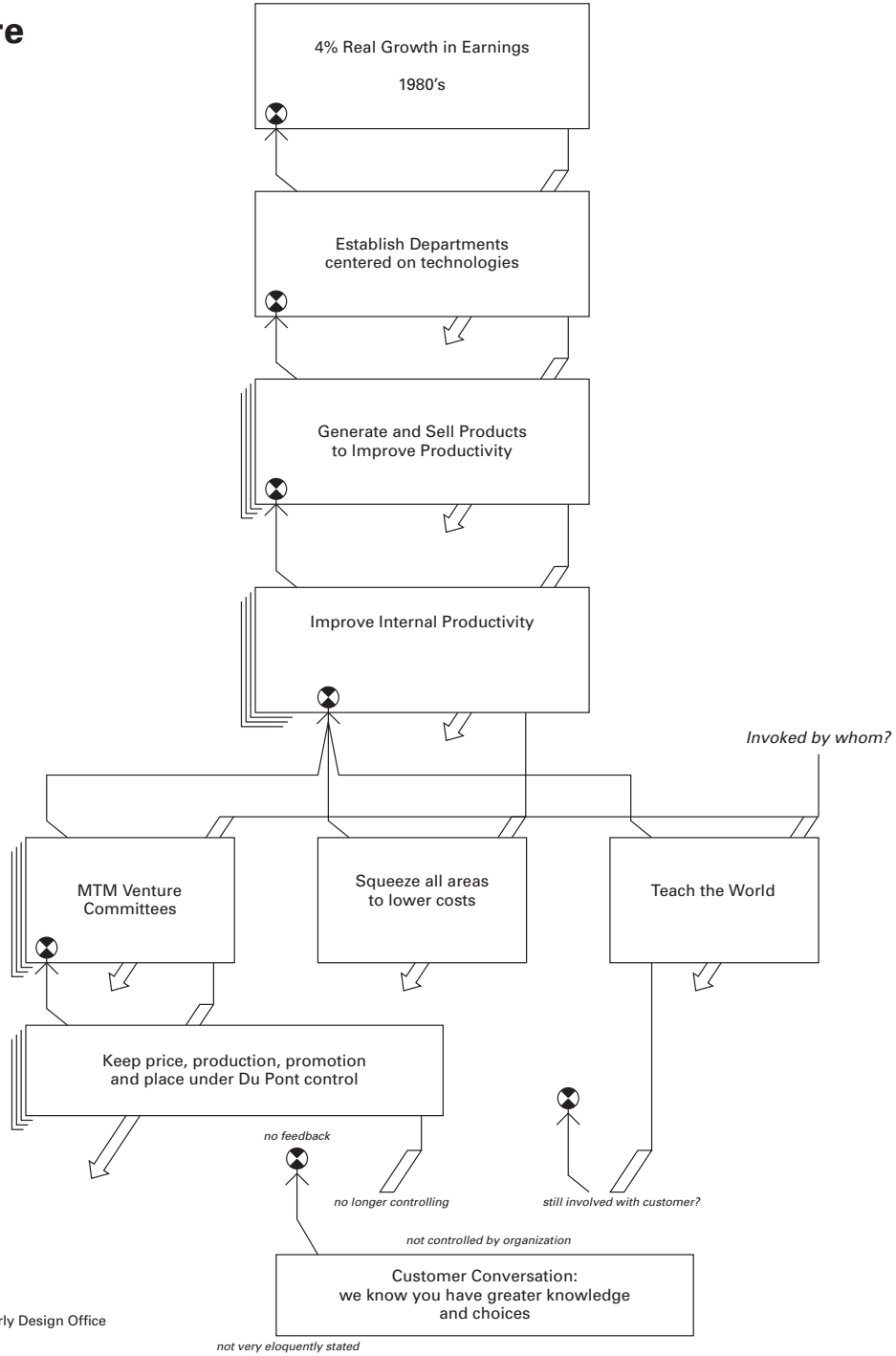
Du Pont Goal Structure
Snapshot 1940 to 1975

Built on the foundation—
"discovery" phase.



Du Pont Goal Structure
Snapshot of 1980's

Milked the existing structure—
"efficiency" phase.

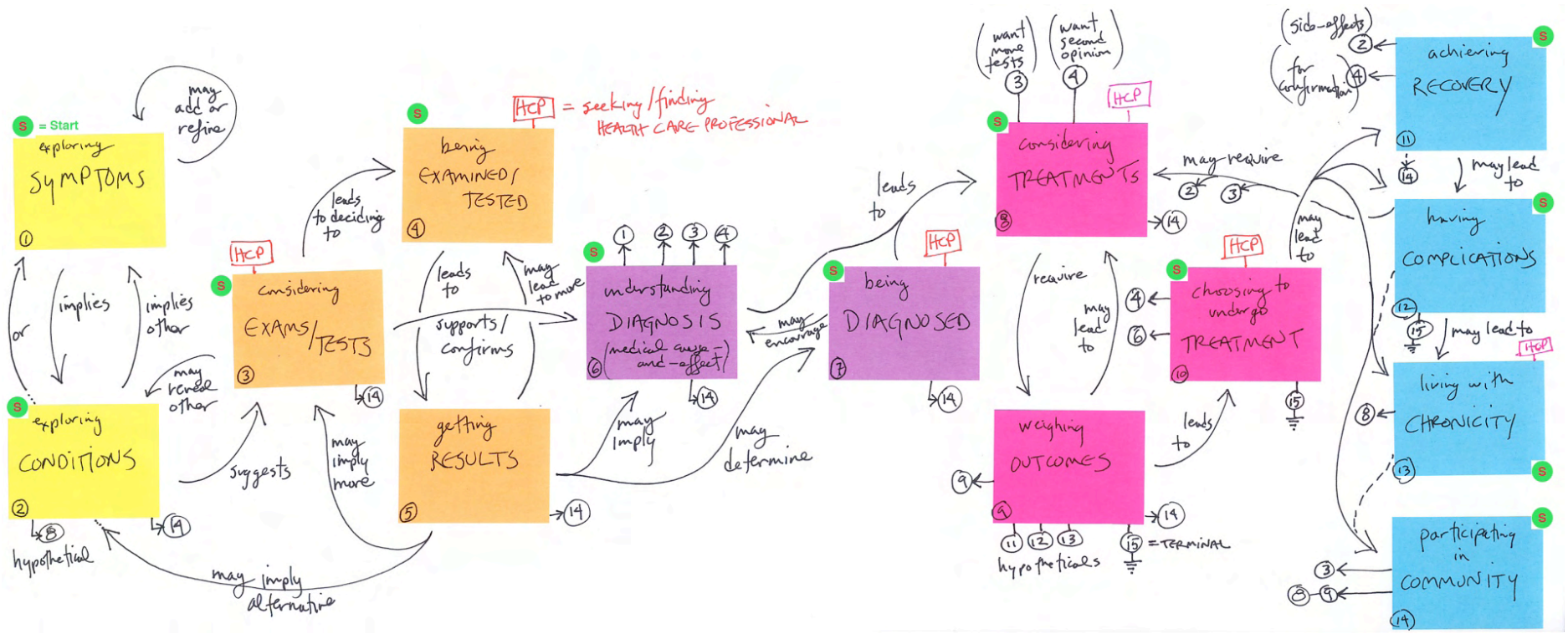


i. conversation models

cybernetics has a rigorous definition of conversation, making it practical to "design for conversation"

a. organizational interfaces

b. user interfaces / conversing with myself


S = Start
exploring SYMPTOMS
1
may add or refine
or
implies
implies other
may reveal other
exploring CONDITIONS
2
8 hypothetical
14
suggests
HCP
considering EXAMS/TESTS
3
14
may imply more
may imply alternative
leads to deciding to
HCP = seeking/finding HEALTH CARE PROFESSIONAL
being EXAMINED/TESTED
4
leads to
may lead to more
supports/confirms
getting RESULTS
5
14
understanding DIAGNOSIS (medical cure- and -affect)
1 2 3 4
6
14
may imply
may encourage
may determine
leads to
HCP
being DIAGNOSED
7
14
HCP
considering TREATMENTS
8
14
want more tests
3
want second opinion
4
may require
2
3
receive
may lead to
HCP
choosing to undergo TREATMENT
4
6
10
15
leads to
weighing OUTCOMES
9
14
11 12 13 hypothetical
15 = TERMINAL
may lead to
side-effects
2
for confirmation
4
achieving RECOVERY
11
14
may lead to
having COMPLICATIONS
12
15
may lead to
HCP
living with CHRONICITY
8
13
participating in COMMUNITY
3
8 9
14

i. conversation models

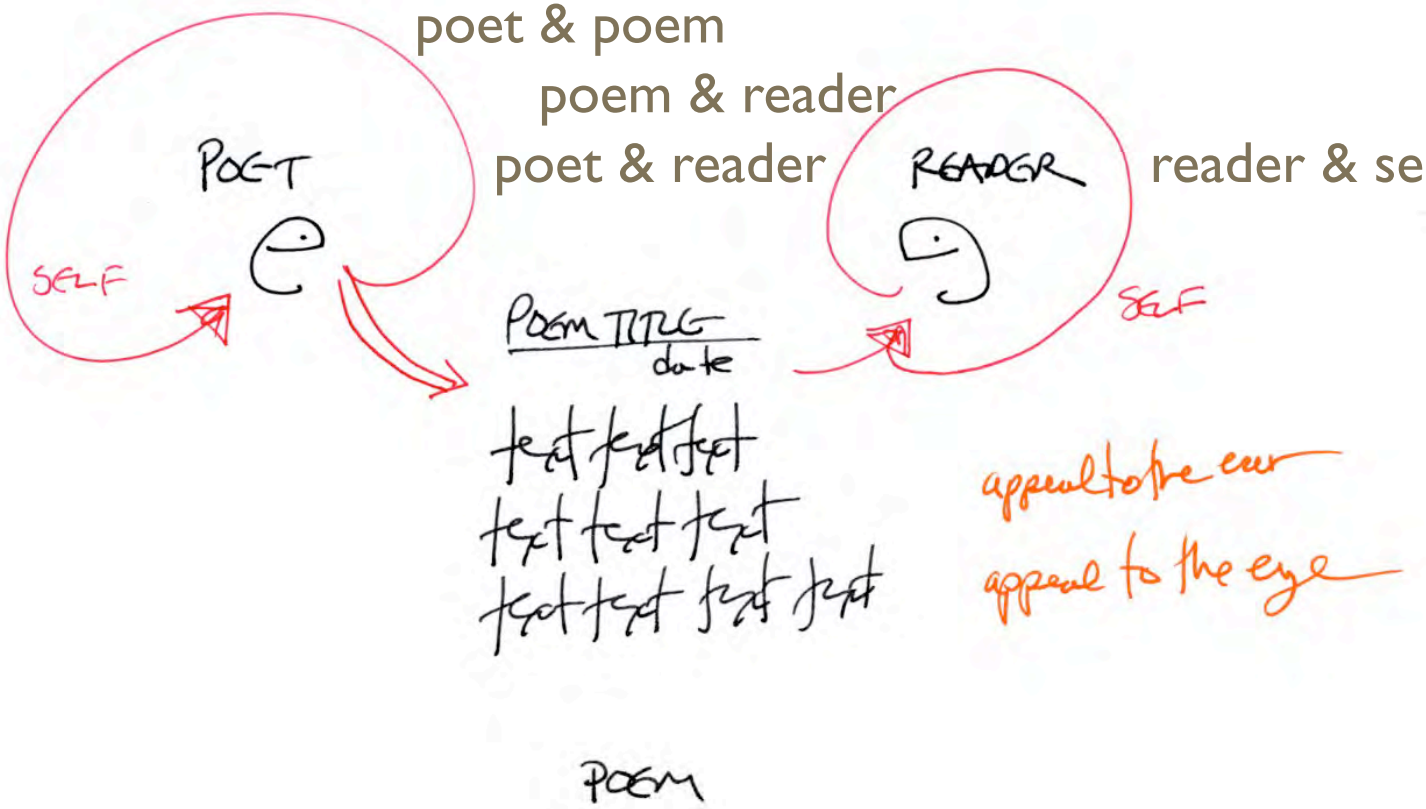
cybernetics has a rigorous definition of conversation, making it practical to "design for conversation"

a. organizational interfaces

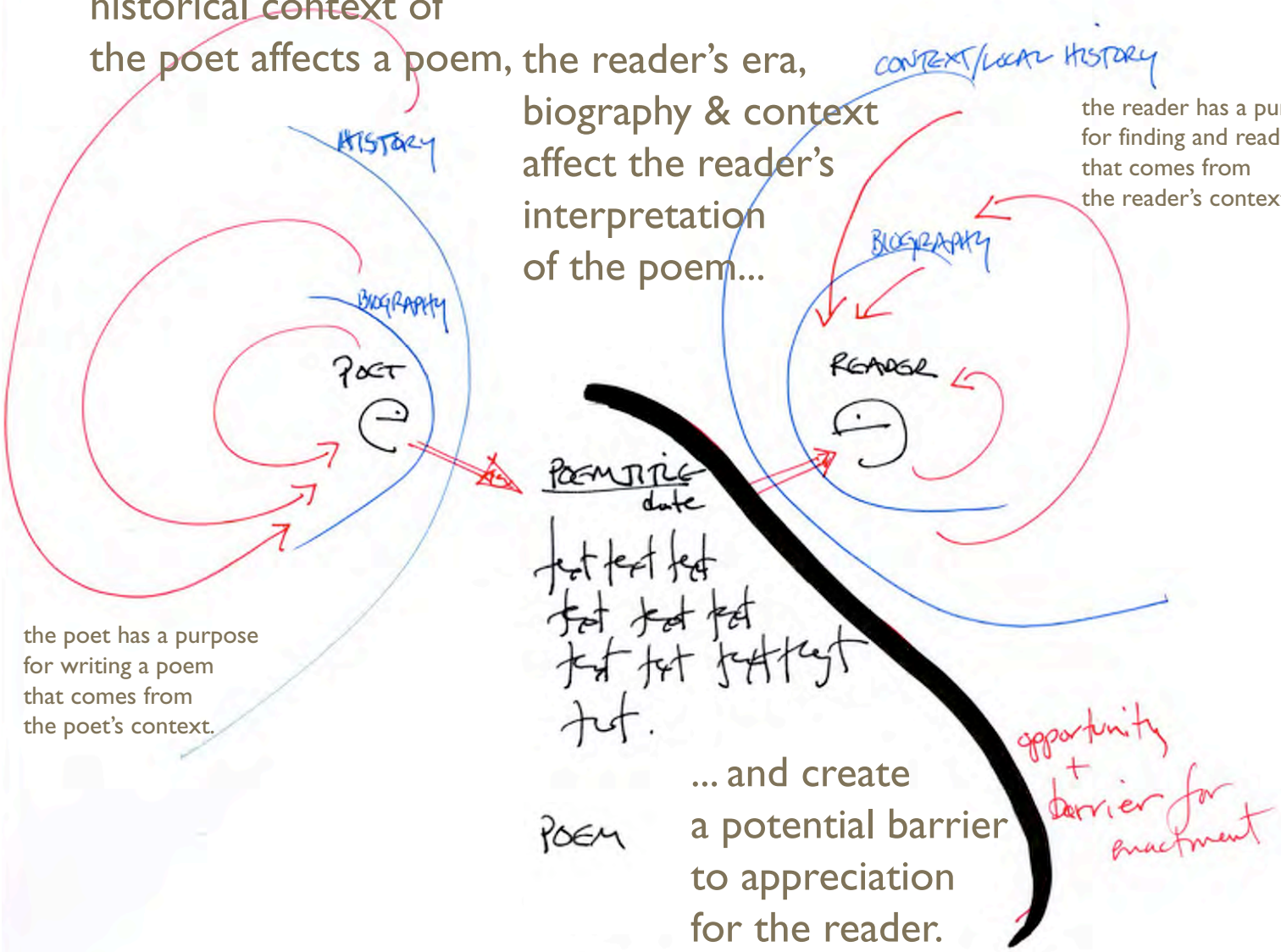
b. user interfaces / conversing with myself

c. user interfaces / conversing with absent-other

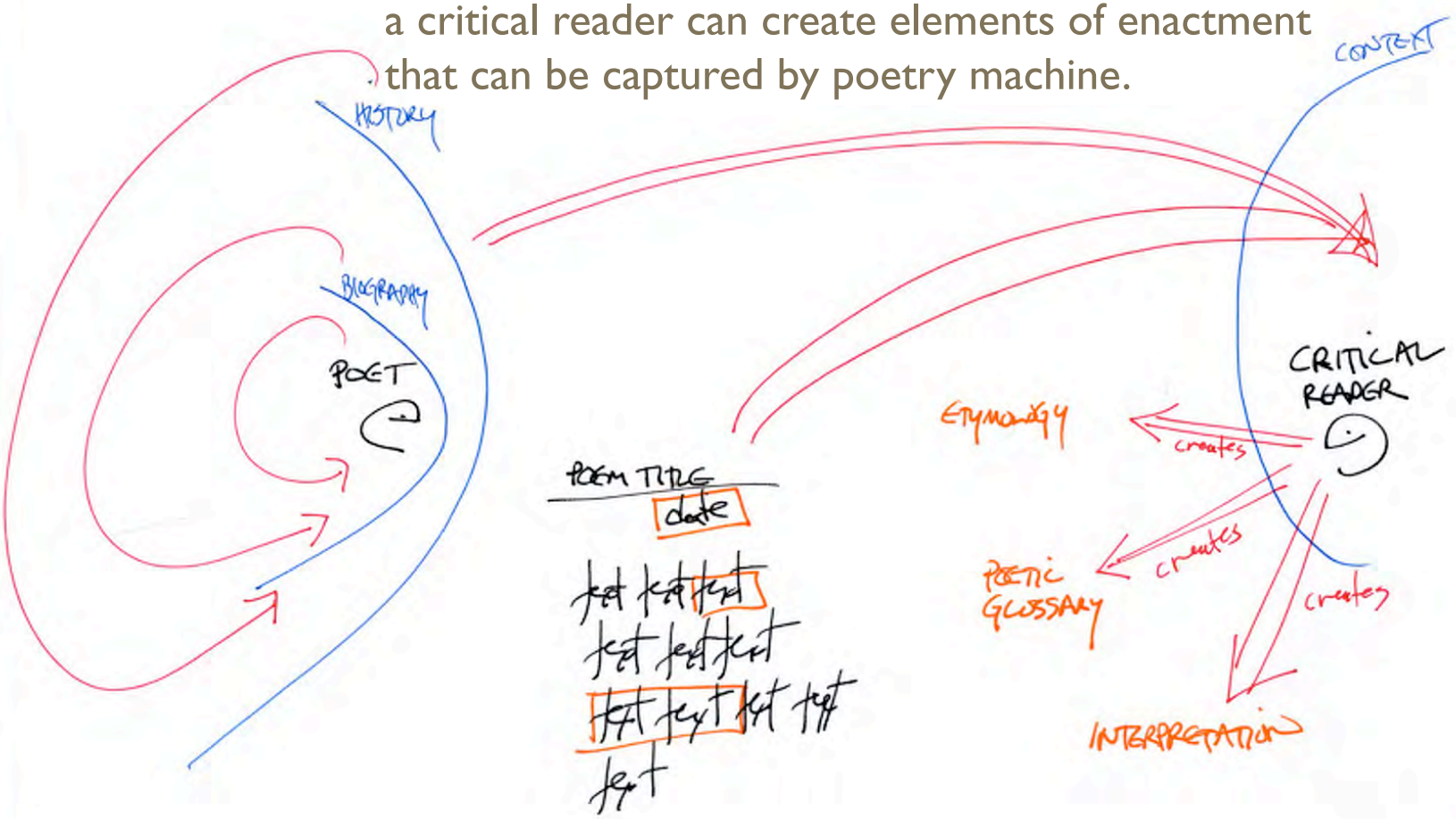
poetry is essentially dialog. dialog is a dynamic relationship.
poetrymachine's purpose is to enact dialog between
poet & self



just as the biography &
historical context of
the poet affects a poem, the reader's era,
biography & context
affect the reader's
interpretation
of the poem...



from an understanding of the poet's biography,
historical context, and the poem itself,
a critical reader can create elements of enactment
that can be captured by poetry machine.

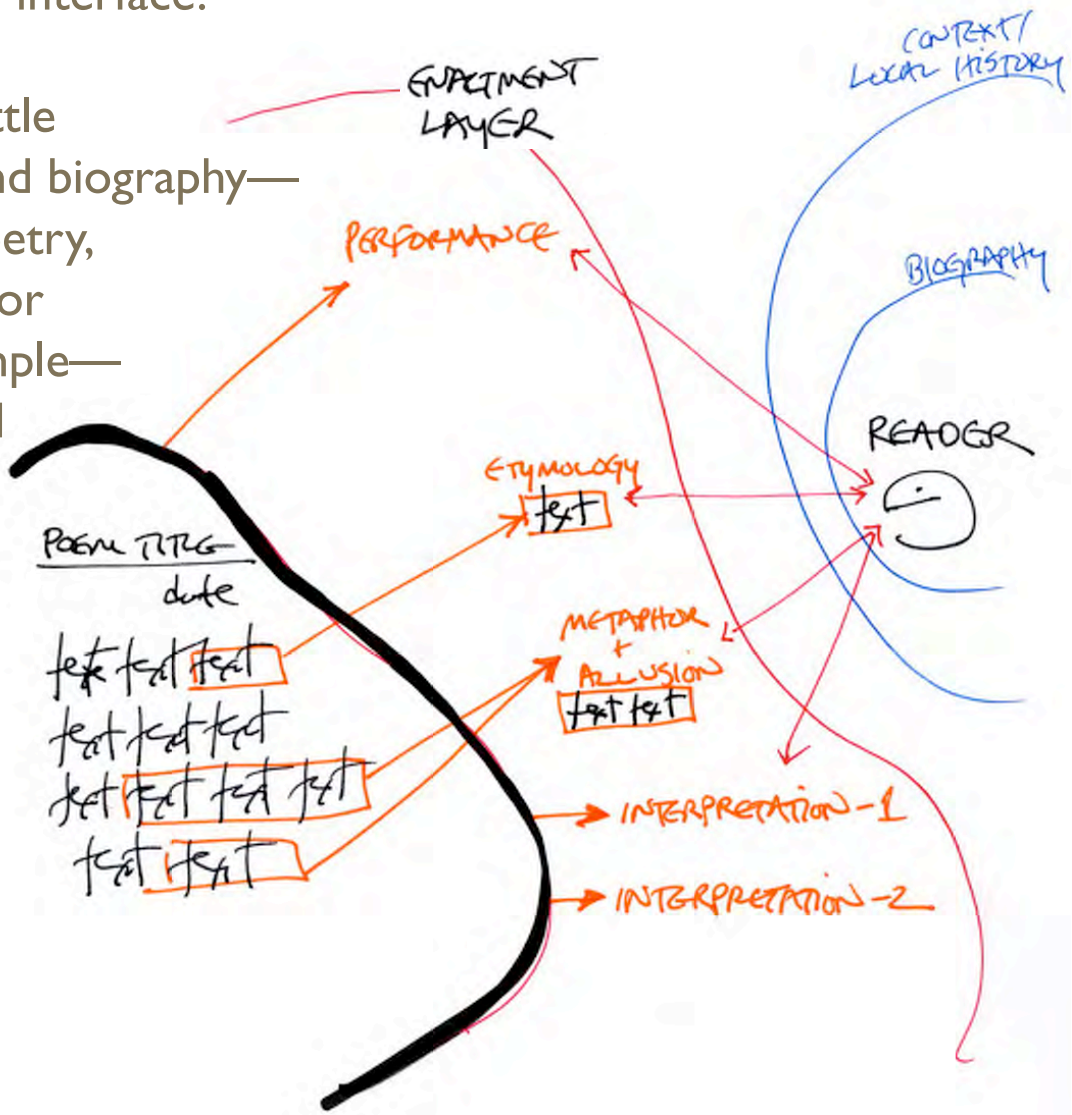


many readers could provide these perspectives,
giving poetry machine a rich storehouse of enactments.

poetrymachine's storehouse of enactments
creates a dynamic software interface.

if poetymachine knows a little
about a reader's context and biography—
level of experience with poetry,
purpose in seeking poetry, or
prior poems read, for example—
it can create a personalized
enactment layer by
choosing specific elements
of enactment to present
to that specific reader.

the enactment layer
enables a dialog
that connects
poem & reader,
poet & reader,
reader & self.

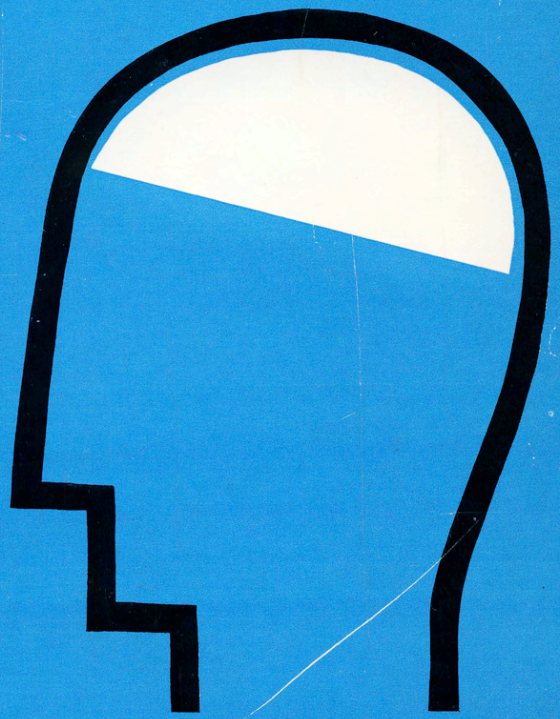


ii. requisite variety

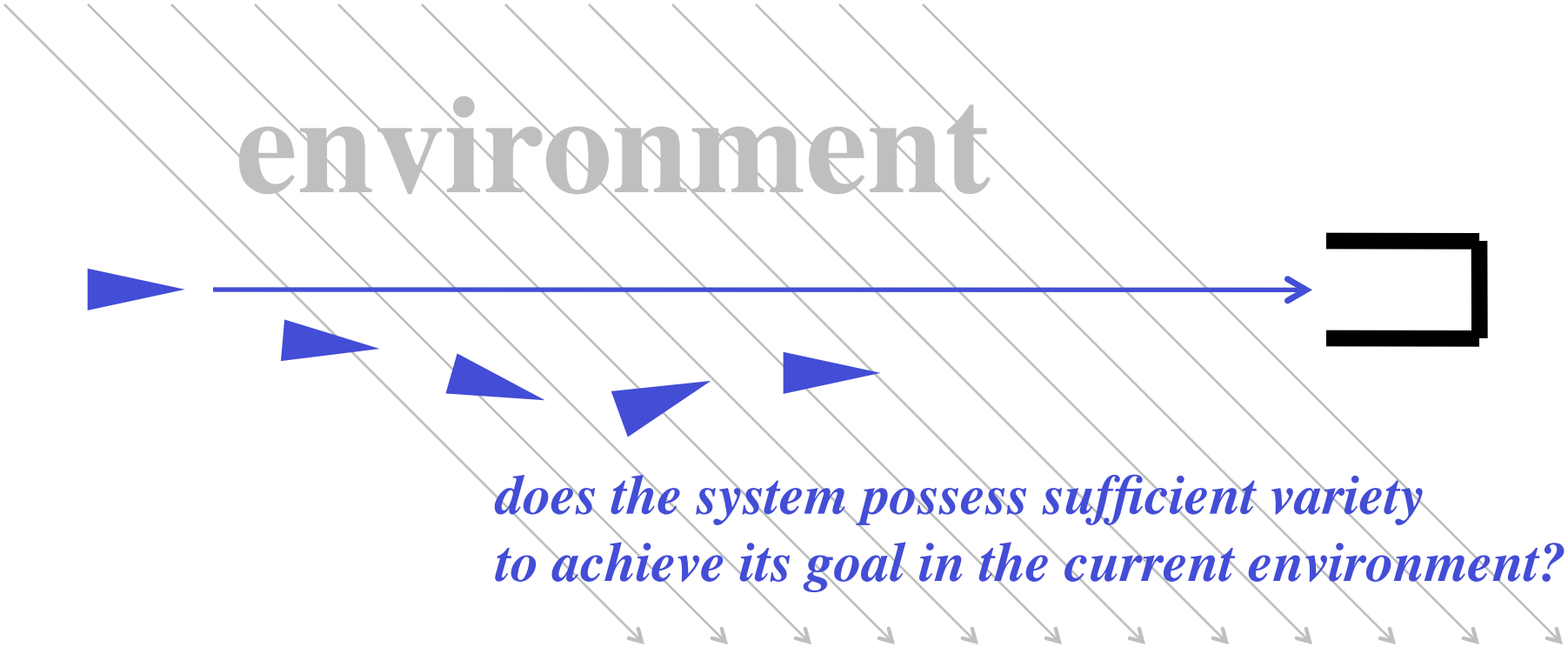
cybernetics has a rigorous definition
of the limitations of a system
to achieve its goal

Design for a Brain

W. ROSS ASHBY



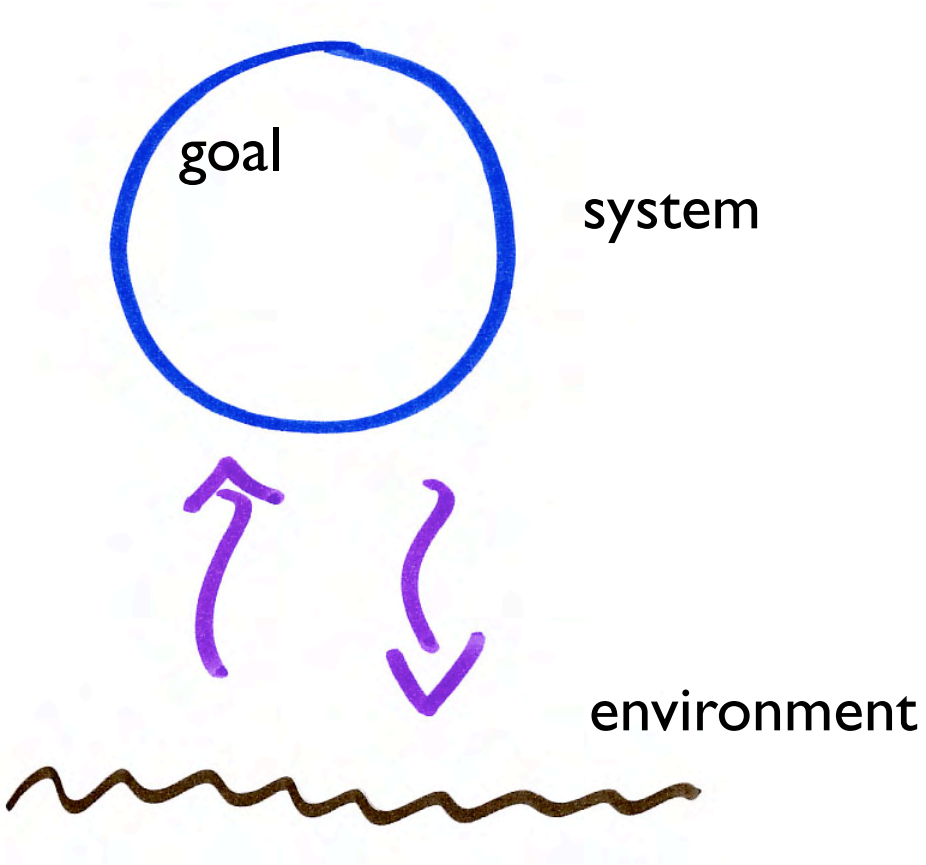
Science Paperbacks


environment
does the system possess sufficient variety
to achieve its goal in the current environment?

requisite variety

yes or no:

does the system possess
sufficient variety to regulate
its essential variables
and maintain its goal?

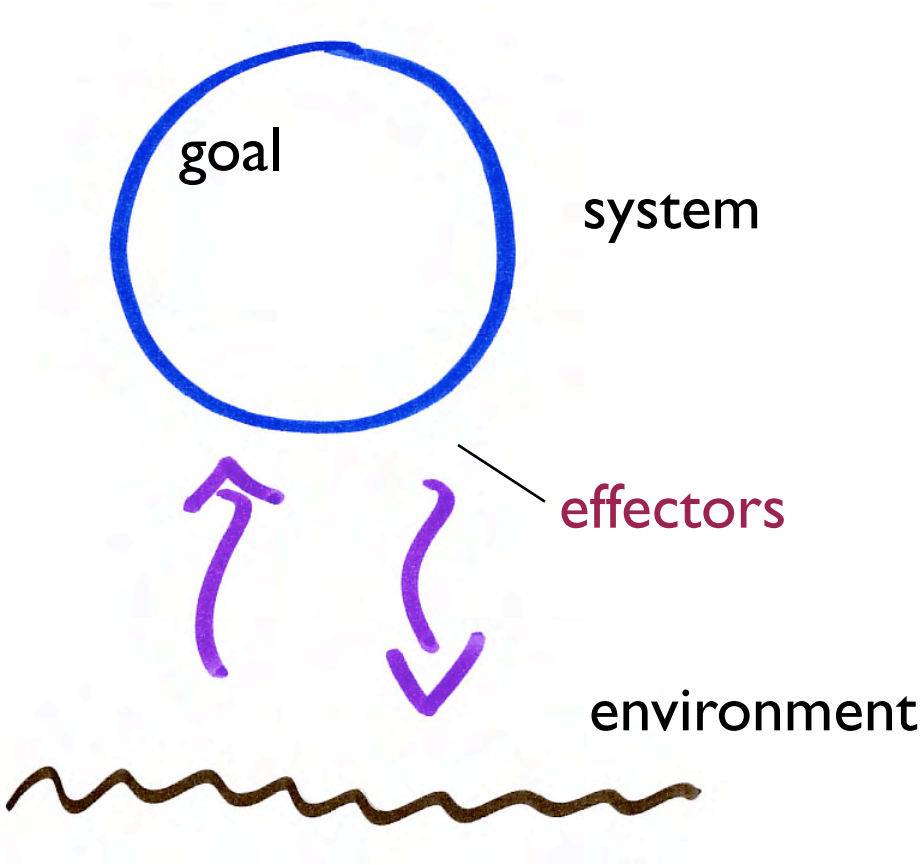


requisite variety—effectors

sufficient variety...

what are the parameters in the environment that the system can effect?

within what range of those parameters can the system maintain control?

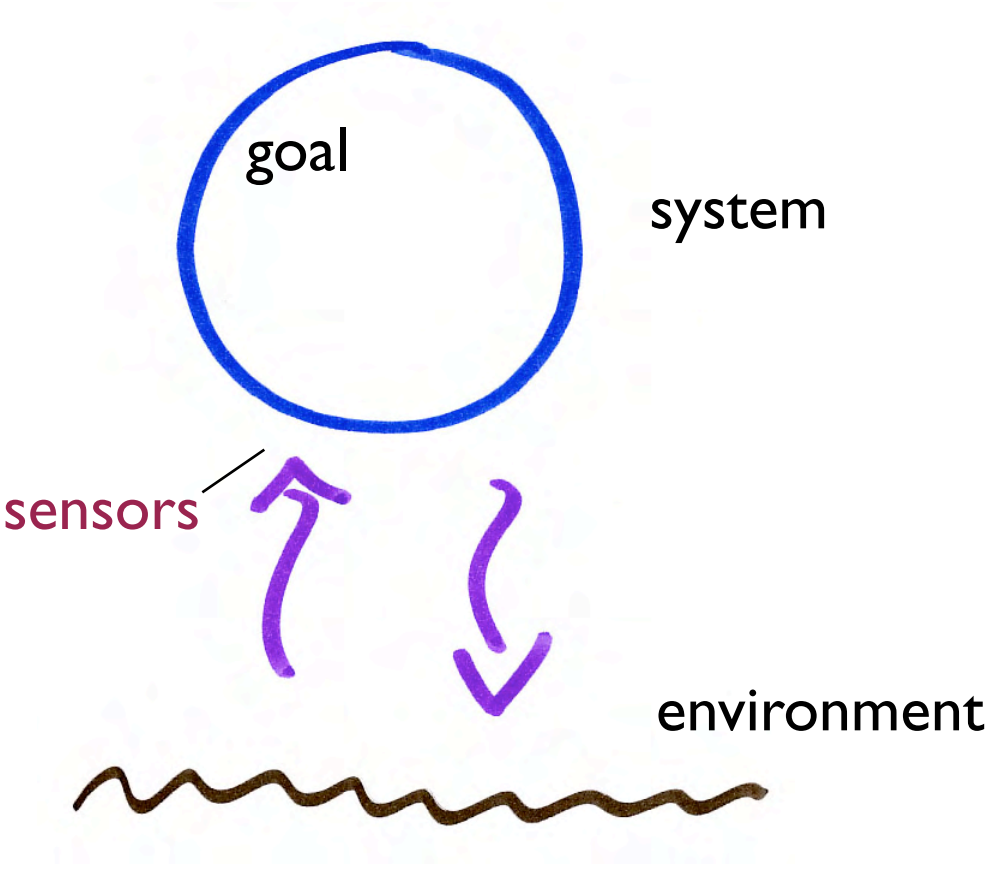


requisite variety—sensors

sufficient variety...

is there sensing of the environment such that deviations from goal can be detected?

do the sensors have sufficient resolution & speed so that the system can respond in time?



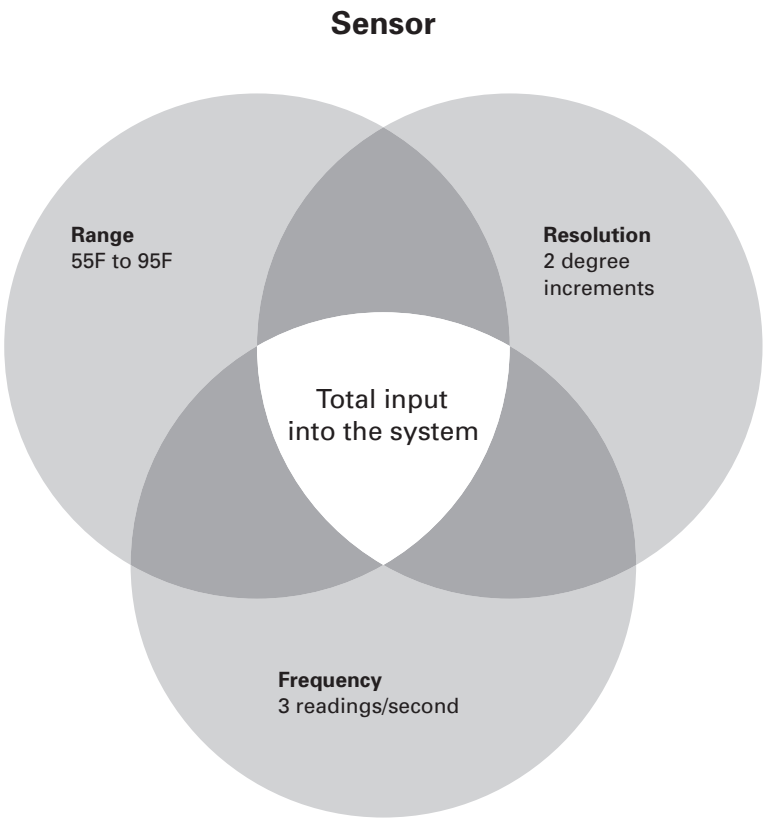
ii. requisite variety

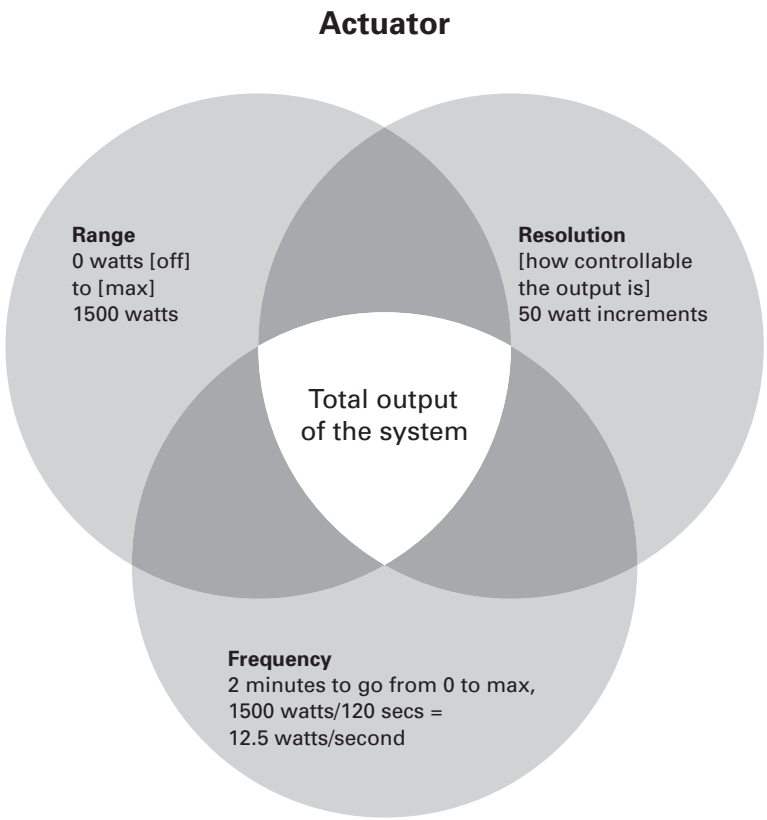
cybernetics has a rigorous definition
of the limitations of a system
to achieve its goal

Ashby's Law of Requisite Variety

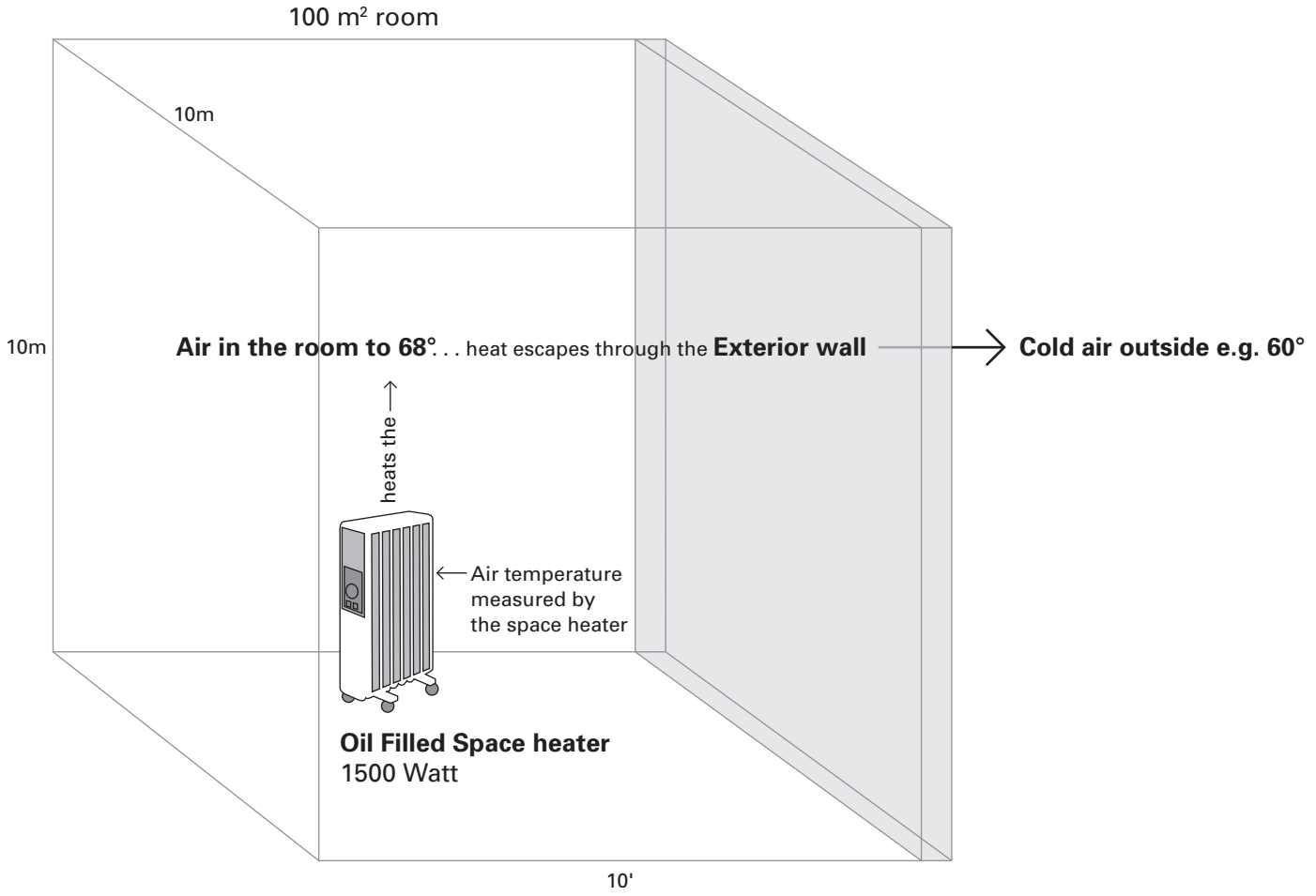
the variety (complexity) of a system
must be equal to (or greater than)
the variety of its environment
for the system to reliably achieve its goals

Example: Space Heater

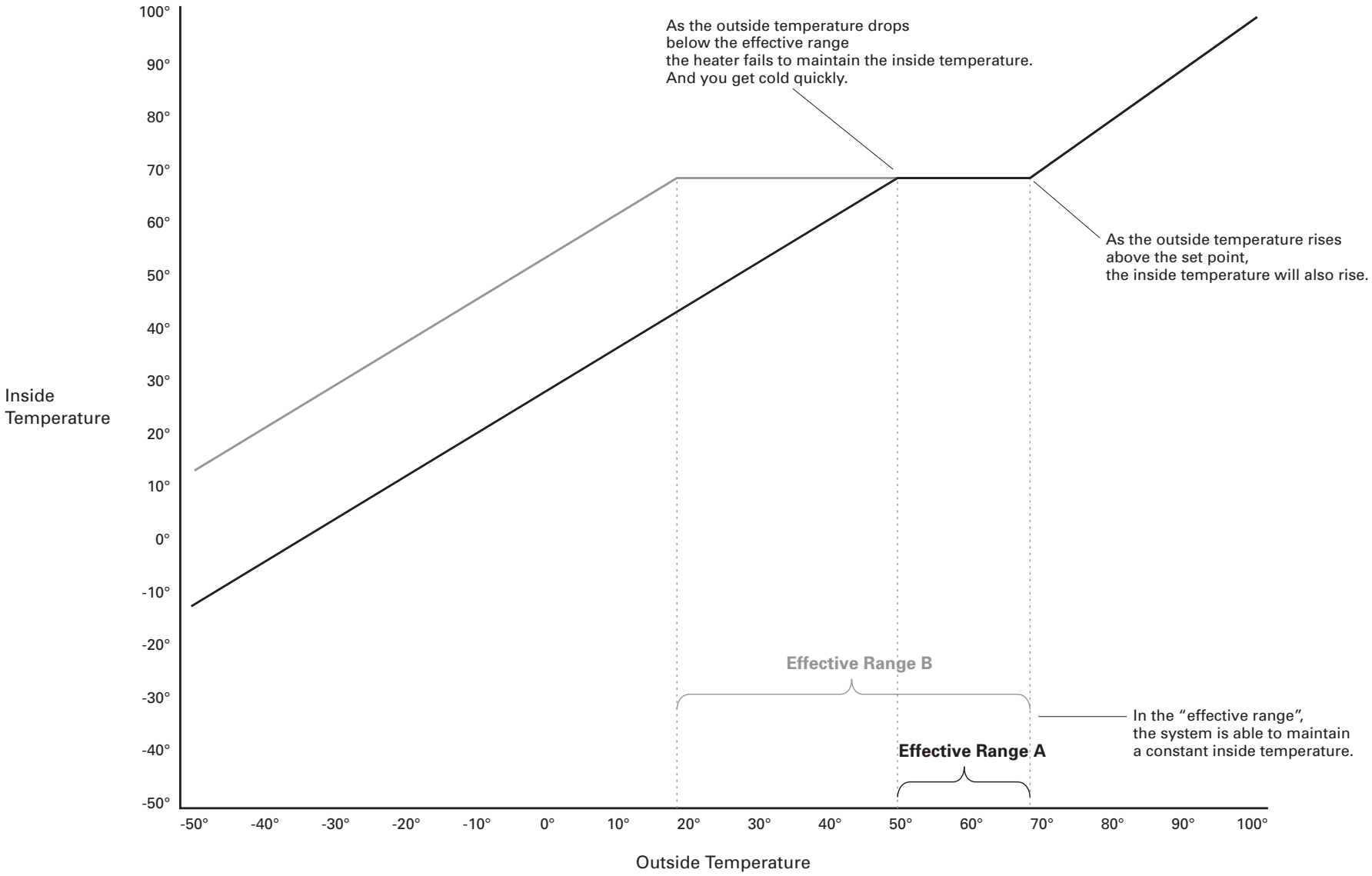




Determining the effective range of a space heater
(How much variety does it have?)

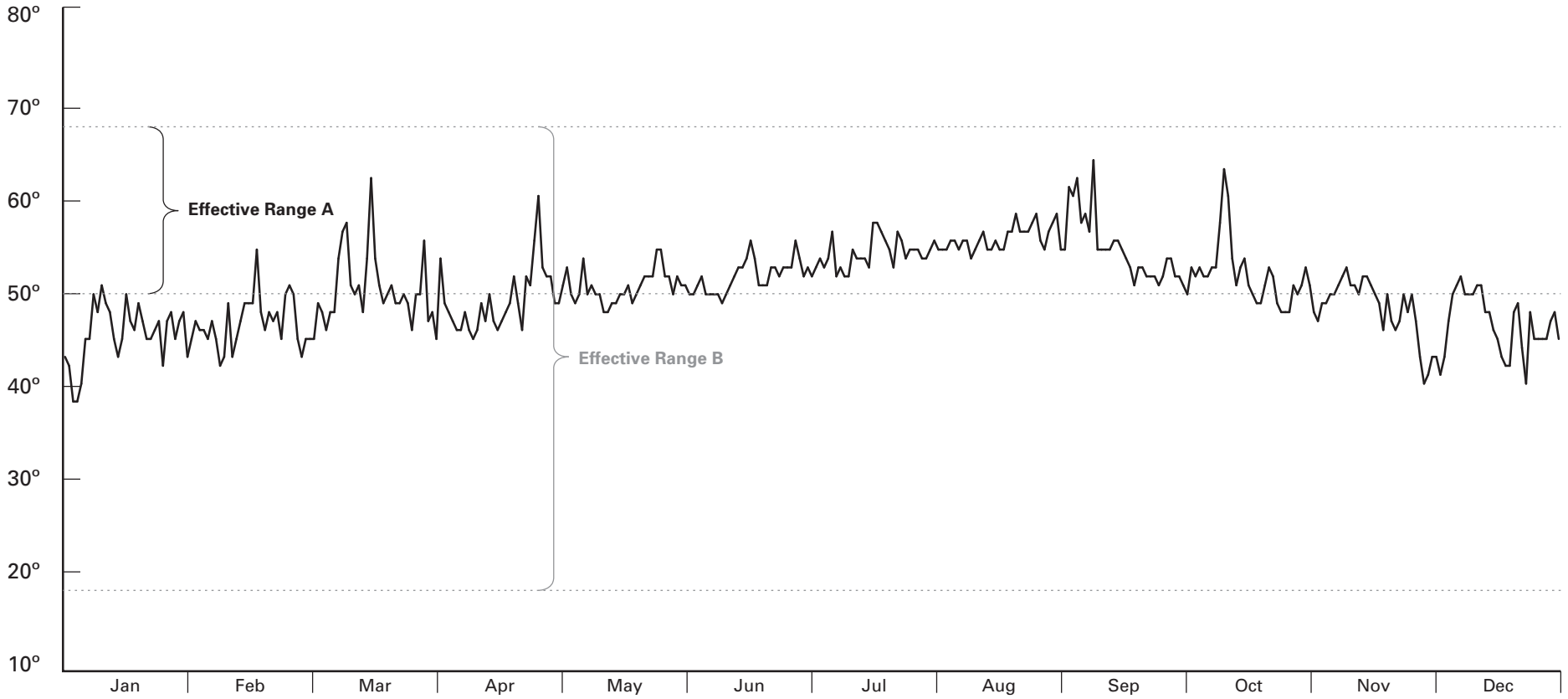


Graphing the effective range of a space heater



These figures are only intended as a theoretical example.

Where does the space heater fail?



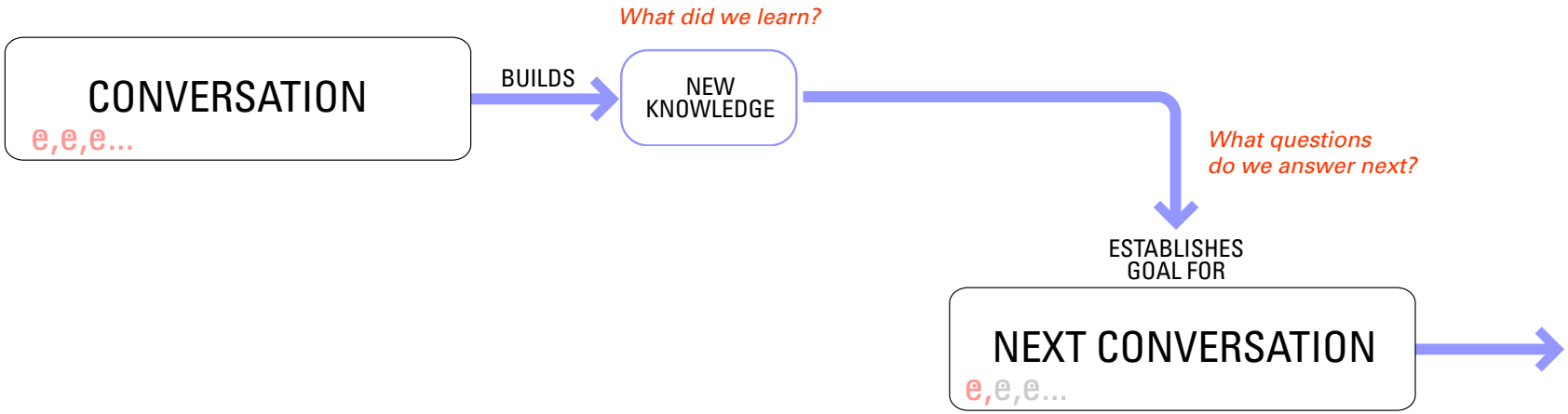
Daily Low Temperature
San Francisco, California 2004

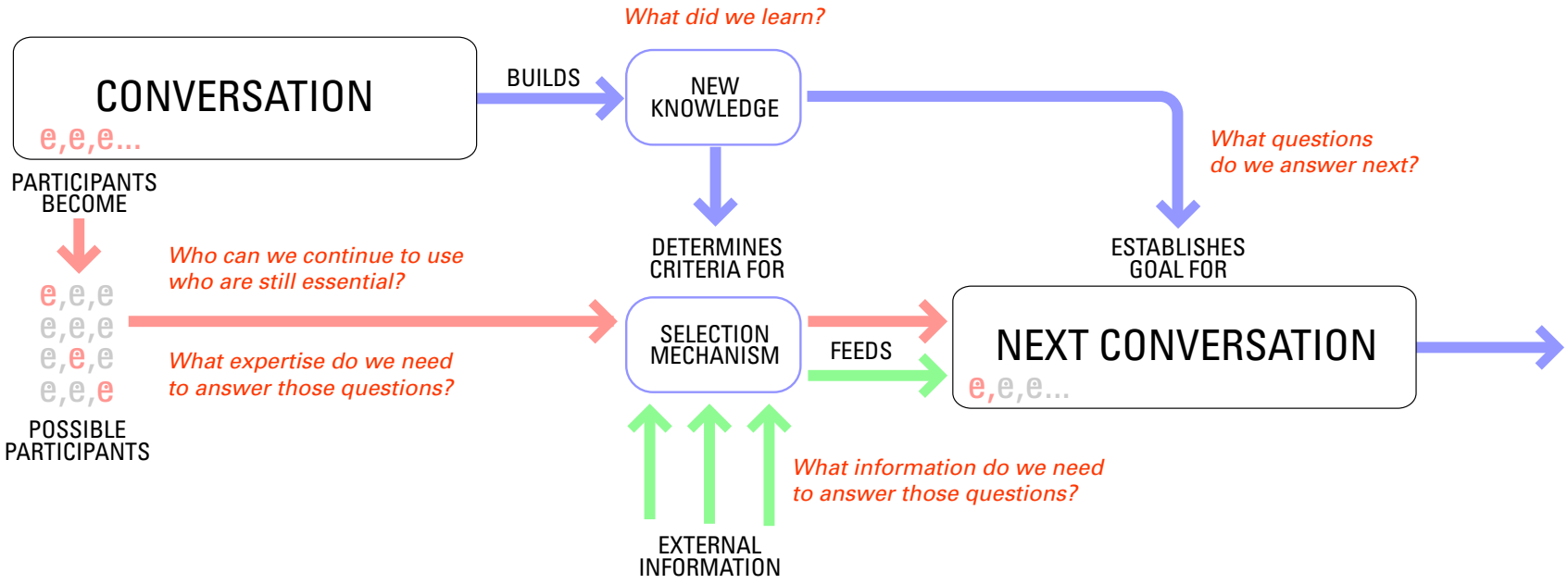
ii. requisite variety

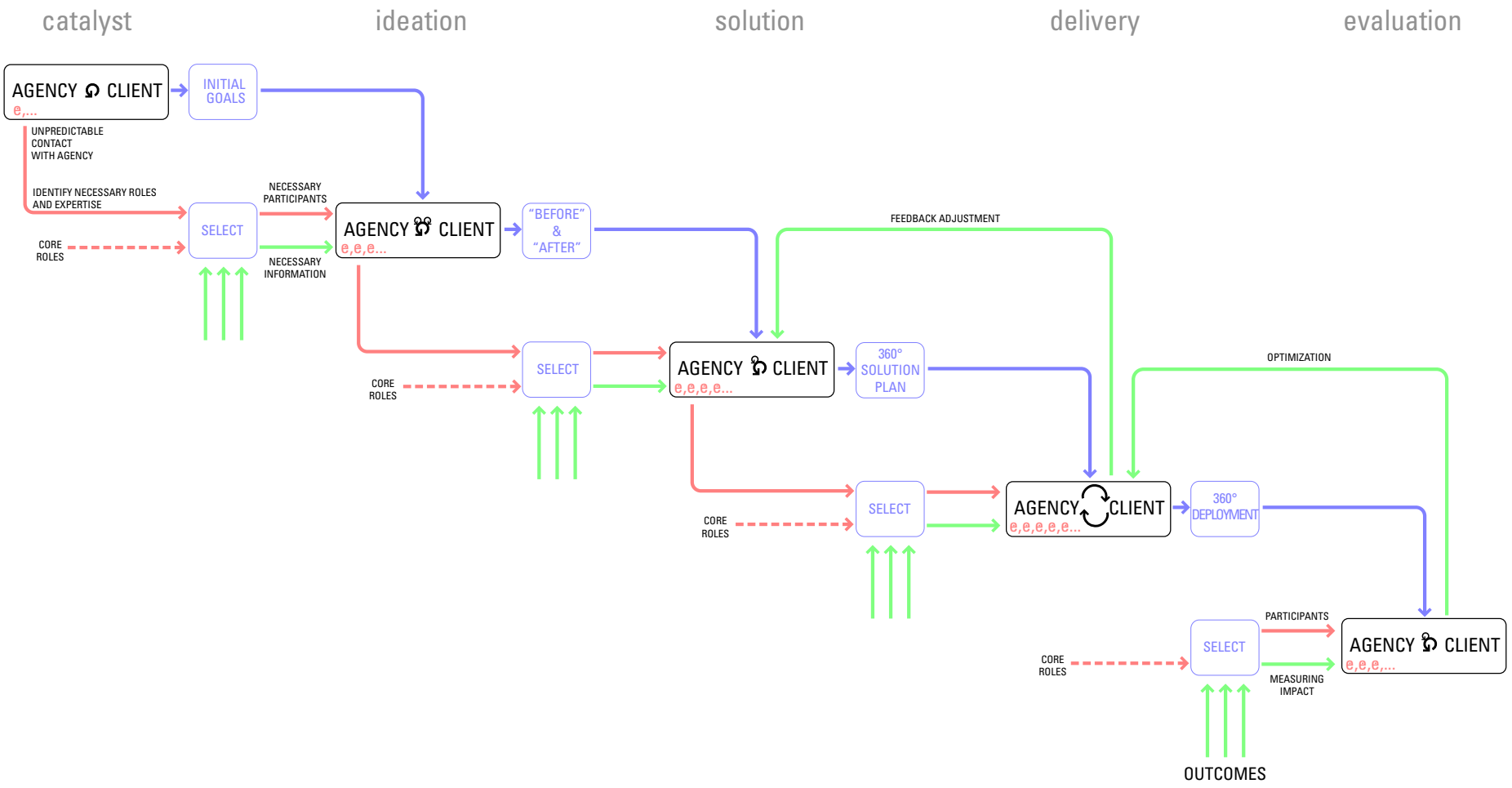
cybernetics has a rigorous definition
of the limitations of a system
to achieve its goal...

which can be applied to social systems

– variety is defined as capacity for conversation
– local truth controls the "essential variables"
that determine the viability system


CONVERSATION
e,e,e...
BUILDS
What did we learn?
NEW KNOWLEDGE
What questions do we answer next?
ESTABLISHES GOAL FOR
NEXT CONVERSATION
e,e,e...


What did we learn?
CONVERSATION
e,e,e...
BUILDS
NEW KNOWLEDGE
What questions do we answer next?
PARTICIPANTS BECOME
DETERMINES CRITERIA FOR
ESTABLISHES GOAL FOR
Who can we continue to use who are still essential?
e,e,e
e,e,e
e,e,e
e,e,e
SELECTION MECHANISM
FEEDS
NEXT CONVERSATION
e,e,e...
What expertise do we need to answer those questions?
POSSIBLE PARTICIPANTS
What information do we need to answer those questions?
EXTERNAL INFORMATION


catalyst
ideation
solution
delivery
evaluation
AGENCY CLIENT
e,...
INITIAL GOALS
UNPREDICTABLE CONTACT WITH AGENCY
IDENTIFY NECESSARY ROLES AND EXPERTISE
SELECT
CORE ROLES
NECESSARY PARTICIPANTS
NECESSARY INFORMATION
AGENCY CLIENT
e,e,e...
"BEFORE" & "AFTER"
FEEDBACK ADJUSTMENT
SELECT
CORE ROLES
AGENCY CLIENT
e,e,e,e...
360° SOLUTION PLAN
OPTIMIZATION
SELECT
CORE ROLES
AGENCY CLIENT
e,e,e,e,e...
360° DEPLOYMENT
SELECT
CORE ROLES
PARTICIPANTS
MEASURING IMPACT
AGENCY CLIENT
e,e,e,...
OUTCOMES

iii. co-evolution

cybernetics models the subjective and objective interactions inherent in any complex system that includes social / linguistic components

a. design for co-evolution

Notes on the Role of **Leadership and Language** in Regenerating Organizations

An organization is its **language.**

Ultimately,
an organization consists of conversations:
who talks to whom, about what.

Conversation leads to agreement.
Agreement leads to transaction.

Narrowing **language** increases efficiency.

Organizations create their own internal language
to solve specific problems.

This language serves as a kind of shorthand:
Managers use it every day,
knowing they will be clearly understood.

Over time, this internal language
grows increasingly specialized—and narrow.

Narrowing **language** also increases ignorance.

The organization's internal language
is designed to help managers
facilitate present-day business — not look beyond it.

Using the internal language,
managers increase efficiencies,
but cannot recognize new fields of research,
new discoveries, new approaches.

Past **language** limits future vision.

Managers understand the organization's past behavior.
But this knowledge,
and the language that accompanies it,
limit their vision
of the organization's potential future state.

Using the language of the past,
managers may try to provide a vision for the future.
But it is an old future—
a memory of what the future could be.

Managers may strive for fundamental change,
but their language prevents them from achieving it.

Expanding **language** increases opportunity.

The conversations necessary
for generating new opportunities
come from outside the system.

For an organization to survive,
it must be able to acquire
new, relevant language domains.

To regenerate, an organization creates a new **language.**

To support an organization's future viability, effective decision makers actively introduce change into the system.

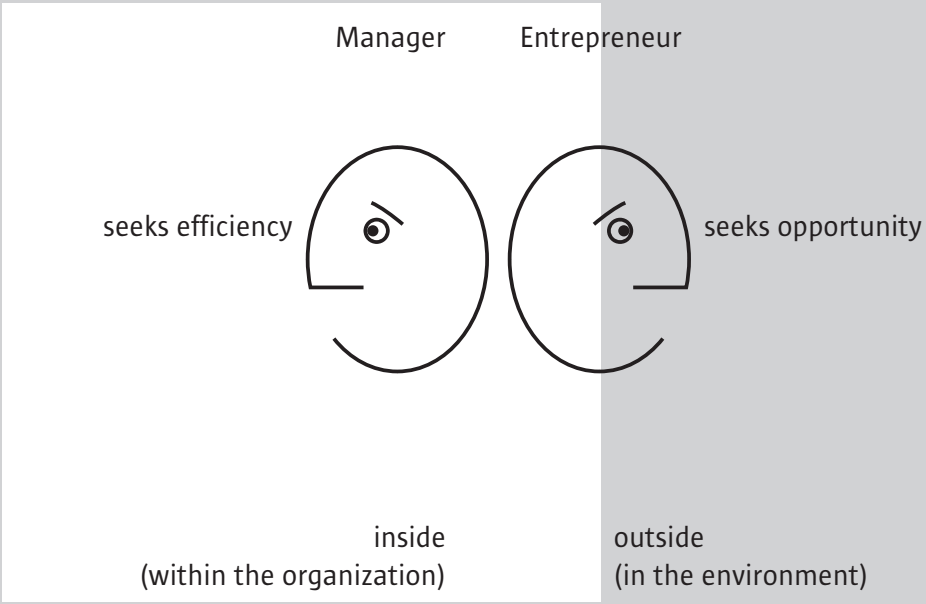
They do so by generating new language that appropriate groups in the organization come to understand and embrace.

This new language does not overtly challenge the pre-existing, efficient system, but rather creates new distinctions and supportive relationships.

Manager and Entrepreneur.

The Manager is responsible for improving the organization's present-day performance.

The Entrepreneur does not concern herself with present-day business.



why is cybernetics a science for design?

because it has a rigorous set of models
that provide powerful explanations and prescriptions
for coordinating diverse teams that are required
to solve today's wicked design problems

i. conversation

ii. requisite variety

iii. co-evolution

innovation

innovation

- what is innovation?
- how do we get it?
- when do we need it?

innovation

innovation is
an insight that
inspires change
that creates value.

innovation is not simply

...an idea

...an invention

...an improvement

...simple creativity.

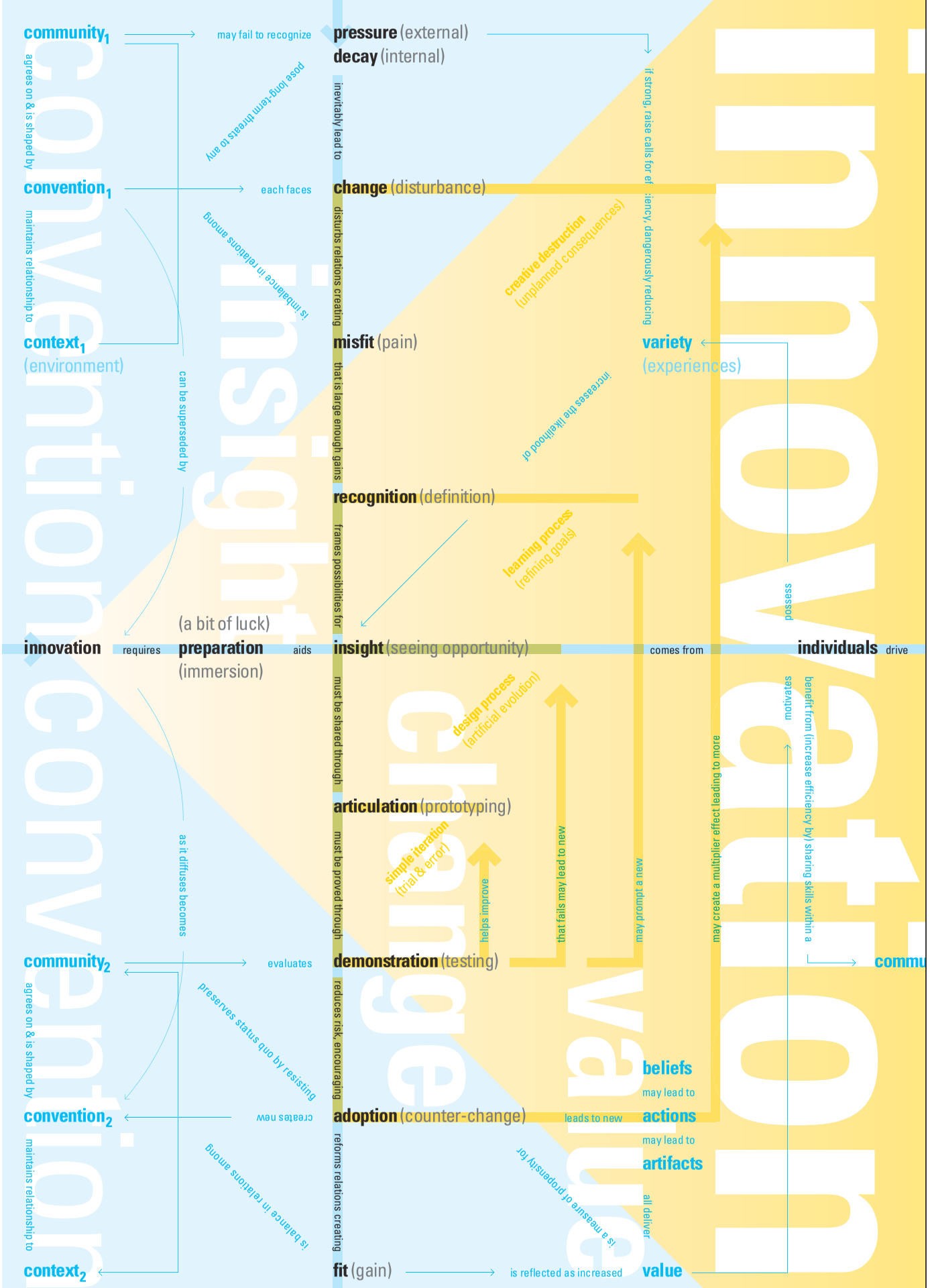
innovation

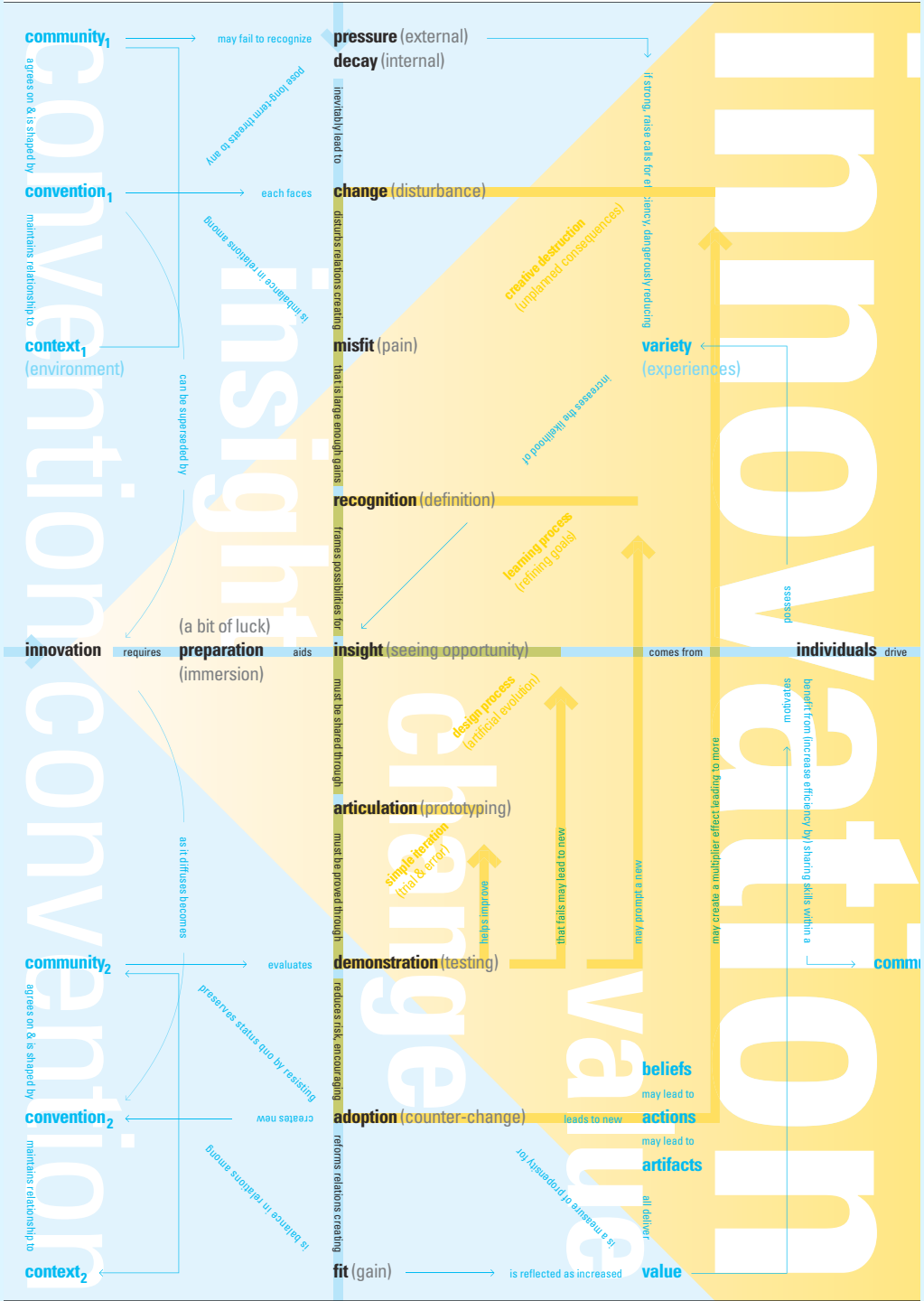
...can be modelled as a conversation
— goals + feedback + actions

...requires sufficient variety

...is a co-evolutionary process.

innovation
change
insight
convention convention


community1
may fail to recognize
pressure (external)
decay (internal)
agrees on & is shaped by
pose long-term threats to any
inevitably lead to
if strong, raise calls for efficiency, dangerously reducing
convention1
each faces
change (disturbance)
maintains relationship to
is imbalance in relations among
disturbs relations creating
creative destruction
(unplanned consequences)
context1
(environment)
misfit (pain)
variety
(experiences)
increases the likelihood of
that is large enough gains
can be superseded by
recognition (definition)
learning process
(refining goals)
possess
(a bit of luck)
innovation
requires
preparation
(immersion)
aids
insight (seeing opportunity)
comes from
individuals
drive
frames possibilities for
design process
(artificial evolution)
must be shared through
articulation (prototyping)
benefit from (increase efficiency by) sharing skills within a
motivates
simple iteration
(trial & error)
helps improve
that fails may lead to new
may prompt a new
may create a multiplier effect leading to more
commu
as it diffuses becomes
community2
evaluates
must be proved through
demonstration (testing)
agrees on & is shaped by
preserves status quo by resisting
reduces risk, encouraging
beliefs
may lead to
convention2
creates new
adoption (counter-change)
leads to new
actions
may lead to
maintains relationship to
is balance in relations among
reforms relations creating
is a measure of propensity for
artifacts
all deliver
context2
fit (gain)
is reflected as increased
value


innovation
change
insight
community1
may fail to recognize
pressure (external)
decay (internal)
agrees on & is shaped by
pose long-term threats to any
inevitably lead to
convention1
each faces
change (disturbance)
maintains relationship to
is in balance in relations among
disturbs relations creating
creative destruction
(unplanned consequences)
if strong, raise calls for efficiency, dangerously reducing
context1
(environment)
misfit (pain)
variety
(experiences)
can be superseded by
that is large enough gains
increases the likelihood of
recognition (definition)
learning process
(refining goals)
frames possibilities for
(a bit of luck)
innovation
requires
preparation
(immersion)
aids
insight (seeing opportunity)
comes from
individuals
drive
possess
design process
(artificial evolution)
must be shared through
benefit from (increase efficiency by) sharing skills within a
articulation (prototyping)
as it diffuses becomes
simple iteration
(trial & error)
helps improve
that fails may lead to new
may prompt a new
must be proved through
may create a multiplier effect leading to more
community2
evaluates
demonstration (testing)
preserves status quo by resisting
reduces risk, encouraging
beliefs
may lead to
agrees on & is shaped by
creates new
adoption (counter-change)
leads to new
actions
may lead to
artifacts
maintains relationship to
is in balance in relations among
reforms relations creating
is a measure of propensity for
all deliver
context2
fit (gain)
is reflected as increased
value

community$_1$

agrees on & is shaped by

convention$_1$

maintains relationship to

context$_1$
(environment)

may fail to recognize

pose long-term threats to any

each faces

is imbalance in relations among

can be supersed

pressure (external)
decay (internal)

inevitably lead to

change (disturbance)

disturbs relations creating

misfit (pain)

that is large enou

creative destruction
(unplanned conse

ses the likelih

community$_1$

may fail to recognize

pressure (external)
decay (internal)

agrees on & is shaped by

pose long-term threats to any

inevitably lead to

convention$_1$

each faces

change (disturbance)

if strong, raise calls for ef iency, dangerously reducing

maintains relationship to

is imbalance in relations among

disturbs relations creating

creative destruction
(unplanned consequences)

context$_1$
(environment)

misfit (pain)

variety
(experiences)

can be superseded by

that is large enough gains

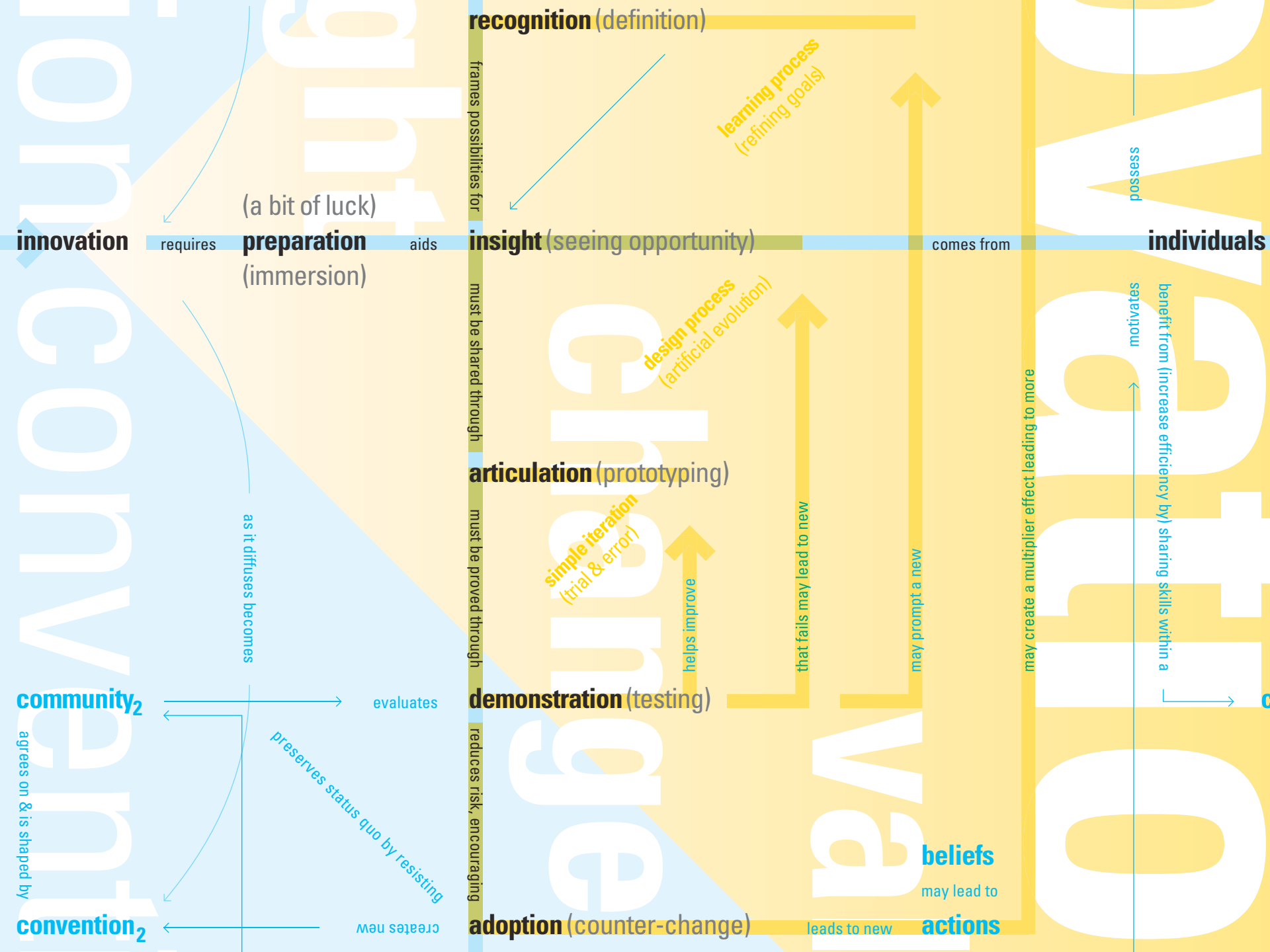
increases the likelihood of

recognition (definition)

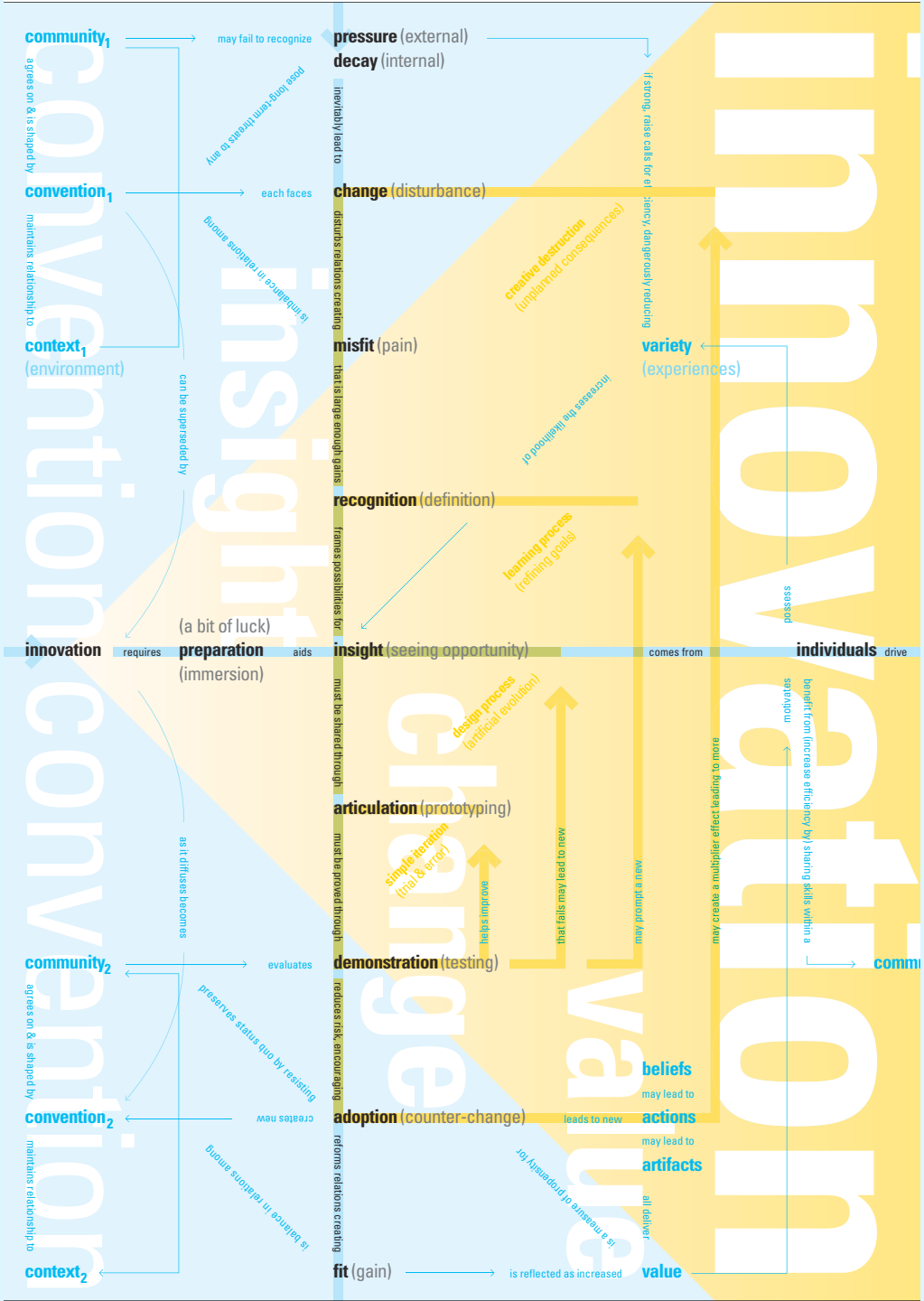
frames po

arning process
ing goals)


recognition (definition)
learning process
(refining goals)
frames possibilities for
(a bit of luck)
innovation
requires
preparation
(immersion)
aids
insight (seeing opportunity)
comes from
design process
(artificial evolution)
must be shared through
articulation (prototyping)
simple iteration
(trial & error)
helps improve
that fails may lead to new
may prompt a new
may create a multiplier effect leading to more
as it diffuses becomes
community2
evaluates
demonstration (testing)
preserves
must be proved through


recognition (definition)
frames possibilities for
learning process
(refining goals)
innovation
requires
preparation
(immersion)
(a bit of luck)
aids
insight (seeing opportunity)
comes from
individuals
possess
design process
(artificial evolution)
must be shared through
articulation (prototyping)
motivates
benefit from (increase efficiency by) sharing skills within a
simple iteration
(trial & error)
helps improve
that fails may lead to new
may prompt a new
may create a multiplier effect leading to more
must be proved through
demonstration (testing)
as it diffuses becomes
community2
evaluates
preserves status quo by resisting
reduces risk, encouraging
agrees on & is shaped by
creates new
convention2
adoption (counter-change)
leads to new
beliefs
may lead to
actions

innovation
requires
preparation
(immersion)
aids
insight (seeing opportunity)
comes from
individuals
conventional
change
value
articulation (prototyping)
demonstration (testing)
adoption (counter-change)
fit (gain)
must be shared through
must be proved through
reduces risk, encouraging
reforms relations creating
design process
(artificial evolution)
simple iteration
(trial & error)
helps improve
that fails may lead to new
may prompt a new
may create a multiplier effect leading to more
motivates
benefit from (increase efficiency by) sharing skills within a
community₂
evaluates
as it diffuses becomes
agrees on & is shaped by
preserves status quo by resisting
convention₂
creates new
maintains relationship to
is balance in relations among
context₂
leads to new
beliefs
may lead to
actions
may lead to
artifacts
all deliver
is a measure of propensity for
is reflected as increased
value


innovation
change
insight
community1
may fail to recognize
pressure (external)
decay (internal)
agrees on & is shaped by
pose long-term threats to any
inevitably lead to
convention1
each faces
change (disturbance)
maintains relationship to
is in balance in relations among
disturbs relations creating
creative destruction
(unplanned consequences)
if strong, raise calls for efficiency, dangerously reducing
context1
(environment)
misfit (pain)
variety
(experiences)
can be superseded by
that is large enough gains
increases the likelihood of
recognition (definition)
learning process
(refining goals)
frames possibilities for
(a bit of luck)
innovation
requires
preparation
(immersion)
aids
insight (seeing opportunity)
comes from
individuals
drive
possess
design process
(artificial evolution)
must be shared through
benefit from (increase efficiency by) sharing skills within a
articulation (prototyping)
as it diffuses becomes
simple iteration
(trial & error)
helps improve
that fails may lead to new
may prompt a new
must be proved through
may create a multiplier effect leading to more
community2
evaluates
demonstration (testing)
preserves status quo by resisting
reduces risk, encouraging
beliefs
may lead to
agrees on & is shaped by
creates new
adoption (counter-change)
leads to new
actions
may lead to
artifacts
maintains relationship to
is in balance in relations among
reforms relations creating
is a measure of propensity for
all deliver
context2
fit (gain)
is reflected as increased
value

why is cybernetics a science for design?

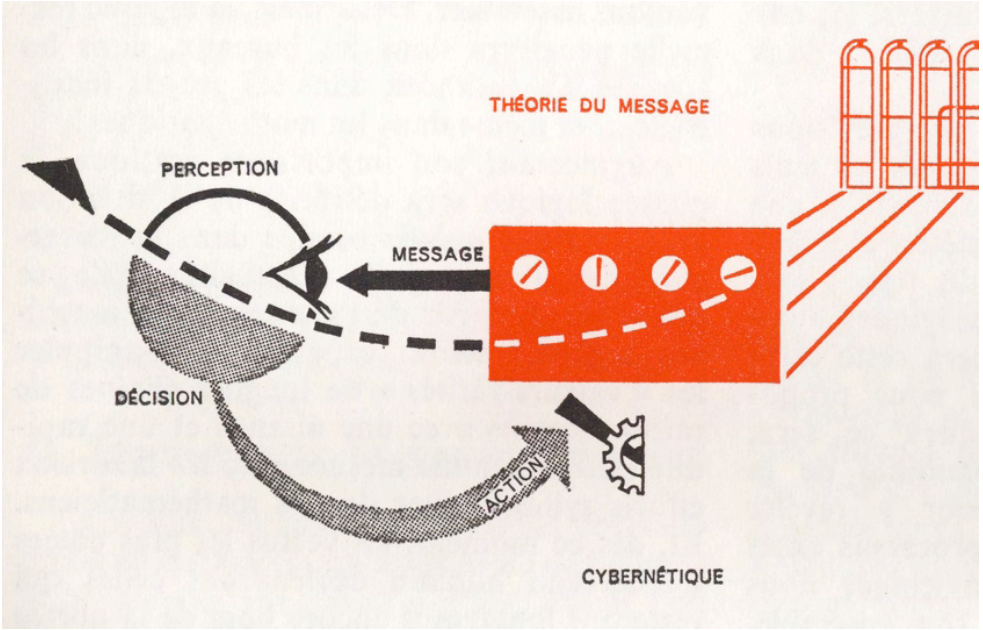
because it has a rigorous set of models
that provide powerful explanations and prescriptions
for coordinating diverse teams that are required
to solve today's wicked design problems

i. conversation

ii. requisite variety

iii. co-evolution

interaction cybernetics design

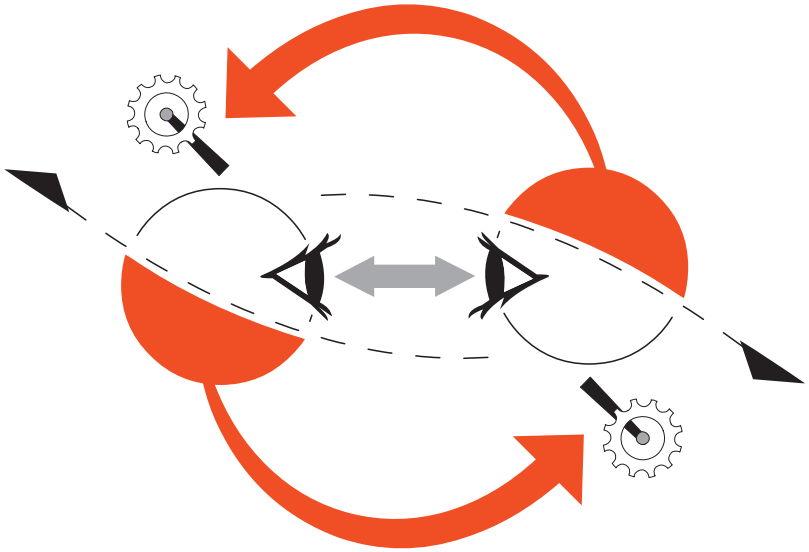


Dr. Paul Pangaro
CyberneticLifestyles.com
New York City

paul@CyberneticLifestyles.com
pangaro.com/ecoledesmines

École Nationale Supérieure des Mines de Paris
2 October 2009

interaction cybernetics design

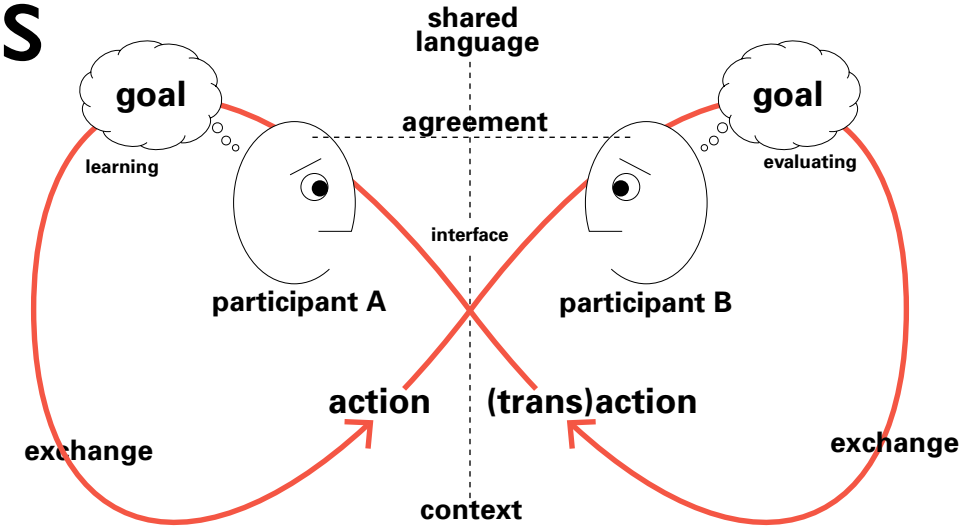


Dr. Paul Pangaro
CyberneticLifestyles.com
New York City

paul@CyberneticLifestyles.com
pangaro.com/ecoledesmines

École Nationale Supérieure des Mines de Paris
2 October 2009

interaction cybernetics design

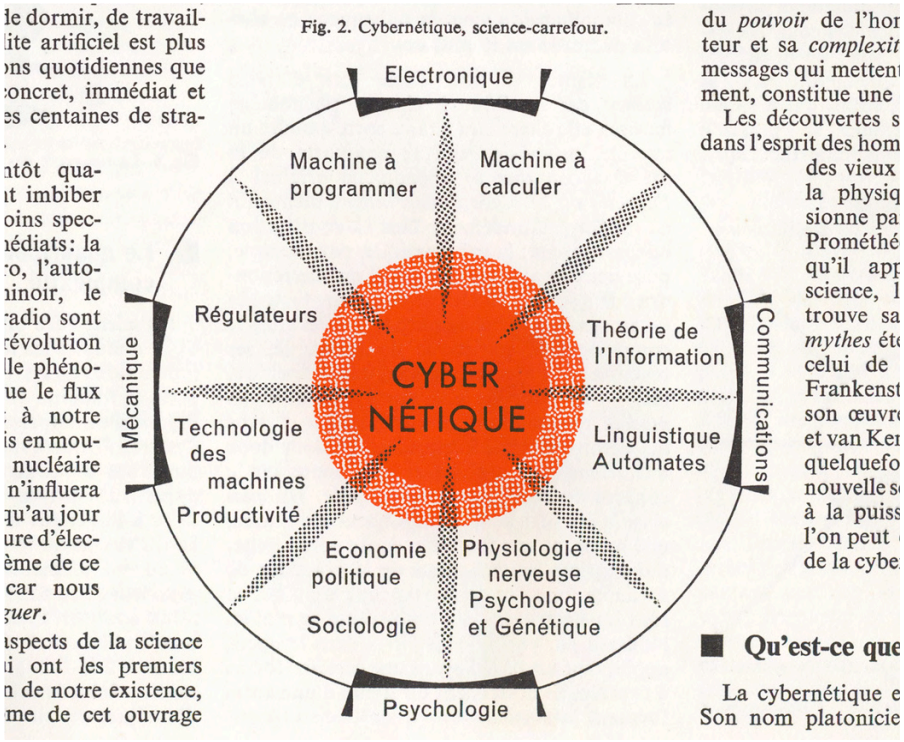


Dr. Paul Pangaro
CyberneticLifestyles.com
New York City

paul@CyberneticLifestyles.com
pangaro.com/ecoledesmines

École Nationale Supérieure des Mines de Paris
2 October 2009

interaction cybernetics design

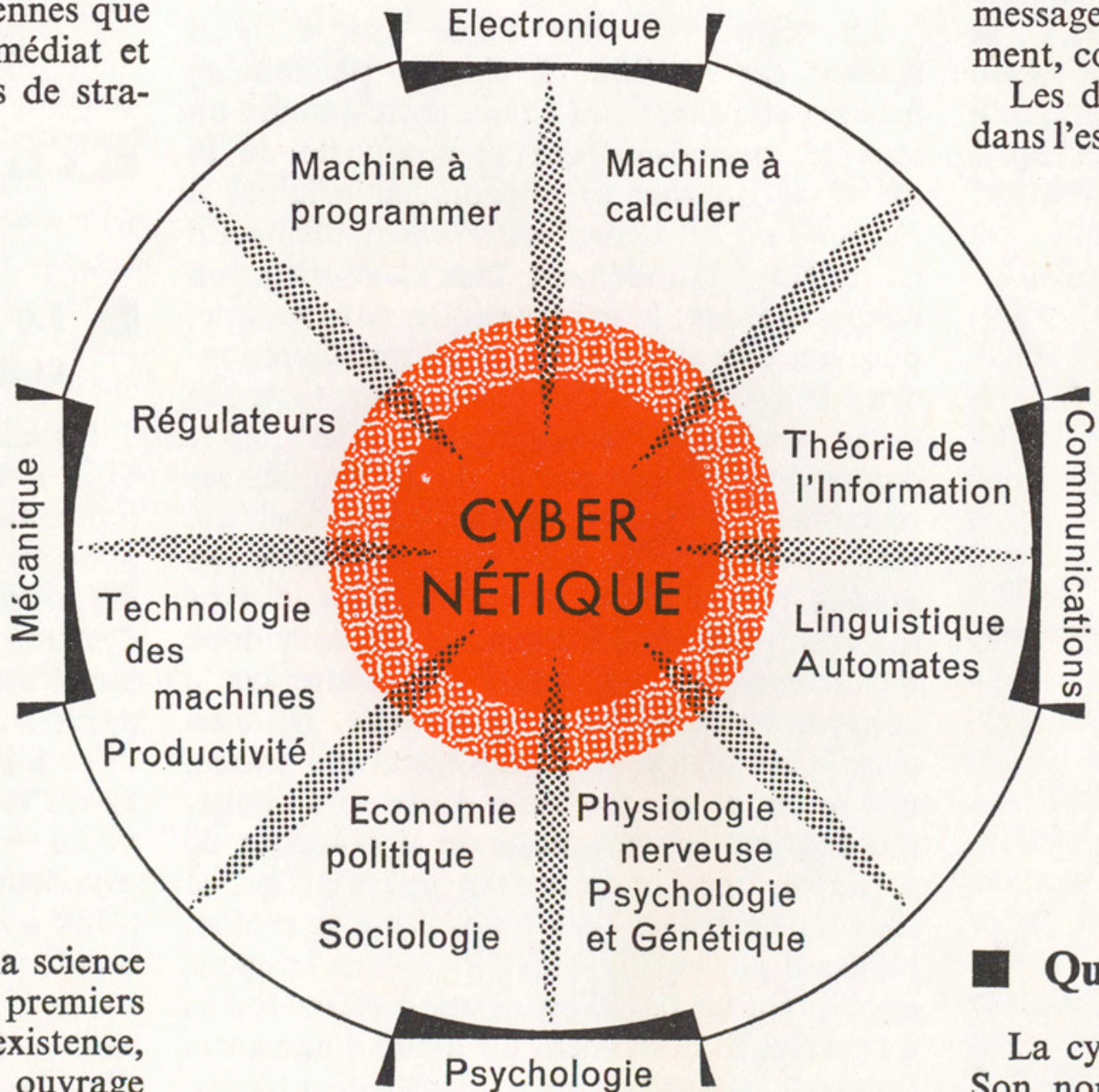


Dr. Paul Pangaro
CyberneticLifestyles.com
New York City

paul@CyberneticLifestyles.com
pangaro.com/ecoledesmines

École Nationale Supérieure des Mines de Paris
2 October 2009

Fig. 2. Cybernétique, science-carrefour.



lite artificiel est plus
ons quotidiennes que
oncret, immédiat et
es centaines de stra-

ntôt qua-
t imbiber
oins spec-
nédiats: la
o, l'auto-
ninoir, le
adio sont
révolution
lle phéno-
ue le flux
à notre
is en mou-
nucléaire
n'influera
qu'au jour
ure d'élec-
ème de ce
car nous
guer.

aspects de la science
i ont les premiers
n de notre existence,
me de cet ouvrage

du *pouvoir* de l'hor
teur et sa *complexit*
messages qui mettent
ment, constitue une

Les découvertes s
dans l'esprit des hom
des vieux
la physiq
sionne pa
Prométhé
qu'il app
science, l
trouve sa
mythes éte
celui de
Frankenst
son œuvre
et van Ker
quelquefo
nouvelle s
à la puiss
l'on peut
de la cybe

■ Qu'est-ce que

La cybernétique e
Son nom platonicie

appendix

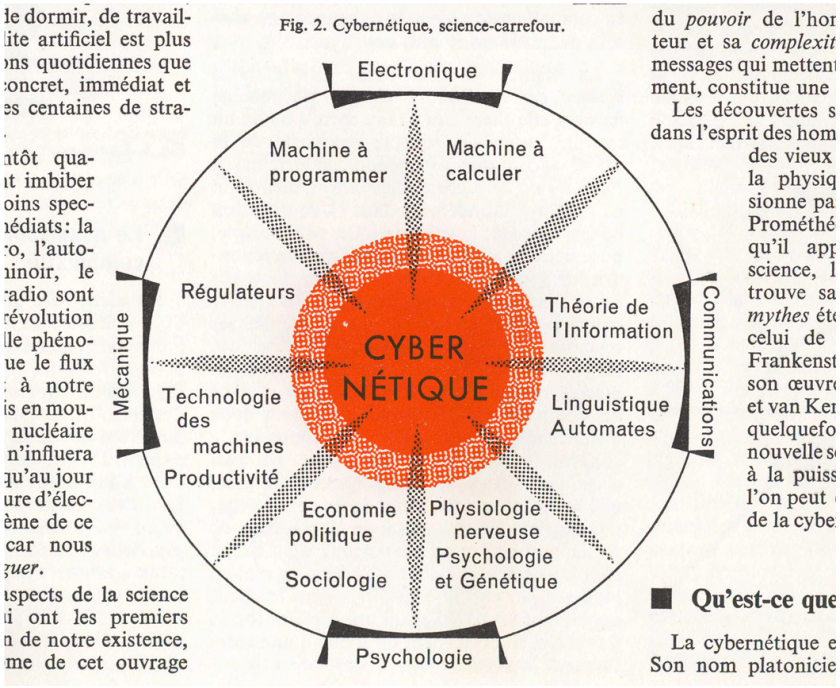


Fig. 2. Cybernétique, science-carrefour.
Electronique
Machine à programmer
Machine à calculer
Régulateurs
Théorie de l'Information
Mécanique
Communications
CYBER NÉTIQUE
Technologie des machines
Linguistique Automates
Productivité
Economie politique
Physiologie nerveuse Psychologie et Génétique
Sociologie
Psychologie

Hochschule für Gestaltung
Ulm, Germany

Founded under the Marshall Plan (1948 / 1953 to 1968)

Goals included social change—design as bulwark against fascism

Classes offered in operations research, cybernetics, and semiotics

Acquired status of the Bauhaus (Gropius blessed it)

Hochschule für Gestaltung
Ulm, Germany

Norbert Wiener and Martin Heidegger visit and lecture

Bucky Fuller and Charles Eames visit

Bruce Archer and Horst Rittel on faculty

American design school leaders visit in 1962

British design school leaders visit in 1966

Then...

In 1963, Horst Rittel and Christopher Alexander are hired to teach at University of California Berkeley

In 1968, Ulm closes

1000+ papers are published in "design rationale", including the process of design as based in feedback

Many more papers on "design patterns" after Alexander

In 1972, Rittel critiques the state of design methods, calls for a shift to design as rhetoric, echoing 2nd-order cybernetics

Design Methods Movement

1st generation ~ 1962–1972

Macy Meetings 1946–1953...

Design Methods Conferences in 1962, 1965, 1967, 1974

Christopher Alexander 1962—Notes on the Synthesis of Form

Bruce Archer 1964—Systematic Method for Designers
(229-step design process)

John Chris Jones 1972—Design Methods

Venturi 1966—Complexity and Contradiction

Venturi 1972—Learning from Las Vegas

... marks the symbolic end of Design Methods as a focus in architecture

John Chris Jones and Chris Alexander both repudiate
1st-generation Design Methods

... systems teaching in design almost disappears after 1980

Rittel and Webber, 1972

The search for scientific bases for confronting problems of social policy is bound to fail, because of the nature of these problems. They are "wicked" problems, whereas science has developed to deal with "tame" problems. Policy problems cannot be definitively described. Moreover, in a pluralistic society there is nothing like the undisputable public good; there is no objective definition of equity; policies that respond to social problems cannot be meaningfully correct or false; and it makes no sense to talk about "optimal solutions" to social problems unless severe qualifications are imposed first. Even worse, there are no "solutions" in the sense of definitive and objective answers.

Rittel's Problems

simple problems

question is clear—we only need to provide an answer

2 + 2 = ?

the lightbulb is not working

most design problems given in school are like this

Rittel's Problems

1st-order cybernetics

complex problems

question is vague or ill formed—we must assess the situation and discuss

through conversation, we "understand" the situation and agree on a definition of the problem

we frame the current situation in order to show how it differs from a preferred situation

thus we have reduced it to a simple problem

most design problems encountered in practice are like this

Rittel's Problems

2nd-order cybernetics

wicked problems

participants hold conflicting views of the problem

coming to agreement on the problem is impossible—without reframing

reframing is a process of construction and agreement

even then, it is impossible to...

– create definitive formulation ("poverty can be fixed by education")

– know when we are done (we don't know if we can do better)

– apply a definitive test of a solution (any solution has consequences)

– avoid consequences of failed solution (cannot unbuild a freeway)

– reuse knowledge on another problem (each is unique)

the most important problems of the 21st century are like this

cybernetic modeling

not about what a system is made of

- not delimited by subject domain, discipline, or distinctions such as biological, physical, ecological, psychological, social, linguistic

includes goals — the 'why' as well as the 'how'

- systems are defined by boundaries made by observers
- systems have goal(s) ascribed by observers
- information flow from the environment to the system relevant to achieving a goal defines 'feedback'

connects goals to actions — 'looping-through'

scope of cybernetics

explanation of communication = *psychology*
modeling of learning = *cognitive science*
limits of knowing = *epistemology*
hearer makes the meaning = *post-modernism*
reality as social construction = *constructivism*
reliable methodologies of describing = *science*

measuring understanding & agreement
= *science of subjectivity*
= *second-order cybernetics*

goals of cybernetic modeling

see causality as a loop
- shift from hierarchy of power to participation in shared goals

place actions in the context of goals

understand what is possible for a system
- possibilities are defined by 'requisite variety' (RV)
- RV enables the design of changes to the system to improve it

measure the degree of mutual understanding
- define 'conversation', 'agreement'

define and realize 'intelligent systems'

discuss participation, choice, ethics

analogs to cybernetics

disciplines relying on feedback processes
refining and clarifying goals = *design*

understanding customer needs = *consultative selling*
organizing evidence to support conclusions = *law*
directing and measuring work = *management*
diagnosing treatments based on symptoms = *medicine*
specifying appropriate physical systems = *engineering*

cybernetics summarized