

Portland State University

PDXScholar

Systems Science Faculty Publications and
Presentations

Systems Science

10-2017

Ideas & Graphs

Martin Zwick

Portland State University, zwick@pdx.edu

Follow this and additional works at: https://pdxscholar.library.pdx.edu/sysc_fac



Part of the [Logic and Foundations Commons](#), and the [Systems Architecture Commons](#)

Let us know how access to this document benefits you.

Citation Details

Zwick, Martin, "Ideas & Graphs" (2017). *Systems Science Faculty Publications and Presentations*. 148.
https://pdxscholar.library.pdx.edu/sysc_fac/148

This Presentation is brought to you for free and open access. It has been accepted for inclusion in Systems Science Faculty Publications and Presentations by an authorized administrator of PDXScholar. Please contact us if we can make this document more accessible: pdxscholar@pdx.edu.

Ideas & Graphs

Martin Zwick

Portland State University

Northwest Philosophy Conference

Washington State University

Oct 5-7, 2017

email: zwick@pdx.edu

paper: http://www.pdx.edu/sysc/sites/www.pdx.edu.sysc/files/Ideas&graphs_NPC2017.pdf

web: <http://www.pdx.edu/sysc/research-systems-theory-and-philosophy>

Abstract

A graph can specify the skeletal structure of an idea, onto which meaning can be added by interpreting the structure.

This paper considers graphs (but not hypergraphs) consisting of four nodes, and suggests meanings that can be associated with several different directed and undirected graphs.

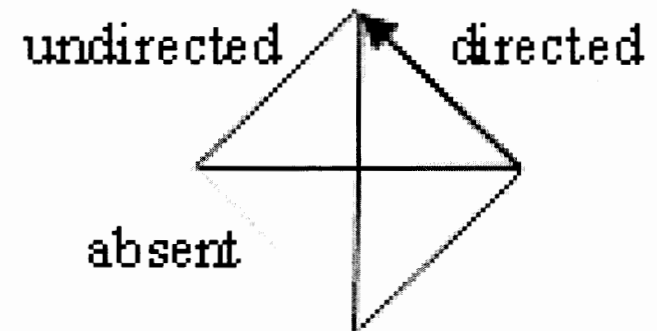
Drawing on Bennett's "systematics," specifically on the Tetrad that systematics offers as a model of 'activity,' the analysis here formalizes and augments the systematics account and shows that the Tetrad is a versatile model of problem-solving, regulation and control, and other processes.

- Introduction
- The Tetrad of Systematics; Applications
- Other Directed Tetradic Graphs
- Summary
- Acknowledgement
- Bibliography

Numbers of undirected/directed tetradic graphs

- For tetradic graphs, there are 6 dyadic links

- If links are undirected,
- each link can be present or absent
- There are $2^6 = 64$ undirected structures

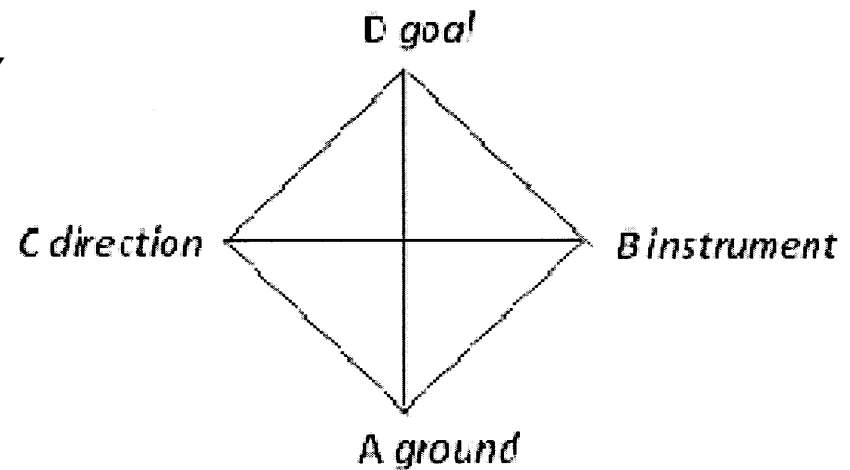


- If links are directed,
 - each link has possible 2 directions or is absent
 - There are $3^6 = 729$ directed structures
-
- If one includes hypergraphs (not discussed), there are **114** undirected structures

- Introduction
- The Tetrad of Systematics; Applications
 - System and terms
 - Interplays and partitions
 - Hierarchy
- Other Directed Tetradic Graphs
- Summary
- Acknowledgement
- Bibliography

Figure 1 Tetrad (Bennett 1966)

- Four-term System: TETRAD
- Systemic Attribute: ACTIVITY
- Term Designation: SOURCE



- Term Characters:
 - MOTIVATIONAL: *ground* (actual) (A)
goal (ideal) (D)
 - OPERATIONAL: *direction* (theoretical) (C)
instrument (practical) (B)
- 1st Order Connectivities: INTERPLAYS (6 lines in diagram)

Notation & nomenclature

- “Relation” = “link” = “interplay”
- $AB:BC:CD$ is an example of an undirected graph; all 3 relations have no direction.
- $AB:BC:CD$ includes $A \rightarrow B \rightarrow C \rightarrow D$, $A \leftarrow B \leftarrow C \leftarrow D$, & also 6 other different directed structures. $AB:BC:CD = DC:CB:BA$
- $AB:BC:CD$ is an example of a directed graph; all 3 relations have directions specified by the order of the variables
- $AB:BC:CD$ means $A \rightarrow B \rightarrow C \rightarrow D$; $DC:CB:BA$ means $A \leftarrow B \leftarrow C \leftarrow D$

Table 1 Tetrad & Aristotelian causes

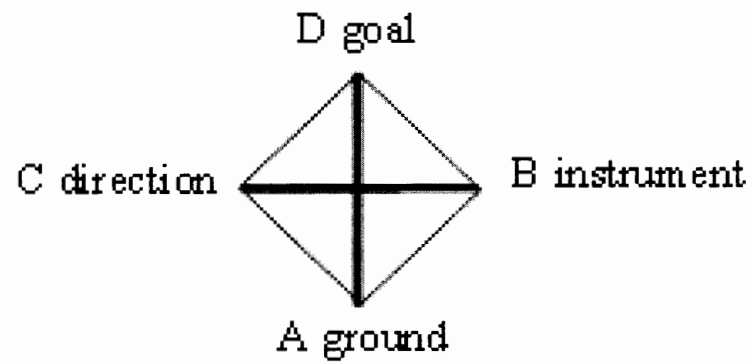
		<u>Bennett</u>	<u>(alternative)</u>
goal	Ideal	Formal	Final
direction	Theoretical	Final	Formal
instrument	Practical	Efficient	Efficient
ground	Actual	Material	Material

- Introduction
- The Tetrad of Systematics; Applications
 - Systems and terms
 - Interplays and partitions
 - Hierarchy
- Other Directed Tetradic Graphs
- Summary
- Acknowledgement
- Bibliography

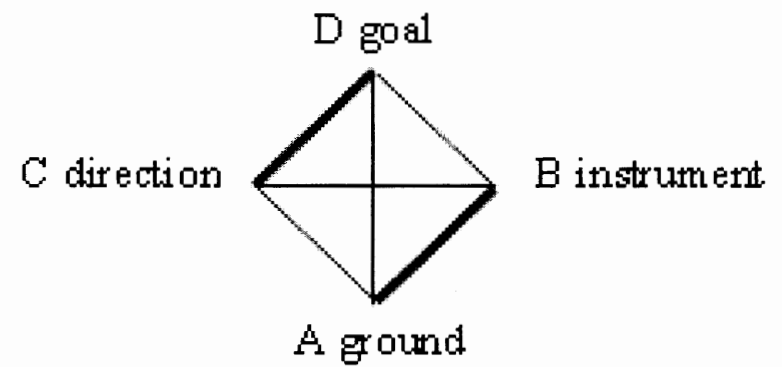
Table 2 Interplays

ground-goal	AD	Motivation
ground-direction	AC	Governance
ground-instrument	AB	Skill
goal-direction	DC	(suggested here: Understanding)
goal-instrument	DB	Integrity
direction-instrument	CB	Operation

Figure 2 Partitions 2:2



(a) AD:BC

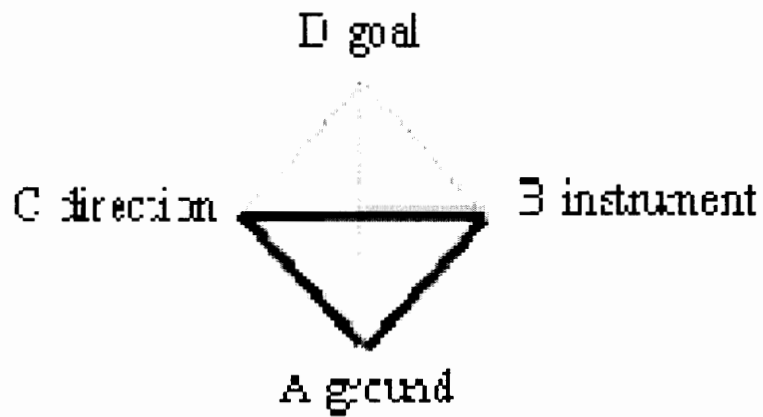


(b) AB:CD

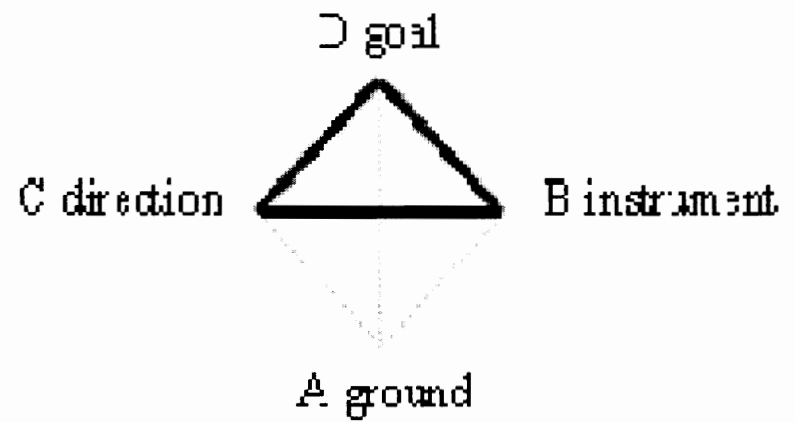
Table 3 Partitions, 3:1

<u>Base</u>	<u>Apex</u>	<u>Structure</u>	
ground-instrument-direction	goal	ABC:D	already existent vs ideal
instrument-direction-goal	ground	A:BCD	controlling vs controlled

Figure 3 Partitions 3:1

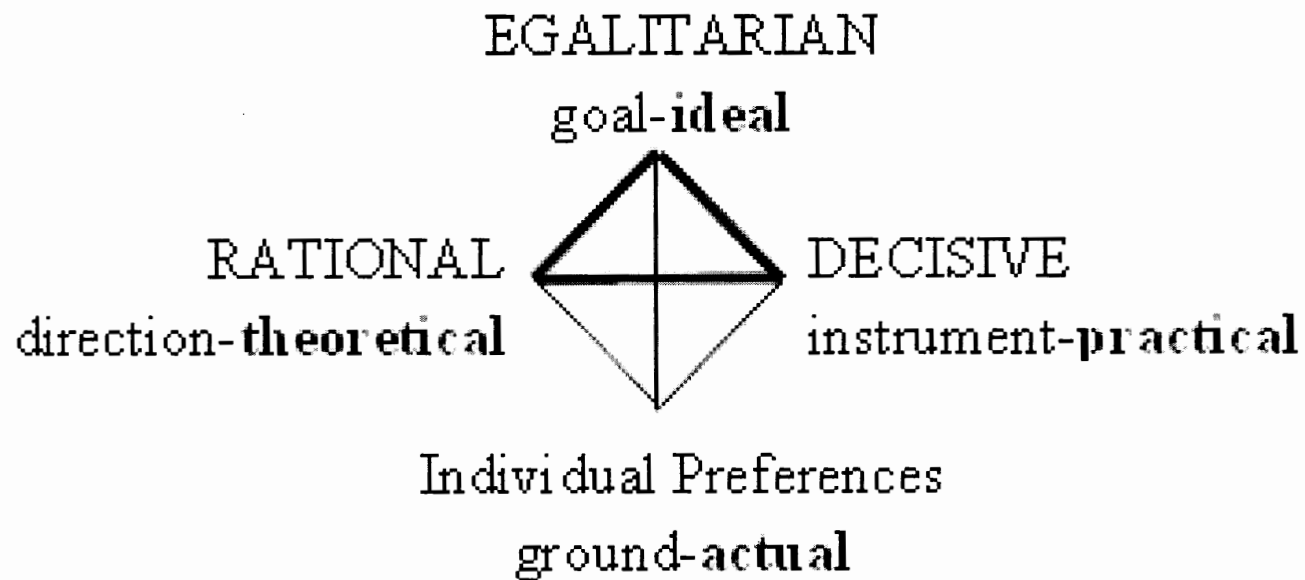


(a) ABC:D



(b) A:BCD

Figure 4 Arrow impossibility theorem



- Introduction
- The Tetrad of Systematics; Applications
 - Systems and terms
 - Interplays and partitions
 - **Hierarchy**
- Other Directed Tetrads
- Summary
- Acknowledgement
- Bibliography

Figure 5 Hierarchy

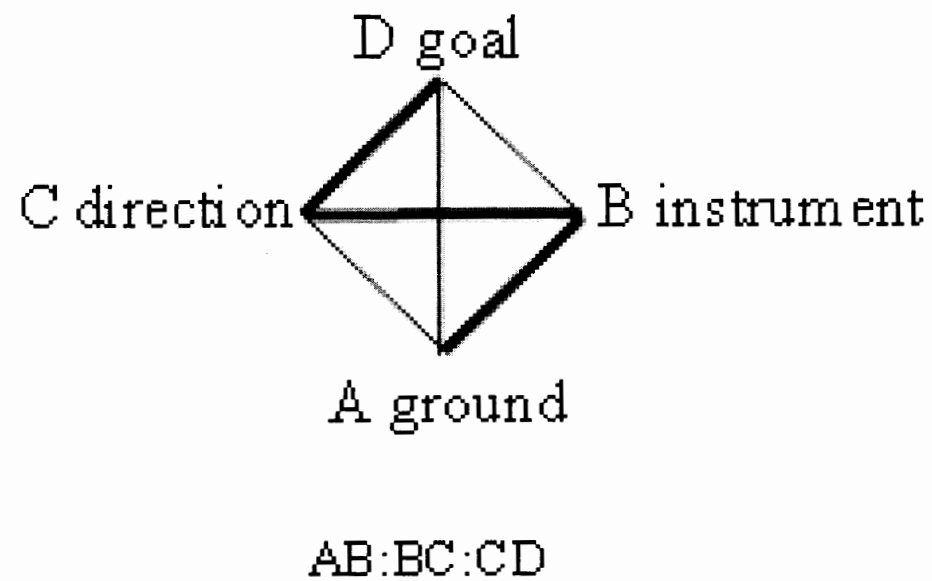
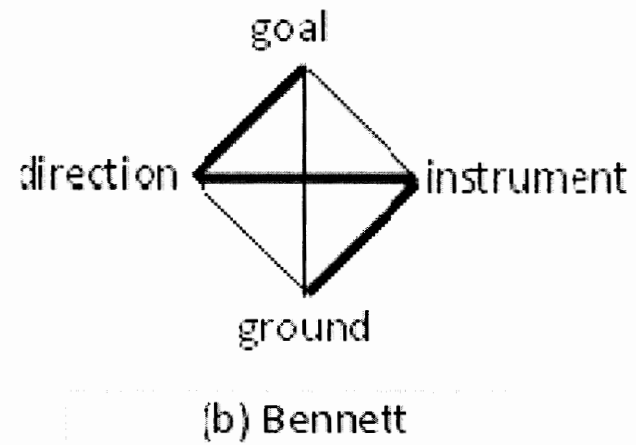
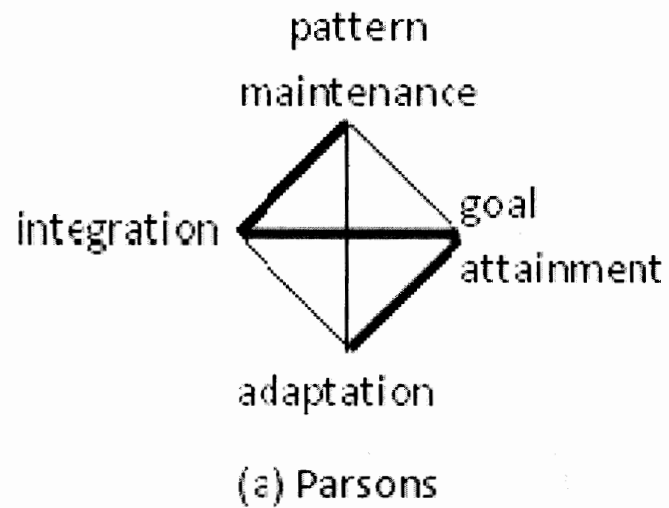


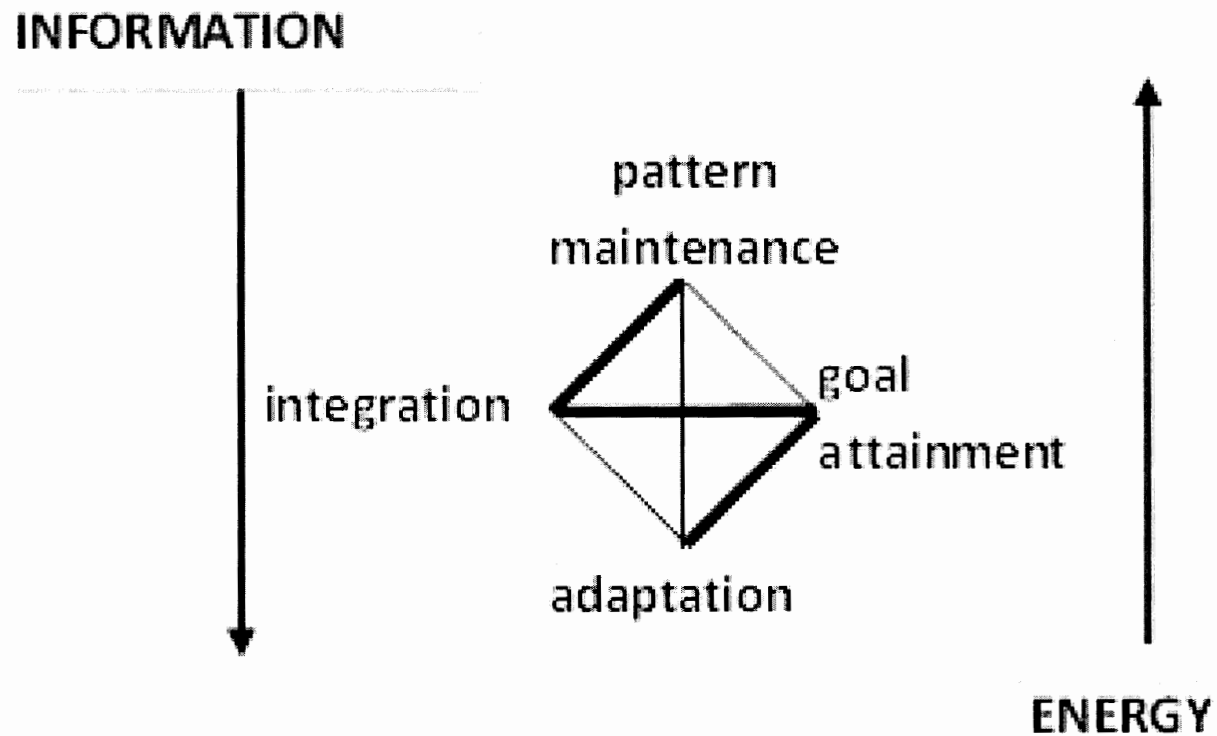
Table 4 Parsons' systems of action

Action	Society	Social System
Pattern Maintenance	Cultural System	Institutionalized Cultural Patterns
Integration	Social System	Community
Goal Attainment	Personality System	Polity
Adaptation	Behavioral Organism	Economy

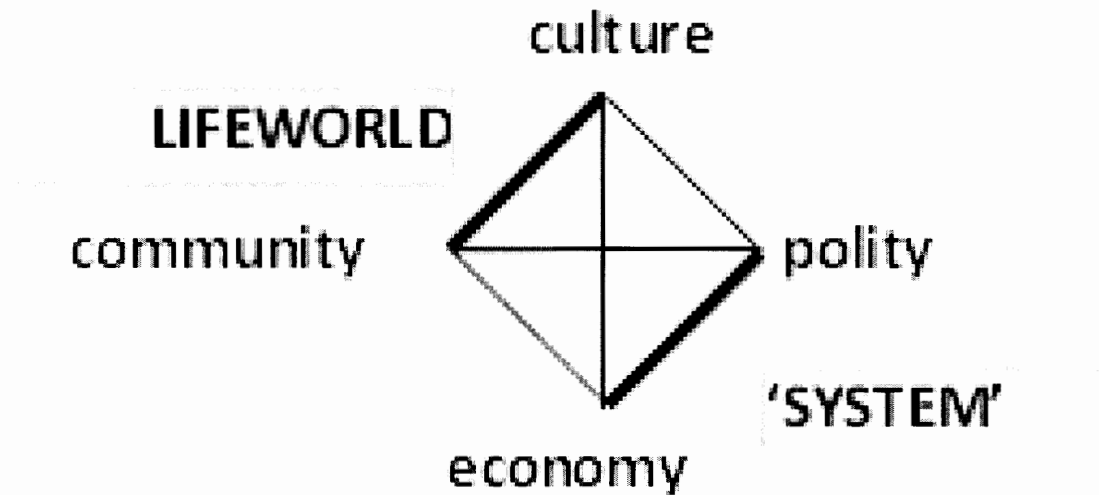
Figure 6 Parsons' & Bennett's Tetrads



Cybernetic control (Parsons)



System and Lifeworld (Habermas)

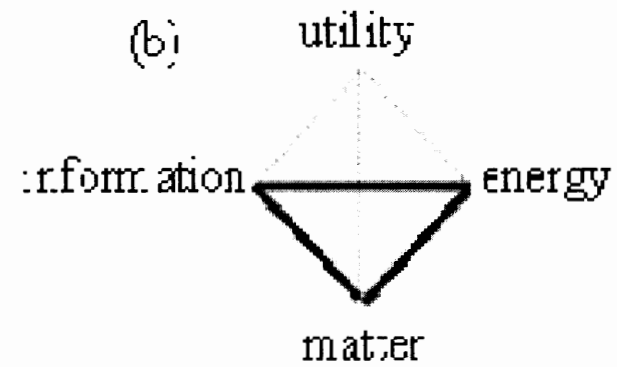
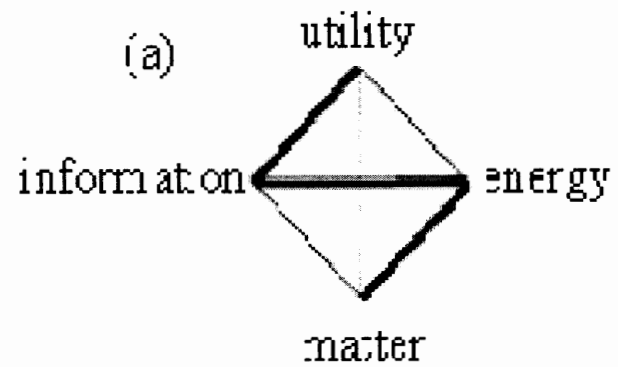


AB:CD = SYSTEM:LIFEWORLD

Table 5 Planning hierarchy

Bennett	Ozbekhan	
goal	Self-Organizing Level (Normative)	policy making
direction	Optimizing & Learning Level (Strategic)	executive decision making
instrument	Control Level (Operational)	administrative functions
ground	Process	

Figure 7 Scientific categories



- Introduction
- The Tetrad of Systematics; Applications
- Other Directed Tetrads
 - Leading parts
 - Lineal paths
- Summary
- Acknowledgement
- Bibliography

Figure 8 Leading parts & fundamentalisms

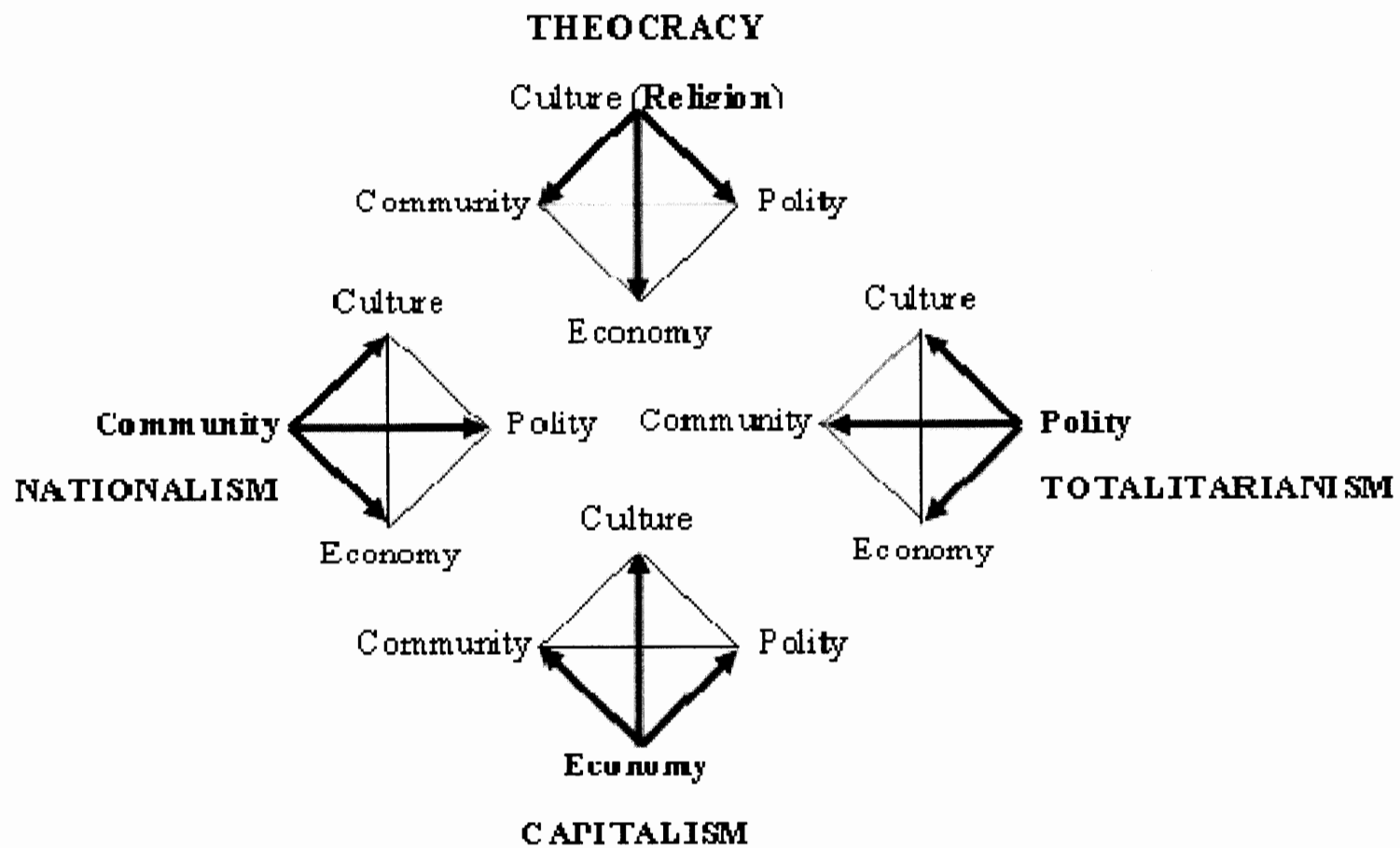


Figure 9 Negative feedback (thermostat) as Tetrad

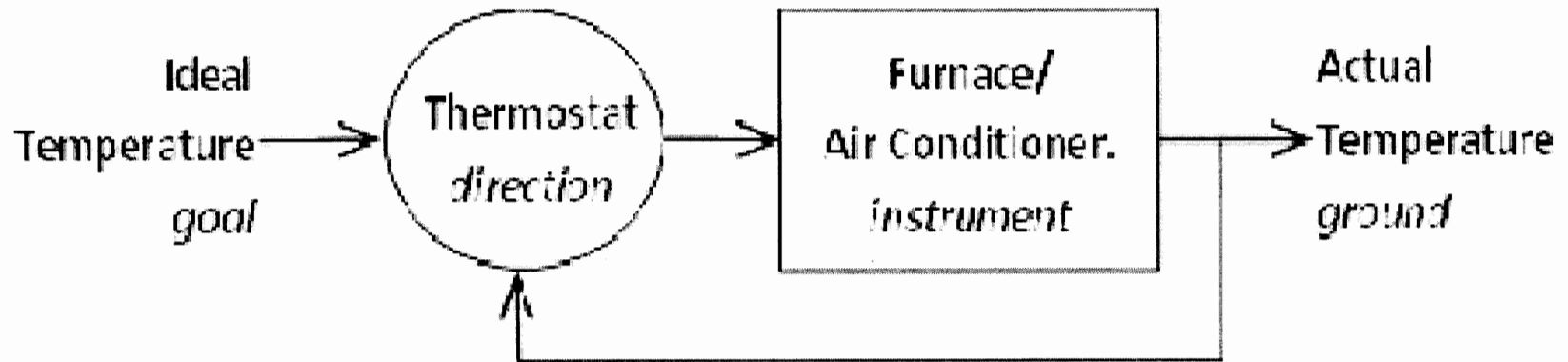
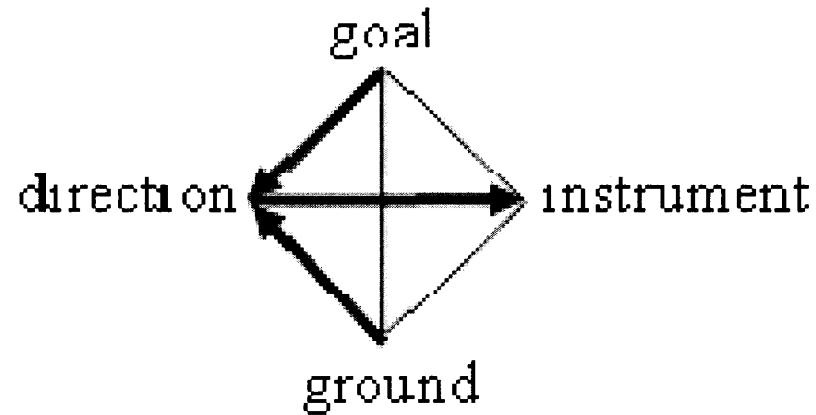


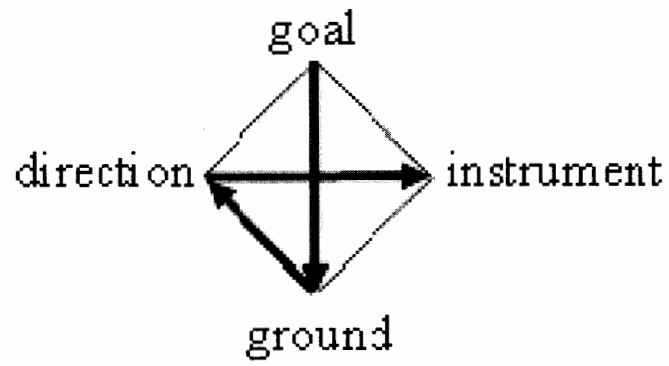
Figure 10 Thermostat system



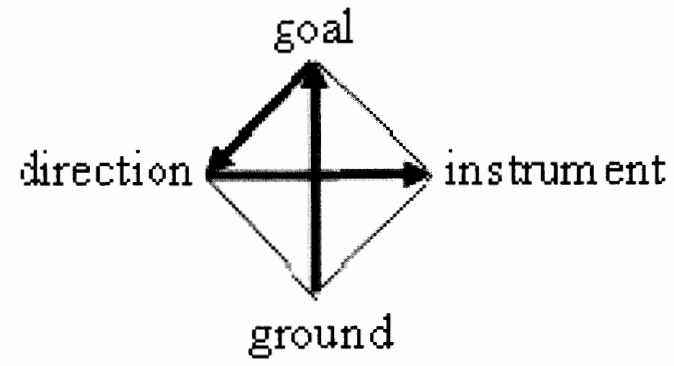
This system is named by its direction component.

- Introduction
- The Tetrad of Systematics
- Other Directed Tetrads; Applications
 - Leading parts
 - Lineal paths
- Summary
- Acknowledgement
- Bibliography

Figure 11 Control, problem solving



(a) Control

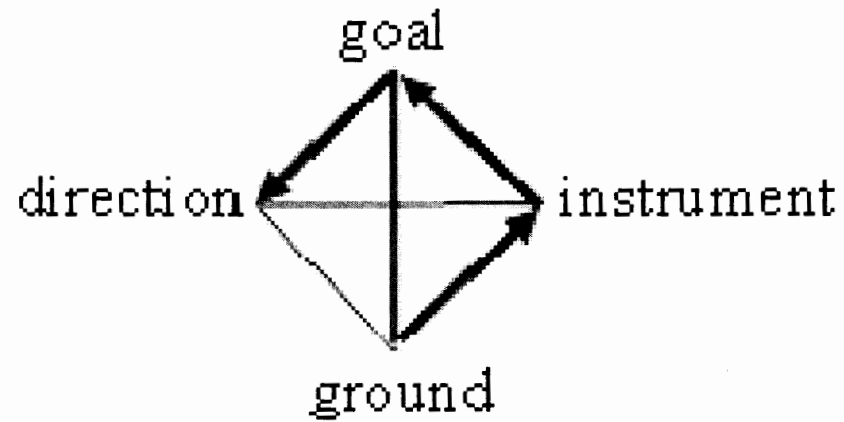


(b) Problem solving

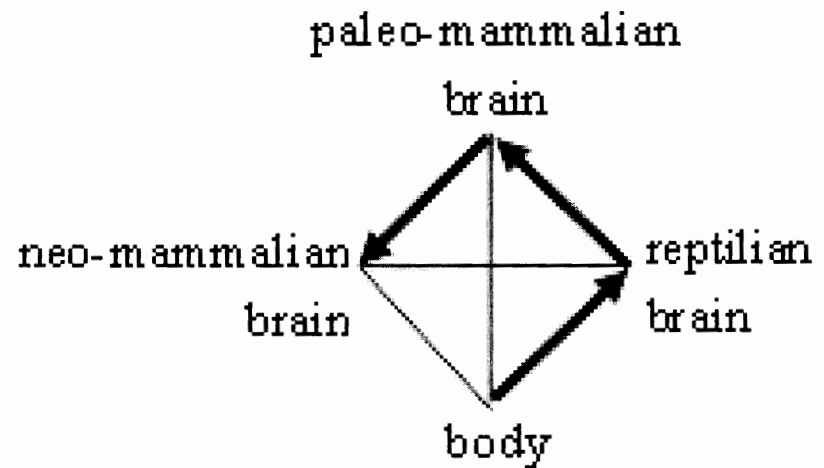
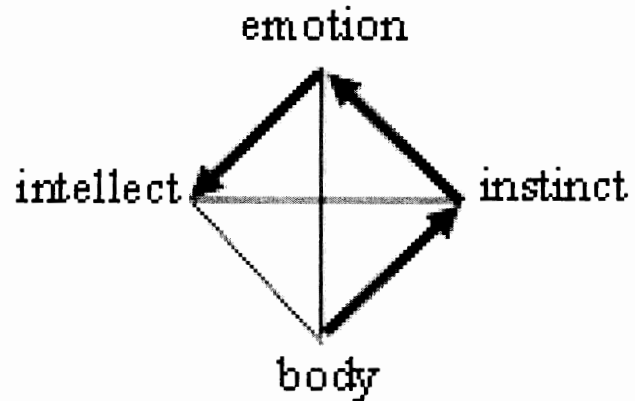
Table 6 Evolutionary genesis of control

Stages	
4. ground-instrument-goal-direction	Hunt & stick regulation with memory
3. ground-instrument-goal	Hunt & stick regulation
2. ground-instrument	Adaptation through natural selection
1. ground	--

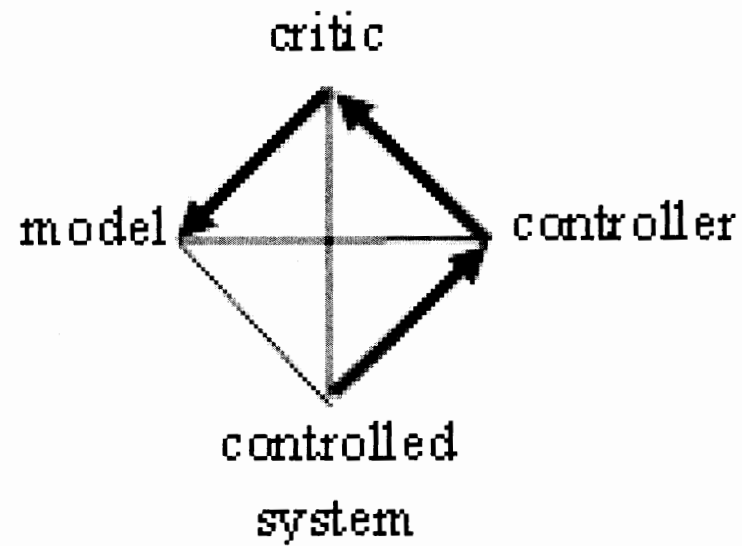
Figure 12 Genesis of control



Higher organisms; McLean's triune brain



Approximate Dynamic Programming (Lendaris)



Synchronic adaptive failure

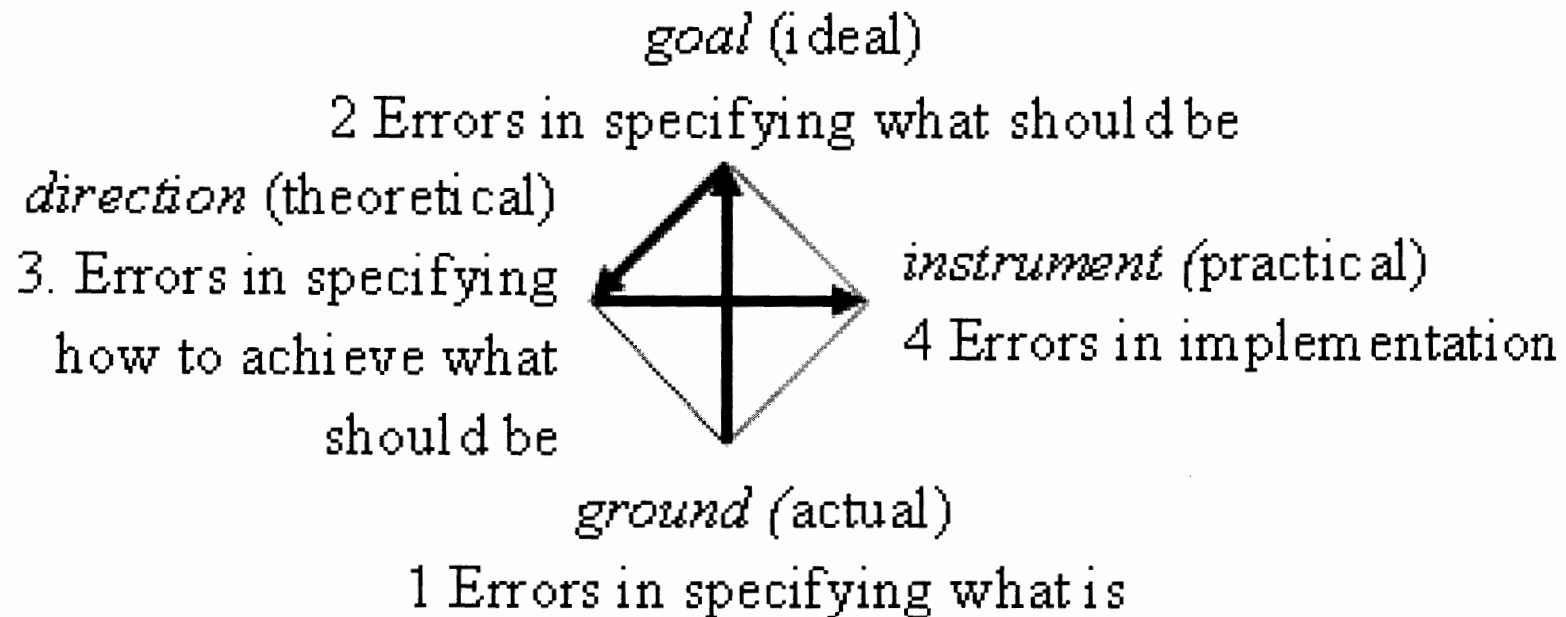
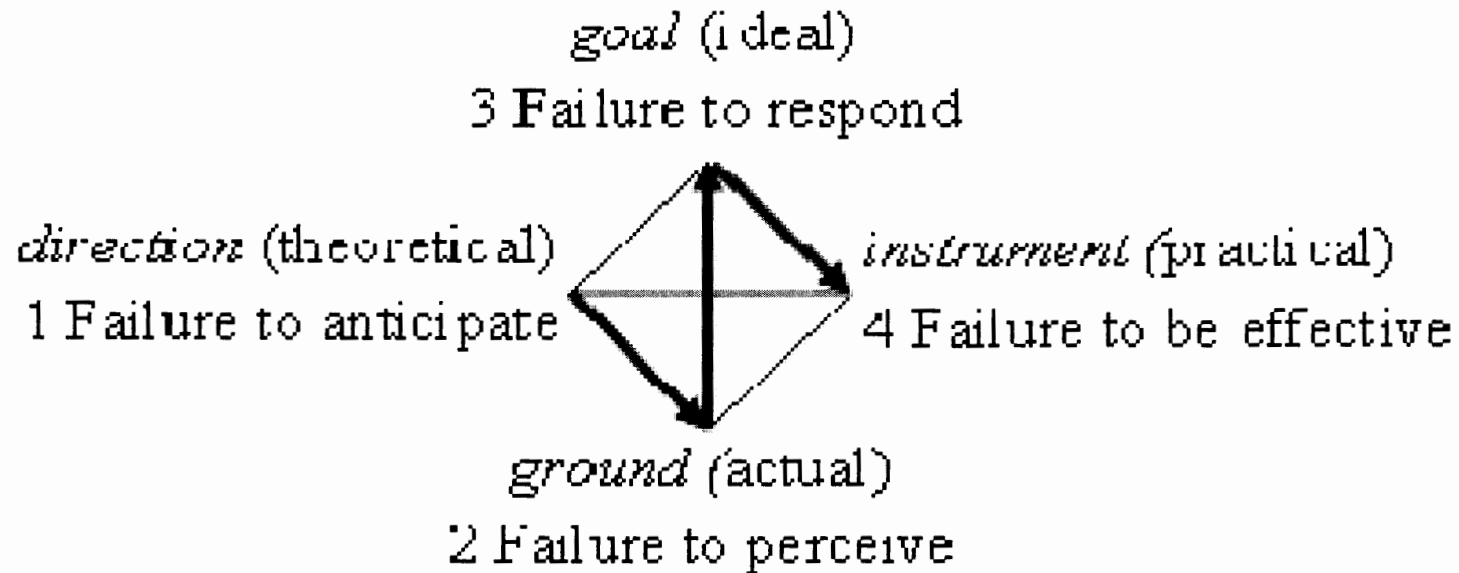


Figure 13 Diachronic adaptive failure (Diamond)



- Introduction
- The Tetrad of Systematics
- Other Directed Tetrads
- Summary
- Acknowledgement
- Bibliography

Acknowledgement

- This paper is a direct result of many stimulating discussions of the author with Anthony Blake; the author's debt to him is more extensive than citations can reflect.

Bibliography (1/2)

- **Arrow**, Kenneth J. (1950), "A Difficulty in the Concept of Social Welfare," *Journal Political Economy*, 58(4), 328–346.
- **Ashby**, W. Ross (1952). *Design for a Brain*. London: Chapman & Hall LTD.
- **Ashby**, W. Ross (1956). *An Introduction to Cybernetics*. London: Chapman & Hall LTD.
- **Bell**, Eric Temple (1986). *Men of Mathematics*. New York: Simon and Schuster.
- **Bennett**, John G. (1993). *Elementary Systematics*. Seamon, ed. Bennett Books, Santa Fe.
- **Bennett**, John G. (1956). *The Dramatic Universe: Vol. One: Foundations of Natural Philosophy*. London: Hodder & Stoughton.
- **Bennett**, John G. (1961). *The Dramatic Universe: Vol. Two: Foundations of Moral Philosophy*. London: Hodder & Stoughton.
- **Bennett**, John G. (1963). "Systematics and General Systems Theory," *Systematics*, 1(2).
<http://www.systematics.org/journal/vol1-2/GeneralSystems.htm>
- **Bennett**, John G. (1966). *The Dramatic Universe: Vol. Three: Man and His Nature*. London: Hodder & Stoughton.
- **Bennett**, John G. (1970). "Systematics and Systems Theories," *Systematics*, 7(4).
<http://www.systematics.org/journal/vol7-4/GST.htm>
- **von Bertalanffy** Ludwig. (1979). *General System Theory*, New York: George Braziller.
- **Blake**, Anthony (1997). "Systematics: A Method of Understanding Complex Wholes." Charles Town WV: DuVersity.
- **Blake**, Anthony (1998). "Systematics: A Method of the Intelligible." Charles Town WV: DuVersity Publications.
- **Blake**, Anthony (1999). "Three Essays on Systematics." Charles Town WV: DuVersity Publications.

Bibliography (2/2)

- **Diamond**, Jared (2005). *Collapse: How Societies Choose to Fail or Succeed*. New York: Viking.
- **Habermas**, Jürgen (1987). *The Theory of Communicative Action*. Vol. II: *Lifeworld and System*, T. McCarthy (trans.). Boston: Beacon.
- **Kauffman**, Stuart (1998). Talk at International Conference on Complex Systems, Nashua, Massachusetts, Oct 25-30. Also, https://www.edge.org/conversation/stuart_a_kauffman-the-adjacent-possible
- **Klir**, G. (1985). *The Architecture of Systems Problem Solving*. Plenum Press, New York.
- **Lendaris**, George G. & Neidhoefer, J.C. (2004). "Guidance in the Use of Adaptive Critics for Control." Chapter 4 in Si, Barto, Powel, & Wunsch, *Handbook of Learning and Approximate Dynamic Programming*, 97-124, New York: John Wiley IEEE Press.
- **MacLean**, Paul D. (1990). *The Triune Brain in Evolution: Role of Paleocerebral Functions*, New York: Plenum.
- **Miller**, James G. (1965). "Living Systems: Cross-Level Hypotheses." *Behavioral Science*, vol. 10, no. 3, p. 394. See also p. 358. Also same hypothesis number cited in p.297 of "The Nature of Living Systems," *Behavioral Science* 16, 277-301 (1971); also *Basic Concepts*, p.193: matter, energy, information, meaning.
- **von Neumann**, John & Morgenstern, Oskar (1944). *Theory of Games and Economic Behavior*. New York: Wiley.
- **Ozbekhan**, Hasan (1971). "Planning and Human Action." In Paul Weiss, ed., *Hierarchically Organized Systems in Theory and Practice*, Hafner, New York, pp. 123-230.
- **Parsons**, Talcott (1966). *Societies: Evolutionary and Comparative Perspectives*. Englewood Cliffs New Jersey: Prentice-Hall, 5-29.
- **Parsons**, Talcott (1971). *The Systems of Modern Societies*. Englewood Cliffs New Jersey: Prentice-Hall.
- **Peirce**, Charles S. (1868). "On a New List of Categories." *Proceedings of the American Academy of Arts and Sciences*, 7.
- **Shannon**, Claude & Weaver, Warren (1949). *Mathematical Theory of Communication*. University of Illinois Press, Urbana.