Cybernetics in a Laboratory Context

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Overview: A Rationale for Cybernetics

This document provides a rationale for Cybernetics as the core of an experimental Laboratory (L4C). It reviews the origins, intentions, and future implications for Cybernetics, including as a direct response to "wicked challenges." With grounding and guidance from history, L4C brings the past of Cybernetics into the complex present, braids it with the mainstream of "systems thinking" and "wicked problems", and articulates our necessary actions, if our shared desires for a sustainable future are to be respected and attained.

Cybernetics affords a bilingual synthesis across the analog and digital, the organic and artificial, as well as across the natural, technological, and social. Cybernetics spans all of these because it is grounded in the role of *information as feedback to effective action*. It explains how a system *may achieve its purpose* as well as *define* its own purpose. Furthermore, as a co-consequence of its focus on purpose, Cybernetics uniquely requires *reflection* by participant-observers, who are responsible for articulating *why they explain the purpose* of a system in one way rather than another. This responsibility is appropriate to the ambiguous, unpredictable, and simply unknowable situations that arise from entanglements bridging natural, technological, and social configurations in the 21st century. The facility by which Cybernetics models complex adaptive systems, and the reflexive responsibility for explanations and consequent actions, begins to explain how and why Cybernetics is so well suited to the choreography of designing[1] for wicked challenges.

The Laboratory for Cybernetics (L4C) is further explored in these additional documents & links within:

a. *Guide to L4C Ecosystem* | *Re-Braiding Cybernetics & AI*
b. *Definition of the Laboratory* | *Description of the Lab's Course*

[1] This owes homage to the phrase "choreography of agency", originated by Andrew Pickering in *Acting with the World: Agency in the Anthropocene*, Duke University Press, 2025.

Recognition of the New Relevancies of Cybernetics

The rationale above offers myriad reasons why Cybernetics is relevant today. One example of its application is the #NewMacy Initiative, which in 2020 at the onset of the COVID-19 pandemic recognized Cybernetics as a foundation for approaching the global pandemics across biology and technology, racism and inequality, environment and economics (read more below). That initiative has offered methods for the local formation of L4C but there are many scholars and practitioners who recognize the new relevancies of Cybernetics.

Here are just a few examples:

1. In science fiction author Bruce Sterling's 46-minute video, Futures of Cybernetics (2024), he speculates on the possible resurgence of Cybernetics and proposes forming a group to explore it from specific futurist exercises.
2. Sociologist and historian of science Andrew Pickering's recent book, Acting with the World: Agency in the Anthropocene (2025) calls for approaching large-scale challenges created by the errors of the Anthropocene with a cybernetic ontology of acting in the face of unknowability.
3. Pickering's prior book, The Cybernetic Brain: Sketches of Another Future (2010) ends with a proposal to bring Cybernetics to education, in part by discussing artifacts from its history, and overall to inculcate principles that would be valuable in design methods across architecture and other major fields.
4. Just one example of the rise of Cybernetics in research practice, Neo Cybernetic Crew (on-going) based in Rome speaks of "the global revival of issues dear to cybernetics" and is committed to rethinking specific cybernetic themes, such as living systems, feedback loops, and organic/inorganic hybrids.
5. Just one example of the rise of Cybernetics in art practice, Angelina Kozhevnikova with Animaspace (on-going) based in Rotterdam challenges the dominant AI computational frames by crafting open-ended interactive systems that rethink autonomy, agency, and control.

L4C supports the efforts of scholars and researchers, practitioners and artists, technologists and designers who also embrace Cybernetics for its future-focused values and value.

Cybernetics—Origins, Intentions, Epistemology

The Central Role of Purpose

Emerging from conversations across the hard and soft sciences beginning in the 1940s, the trans-discipline of Cybernetics is unique in approaching complex adaptive systems of any makeup from the perspectives of *purpose*—the purpose attributed *to* the system and the purpose *of those who are responsible* for articulating the system's purpose. Cybernetics is unique because it *demands* both humane-based *explanations* for how systems behave as well

as *responsibility* for our own behavior in how we encounter, delimit, explain, and interact with those systems.

Steering

The term “Cybernetics” emerged from its Greek root *kubernetes* that means “to steer”, as in piloting a ship. The modern term “Cybernetics” encompasses the nuance of “the art of steering”, meaning *to achieve one's intention through action*, even while the intention or goal may be evolving.

Information & Feedback

A core principle of Cybernetics is how *information* is used as feedback to correct actions. The result is a “feedback loop”—from goal to action, to sensing the result of that action, to again comparing to goal, then to further action to achieve the goal. This is fundamental to any “intelligent” system, that is, any system that has a purpose and takes actions that are effective in achieving that purpose—or at least comes close enough to that purpose to maintain its identity. Rigorous understanding of the principle of feedback is one of the core contributions of Cybernetics.

Transdisciplinarity

The universality of feedback and the appeal of thinking of systems as having purpose inspired an extra-ordinary degree of interest across the spectrums of abstract and applied disciplines. Scholars and researchers from dozens of fields became engaged from the inception of Cybernetics in the 1940s. Conversations took place across the hard and soft sciences as well as across the nascent fields of information theory and computer engineering. Here is a partial list of disciplines of scholars who were actively engaged in conversations about Cybernetics beginning in the 1940s: physiology, neurophysiology, chemistry, biology, biophysics, physics, zoology, anthropology, sociology, linguistics, philosophy, psychiatry, mathematics, electrical engineering.

Misunderstandings

It is important to address the mis-construal of “Cybernetics” as no more than robotics, or AI, or biomechatronics, or brain-computer interfaces… or control of machines or human beings… not to mention cyber-space, cyber-punk, cyber-security, and more. Cybernetics may touch on these but the foundation is purpose and steering, information as feedback, and the responsibility that arises from examining the purpose of our purpose as participant-observers.

The prefix “cyber” was appropriated from its original use in “Cybernetics” as a short-hand for something steeped in anything from robots and cyborgs—there it is again—to the Internet and any technology. This can make sense for two reasons:

1. The existence of feedback loops in systems of any makeup: technical, environmental, biological, social
2. The ability of Cybernetics to bridge both the analog and digital world.

First major book on Cybernetics—Bridging "animal and machine"

Many have heard of *Cybernetics*, Wiener's widely influential book from 1948[2], coming at the dawn of the digital age and a rich era of research on the functioning of neurons in the brain.

Wiener's subtitle is also important: "control and communication in the animal and the machine." By "animal and machine", Wiener intended to emphasize that both animals and machines could be seen as having capabilities in common—specifically, both were concerned with "communication and control." But these terms need qualification and context.

By *communication* Wiener meant signals of information moving across systems, but he also meant information returning to a system that had already acted, affording "feedback" (see mention above) of the consequences of that action. From this, the system could take corrective action in order to *control* some aspect of its environment in a manner specific to its goals. So, Wiener's subtitle contains the essences of Cybernetics as a new field, unlike any that came before, that encompassed information and feedback, effective actions and goals.

Part of the revolution here is the de-emphasis of the *material* aspects of systems—what they are made of—whether biological/organic/analog, electronic/digital, social/linguistic, etc. Information, feedback, and goals are *immaterial* aspects of systems[3], here in Cybernetics recognized as a framing for a new science that crosses the boundaries of conventional disciplines. This explains, in part, the deep influence that Cybernetics had across the wide range of disciplines mentioned above.

In sum, Cybernetics originated from the bridging of analog, organic systems, including nervous systems, linguistic, and social systems—as well as technical systems, including mechanical, electrical, electronic, and digital systems. Thus, Cybernetics bridged the hard and soft sciences and influenced them for generations. Cybernetics can offer both quantitative and qualitative models—measures in feedback loops from which simulations, anticipations, and predictions can be made. It also encompasses or frames systems in which different vocabularies or language have priority, where forefronting different values—economics vs. efficiency; responsibility vs. ethics—has consequences for *building understanding* and for *taking effective action in cooperative groups*.

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[2] Wiener, Norbert: *Cybernetics or control and communication in the animal and the machine*, John Wiley & Sons, New York, 1948.
[3] Ross Ashby went so far as to say, "the materiality is irrelevant", p3, Ashby, W. R. An introduction to cybernetics. John Wiley & Sons, New York, 1956.

First major conferences on Cybernetics—Bridging all disciplines

But it must be emphasized that Wiener was not the only major force in the founding of Cybernetics. There were a series of 10 meetings with participating scholars across the hard and soft sciences (per the list in Transdisciplinarity, above). These small-group conversations were funded by a non-profit in New York City called the Josiah Macy Jr Foundation, and the "Macy Meetings" in Cybernetics, as they came to be called, were responsible for beginning the spread of Cybernetics into those disciplines and causing re-evaluations of the nature of purpose and information across the scientific landscape. The Macy Meetings from 1945 through 1953 established "transdisciplinarity" as table stakes, that is, a staple or a requirement, for structuring of research and practice, though it can be argued that it took until the 21st century for "interdisciplinarity" to be broadly popular in academia and ultimately business practice. (To be clear, it is the full journey to the prefix "trans" that brings the necessary richness that expresses the contribution of Cybernetics; see comparison to multidisciplinary and interdisciplinary from E. Jantsch).

21st-century Cybernetics

Relating Cybernetics, Design, and Wicked Problems[4]

"... Cybernetics is a necessary foundation for twenty-first century design practice:

- If design, then systems: Due in part to the rise of computing technology and its role in human communications, the domain of design has expanded from giving form to creating systems that support human interactions; thus, systems literacy becomes a necessary foundation for design.

- If systems, then cybernetics: Interaction involves goals, feedback, and learning, the science of which is cybernetics.

- If cybernetics, then second-order cybernetics: Framing wicked problems requires making explicit one's values and viewpoints, accompanied by the responsibility to justify them with explicit arguments; this incorporates subjectivity and the epistemology of second-order cybernetics.

- If second-order cybernetics, then conversation: Design grounded in argumentation requires conversations so that participants may understand, agree, and collaborate on effective action – that is, participants in a design conversation learn together in order to act together. The authors see cybernetics as a way of framing both the process of designing and the things being designed – both means and ends – not only design-as-conversation but also design-for-conversation. Second-order cybernetics frames design as conversation, and they explicitly frame 'second-order design' as creating possibilities for others to have conversations."

[4] Dubberly, H. & Pangaro, P., "Cybernetics and Design: Conversations for Action", in Fischer, T., Herr, C. (eds) *Design Cybernetics. Design Research Foundations*, Springer, 2019, https://doi.org/10.1007/978-3-030-18557-2_4.

Bridging analog and (modern) digital systems

COVID-19 landed in March 2020, causing recognition not only of that particular biological pandemic but the universal spread of a range of wicked challenges, such as climate change, social justice, and artificial intelligence. Evoking Cybernetics and the demands of a trans-disciplinary attack on these global issues—what could Cybernetics offer? But also, what has changed since the transdisciplinary explorations in Cybernetics that were the Macy Meetings from the 1940s and 1950s? So, what revision would a revisiting of the Macy Meetings require? In addition to trans-disciplinary, we would need:

- trans-geographical = recognizing the historical grounding in Western, Caucasian, mostly male scholarly traditions, to expand to global reach, to trans-cultural viewpoints

- trans-generational = acknowledging the critical need for and challenges in bridging the differences in education, culture, social conventions, and learning methods across the age generations

Hence, #NewMacy emerged. Today's techno-cultural emphasis is on *the digital*—the binary logic of computers which has been dominated by a Western worldview of logic, severely reducing possibilities. In the adaptation of binary logic and binary representation, to say it ironically, there are "too many zeros, too many ones"—"Experience will not be digitized!"—we are analog, organic, biological creatures, not ruled by digital logic—and simulating the analog or the blurry or the grey between black and white may not suffice. Limited logic limits our conversations, our possibilities, and our futures.

This blog post contains the essence of the argument, which is elaborated in this deeper dive, both of which are built on top of the #NewMacy Manifesto.

Continuing

The content and rationale of this document will continue to evolve, always in support of explaining Cybernetics and representing its value as a foundation for an experimental laboratory on a university campus, serving students from all disciplines.

Further Materials

This section contains a skeletal list of resources to be extended over time.

Cybernetics

- Introductory Videos: Basics of Cybernetics
- Cybernetics—Getting Started Guide: Webpage and links to further materials

- Talking about The Future of Cybernetics: 20min video presentation, Paul Pangaro (see also related blog post)
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Cybernetics & Design

- Dubberly, H. & Pangaro, P., “Cybernetics and Design: Conversations for Action”, in Fischer, T., Herr, C. (eds) *Design Cybernetics. Design Research Foundations*, Springer, 2019, https://doi.org/10.1007/978-3-030-18557-2_4.
- Sweeting, Ben, “Wicked problems in design and ethics”, in Jones, P. H. & Kijima, K. (eds), *Systemic design: Theory, methods, and practice* (pp. 119-143), Springer, Tokyo Japan, 2018. DOI: 10.1007/978-4-431-55639-8
- Pickering, Andrew, *Acting with the World: Agency in the Anthropocene*, Duke University Press, 2025.
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#NewMacy Topics

- Responding to the Pandemic of ‘Today’s AI’: Blogpost with further links
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