

Designing Ethical Interfaces

pangaro.com/ethics2019/

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Ethics for Technologists Series

Carnegie Mellon University

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Designing Ethical Interfaces

Organizing Principle

“I shall act always...”

Designing Ethical Interfaces

Organizing Principle

“I shall act always so as to increase...”

Designing Ethical Interfaces

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“I shall act always so as to increase the total number of choices.”

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— Heinz von Foerster

Click for PDF of “Ethics and Second-Order Cybernetics”, 1991

Designing Ethical Interfaces

Organizing Principle

“I shall act always so as to increase the total number of choices.”

— **Ethical Imperative**, Heinz von Foerster

Click for PDF of “Ethics and Second-Order Cybernetics”, 1991

Designing Ethical Interfaces

Ethical Interfaces — Axiom #1

“As a designer, I shall act always so as to increase the total number of choices for a user.”

— Ethical Imperative, Interaction Designers

What the hell does this mean? How do we do this?

Interface Quandry #1

a. Recommendation Engines

***Recommendations are based on who the user **was**
— recommendations are based on the **past**.***

At worst, the interface presumes a **non-evolving, non-living user**.

Interface Quandry #1

b. Search Engines

***Search results are based on who the user **was**
– search results are grounded in the **past**.***

Search results are “of the past” – they are “dead on arrival.”

Interface Quandry #1

Recommendations & Search Results = Looking Backward

These engines deliver outcomes based on the **past** — treating us as we **used to be**, as if we are **dead**.

Questions are alive — questions are “of the now”.

How would a user manifest as *alive* in these interactions?

I. Treat Users as Alive & Evolving

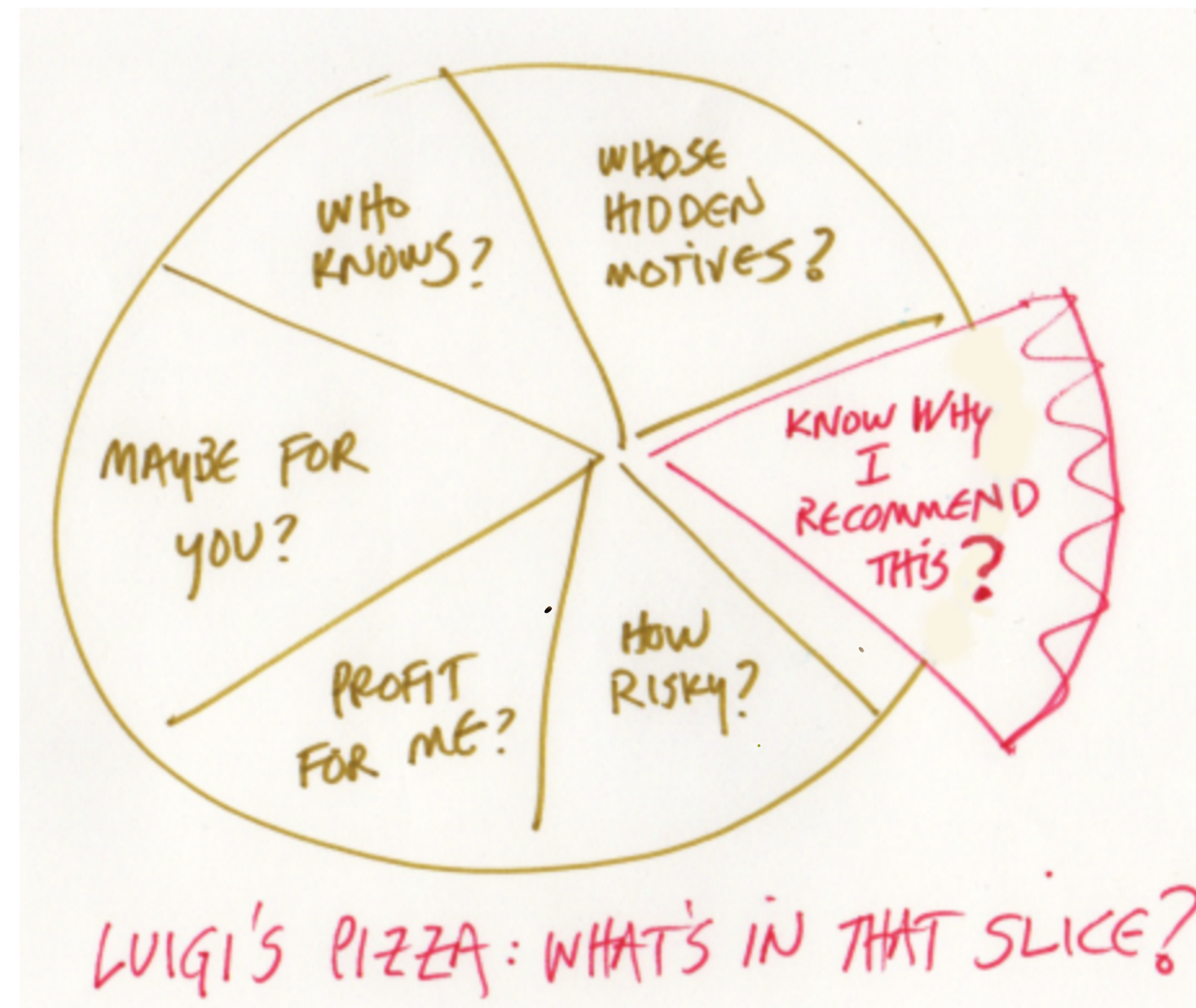
Design Prototype #1: Build Question Engines

*Compute relevant questions that invite a **generative conversation** such that novel, forward-seeing choices may be explored.*

Designing Ethical Interfaces

Interface Quandry #2

Luigi's Pizza — A Parable



[Click for more about Luigi's Pizza](#)

II. Give Users Agency Equal to the Algorithm

Design Prototype #2 — Universal Dialog UI

Always incorporate a **dialogical interface** so that a user can question the computed offering of any recommendation or result.

“Why did you recommend that? Where did that result come from?”

“Did you consider this (objective) factor or this (subjective) concern?”

III. Guide Users to Valuable Conversations

Design Prototype #3 — “Intelligent Conversation” Metric

Implement a heuristic to evaluate a conversation in terms of its intelligence and value, in order to draw human attention to generative interactions.

In contrast to the “Turing Test, let’s build a “Turning Test.”

[Click for more](#)

Designing Ethical Interfaces

Design & Prototyping – Research Questions

#1. Question Engine – Do users evolve better understanding?

#2. Universal Dialog UI – Do users increase their agency?

#3. Turning Test – Do users improve their focus of attention?

Designing Ethical Interfaces

How do we do better at Interaction Design? I propose we:

- *apply models of human conversation*
- *strive for interfaces that are cooperative, ethical, humane*
- *push for new forms of conversational interfaces.*

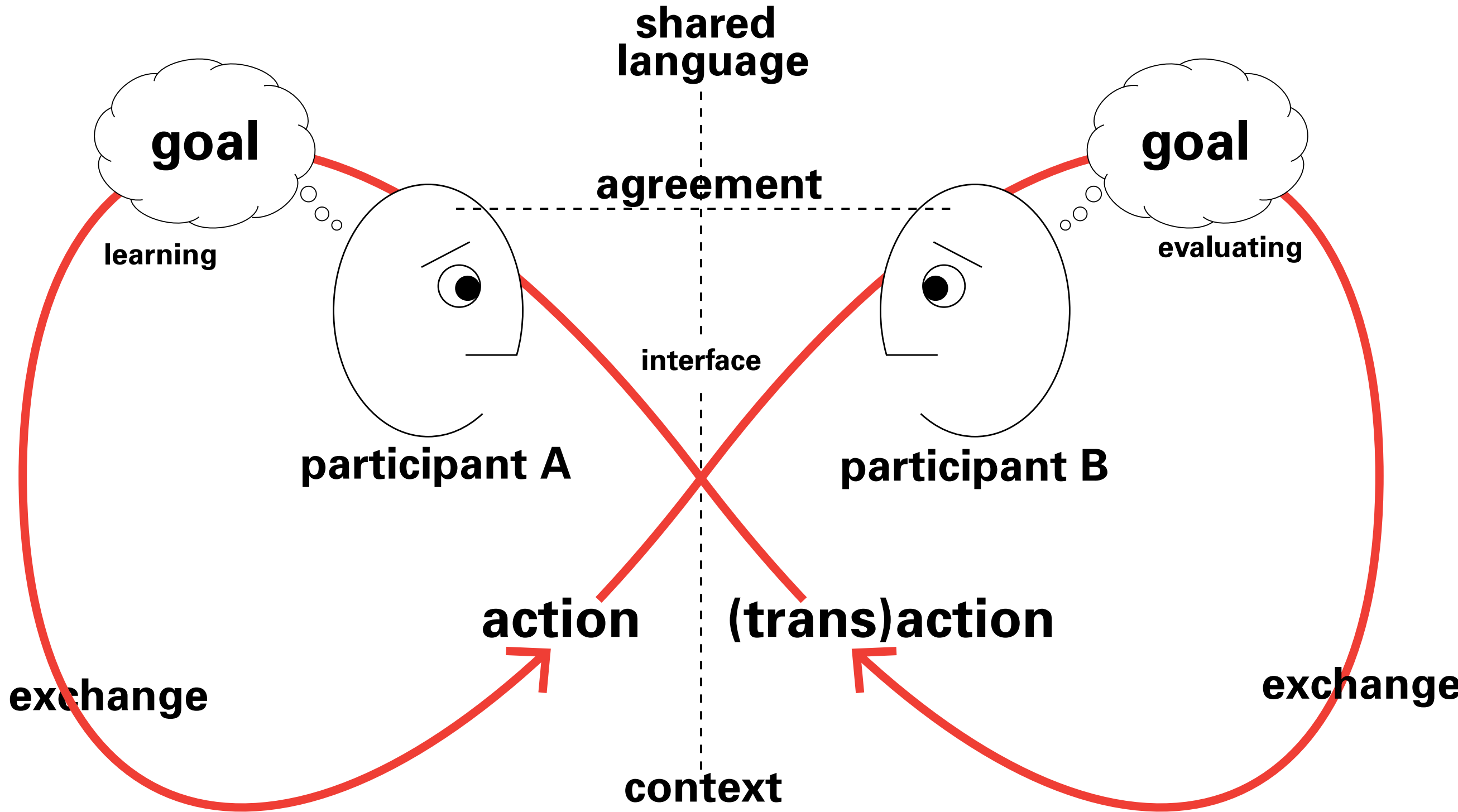
These are the offers in my presentation today.

Designing Ethical Interfaces

Alexa, can you please acquire the skill of conversation?

Alexa, what is “conversation”?

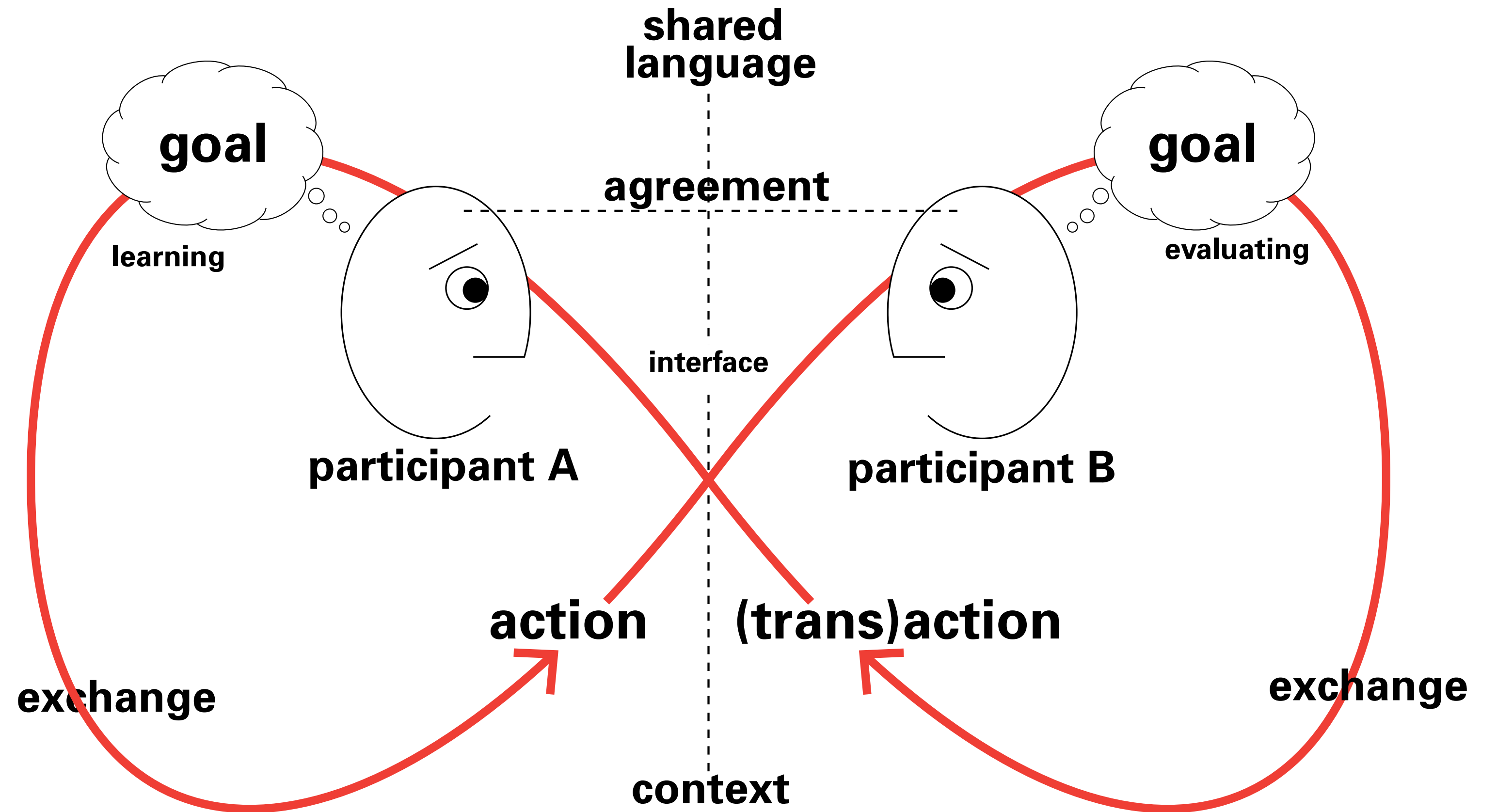
Conversation Model



See also Pangaro: Economy of Insight

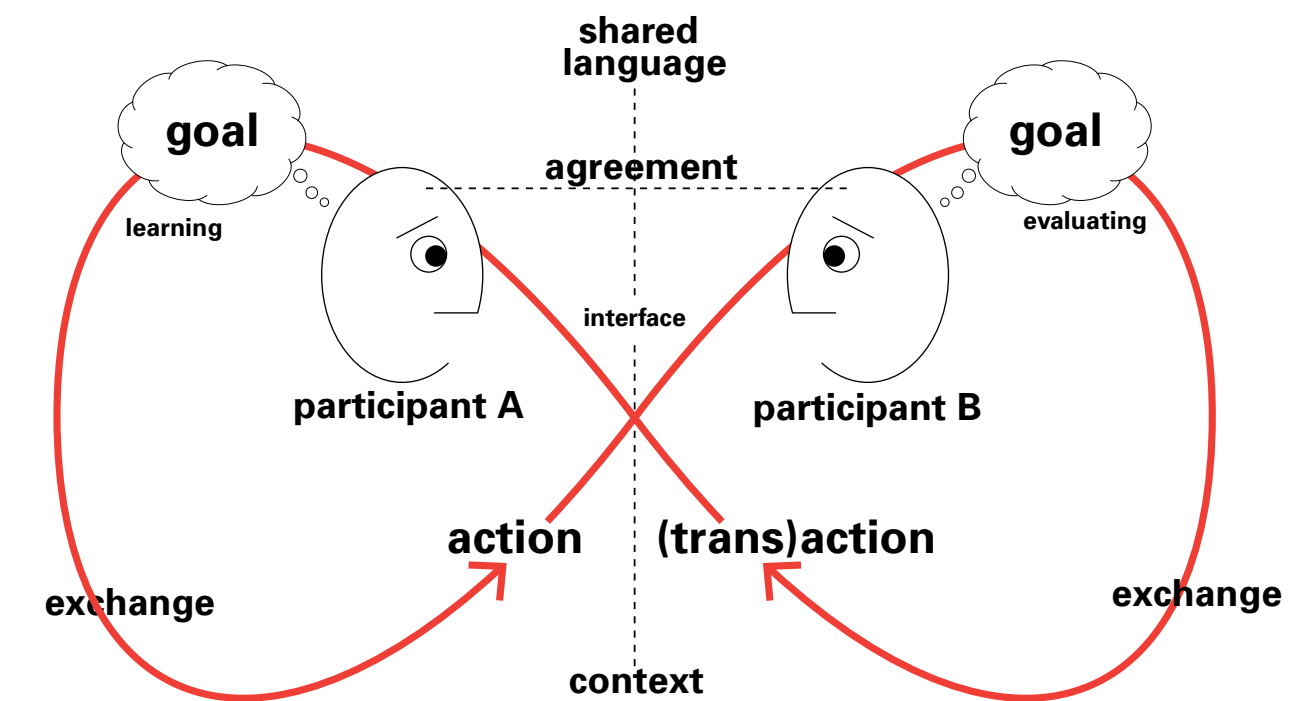
Conversation Model – C-L-E-A-T

C – Context
L – Language
E – Engagement
A – Agreement
T – (Trans)Action



Types of Conversation

What is an **effective** conversation?



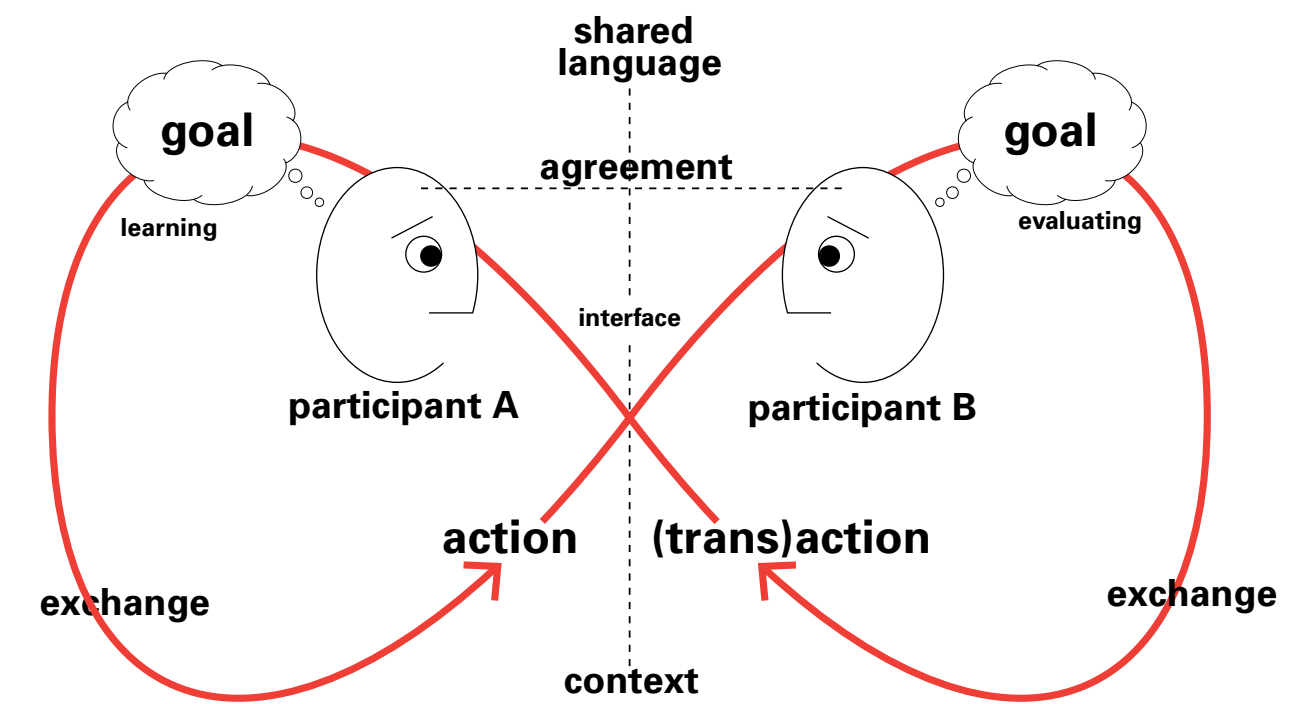
A conversation in which something changes* and brings (lasting) value to one or more participants.

*changes may be informational, transactional, rational, emotional...

Click for “What is conversation? Can we design for effective conversation?” – Dubberly and Pangaro, 2009

Matters of Conversation

Why does conversation matter?

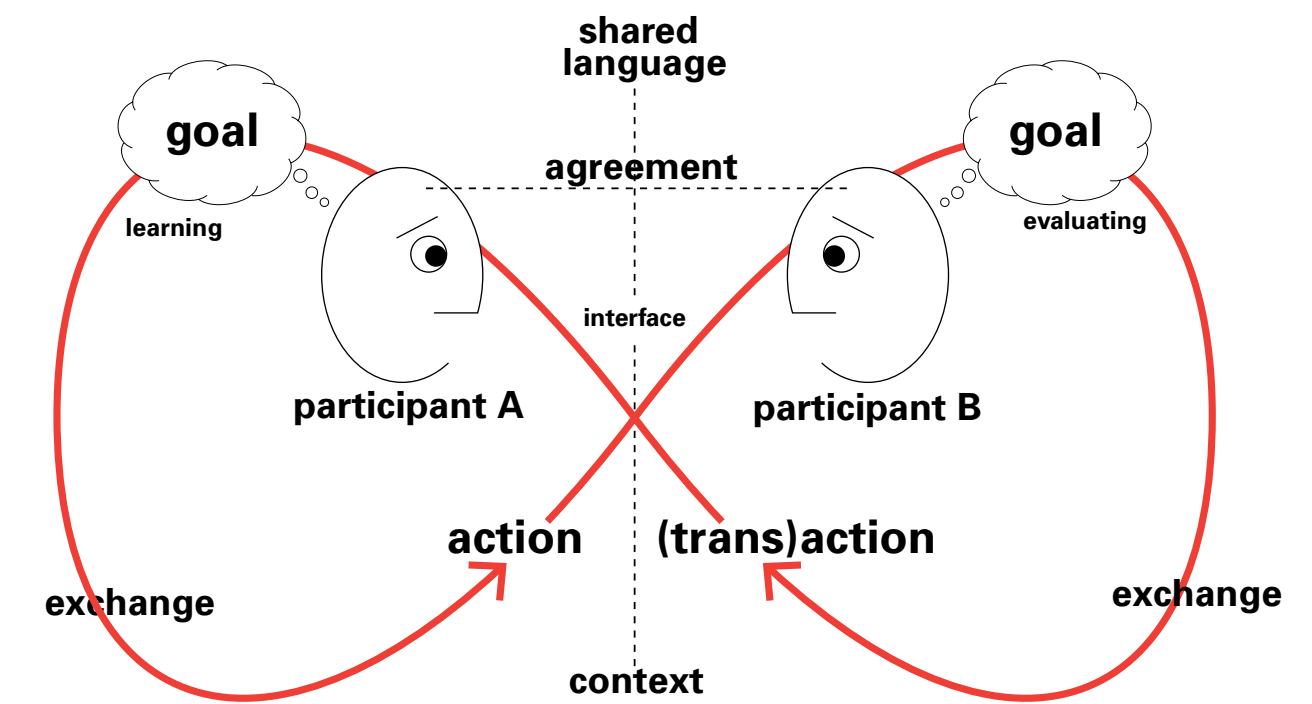


- *to act together, we must reach agreement*
- *to reach agreement, we must have an exchange*
- *to hold an exchange, we must have shared language.*

To cooperate and collaborate requires conversation.

Benefits of Conversation

What may follow from conversation?

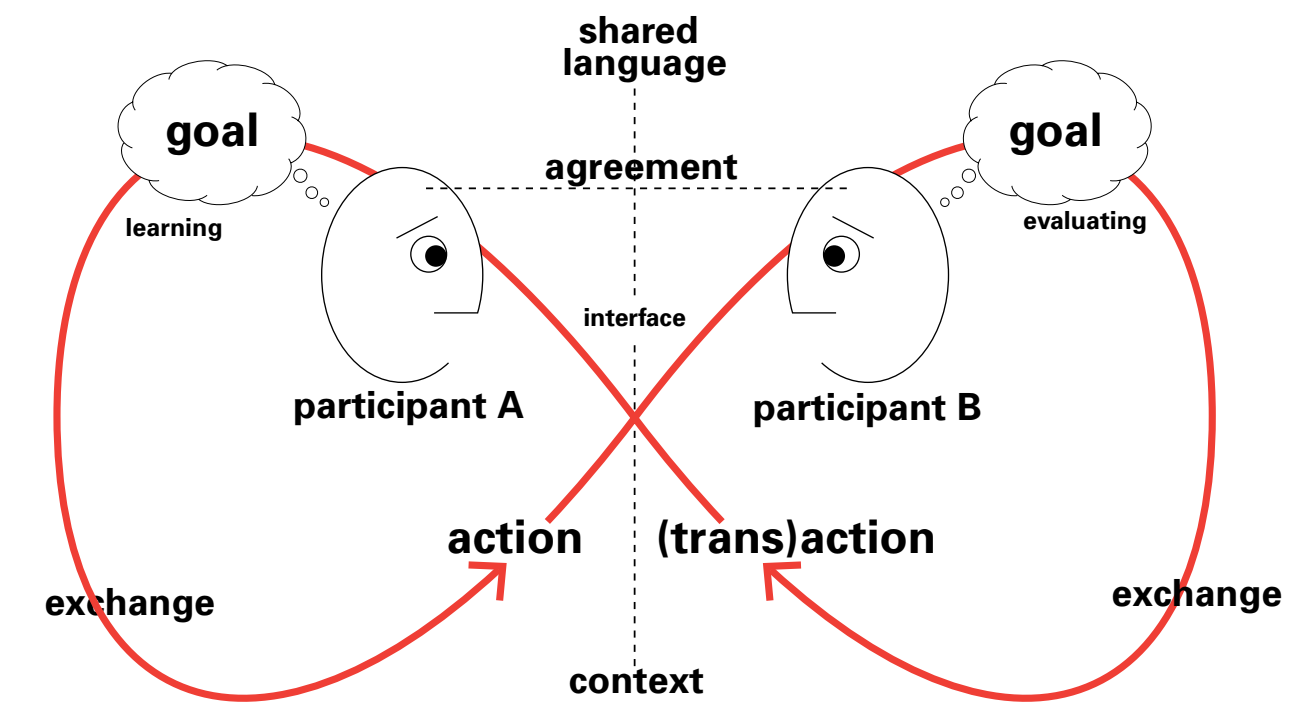


- *shared history*
- *relationship*
- *trust*
- *respect*
- *unity.*

All these require conversation.

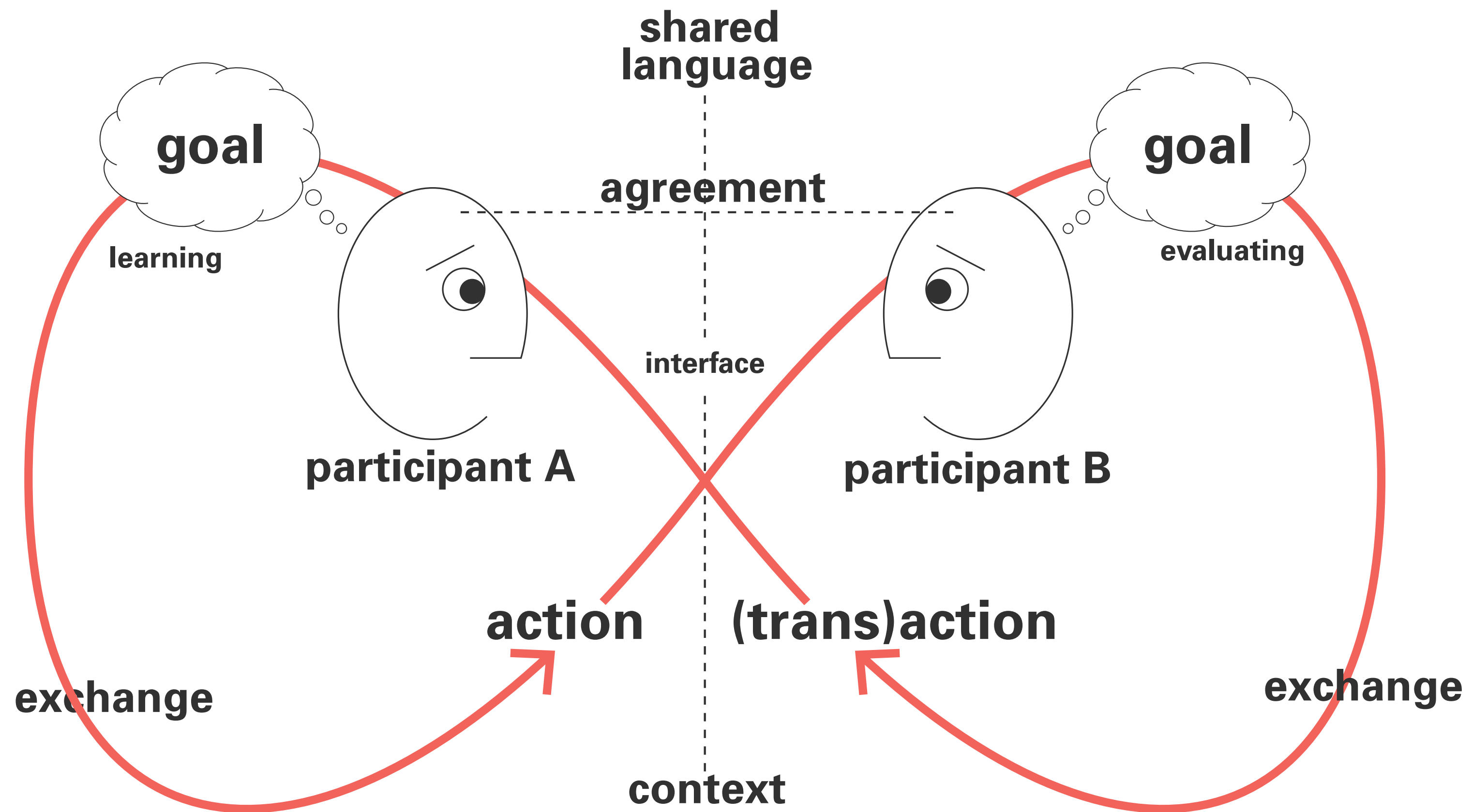
Benefits of Conversation

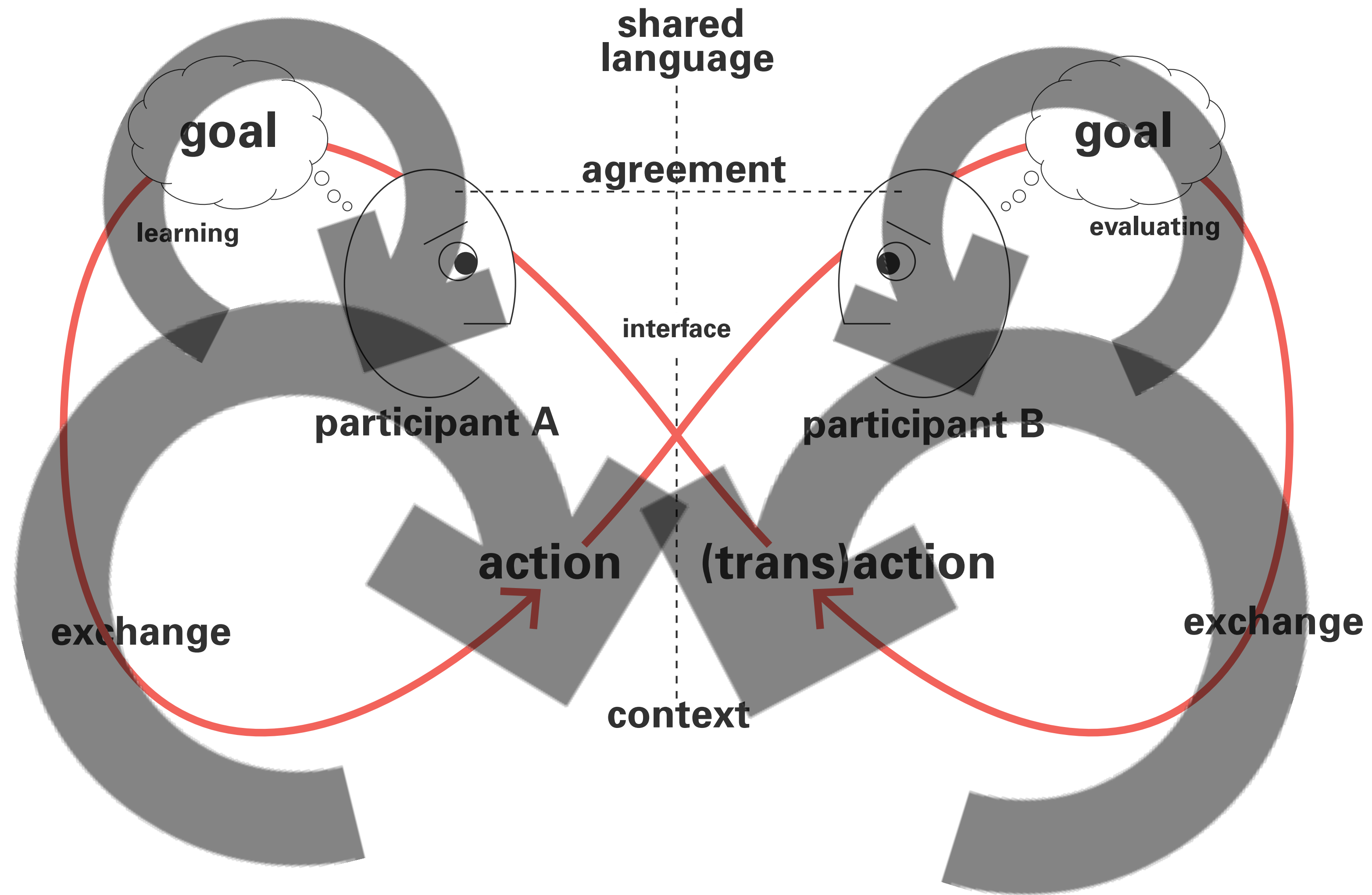
What does conversation enable?



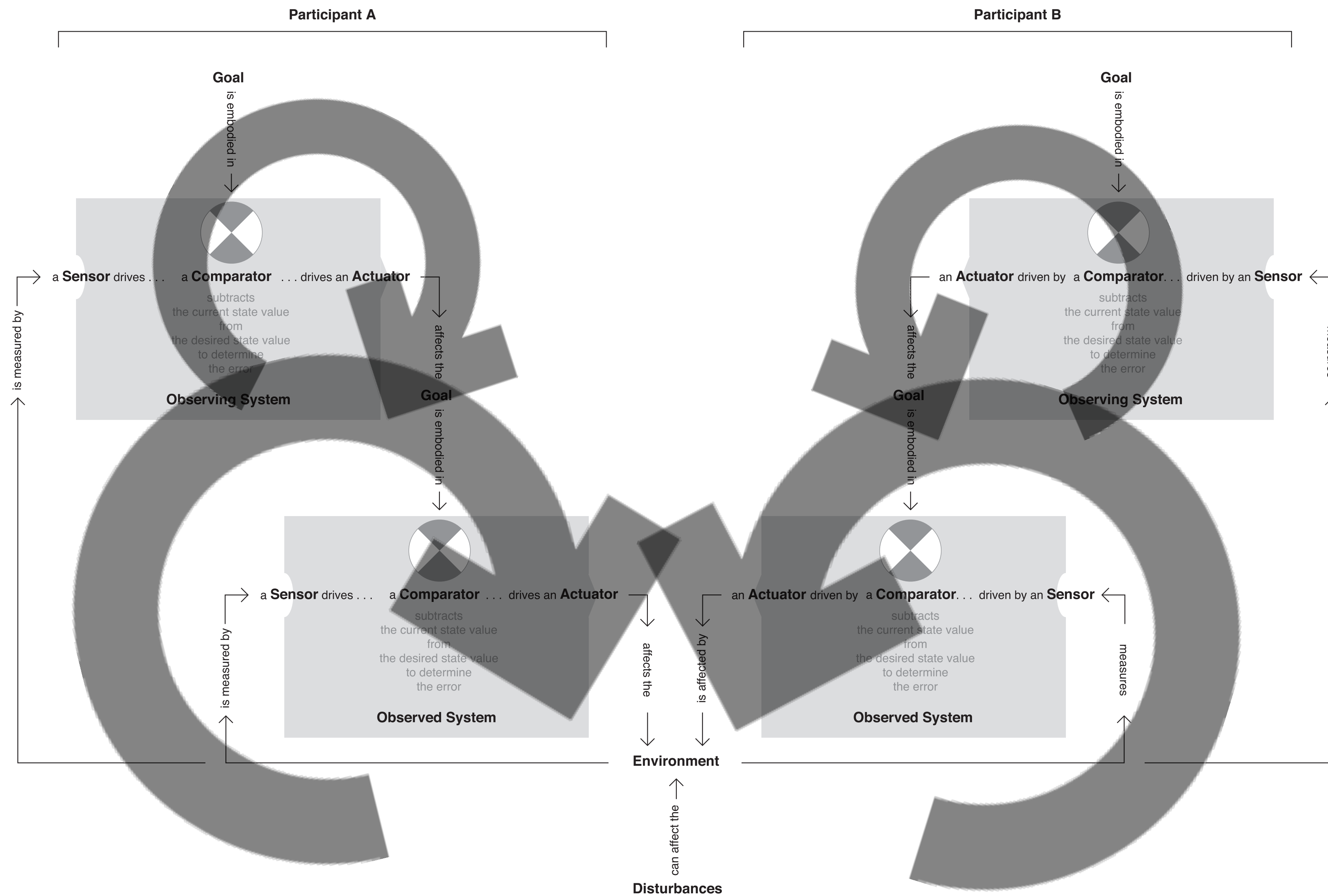
- *community*
- *commerce*
- *culture*
- *government*
- *society.*

All these **demand** conversation.

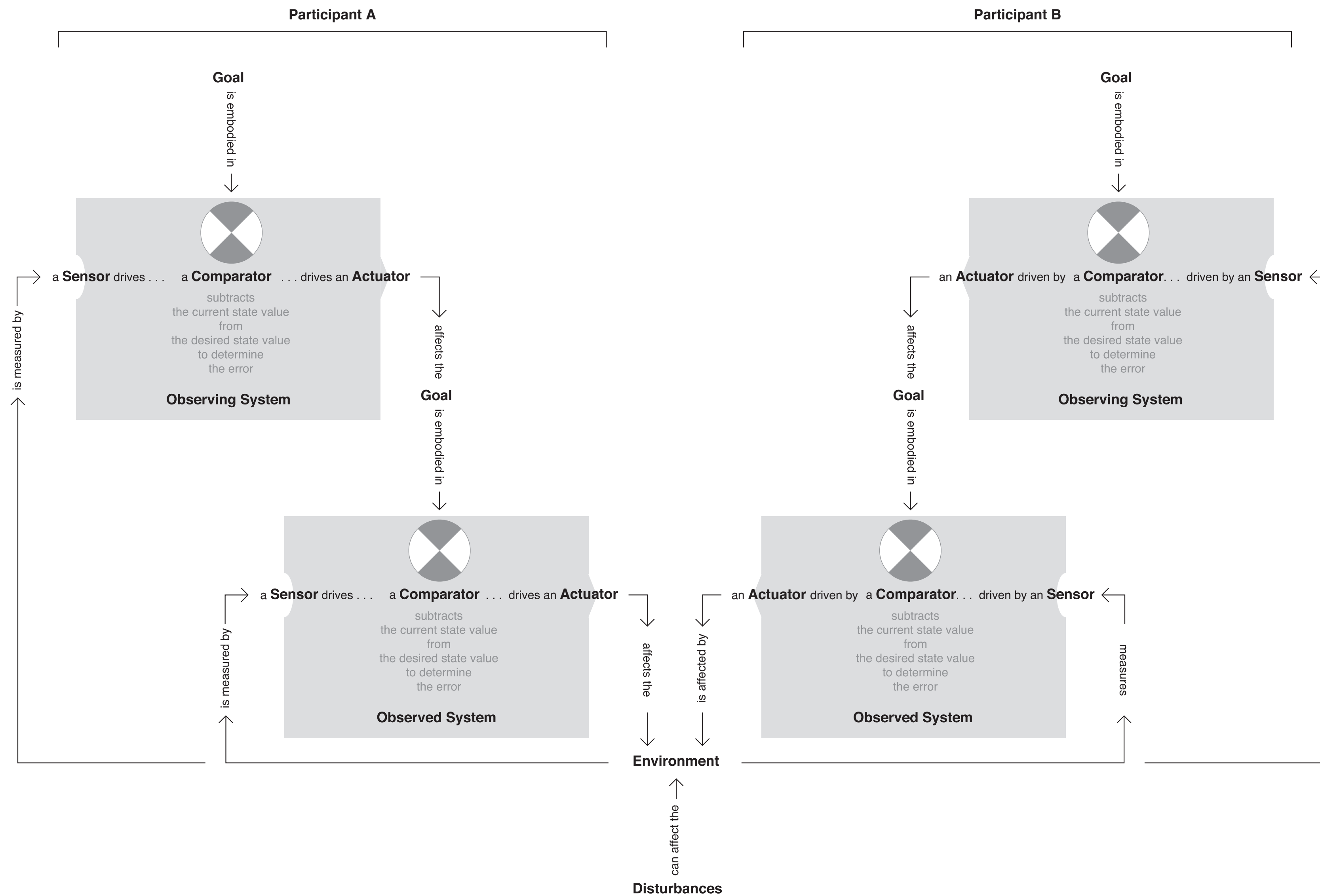




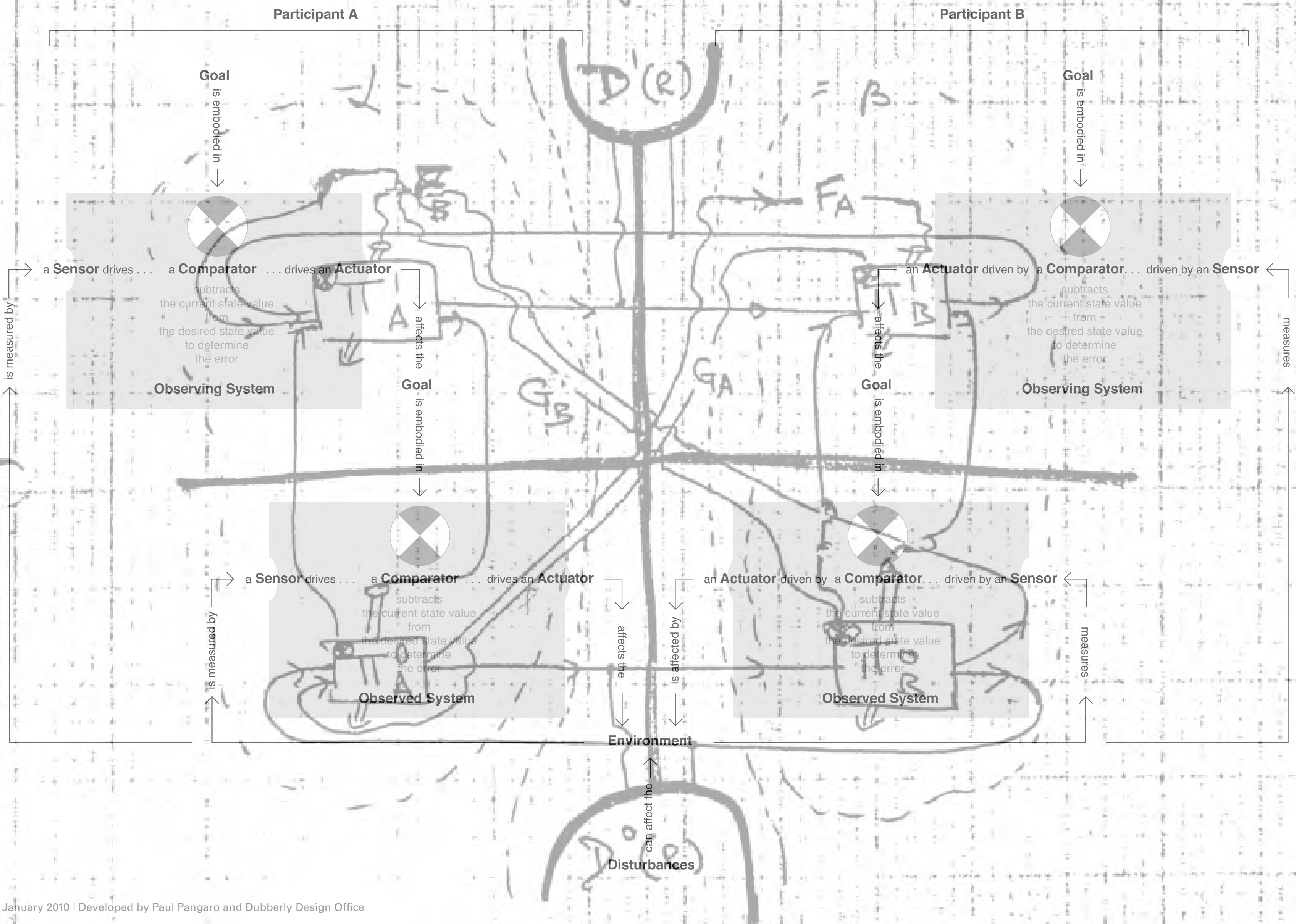
Conversation: Formal Mechanism



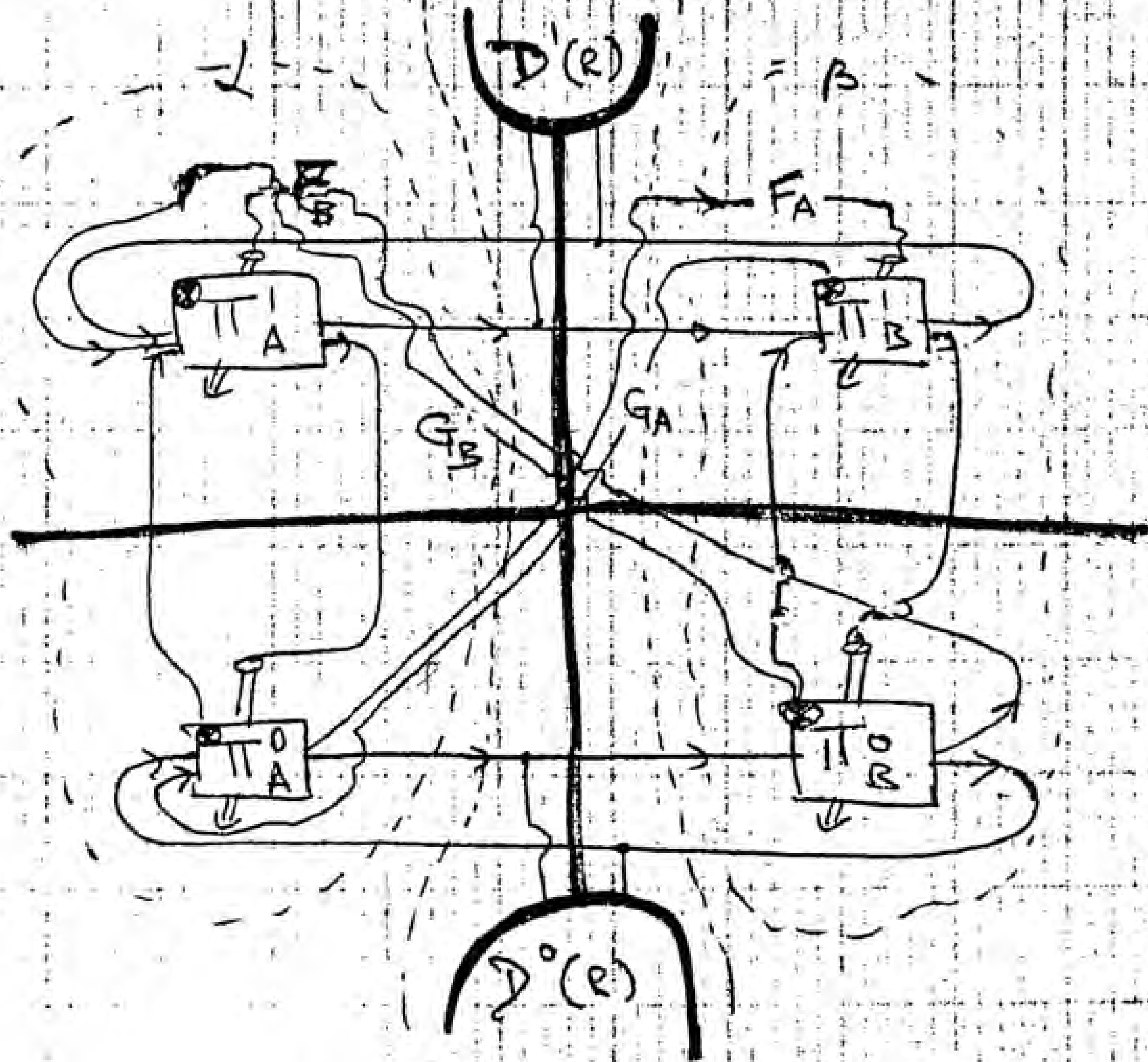
Conversation: Formal Mechanism



Conversation: Formal Mechanism

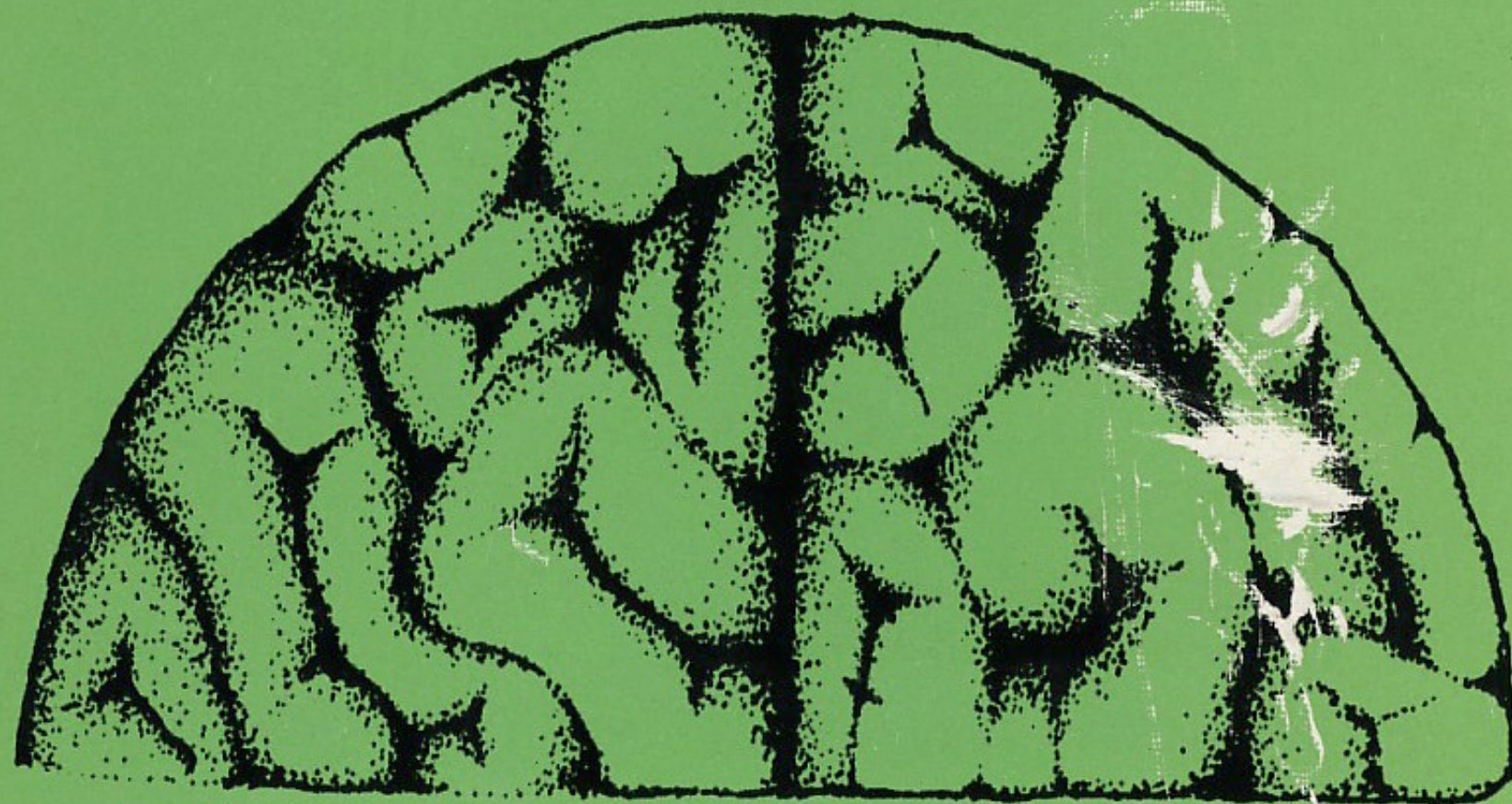


Open
Interface



GORDON PASK

CONVERSATION,
COGNITION AND
LEARNING



A CYBERNETIC THEORY
AND METHODOLOGY

ELSEVIER

1975

GORDON PASK

CONVERSATION
THEORY



APPLICATIONS IN EDUCATION
AND EPISTEMOLOGY

ELSEVIER

1976



Soft Architecture Machines

Negroponte

Soft

Architecture

Machines

Nicholas
Negroponte

Soft Architecture Machines
Nicholas Negroponte, ed.,
MIT Press, 1976

Book Design: Muriel Cooper

Aspects of Machine Intelligence

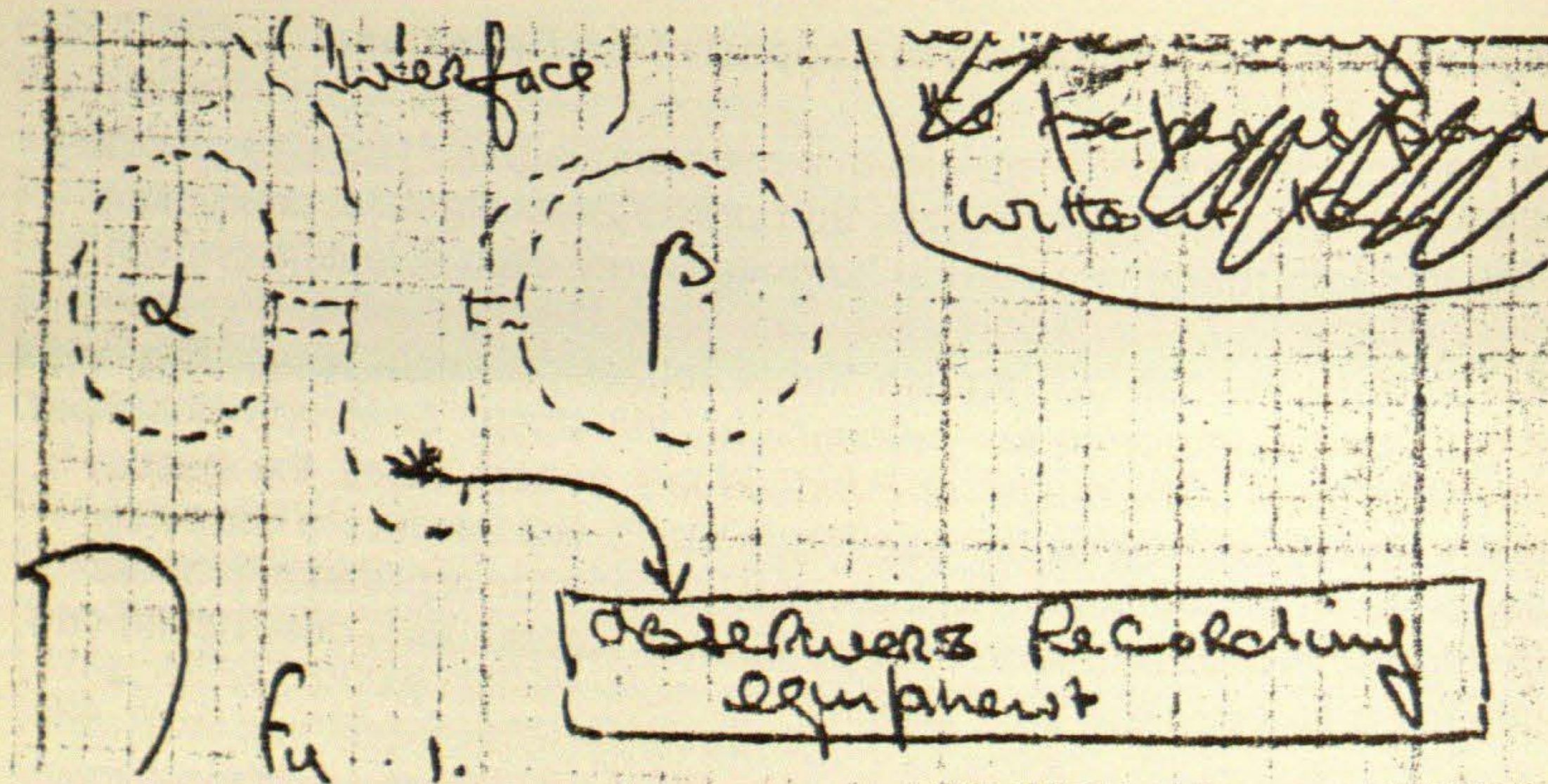
Introduction by Gordon Pask

The current status of mindlike computer programs is summarized, at a philosophical rather than technical level, in the following short but authoritative papers: Minsky (1968), Simon (1966), Turing (1969). Whoever wishes to delve into this subject in greater depth may read the books where these papers are published in their entirety, augmenting them, to obtain comprehensive background, by Ernst and Newell (1969); Ashby (1960); Cohen (1966); Fogel, Owens, and Walsh (1966); Von Foerster and Zopf (1962); Uttley (1959); Von Foerster et al. (1968); McCulloch (1965); Oestreicher and Moore (1968); Amarel (1969); Rose (1970); Minsky and Papert (1969); Feigenbaum and Feldman (1963); Banerji (1969); and Garvin (1970). It is also worth perusing all volumes of the journal *Artificial Intelligence*.

Henceforward, it is assumed either that the reader knows the *kind* of symbolic operations performed by computer programs and other artifacts, that he will study the matter at leisure, or that he will take these operations for granted. With this supposition in mind I shall give a personal and possibly idiosyncratic view of the conditions under which *artificially intelligent* is a properly used term and offer an interpretation of these conditions with respect to *use* of the *architecture machine*. Apart from the pictograms or ikons developed in the text, the only special symbols used are the special brackets \langle and \rangle which enclose *ordered* collections of objects; the equality sign $=$; and \triangleq , which is read as "*defined as equal to*."

Overview

The contention is as follows: Intelligence is a property that is ascribed by an *external observer* to a *conversation* between *participants* if, and



2.1.3. It is crucial to the argument that *all* observations occur at such a spatio-temporally localized interface; the observer's measuring and recording equipment is, in the last resort, bound to it. But the interface is neutral regarding the type of interaction, if any, that takes place across it.

In Figure 1, which introduces the notation for distinguishing *M Individuals*, α may be a user of the architecture machine regarded as a biological unit and β the architecture machine regarded as a chunk of metal and semiconductor material. But α may also be a rat and β its experimental environment.

2.2. A *P Individual* is distinguished as a self-replicating and (usually) evolving *organization*. It is respectably and precisely defined in terms of an object language *L* and a relational domain *R* described in *L* by a description *D(R)* with respect to which it *is* self-replicating. Here, self-replication is intended in the abstract sense of the theory of reproductive automata, as originally conceived by von Neumann (1968) and as recently developed by Loefgren (1972).

2.2.1. Though, in general, the domain may be allowed to grow systematically under the control of the given *P Individual*, we confine our attention to cases in which *R* is fixed. Under these circumstances, it is possible to specify domains with the property that if a given *P Individual* is viable (that is, is able to reproduce) on occasion *n*, then it is also viable at any later occasion $n + r$ (*r* finite) for *R*, in *R*.²

2.2.2. It is assumed that a *P Individual* is active or that any conversation in which it is a participant does in fact proceed, that is, for each occasion, some topic relation *R* (a part of *R* or all of it) is actually ostended for

d. That A will converse in L with a further entity B , that is, on each occasion n , A will aim for some goal; hence, some L expressions are used in an imperative or interrogative mode to pose and solve problems.

e. That the observer, for his part, will choose an L that is rich enough to accommodate the required questionings, commandings, answerings, etc.

f. That the observer will furnish a participant B (for example, the *heuristic* in the architecture machine) so devised that it will be *possible* for the other participant to realize the agreed-upon intention of playing the role of A .

4. In order to satisfy clause (6) of Section 3.2, an external observer must have an unambiguous representation of A . Because of that condition—because he wants to distinguish between a *concept* \triangleq a goal-directed or problem-solving procedure \triangleq the reproduction of a relation, such as R , and a *memory* \triangleq the reproduction of a concept, because he wants to judge the conversation “intelligent” or “not intelligent”—an observer finds it convenient to avoid dilemmas of self-reference: for example, the notion of a program that “writes itself” or a procedure that “questions itself” or even the operational evocation of a self-reproducing system (so that the *sprout* of a conversation, which is a *P Individual*, can be represented as a productive pair, S_a, S_b). One expedient adopted for this purpose is to stratify L , that is, to specify $L = L', L^\circ$ where expressions in L° refer to the bringing about of relations R , (the solution of problems, the achievement of goals), and expressions in L' refer to the construction or learning to formulate and achieve goals or learning to solve problems.

5. The distinction between levels of discourse in the object language L', L° , is symbolized by a horizontal cleft —.

5.1. Moreover, once imposed, the stratification engenders two descriptions of R , namely, $D(R) = \langle D'(R), D^\circ(R) \rangle$.

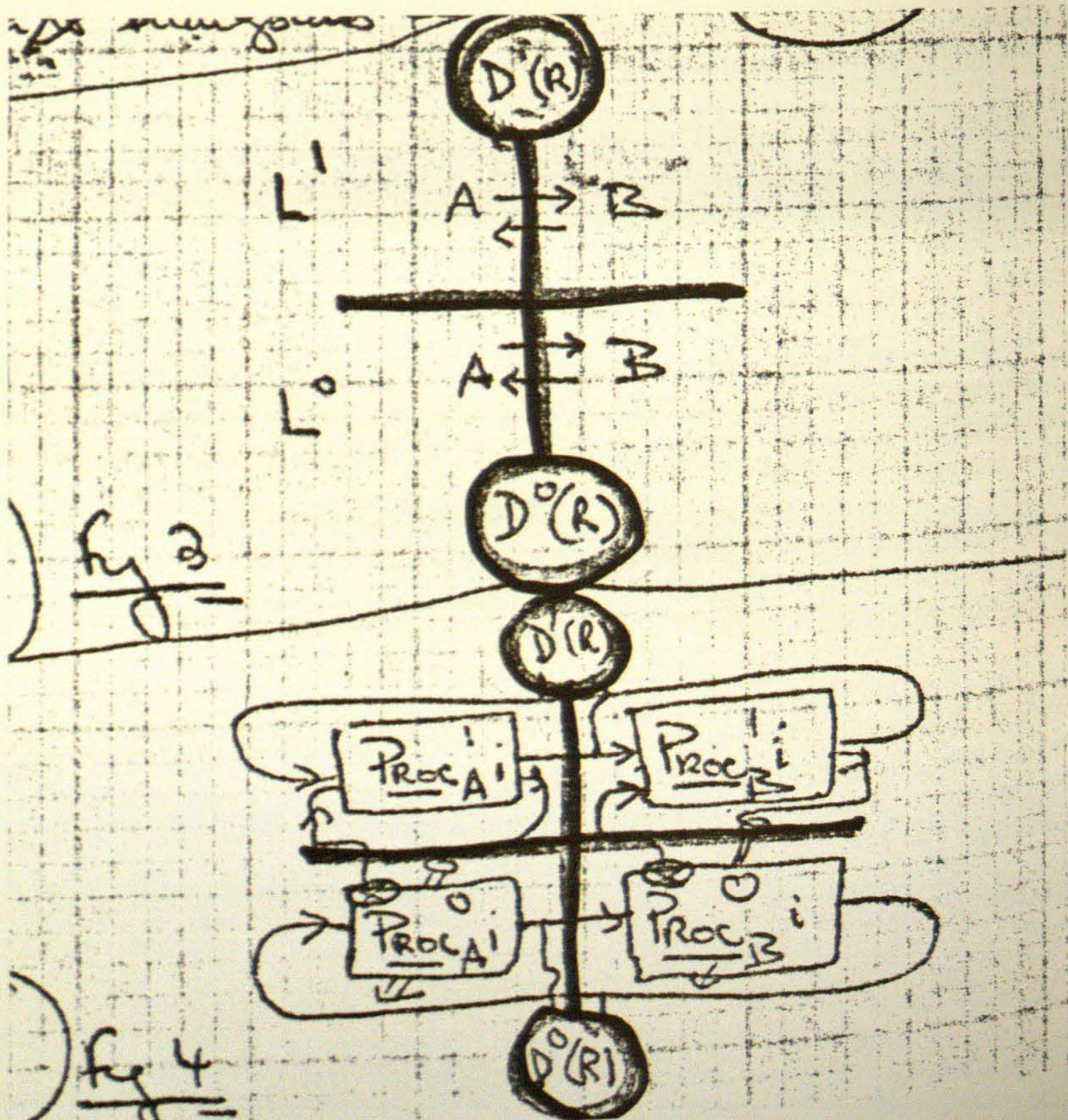
5.2. $D'(R)$ is a grammarlike structure indicating *what may be known or learned*.

5.3. $D^\circ(R)$ is grammarlike structure indicating *what may be done* (either by physical operations, to make a tangible model for some R_i in R), or by intellectual operations, to model R_i as an explanation—literally, of how to solve problems under R_i .

6. On making the distinction I and the distinction —, the observer declares the tableau of Figure 3 the conversational *skeleton*. This skeleton L and R are all described in L^* .

7. To lay foundations for the representation required to satisfy clause 6 of Section 3.2 and, simultaneously, to exhibit levels L', L° , in L as levels of control, the spaces in the skeleton are filled by boxes (Figure 4) representing classes of goal-directed or problem-solving procedures, *Proc i* being a procedure that *brings about* \triangleq *reproduces* a topic relation R_i .

7.1. The *superscripts* signify levels.



7.2. ♀ means "operates upon according to a hypothesis," and ⊗ means "gives a description (in the language appropriate to the level where the line terminates), which may or may not confirm the hypothesis."

7.3. Thus a complete circuit on one side of I , starting at ⊗, passing through — to a *Proc*, and returning by way of — and ♀ on the original *Proc* is a *causal coupling*, or, equivalently, it permits *reproduction* of the original *Proc*.

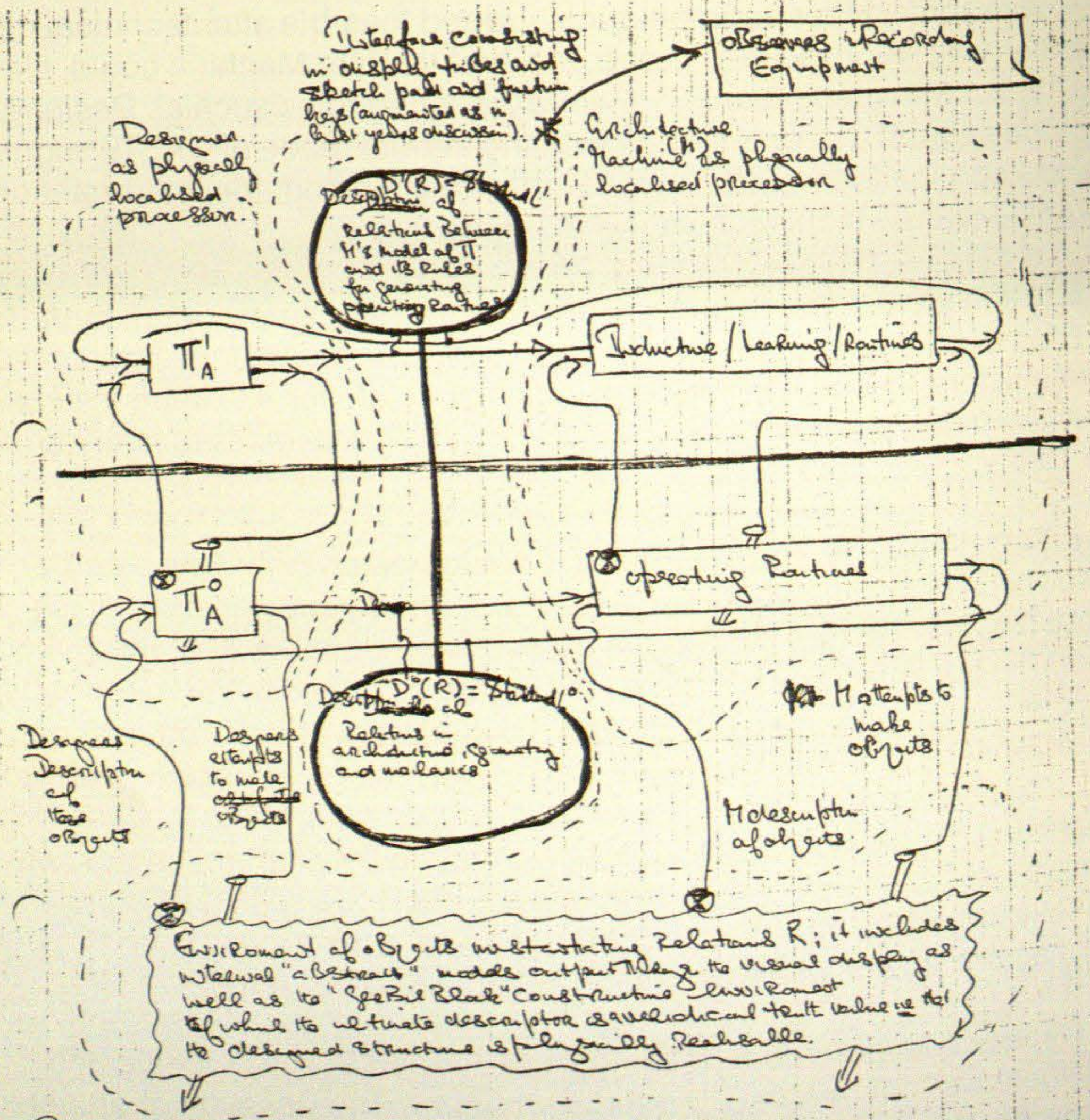
7.4. The unadorned, horizontal connections have a different meaning: they are *inferential couplings*, which, limiting cases apart, entail the notion of choice.

7.5. Hence, any complete circle (such as the line emanating from *Proc_A* *i* to *Proc_B* *i* and terminating on *Proc_A* *i*) may be called a *deductive chain*.⁵

7.6. Finally, the lines to and from $D'(R)$ and $D^\circ(R)$ indicate whatever is referenced by the inference, that is, whatever R_i in R is ostended by the participants A and B on occasion n .

7.7. Call this ikon (Figure 4) the *conversational paradigm*.

7.8. If one ikon is created by filling the spaces in Figure 3, then (obeying the proper rules) the process can be iterated laterally to yield a further *paradigm*, for example, the ikon in Figure 5. The motivation for doing so is noted in Section 2.1.1 ≙ to represent as much of mind as desired.



Interface consisting in display tubes and sketch pads and function keys (augmented as in last year's discussion).

Designed as physically localized processes.

Architecture Machine as physically localized processes.

Description of Relations Between H's Model of T1 and T2 Rules for generating operating Routines

Inductive / Learning / Routines

Operating Routines

Description of Relations in architecture, geometry and mechanics

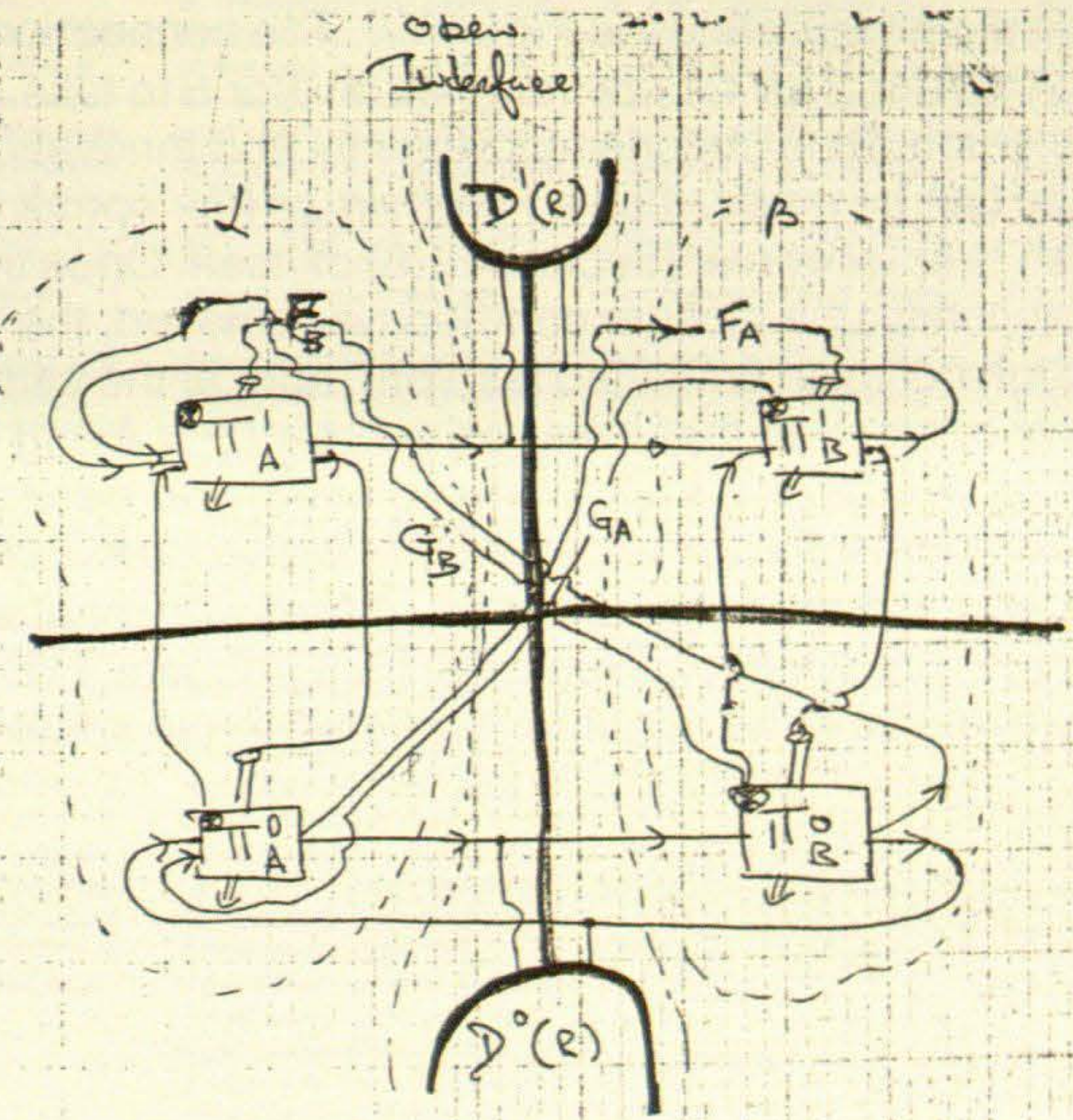
Attempts to make objects

Description of objects

Environment of objects interacting Relations R; it includes internal "abstract" models output along to visual display as well as to "Geometric" construction Environment of which the ultimate descriptor is a hierarchical tree whose value is the designed structure is physically Resizable.

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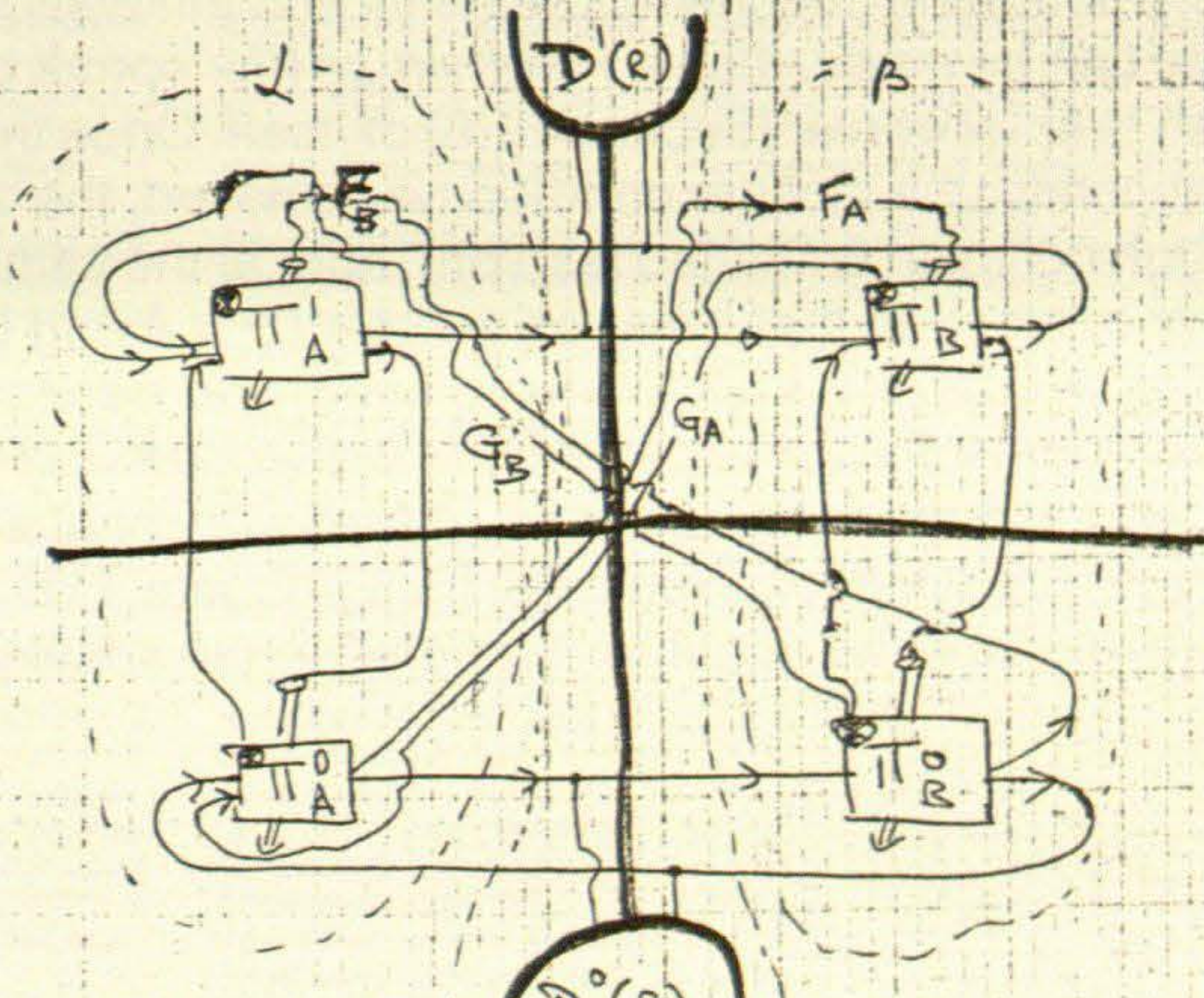
F. 9.



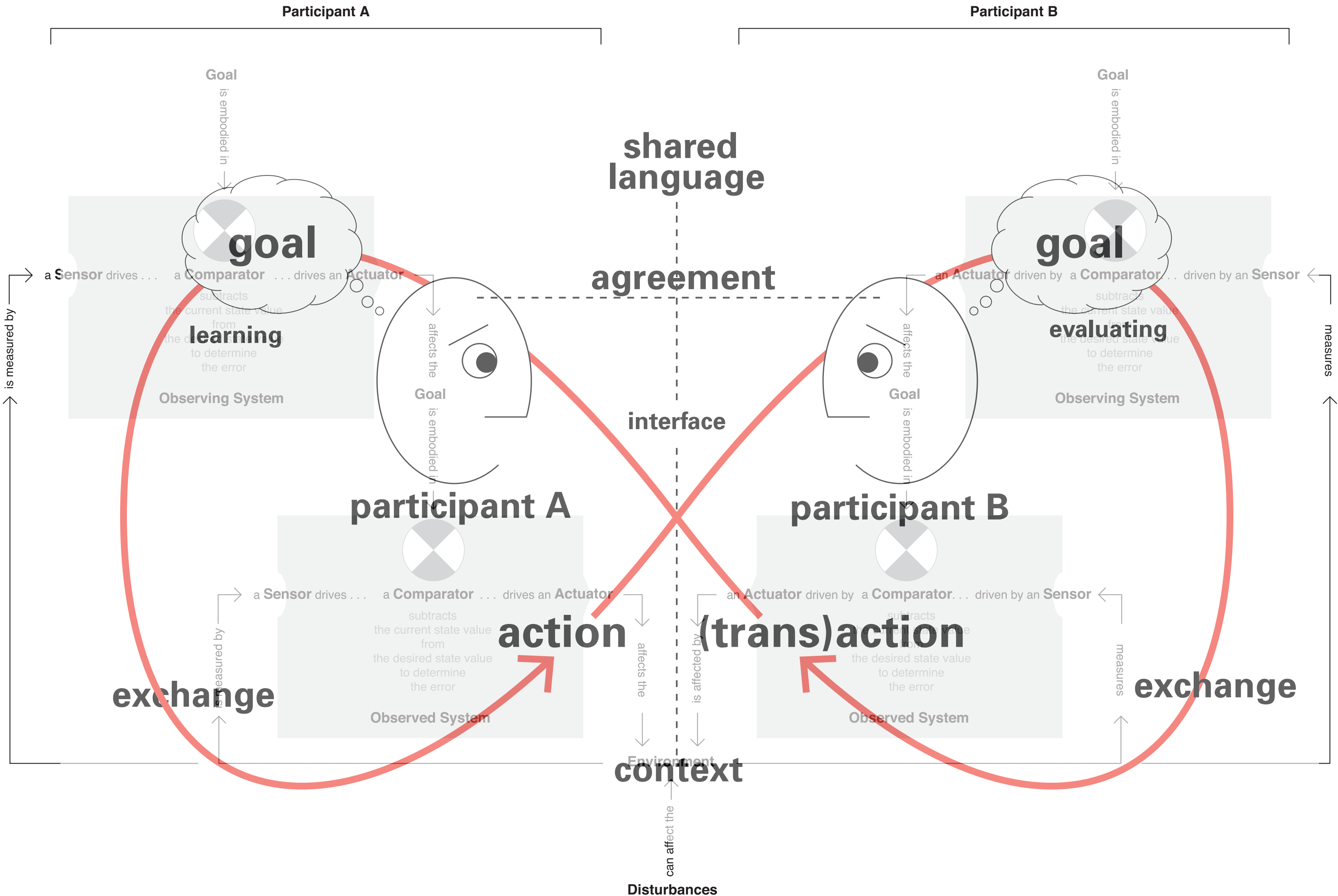
10. The conditions to be satisfied as a prerequisite for creative and innovative activity the formal way be exhibited by either of F_A, G_A or F_B, G_B are properly couplings. For creativity (communication usage) it is essential that both F_A, F_B and G_A, G_B are developed and realized.

10

Open
Interface



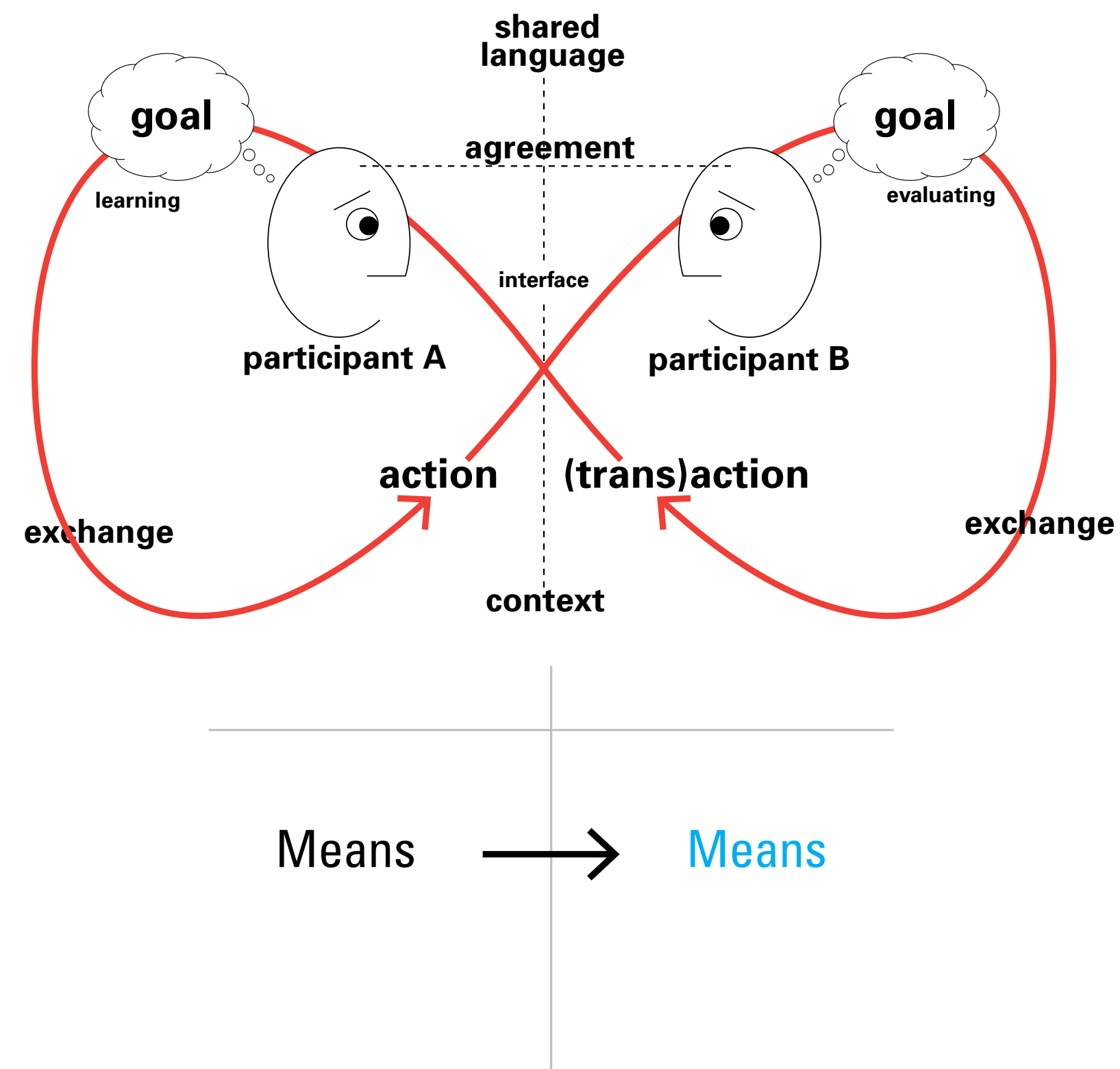
Conversation: Formal Mechanism



Architecture of Conversation

A and B may talk about goals, means, or both

“What is the goal? And how

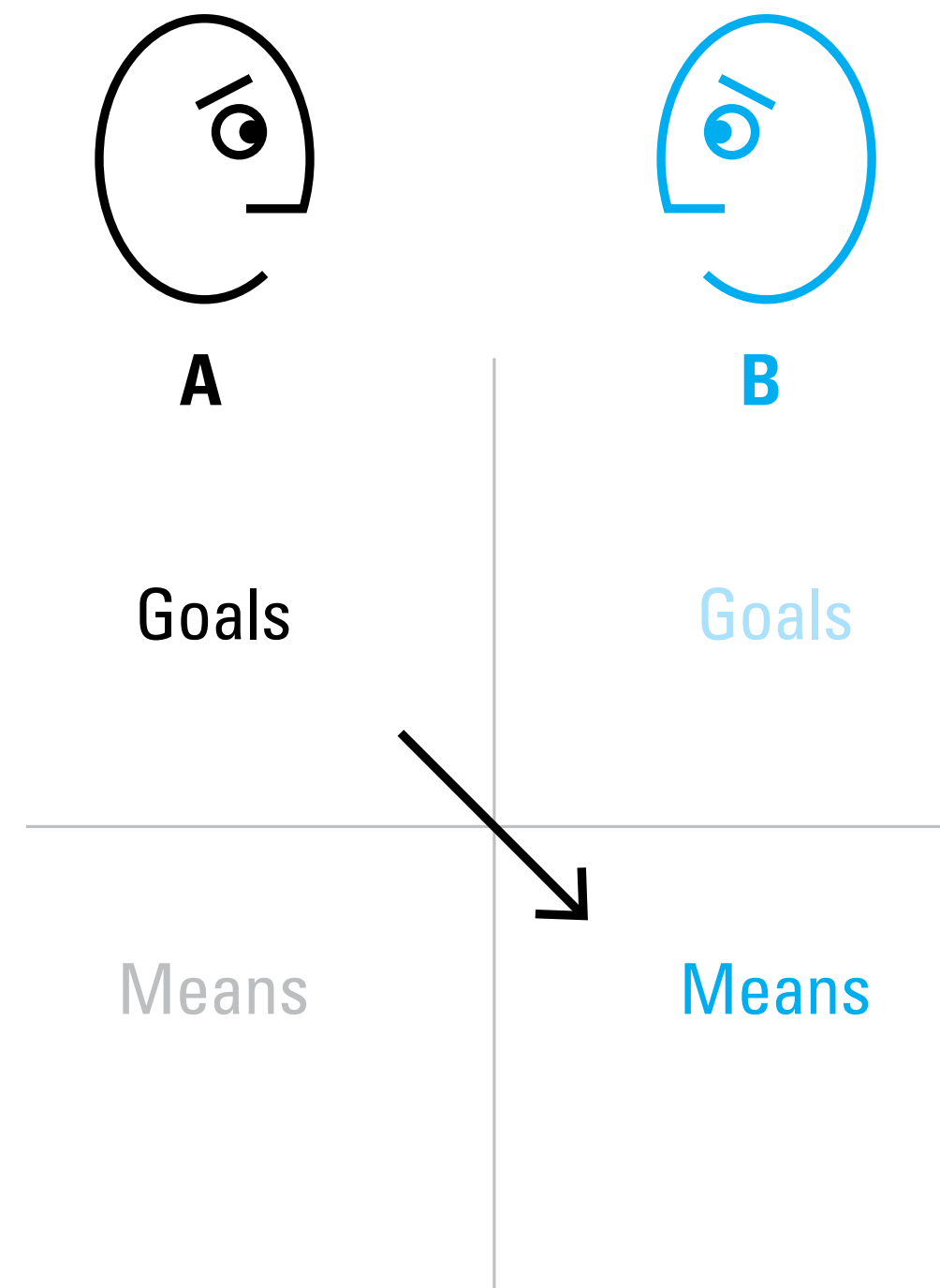


— adopted from Hugh Dubberly
after Paul Pangaro and Gordon Pask

Controlling

A tells B what to do and how to do it

“Alexa, give me some news from NPR.”

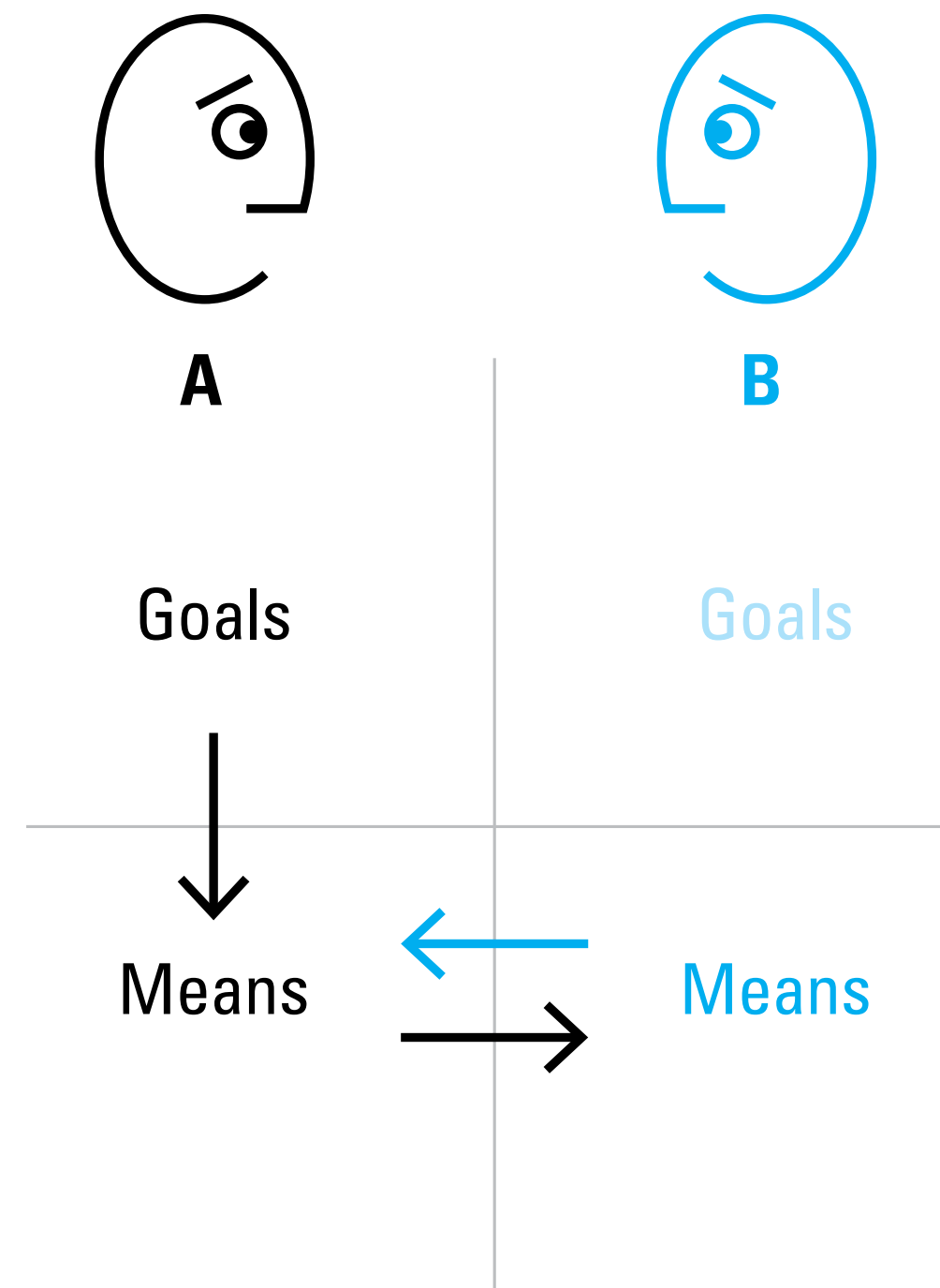


— adopted from Hugh Dubberly
after Paul Pangaro and Gordon Pask

Guiding

A sets goal but discusses means with B

“Alexa, I want to listen to news, what are my options?”

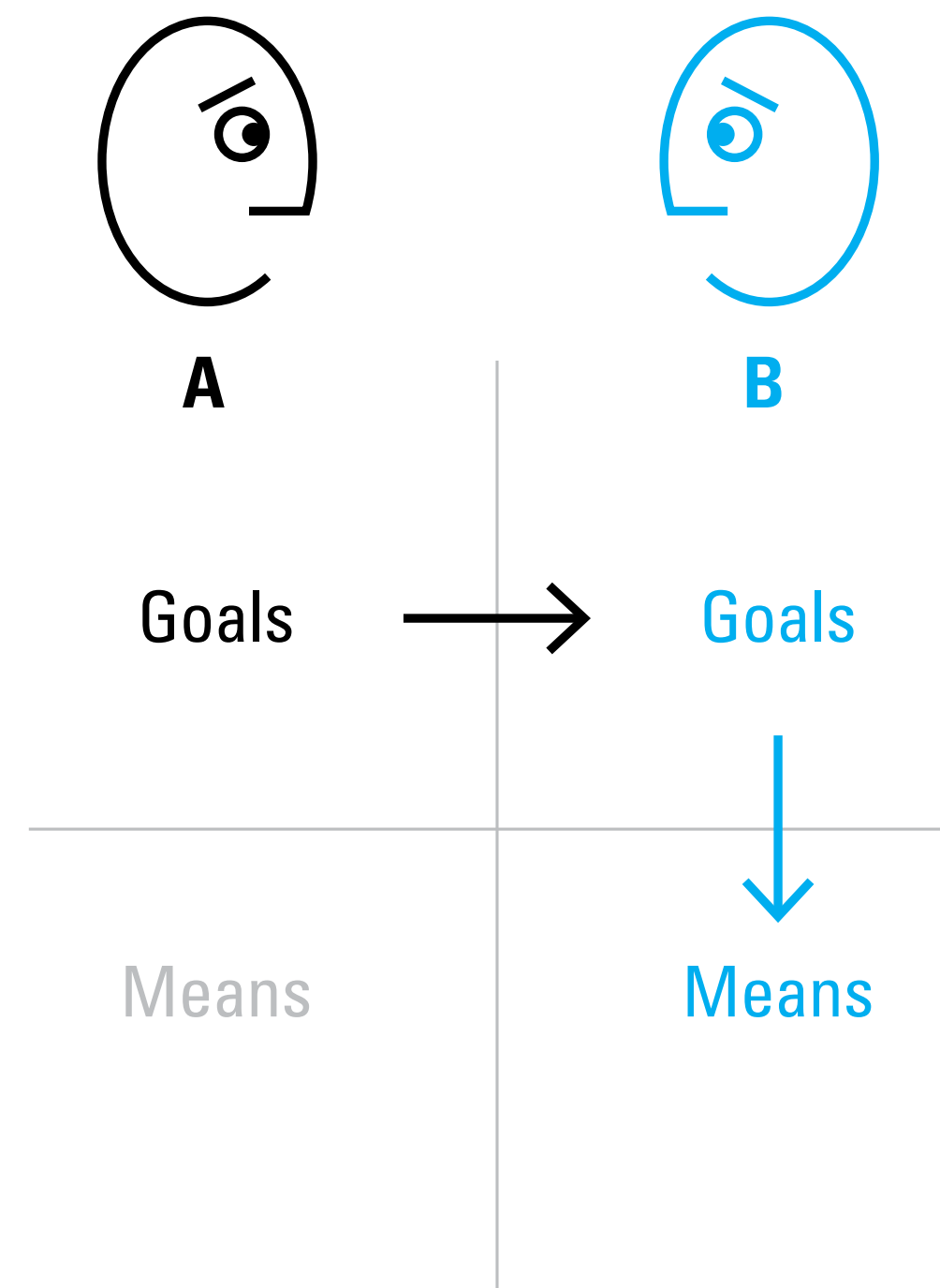


— adopted from Hugh Dubberly
after Paul Pangaro and Gordon Pask

Delegating

A sets the goal but lets B decide the means to reach it

“Alexa, some news please.”

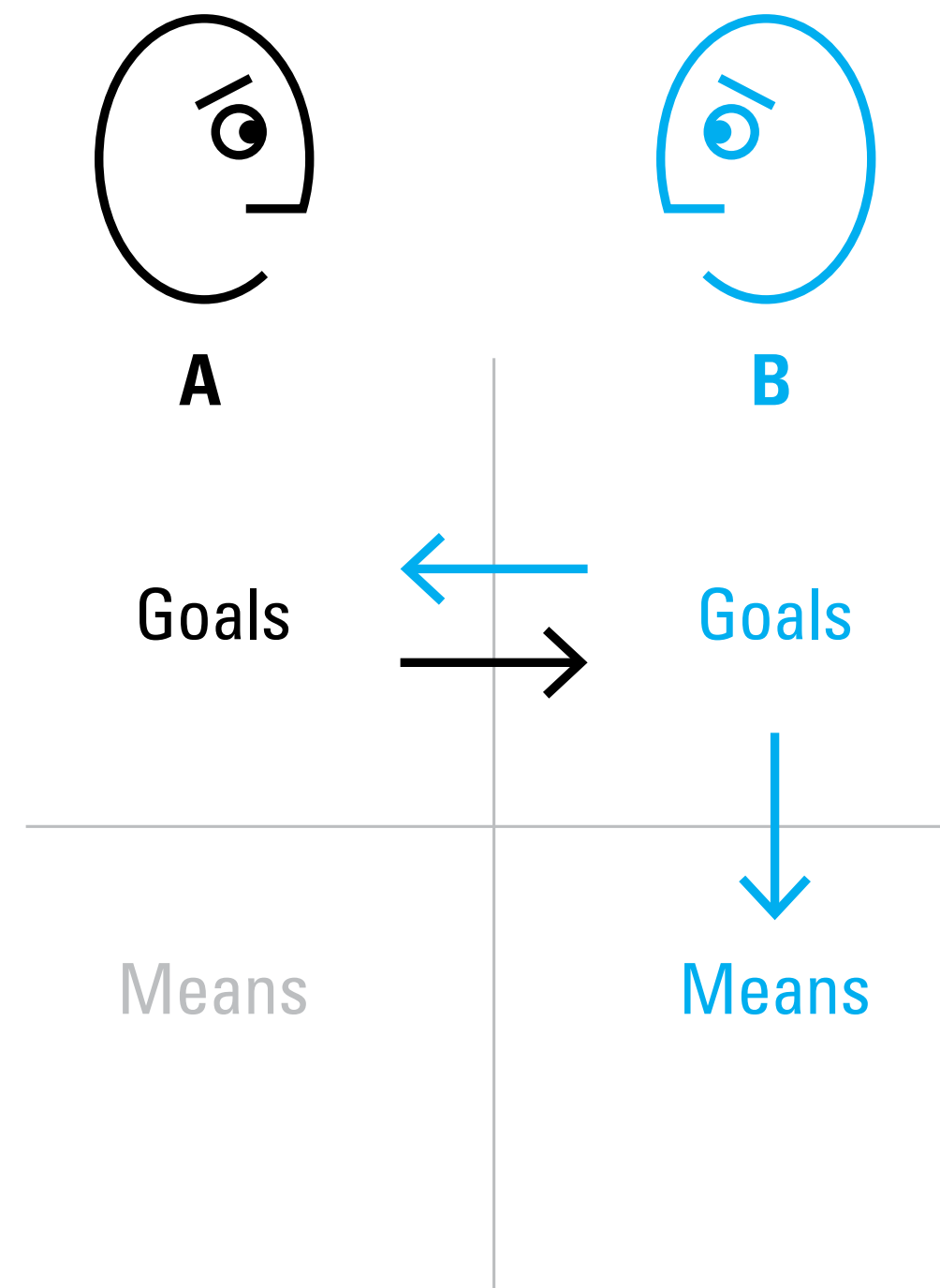


— adopted from Hugh Dubberly
after Paul Pangaro and Gordon Pask

Collaborating

A and B decide together on goals

“Alexa, how about I listen to something?”



— adopted from Hugh Dubberly
after Paul Pangaro and Gordon Pask

Conversational Interfaces

Alexa, define a “**good conversation**”?

- *stays sensitive to your context & language*
- *engages you — keeps continuity in the exchange*
- *leads to agreements — even agreements-to-disagree*
- *enables coordination — acting together with others.*

Alexa, how well does AI + today’s “Conversation Interfaces” do these things?

Conversational Interfaces

Cortana, define a “**great conversation**”?

- *tells you things you enjoy learning – delights you*
- *is surprising – energizes you*
- *goes places you didn't expect to go – is generative*
- *evolves in ways you couldn't evolve on your own.*

*“As a designer, I shall act always so as to
increase the total number of choices for a user.”*

— Ethical Imperative, Interaction Designers

Ethical Intentions — Conversational Interfaces

Intention #1 — Build cooperative interfaces

Conversation is a cooperative interface when sequences of **coherent interactions** enable participants to **evolve points-of-view** such that **understanding and agreement** are ongoing.

Intentions of Interactions for Conversation v4 — November 2019

Ethical Intentions — Conversational Interfaces

Intention #2 — Build ethical interfaces

Conversation is an ethical interface when there is reliable transparency of action + intent (what + why), such that trust may build and be maintained over time.

Intentions of Interactions for Conversation v4 — November 2019

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- What information we collect and why we collect it.
- How we use that information.
- The choices we offer, including how to access and update information.

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Information we collect [Back to top](#)

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We collect information in the following ways:

- **Information you give us.** For example, many of our services require you to sign up for a Google Account. When you do, we'll ask for [personal information](#), like your name, email address, telephone number or [credit card](#) to store with your account. If you want to take full advantage of the sharing features we offer, we might also ask you to create a publicly visible [Google Profile](#), which may include your name and photo.
- **Information we get from your use of our services.** We collect information about the services that you use and how you use them, like when you watch a video on YouTube or visit a website that uses our advertising services, or view and interact with our ads and content. This information includes:

- **Device information**

We collect [device-specific information](#) (such as your hardware model, operating system version, [unique device identifiers](#), and mobile network information including phone number). Google may associate your [device identifiers](#) or [phone number](#) with your Google Account.

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- telephony log information like your phone number, calling-party number, forwarding numbers, time and date of calls, duration of calls, SMS routing information and types of calls.

- [Internet protocol address](#).

- device event information such as crashes, system activity, hardware settings, browser type, browser language, the date and time of your request and referral URL.
- cookies that may uniquely identify your browser or your Google Account.

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Certain services include a unique application number. This number and information about your installation (for example, the operating system type and application version number) may be sent to Google when you install or uninstall that service or when that service periodically contacts our servers, such as for automatic updates.

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Information you share [Back to top](#)

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Accessing and updating your personal information [Back to top](#)

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Information we share [Back to top](#)

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- view statistics regarding your account, like statistics regarding applications you install.
- change your account password.
- suspend or terminate your account access.
- access or retain information stored as part of your account.
- receive your account information in order to satisfy applicable law, regulation, legal process or enforceable governmental request.
- restrict your ability to delete or edit information or privacy settings.

Please refer to your domain administrator's policies for more information.

- **For external processing**

We provide personal information to our [affiliates](#) or other trusted businesses or persons to process it for us, based on our instructions and in compliance with our

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If you have a Google Account, we may display your Profile name, Profile photo, and actions you take on Google or on third-party applications connected to your Google Account (such as +1's, reviews you write and comments you post) in our services, including displaying in ads and other commercial contexts. We will respect the choices you make to [limit sharing or visibility settings](#) in your Google Account.

When you contact Google, we keep a record of your communication to help solve any issues you might be facing. We may use your email address to inform you about our services, such as letting you know about upcoming changes or improvements.

We use information collected from cookies and other technologies, like [pixel tags](#), to improve your user experience and the overall quality of our services. One of the products we use to do this on our own services is Google Analytics. For example, by saving your language preferences, we'll be able to have our services appear in the language you prefer. When showing you tailored ads, we will not associate an identifier from cookies or similar technologies with [sensitive categories](#), such as those based on race, religion, sexual orientation or health.

Our automated systems analyze your content (including emails) to provide you personally relevant product features, such as customized search results, tailored advertising, and spam and malware detection.

We may combine personal information from one service with information, including personal information, from other Google services – for example to make it easier to share things with people you know. Depending on [your account settings](#), your activity on other sites and apps may be associated with your personal information in order to improve Google's services and the ads delivered by Google.

We will ask for your consent before using information for a purpose other than those that are set out in this Privacy Policy.

Compliance and cooperation with regulatory authorities [Back to top](#)

We regularly review our compliance with our Privacy Policy. We also adhere to several [self regulatory frameworks](#), including the EU-US and Swiss-US Privacy Shield Frameworks. When we receive formal written complaints, we will contact the person who made the complaint to follow up. We work with the appropriate regulatory authorities, including local data protection authorities, to resolve any complaints regarding the transfer of personal data that we cannot resolve with our users directly.

Changes [Back to top](#)

Our Privacy Policy may change from time to time. We will not reduce your rights under this Privacy Policy without your explicit consent. We will post any privacy policy changes on this page and, if the changes are significant, we will provide a more prominent notice (including, for certain services, email notification of privacy policy changes). We will also keep prior versions of this Privacy Policy in an archive for your review.

Specific product practices [Back to top](#)

The following notices explain specific privacy practices with respect to certain Google products and services that you may use:

- [Chrome and Chrome OS](#)
- [Play Books](#)
- [Payments](#)
- [Fiber](#)
- [Project Fi](#)
- [G Suite for Education](#)
- [YouTube Kids](#)
- [Google Accounts Managed with Family Link](#)

For more information about some of our most popular services, you can visit the [Google Product Privacy Guide](#).

Other useful privacy and security related materials [Back to top](#)

Further useful privacy and security related materials can be found through Google's [policies and principles pages](#), including:

- Information about our [technologies and principles](#), which includes, among other things, more information on
 - [how Google uses cookies](#).
 - technologies we use for advertising.
 - how we [recognize patterns like faces](#).
- A [page](#) that explains what data is shared with Google when you visit websites that use our advertising, analytics and social products.
- The [Privacy Checkup](#) tool, which makes it easy to review your key privacy settings.
- Google's [safety center](#), which provides information on how to stay safe and secure online.

- **For external processing**

We provide personal information to our [affiliates](#) or other trusted businesses or persons to process it for us, based on our instructions and in compliance with our Privacy Policy and any other appropriate confidentiality and security measures.

- **For legal reasons**

We will share personal information with companies, organizations or individuals outside of Google if we have a good-faith belief that access, use, preservation or disclosure of the information is reasonably necessary to:

- meet any applicable law, regulation, [legal process or enforceable governmental request](#).
- enforce applicable Terms of Service, including investigation of potential violations.
- detect, prevent, or otherwise address fraud, security or technical issues.
- protect against harm to the rights, property or safety of Google, our users or the public as required or permitted by law.

We may share [non-personally identifiable information](#) publicly and with our partners – like publishers, advertisers or connected sites. For example, we may share information publicly to [show trends](#) about the general use of our services.

If Google is involved in a merger, acquisition or asset sale, we will continue to ensure the confidentiality of any personal information and give affected users notice before personal information is transferred or becomes subject to a different privacy policy.

Information security [Back to top](#)

We work hard to protect Google and our users from unauthorized access to or unauthorized alteration, disclosure or destruction of information we hold. In particular:

- We encrypt many of our services [using SSL](#).
- We offer you [two step verification](#) when you access your Google Account, and a [Safe Browsing feature](#) in Google Chrome.
- We review our information collection, storage and processing practices, including physical security measures, to guard against unauthorized access to systems.
- We restrict access to personal information to Google employees, contractors and

Ethical Intentions — Conversational Interfaces

Intention #3 — Build humane interfaces

Conversation is a humane interface when any participant may influence its focus and flow such that collaboration is ongoing.

Intentions of Interactions for Conversation v4 — November 2019

Designing Ethical Interfaces

Ethical Intentions = Conversational Interfaces

- 1. Cooperative** → *evolving points-of-view* → **agreement**
- 2. Ethical** → *reliable transparency of what + why* → **trust**
- 3. Humane** → *shared focus and flow* → **collaboration**

Place Conversation at the Heart of IxD

Designers, can we enable conversation for others?
Can we design for interaction that...

- *asks great questions*
- *offers different ways to achieve your goal*
- *collaborates with you to define new goals*
- *helps you to be what you want to be... or **to become.***

“As a designer, I shall act always so as to increase the total number of choices for a user.”

— Ethical Imperative, Interaction Designers

Designing Ethical Interfaces

“As a designer, I shall act always so as to increase the total number of choices for a user.”

— Ethical Imperative, Interaction Designers

“As a designer, I shall act always so as to increase the total number of choices for a user.”

Thank you.

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***“I shall act always so as to increase
the total number of choices.”***

Thank you.

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Place Conversation at the Heart of IxD

Second-order Design = Design for Conversation

The goal of second-order design is to facilitate the emergence of conditions in which others can design — to create conditions in which conversations can emerge — and thus to increase the number of choices open to all.

— Dubberly & Pangaro, *Cybernetics and Design: Conversations for Action*, 2019

Appendices

Design and Cybernetics

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Designing Ethical Interfaces

“If you desire to see, learn how to act.”

— **Aesthetic Imperative**, Heinz von Foerster

Click for PDF of “Ethics and Second-Order Cybernetics”, 1991

We believe cybernetics offers a foundation for 21st-century design practice, with this rationale:

— Dubberly & Pangaro, “Cybernetics and Design: Conversations for Action”, 2019

If design, then systems:

- The prominence of digital technology in daily life cannot be denied (or reversed).
Digital technology comprises systems of systems (Internet of Things).
- Design has expanded from **giving-form** to **creating systems** that support interactions.
Human interactions span thinking and acting, whether mundane or metaphysical.

We must model and tame this complex mesh of mechanisms.

Therefore: systems literacy is a necessary foundation for design.

If design, then systems.

If systems, then cybernetics:

- Digital interactions comprise reliable connections, communication, and feedback.
Human interactions comprise purpose, feedback, and learning.
- The science of communication and feedback, interaction and purpose, is cybernetics.

We must model communication and intention in a common frame.

Therefore: cybernetics is a necessary foundation for design.

If design, then systems.

If systems, then cybernetics.

If cybernetics, then second-order cybernetics:

- Framing “wicked challenges” requires articulating human values and viewpoints. Values and viewpoints are subjective.
- Designers must offer a persuasive rationale for our subjective viewpoints.
- Modeling subjectivity is the province of second-order cybernetics.

We must embrace values and subjectivity at the heart of designing.

Therefore: second-order cybernetics is a necessary foundation for design.

If design, then systems.

If systems, then cybernetics.

If cybernetics, then second-order cybernetics.

If second-order cybernetics, then conversation:

- Taming “wicked challenges” must be grounded in argumentation.
- Argumentation requires conversation so that participants may understand and agree.
- Agreement is necessary for collaboration and effective action.

We must embrace argumentation and collaboration to the heart of 21st-century design.

Therefore: conversation is a necessary foundation for design.

If design, then systems.

If systems, then cybernetics.

If cybernetics, then second-order cybernetics.

If second-order cybernetics, then conversation.

— Dubberly & Pangaro, “Cybernetics and Design: Conversations for Action”, 2019

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