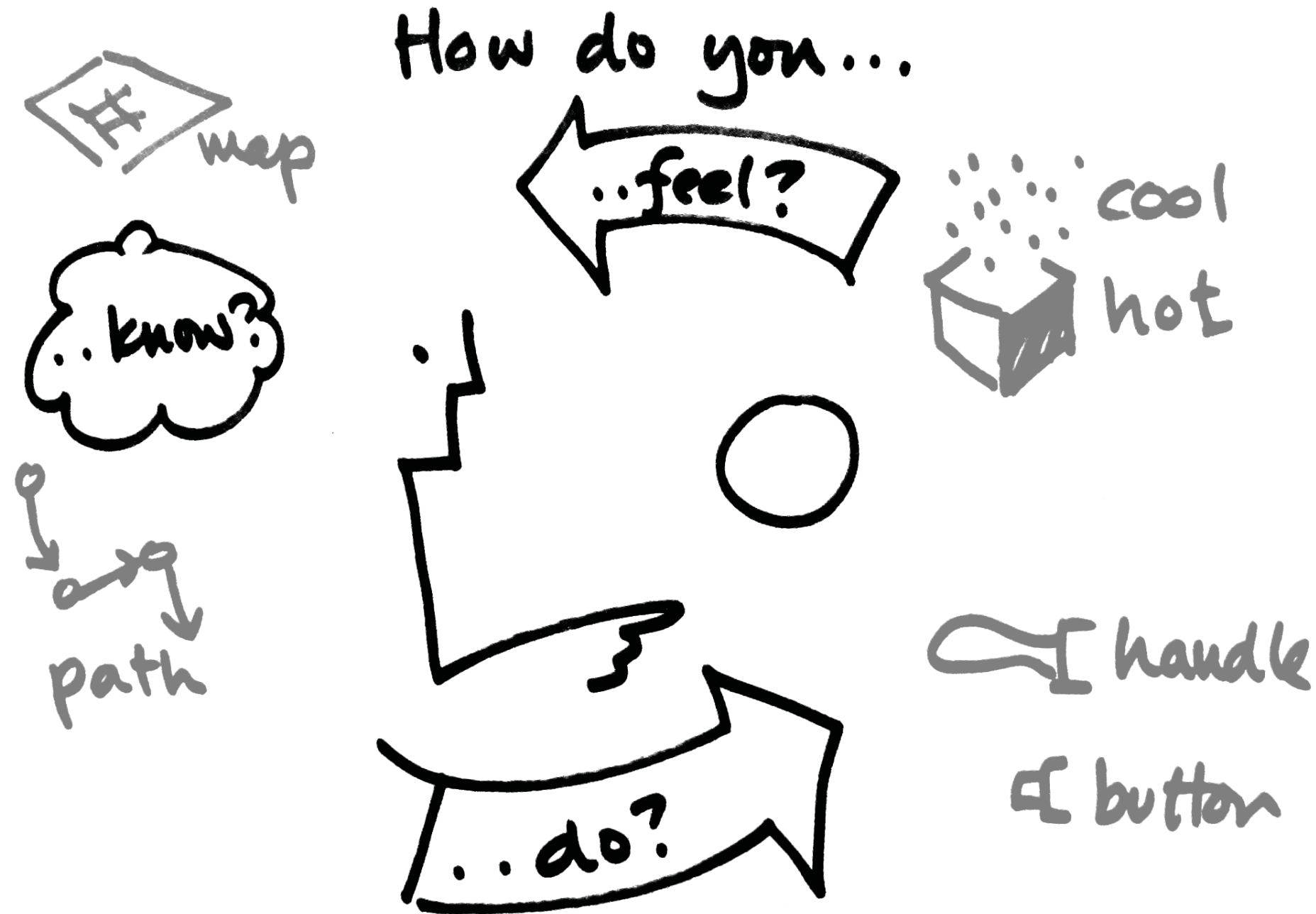# Systems Theory in Design
# Conversation

Hugh Dubberly
Dubberly Design Office

How do systems interact?

So far, our basic model of interaction has been 'feedback' — a first-order system interacting with its environment.

Goal . . . describes a relationship
that a system desires to have
with its environment

is embodied in

Environment

System

input

output

a **Sensor** passes the current state value to a **Comparator** . . . . responds by driving an **Actuator**

. . . has
resolution – (Accuracy)
frequency – (Latency)
range – (Capacity)

subtracts
the current state value
from
the desired state value
to determine
the error

. . . has
resolution
frequency
range

is measured by

affects the

**Significant
Variable**

can affect the

Disturbances . . . may be characterized as certain types
typically falling within a known range;
but previously unseen types may emerge
and values may vary beyond a known range;
in such cases the system will fail
because it does not have requisite variety

The feedback model is a useful first approximation of how people interact with personal computers.

Feedback is the basic process of learning.

goals

perception

evaluation

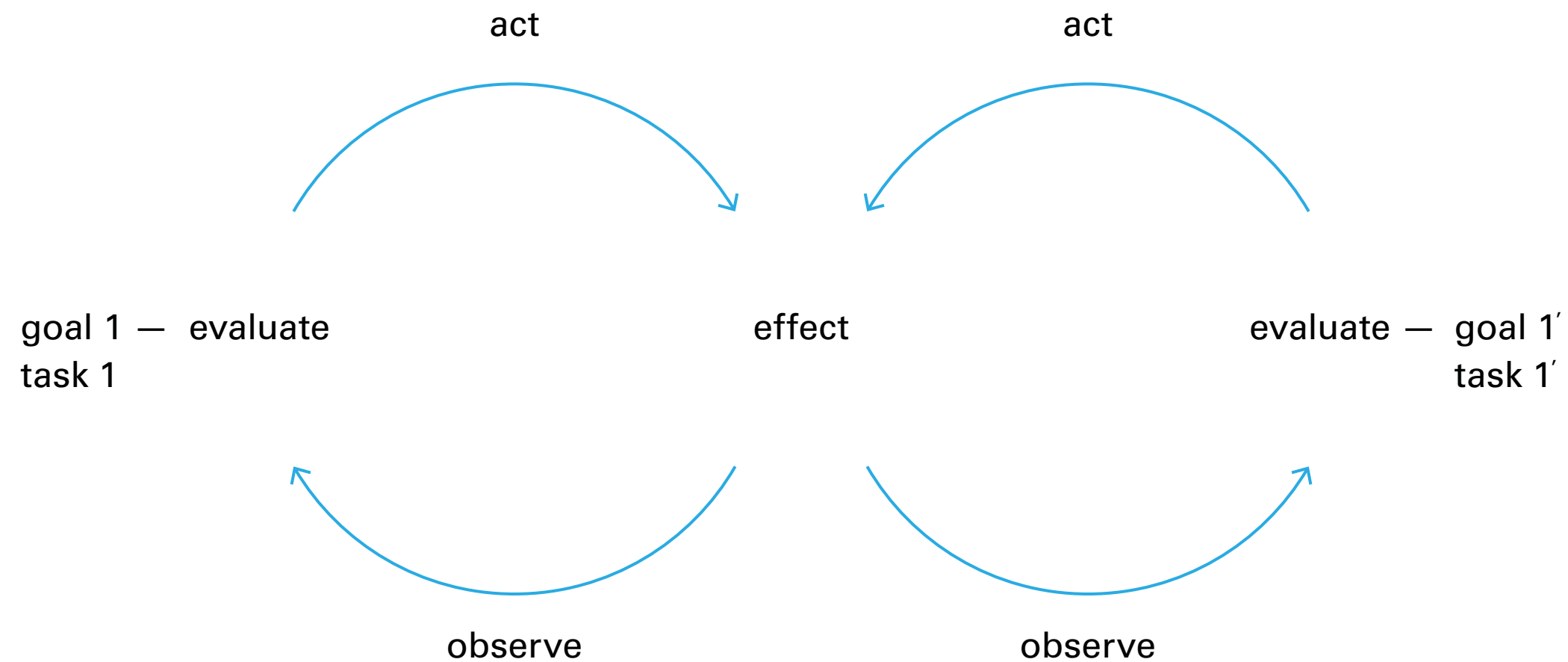effect
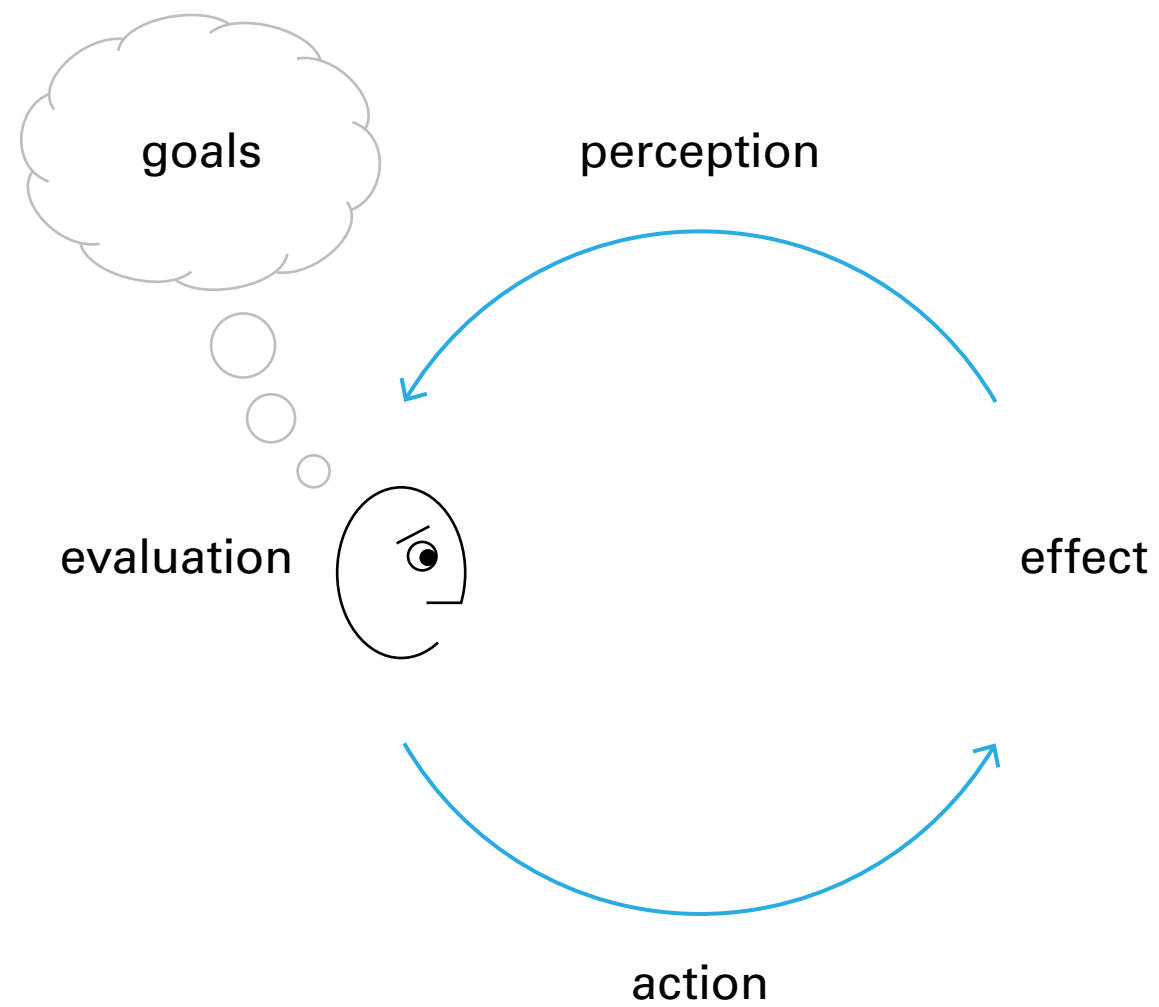
action

The personal computer also operates as a feedback loop, assessing input, comparing to goals, and acting to maintain balance.

input

goals

effect

evaluation
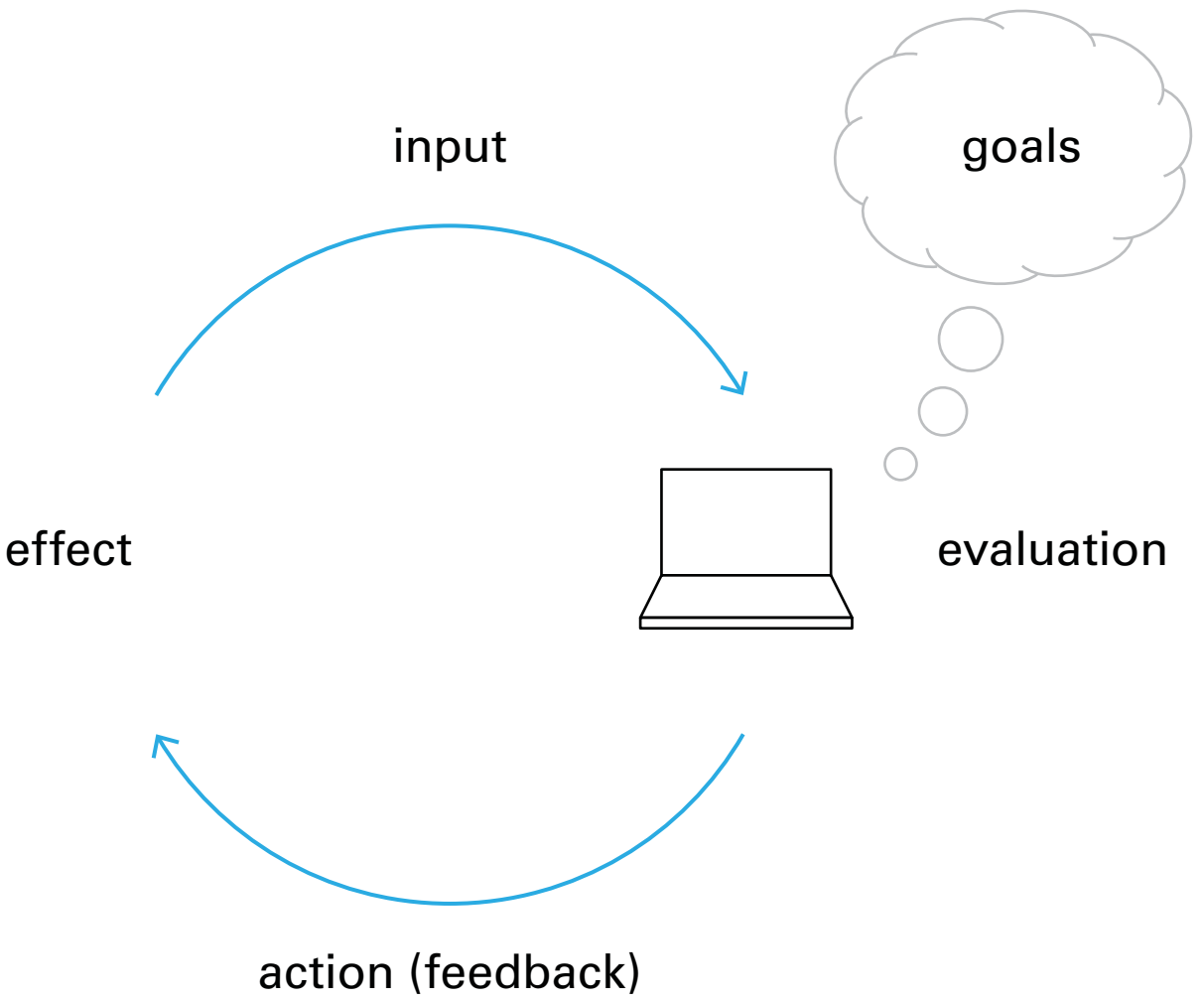
action (feedback)

We might combine these two first-order feedback loops, to make another approximation of human-computer interaction.

goals · perception · input · goals

evaluation · effect · evaluation

action · action (feedback)
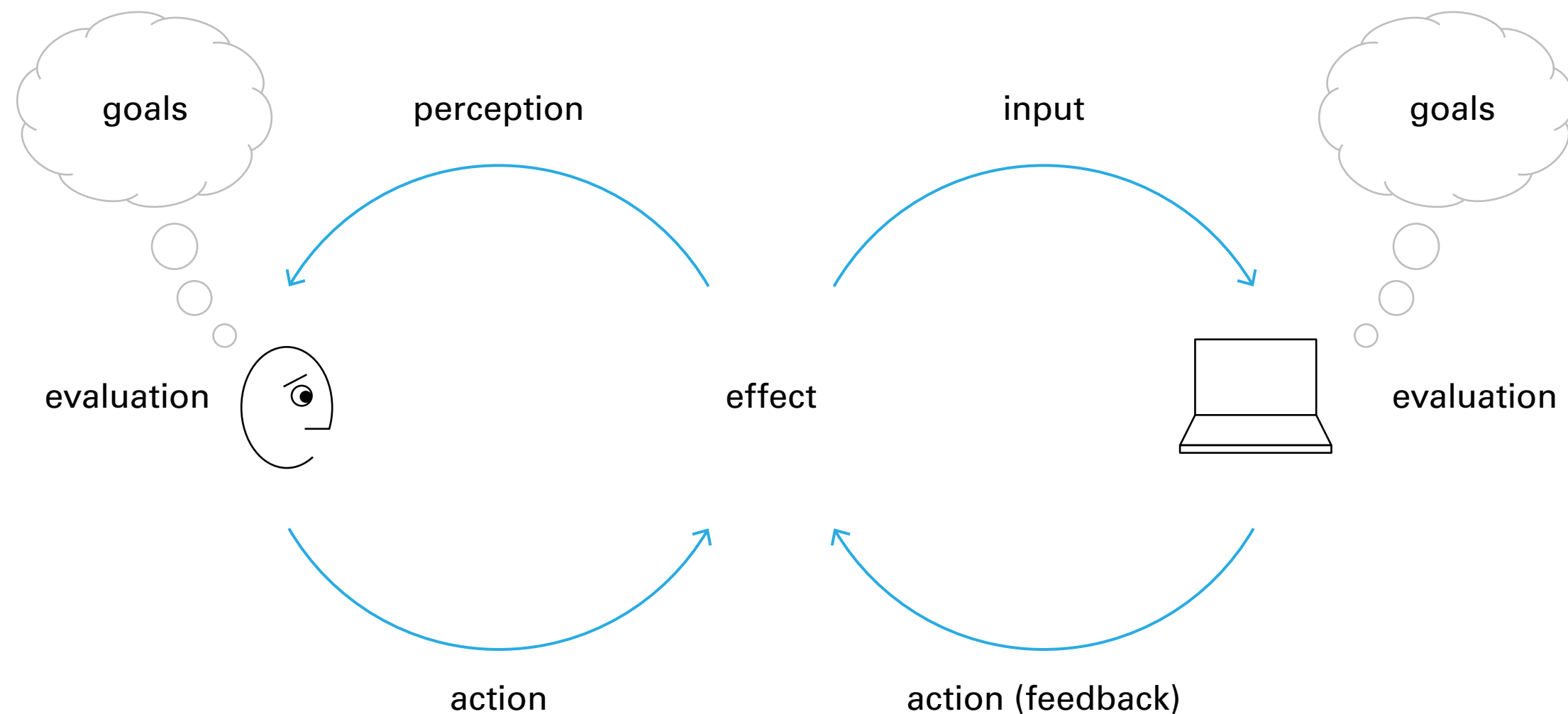
More generally, we might represent two first-order systems interacting...

act act

goal 1 — evaluate   effect   evaluate — goal 1′
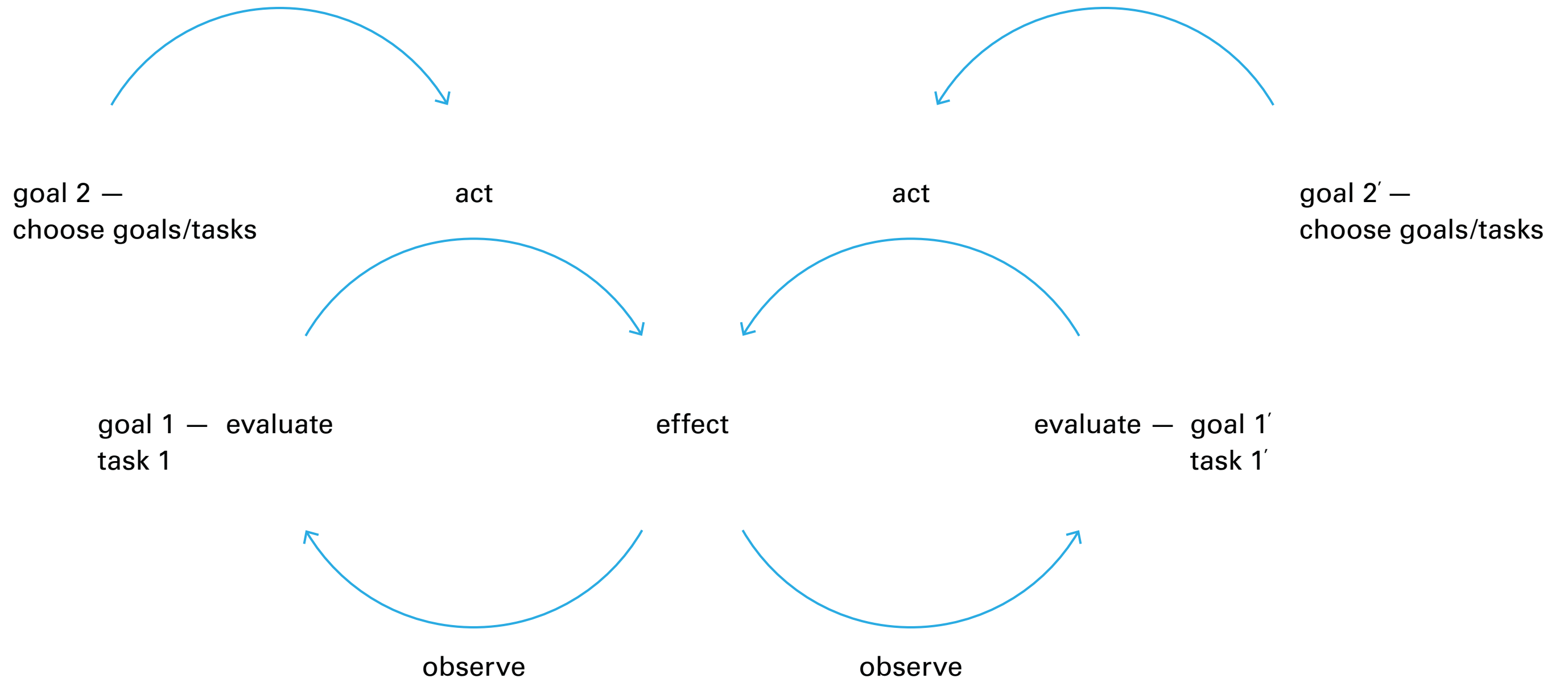task 1   task 1′

observe observe

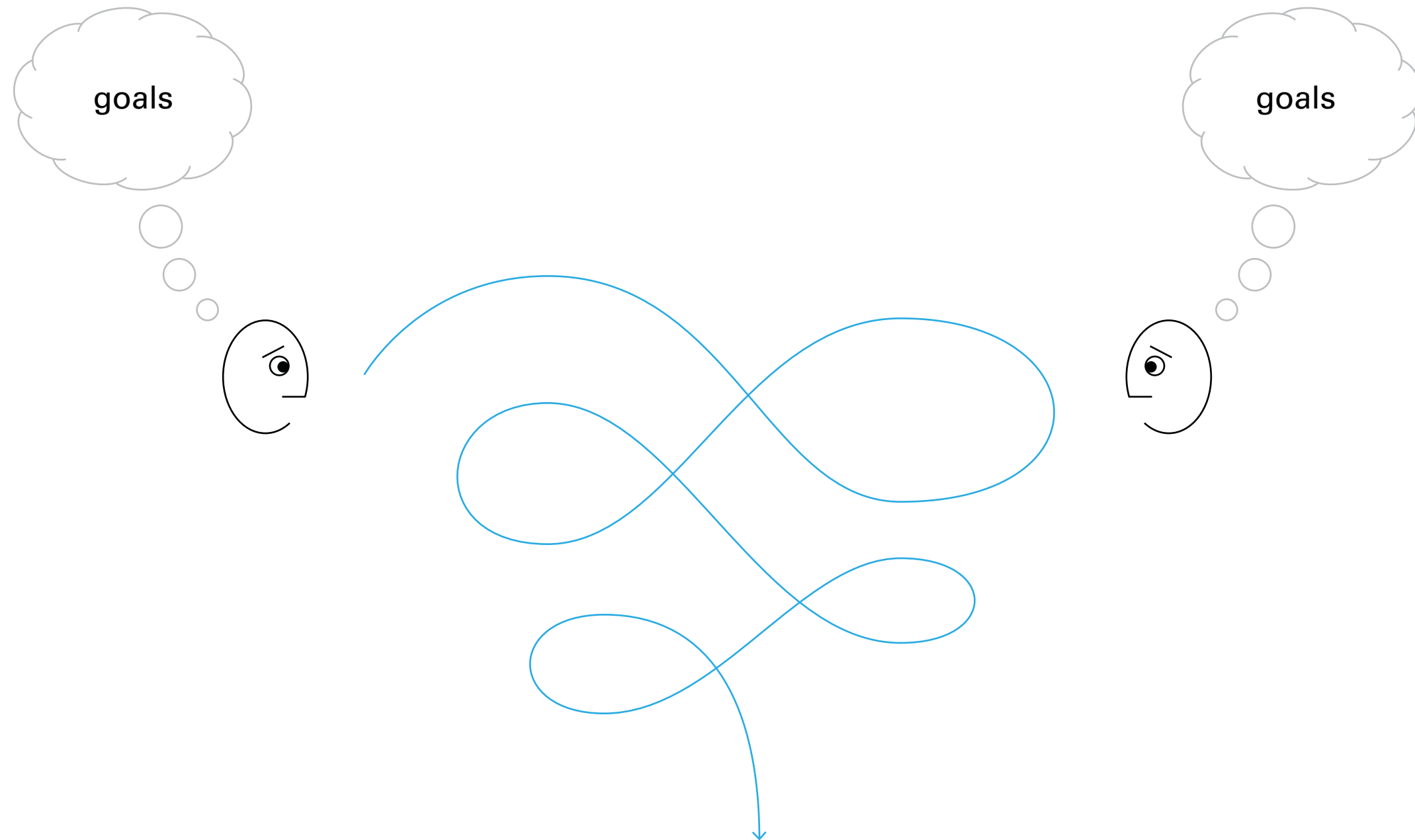# Yet, people are more than first-order systems; they learn, and we've described learning systems as second-order.

goal 2 — choose goals/tasks

act

goal 1 — evaluate task 1

effect

observe
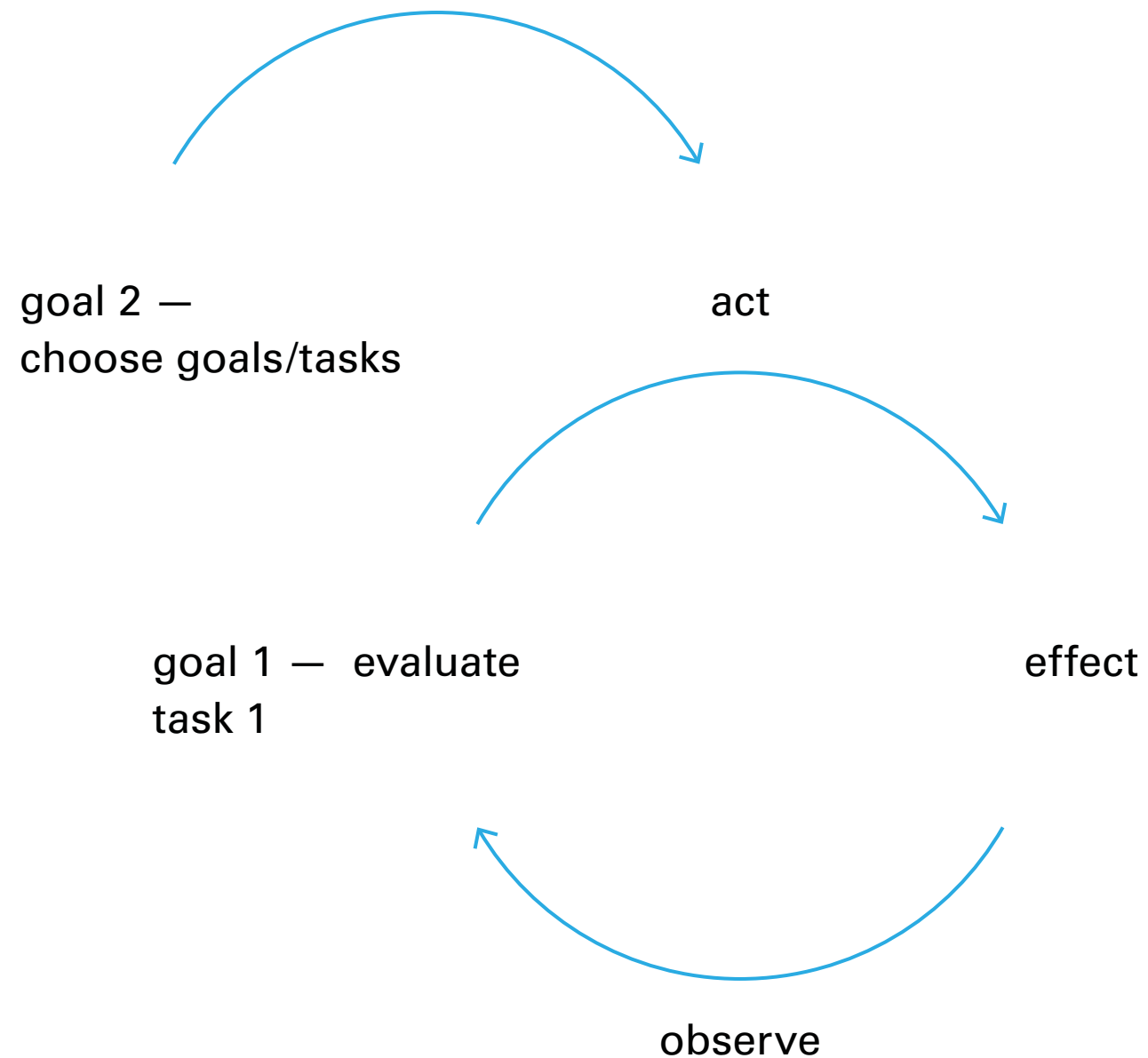
So, human-computer interaction might also be described as a second-order system interacting with a first-order system.

goal 2 —
choose goals/tasks

act

act

goal 1 —   evaluate
task 1

effect

evaluate —   goal 1′
task 1′

observe

observe
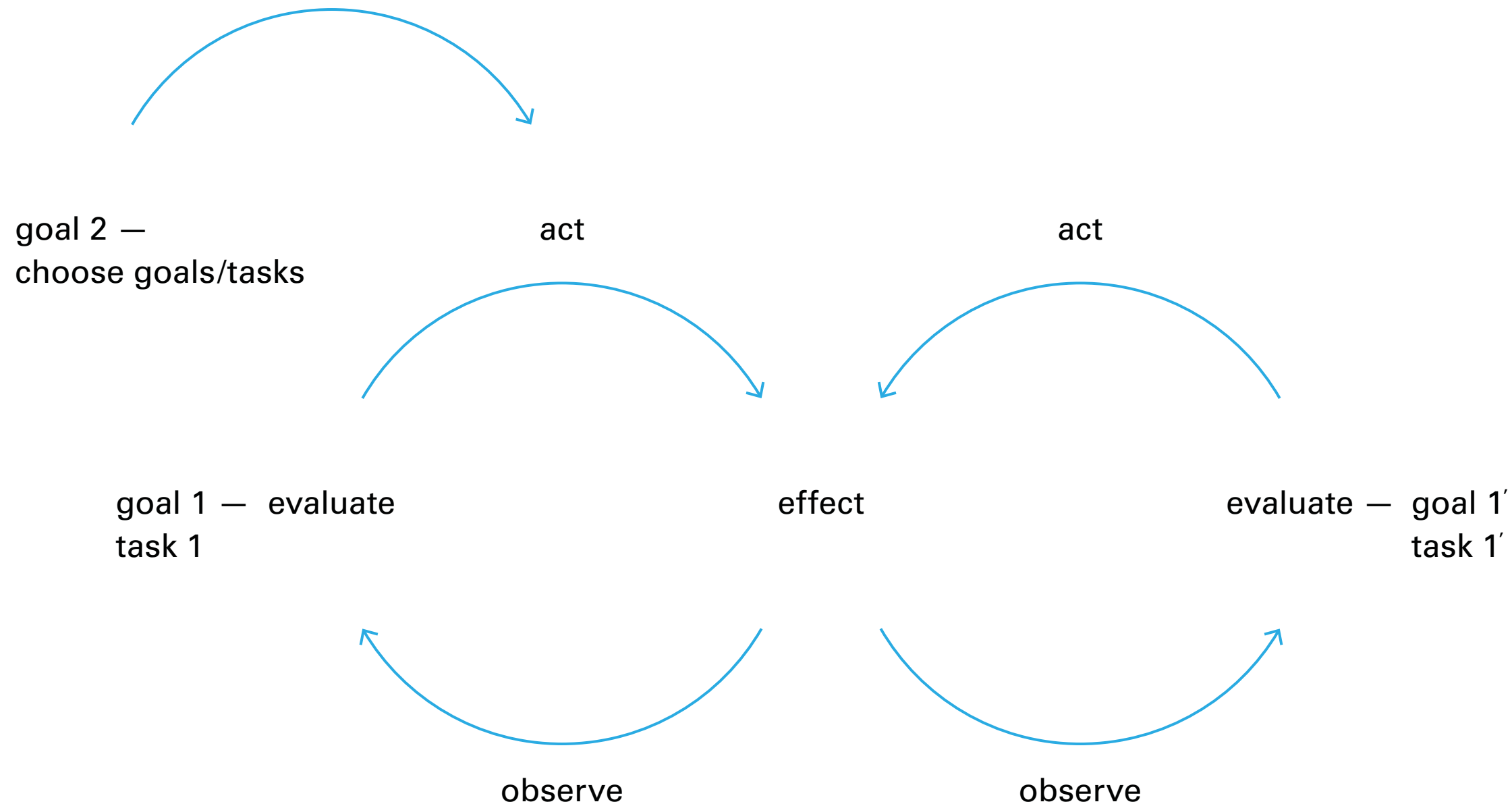
Of course, we might imagine a more sophisticated computer system, so that we might have two second-order systems interacting.
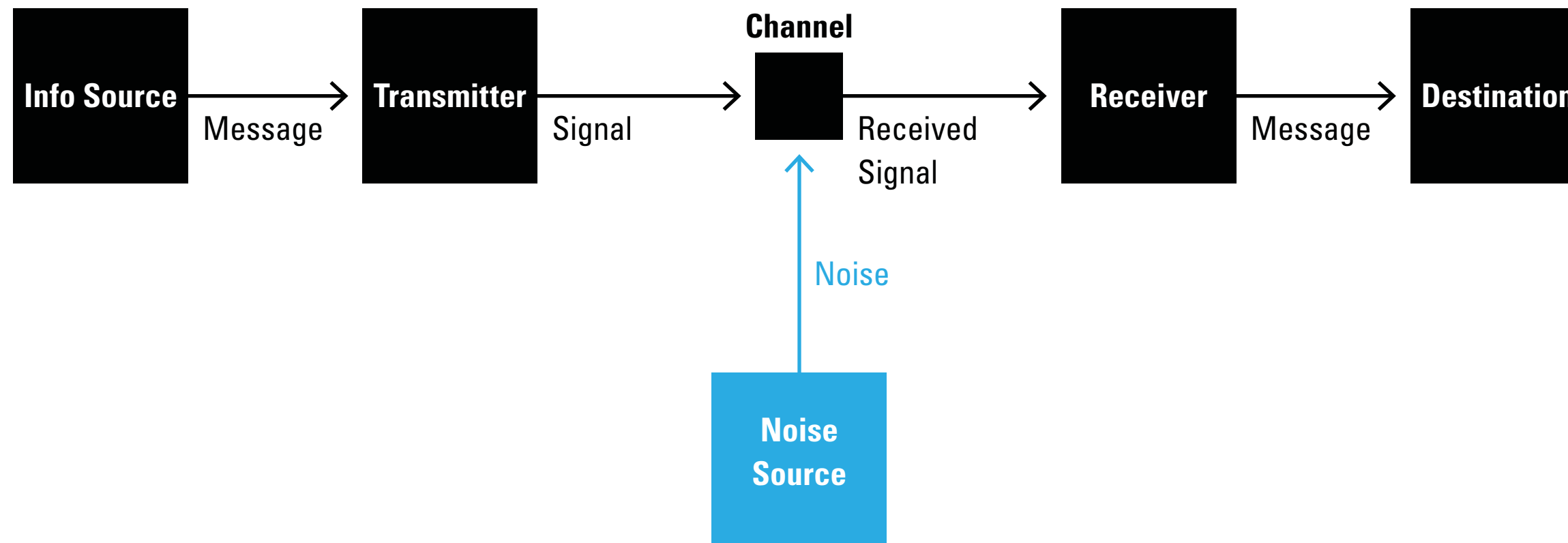
goal 2 —
choose goals/tasks

act

act

goal 2′ —
choose goals/tasks

goal 1 — evaluate
task 1

effect

evaluate — goal 1′
task 1′

observe

observe

Such a system would, in essence, replicate human conversation.

goals

goals

What is conversation?

# Conversation requires communication, though **communication is not conversation**

See Claude Shannon, "A Mathematical Theory of Communication," 1948

In addition to communication, conversation requires **shared context, experience, and language**
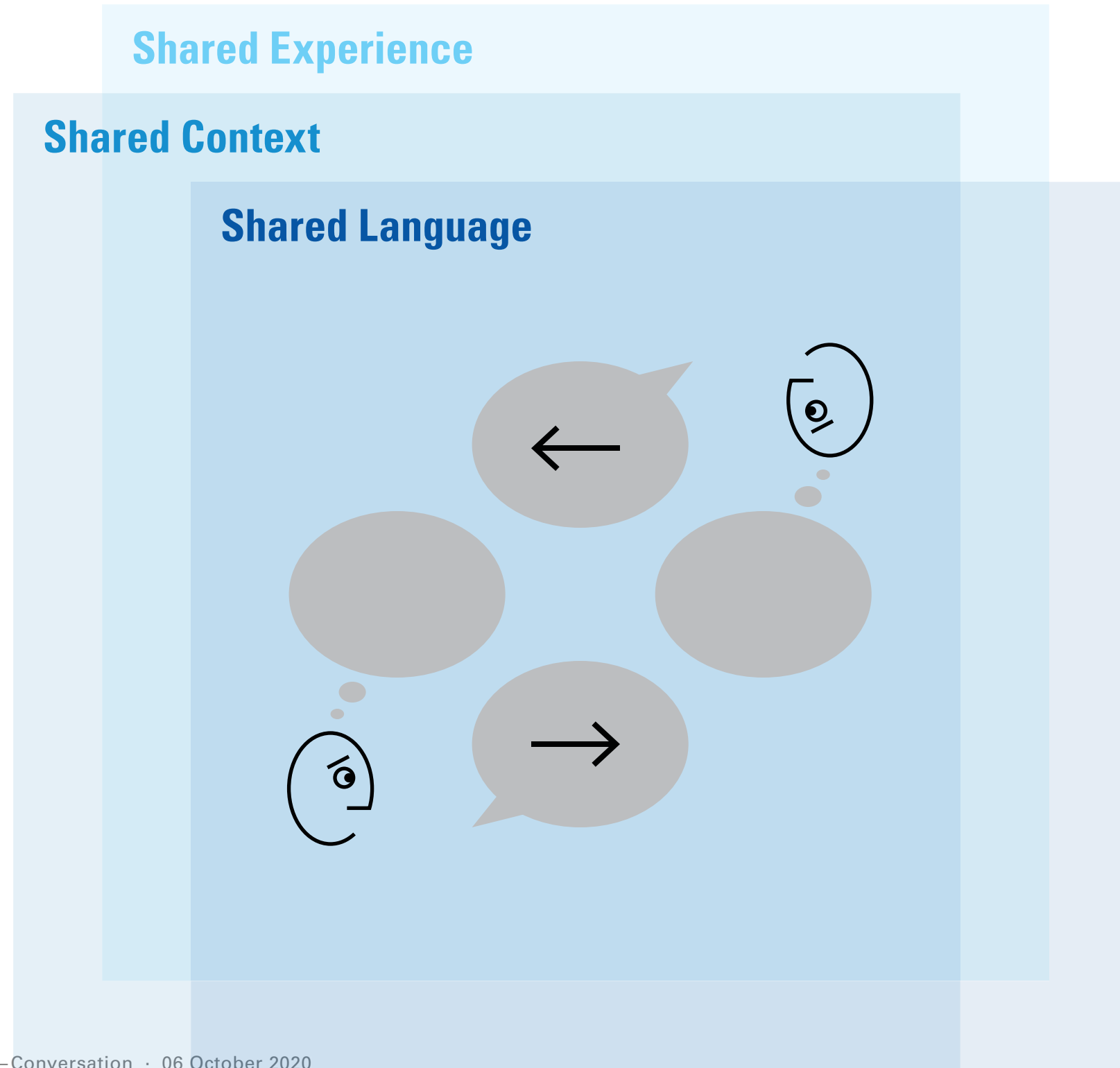
Conversation begins with **distinctions,** noticing differences, suggesting boundaries,* e.g., up/down, front/back, inside/outside
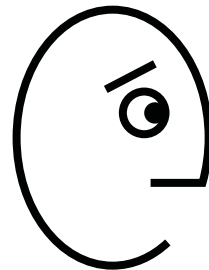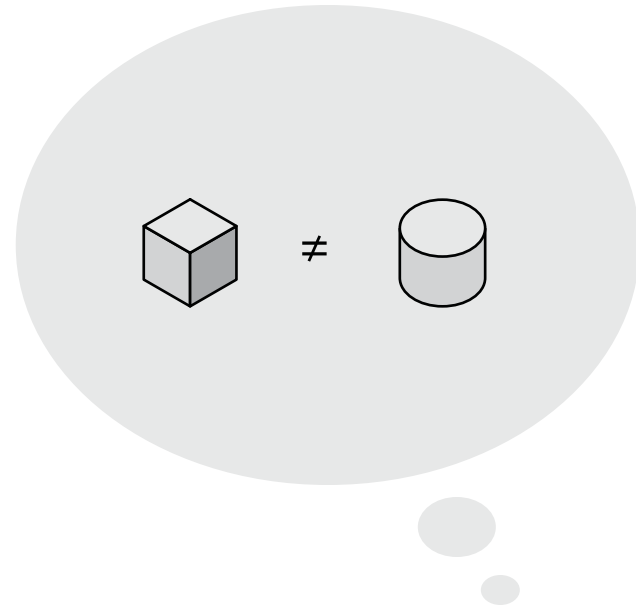
Square box
≠
round box
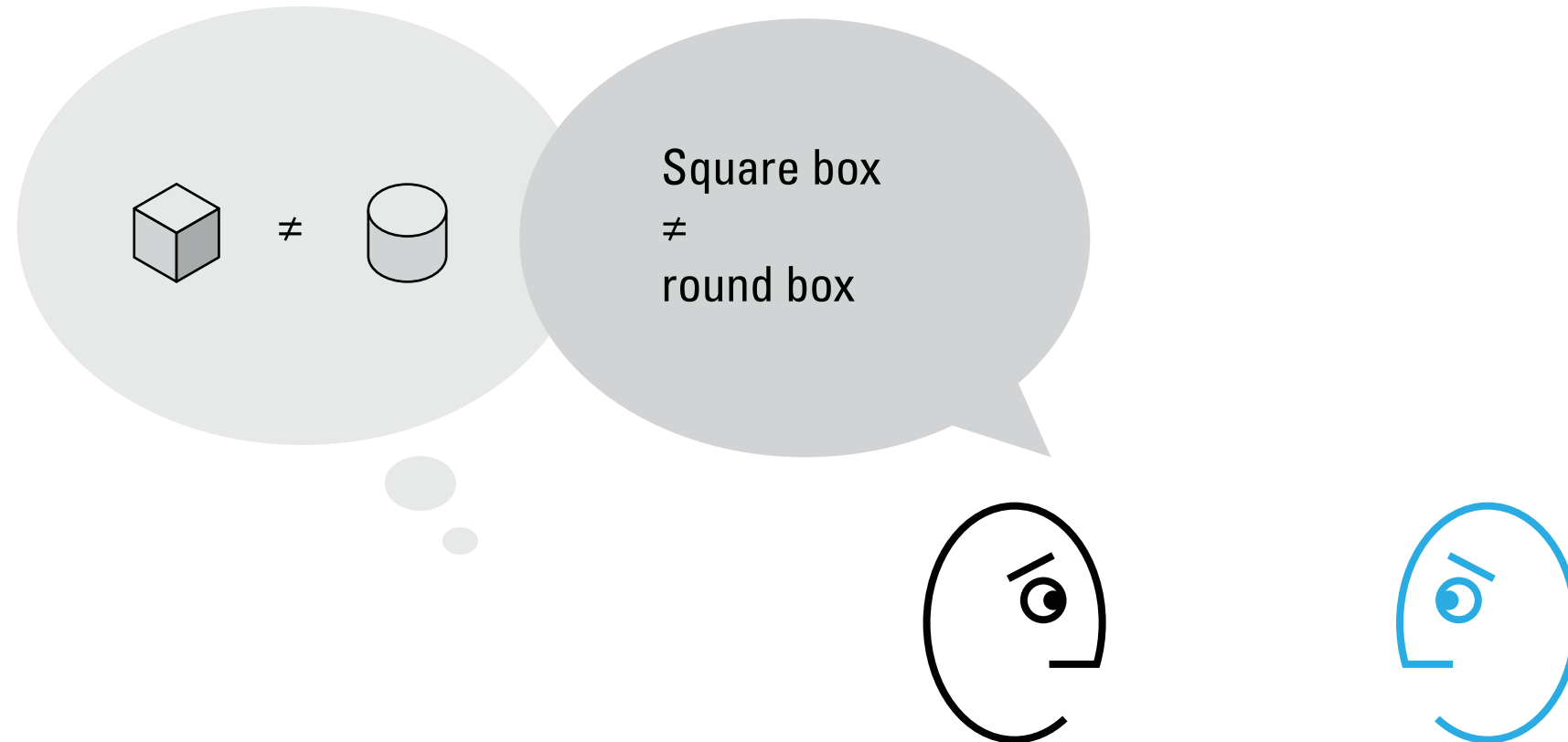
*See Gregory Bateson's Steps to an Ecology of Mind: Collected Essays in Anthropology, 1972,
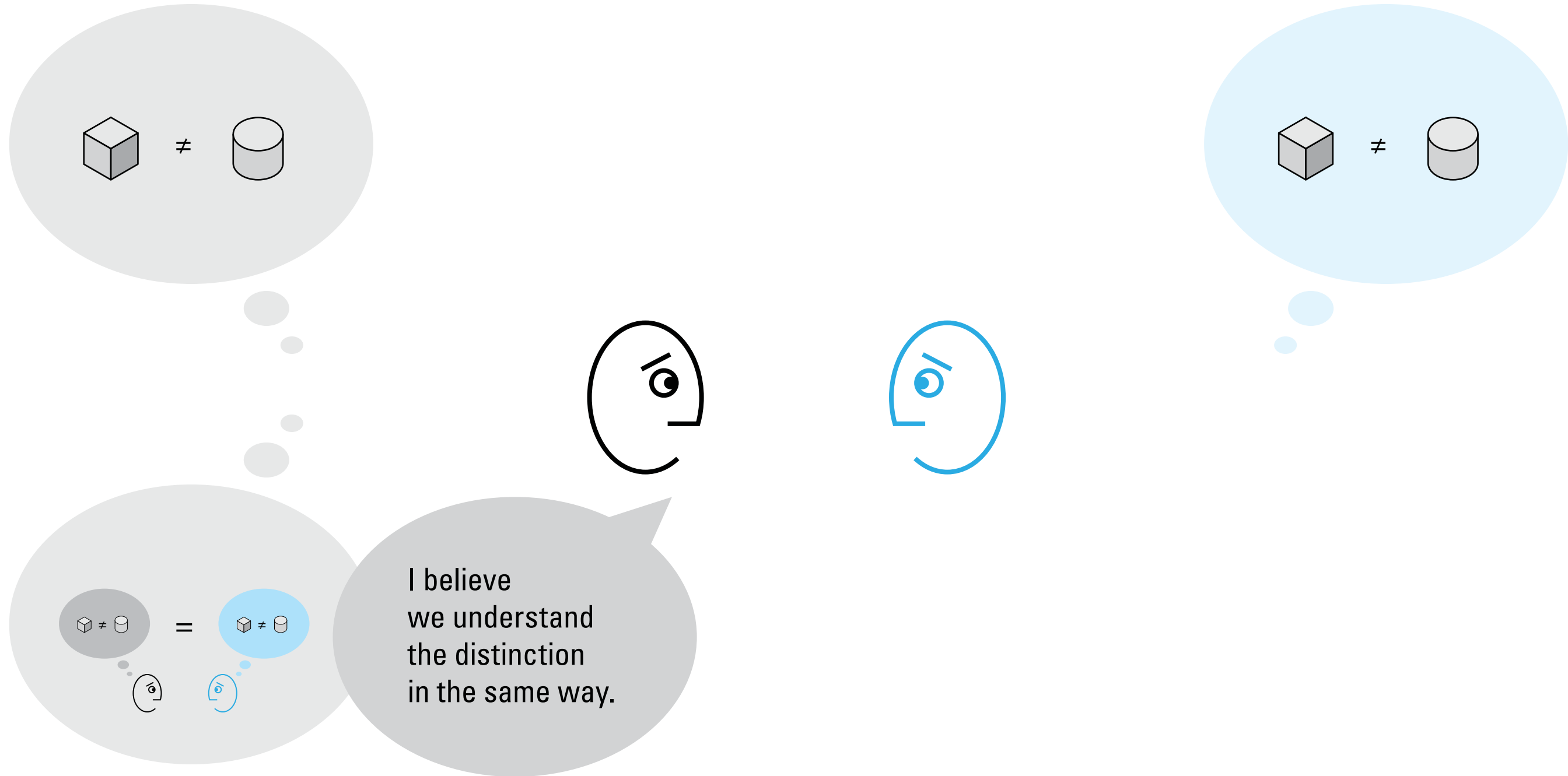"a bit of information is a difference that makes a difference."

See also G. Spenser Brown's Laws of Form, 1969,
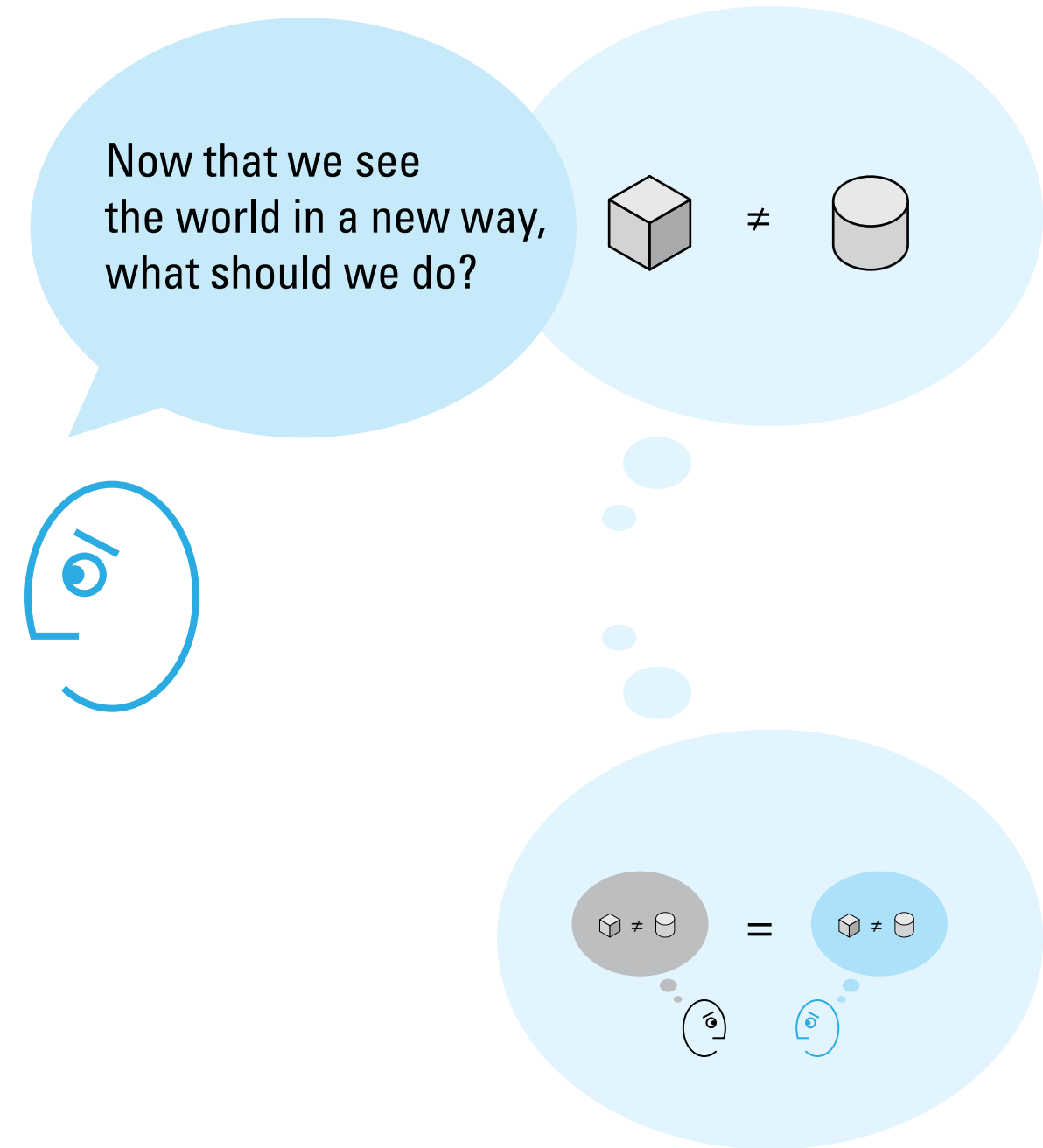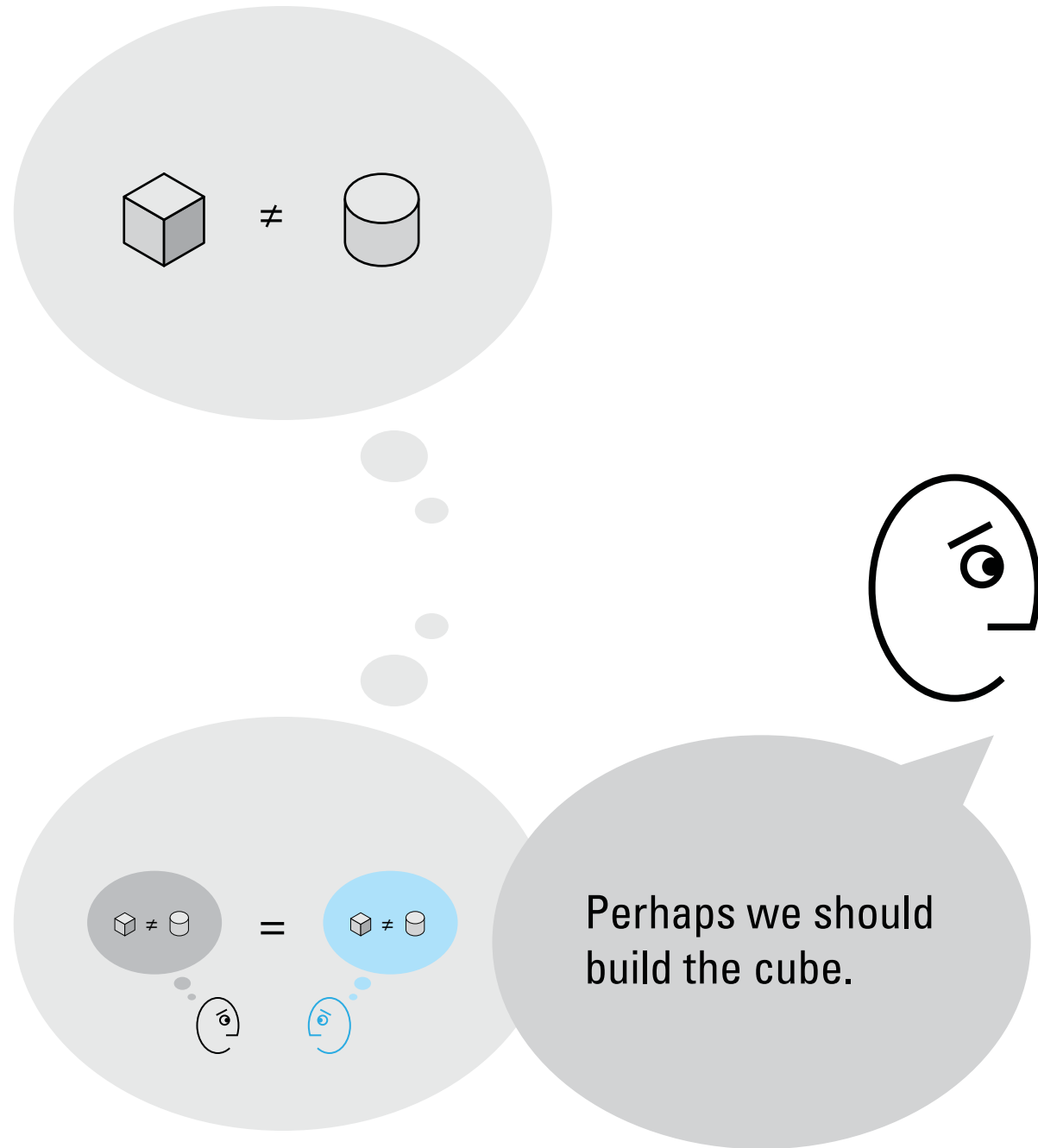"we cannot make an indication without drawing a distinction."

Conversations about distinctions may lead to **understanding**

Further conversations may lead to **agreement**

I believe
we understand
the distinction
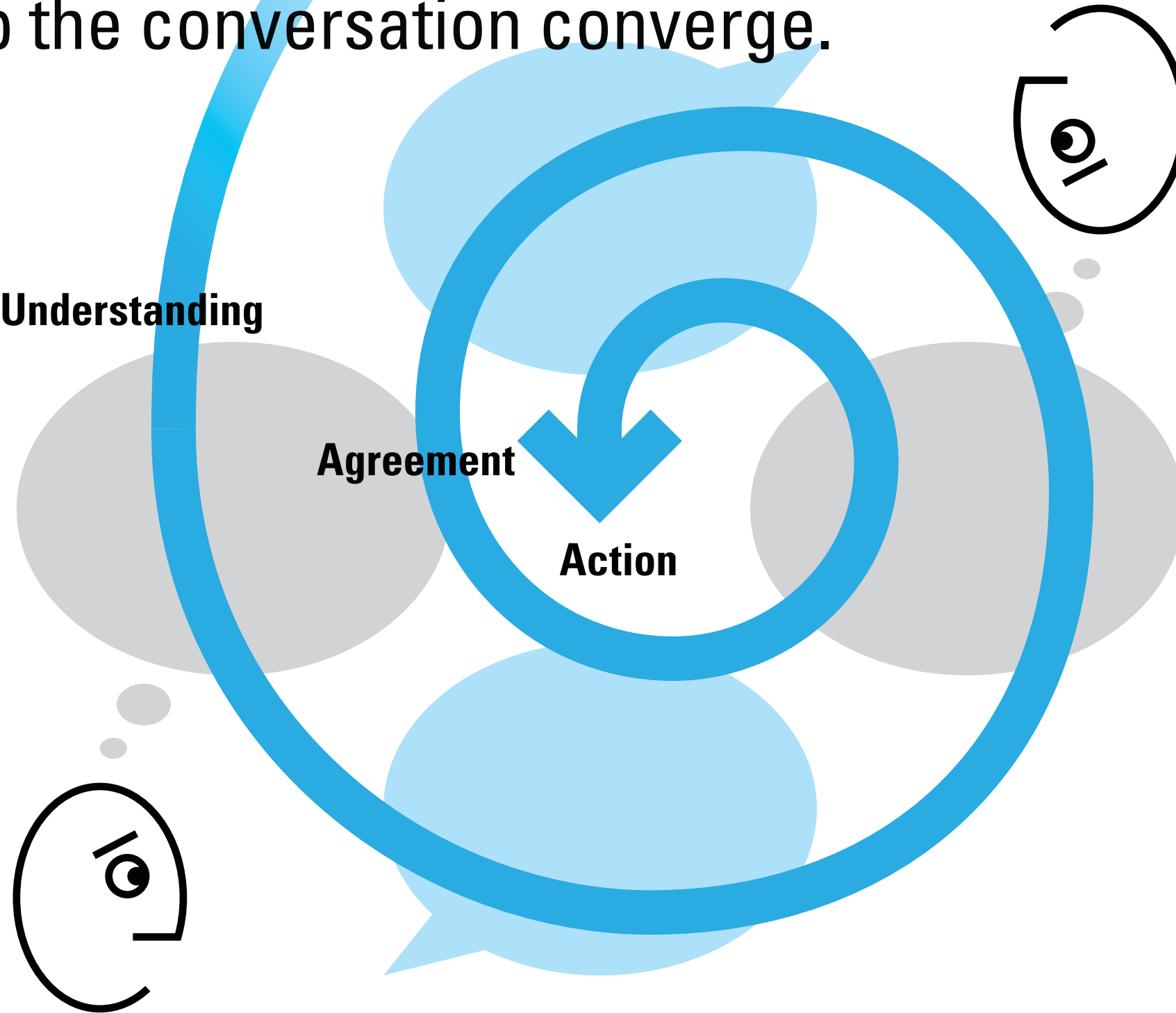in the same way.

Further conversations may lead to **action**

In sum: design is **conversation for action,**
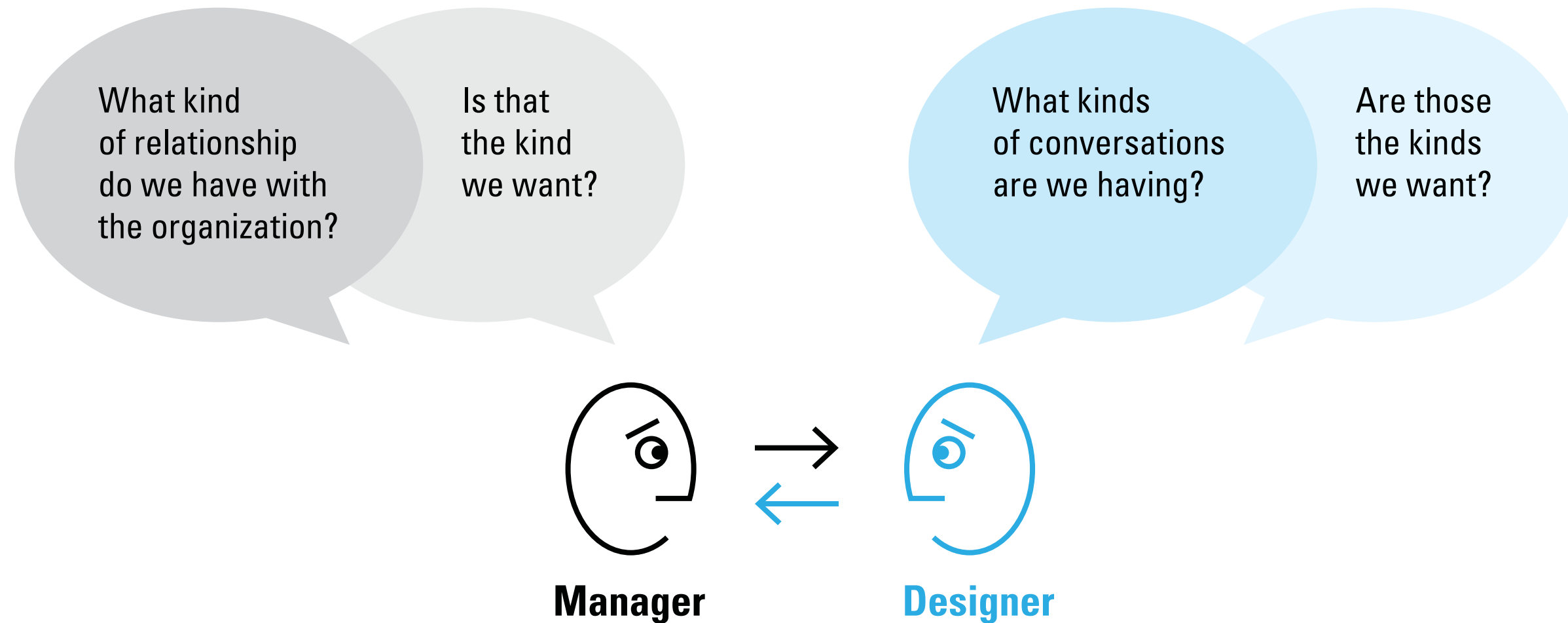and models help the conversation converge.

Distinction

Understanding

Agreement

Action

What are the types of conversation?

Mature organizations have **conversations about conversations;** managers and designers ask themselves and their colleagues:

What kind of relationship do we have with the organization?

Is that the kind we want?

What kinds of conversations are we having?

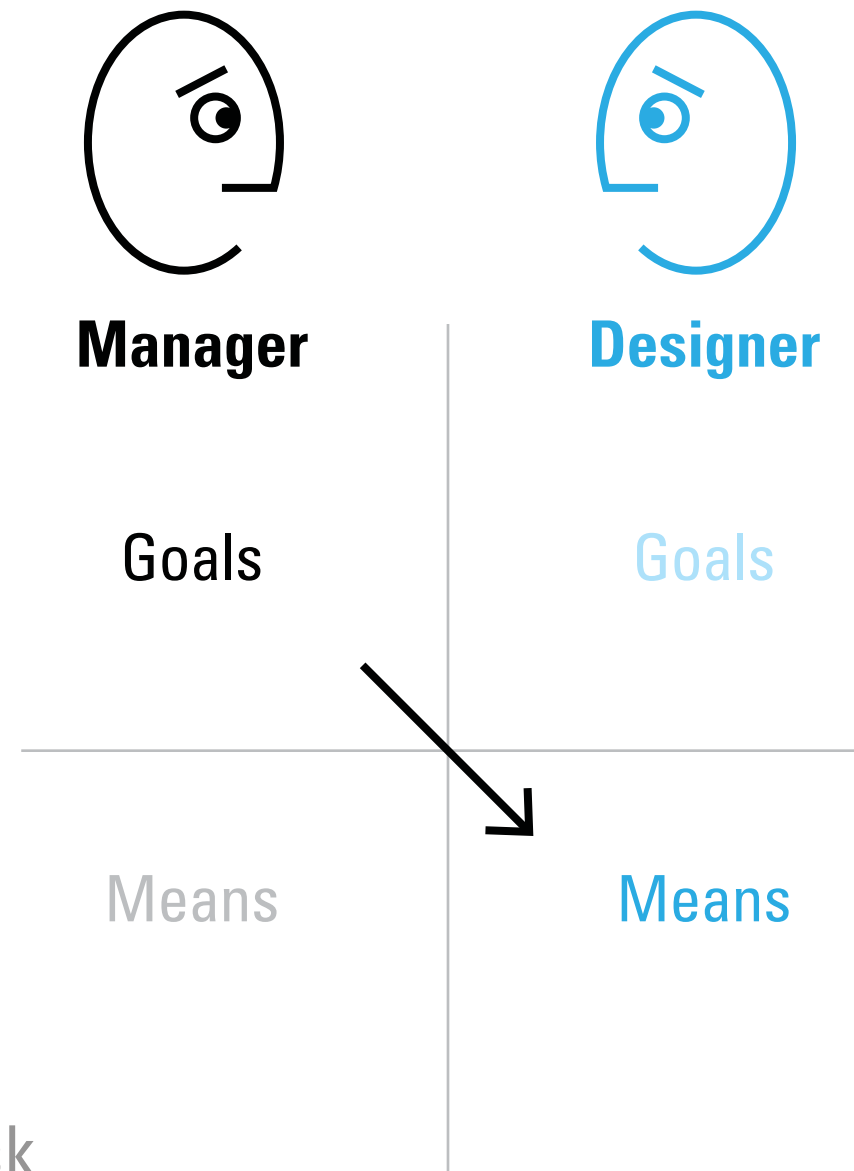Are those the kinds we want?

Manager

Designer

Controlling
Manager tells designer what to do and how to do it

Hallmark of a traditional
industrial-age organization;
may be appropriate for new
or under-performing employees

e.g., "Make the logo bigger."

Manager **Designer**
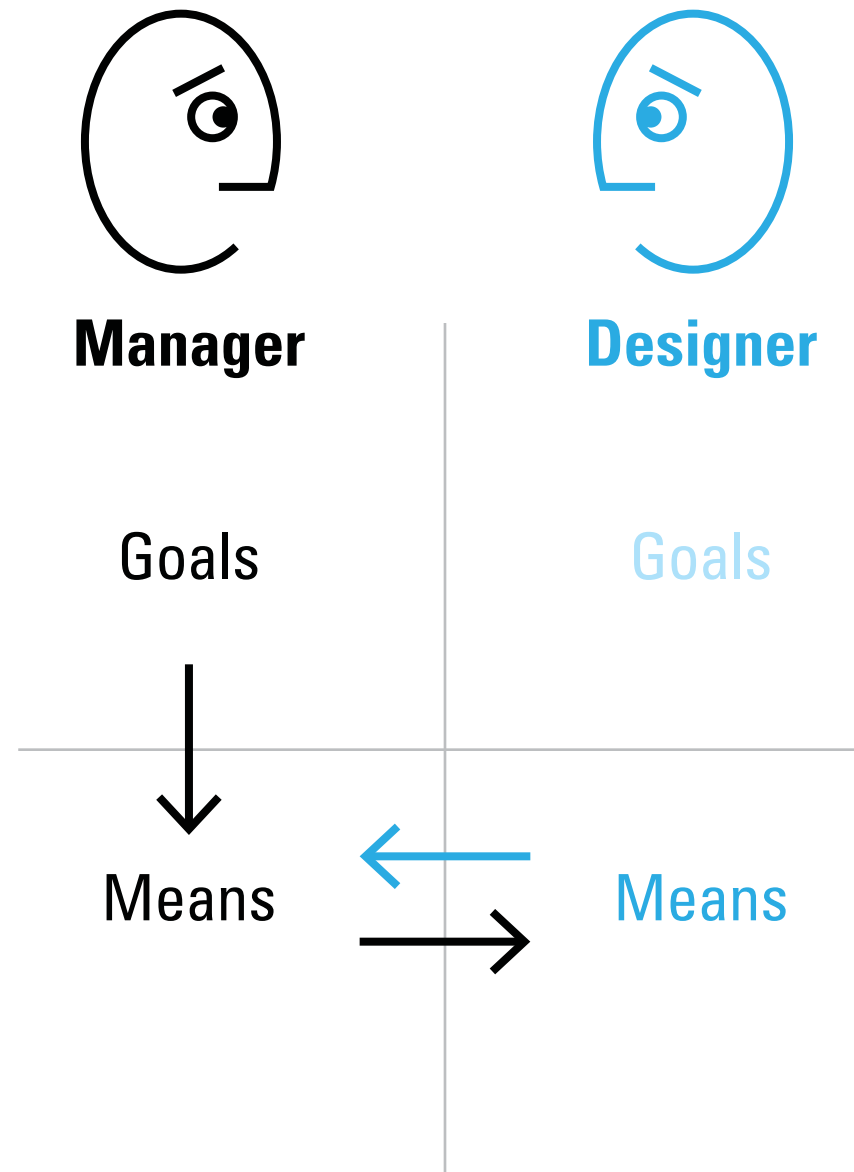
Goals   Goals

Means   Means

—after Paul Pangaro and Gordon Pask

Mentoring
Manager sets goals and discusses means with designer

Enlightened managers realize
that teaching is a key responsibility

e.g., "What's the best way
to make sure our name really pops?"

Manager   **Designer**
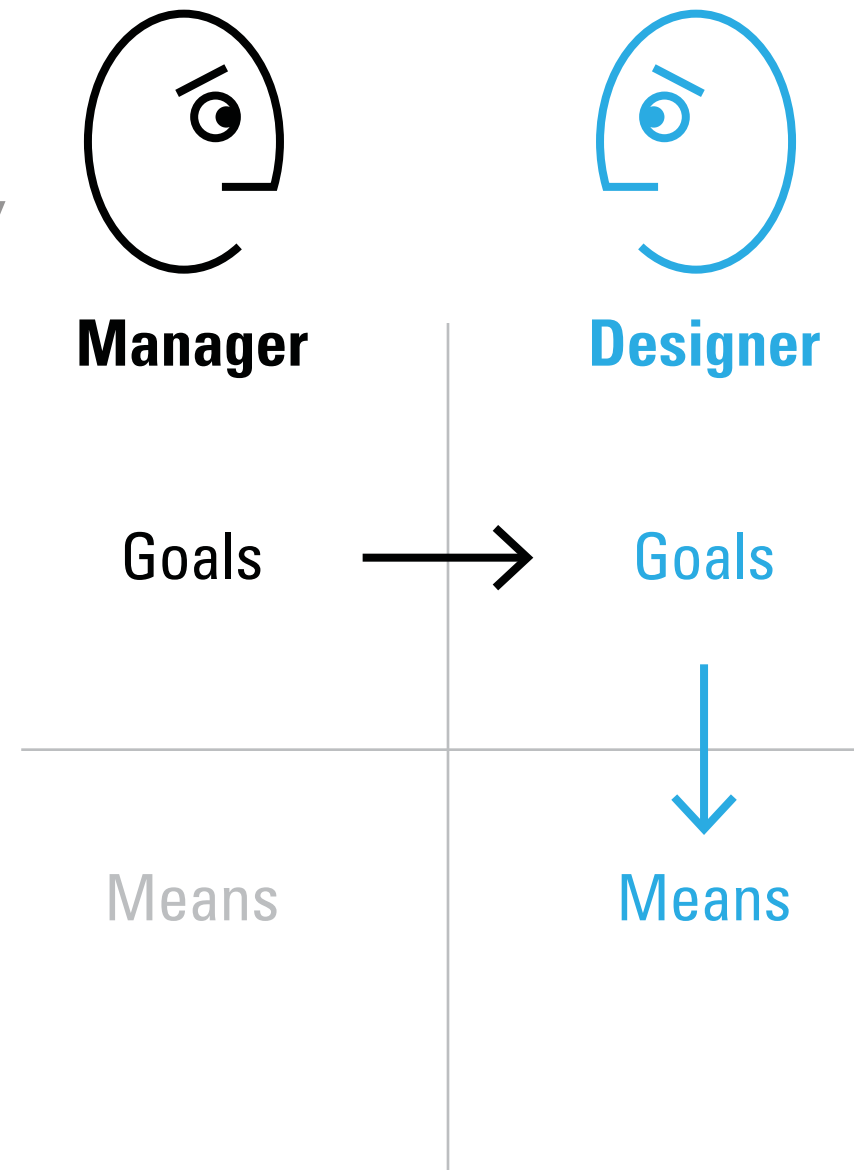
Goals   Goals

Means   Means

Delegating
Manager sets goal and leaves means to the designer

Good managers get out of the way
of good employees
and let them to do their jobs

e.g., "Make sure this ad gets noticed."

Manager   **Designer**

Goals ⟶ Goals

                      Means
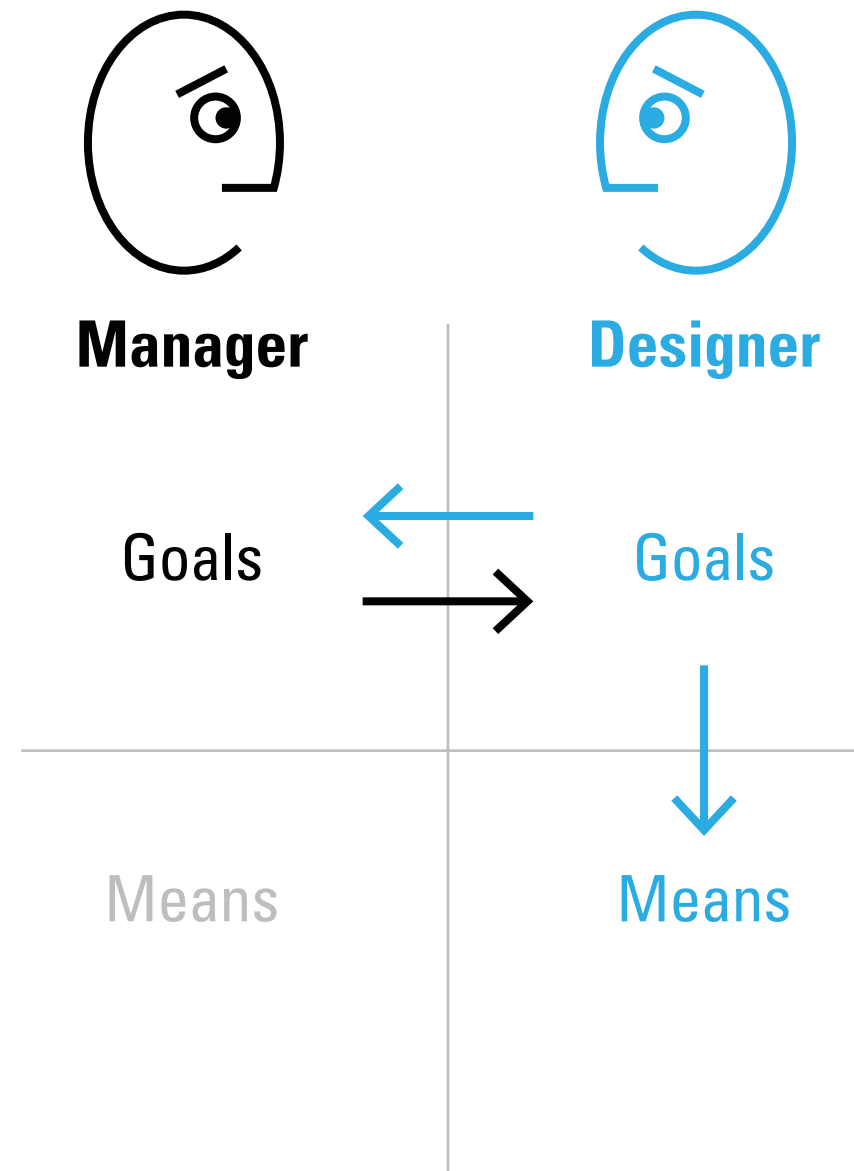
Means   Means

Collaborating
Manager and designer set goals together

Information-age management
is less hierarchical
and more collegial

e.g., "Which methods
of engaging customers
are right for us?"

Manager

Designer

Goals

Goals

Means

Means

So far, we have assumed **problems are familiar,** and standard operating **procedures are effective**

Existing language, procedures, and people

Manager   **Designer**

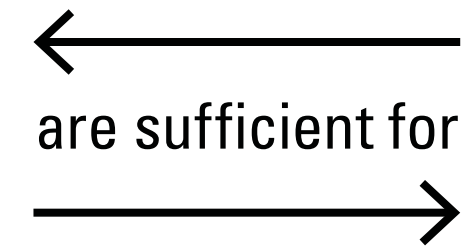Goals   Goals
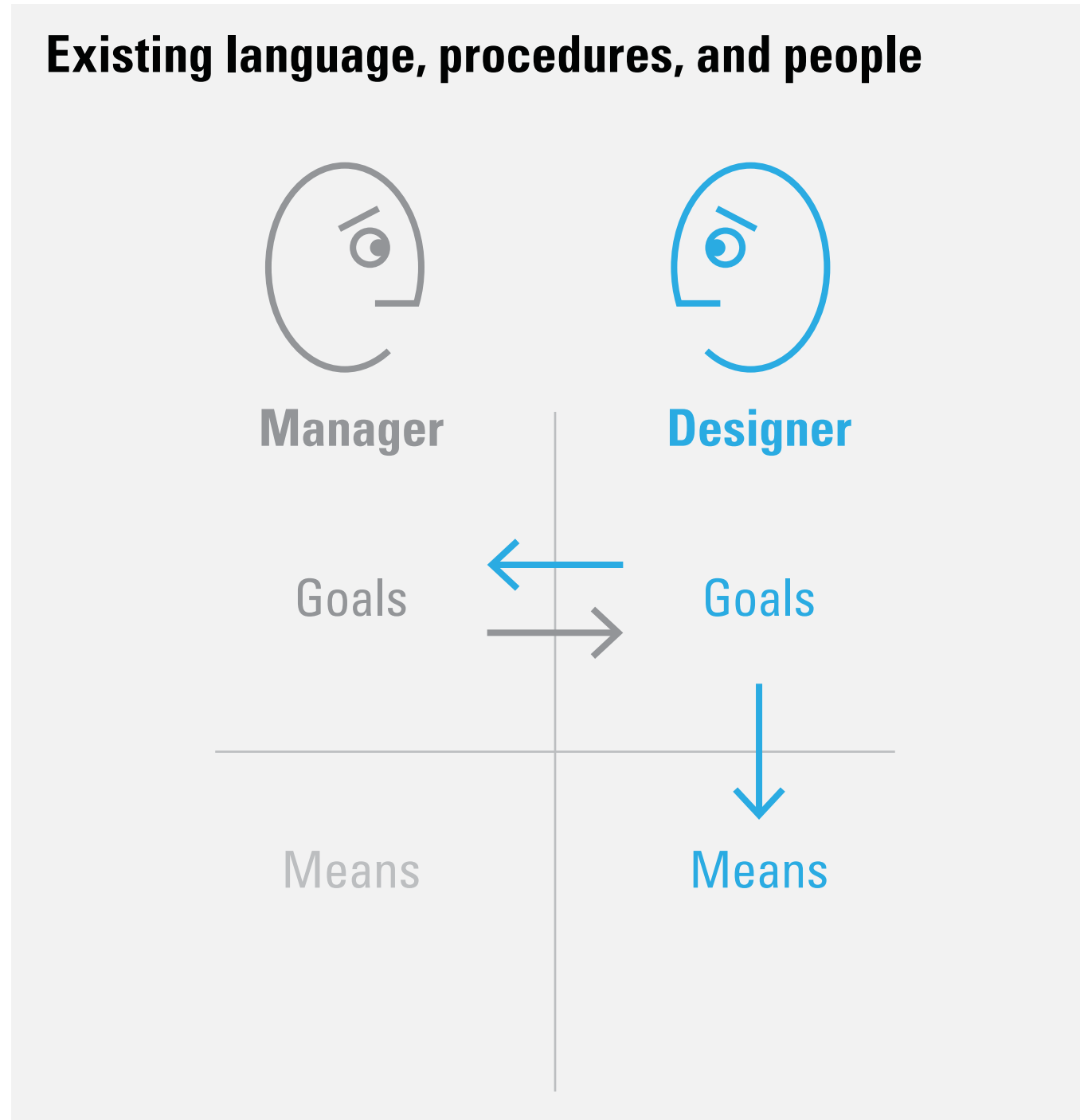
Means   Means
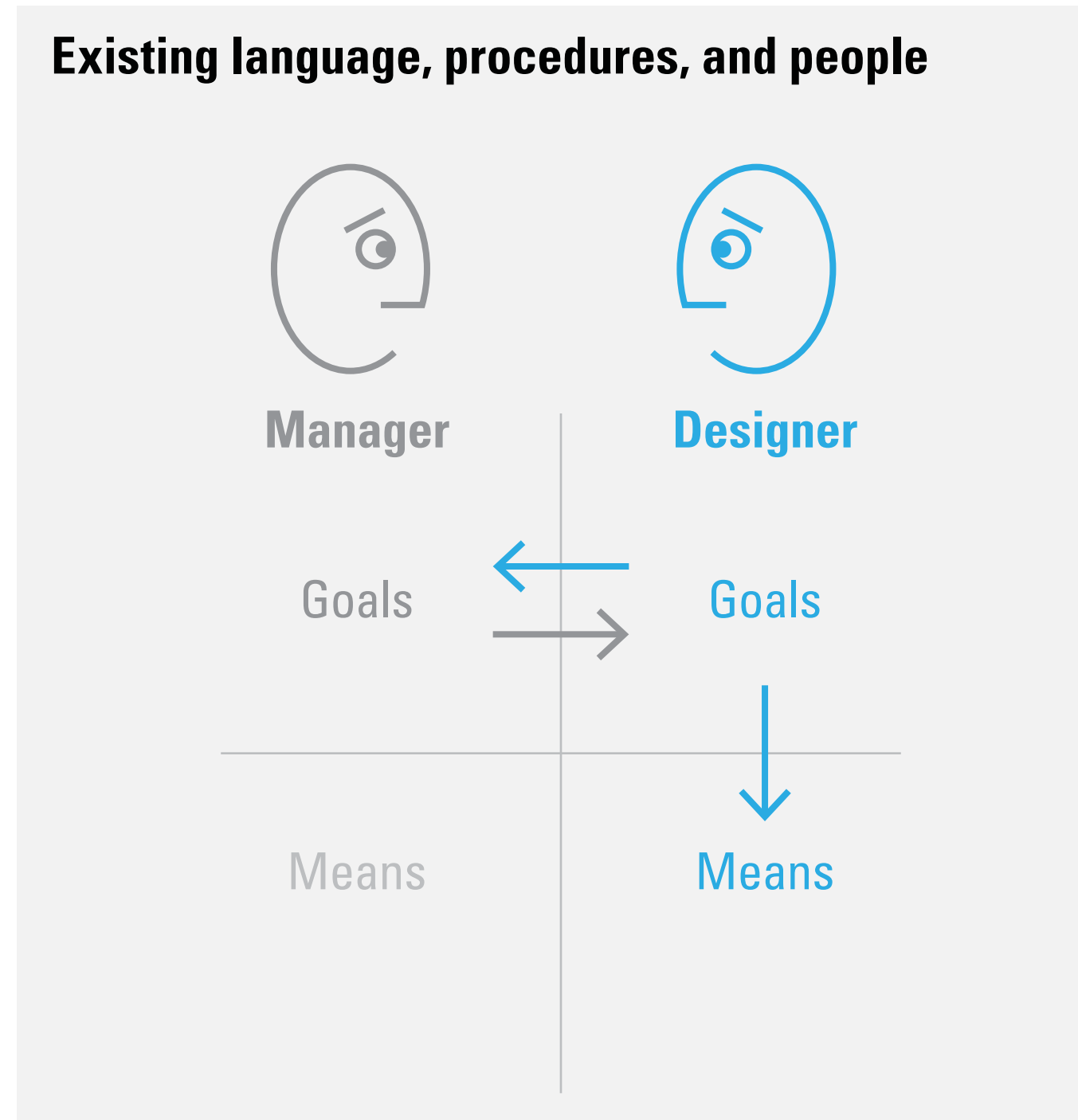
← are sufficient for →

Existing classes of problems

More and more organizations face **unfamiliar problems** and find existing procedures are less and less effective
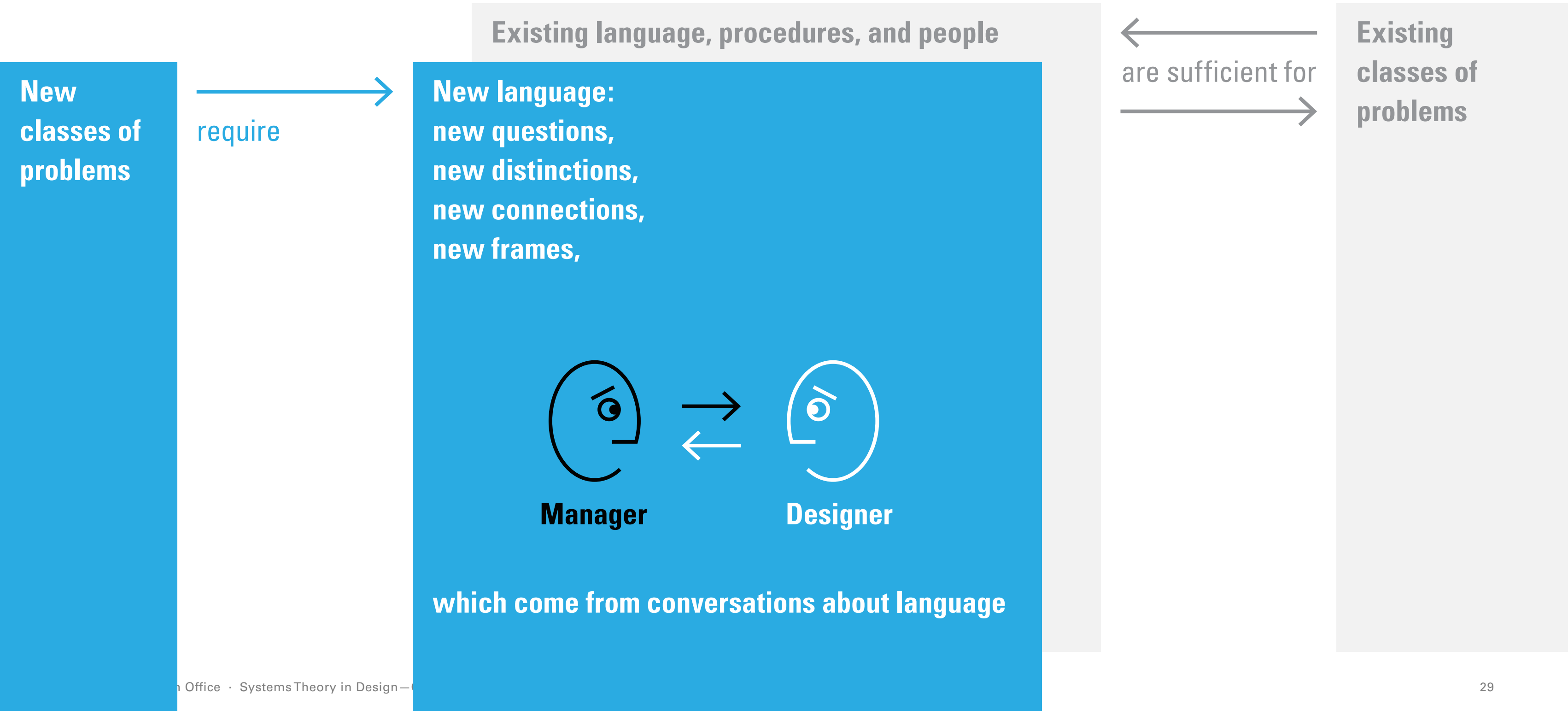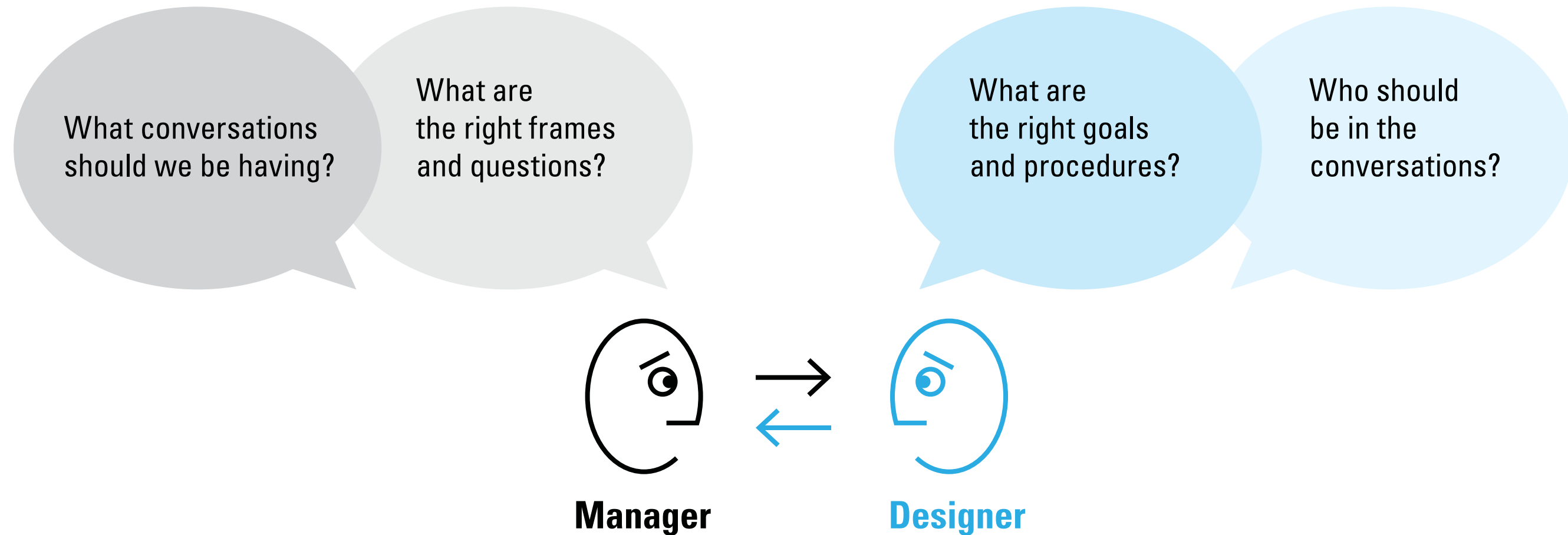
New classes of problems

challenge →

Existing language, procedures, and people

Manager   Designer

Goals ← Goals

→

↓

Means   Means

← are sufficient for →

Existing classes of problems

Inventing
Manager and designer develop new language

New classes of problems

require

Existing language, procedures, and people

New language:
new questions,
new distinctions,
new connections,
new frames,

Manager   **Designer**

which come from conversations about language

are sufficient for

Existing classes of problems

Bootstrapping
Manager and designer develop new conversations

What conversations should we be having?

What are the right frames and questions?

What are the right goals and procedures?

Who should be in the conversations?

Manager

Designer

Regarding design in terms of conversations

"...*every design problem begins with* an effort to achieve fitness *between two entities: the form in question and its context.*"
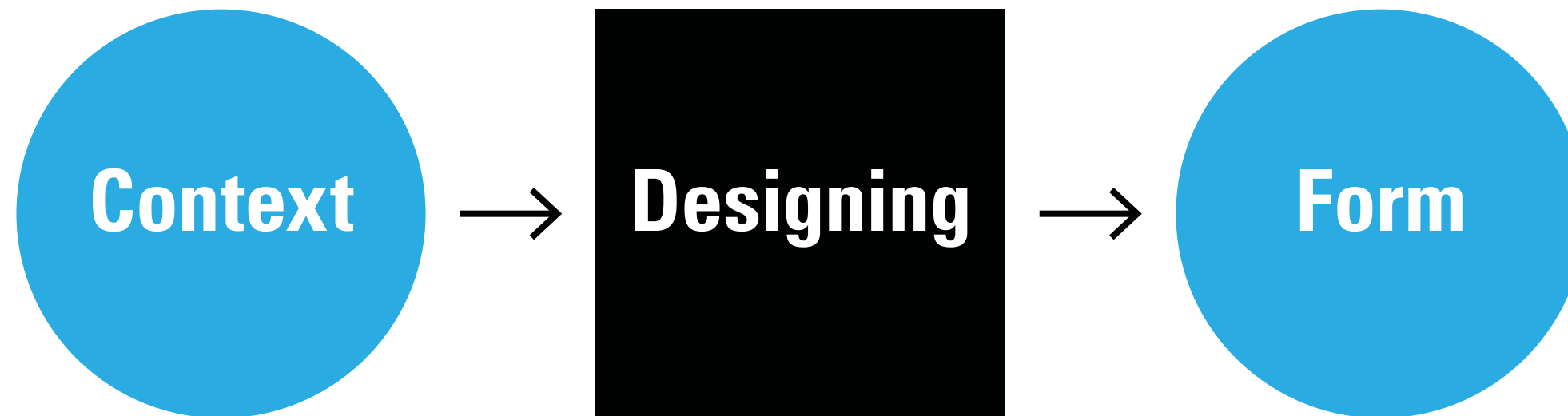
"*The form is the solution to the problem; context defines the problem. In other words, when we speak of design, the real object of discussion is not the form alone, but the ensemble comprising the form and its context.*"

—Christopher Alexander, Notes on the Synthesis of Form, 1964

Design as **transformation**

Context → **Designing** → **Form**

—after Christopher Alexander

What Alexander calls "fit" is based on **continuous symmetrical feedback**

"... adaptation is a mutual phenomenon referring to the context's adaptation to the form as much as the form's adaptation to the context..."
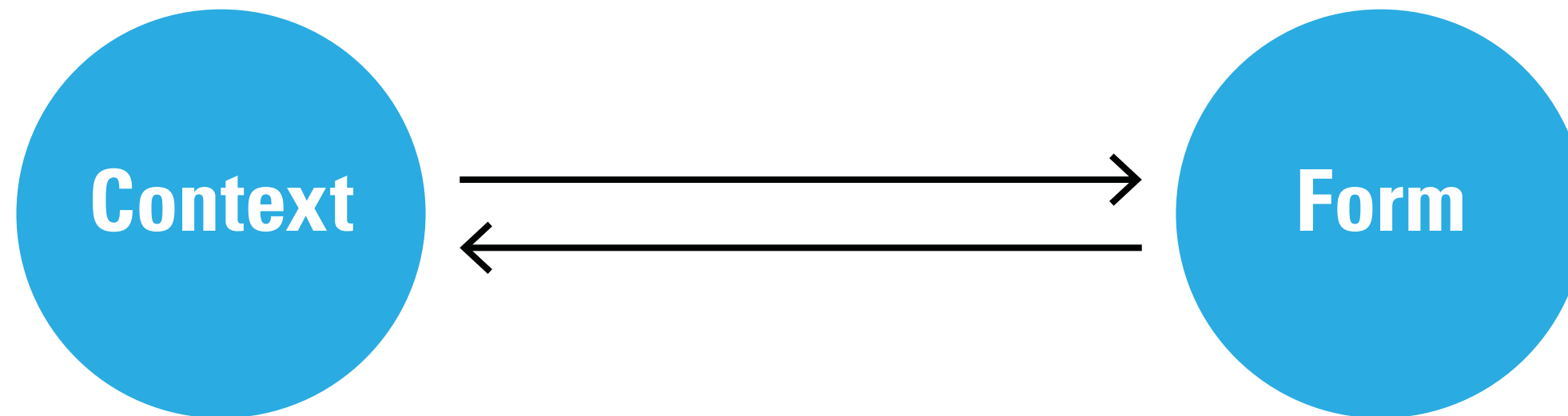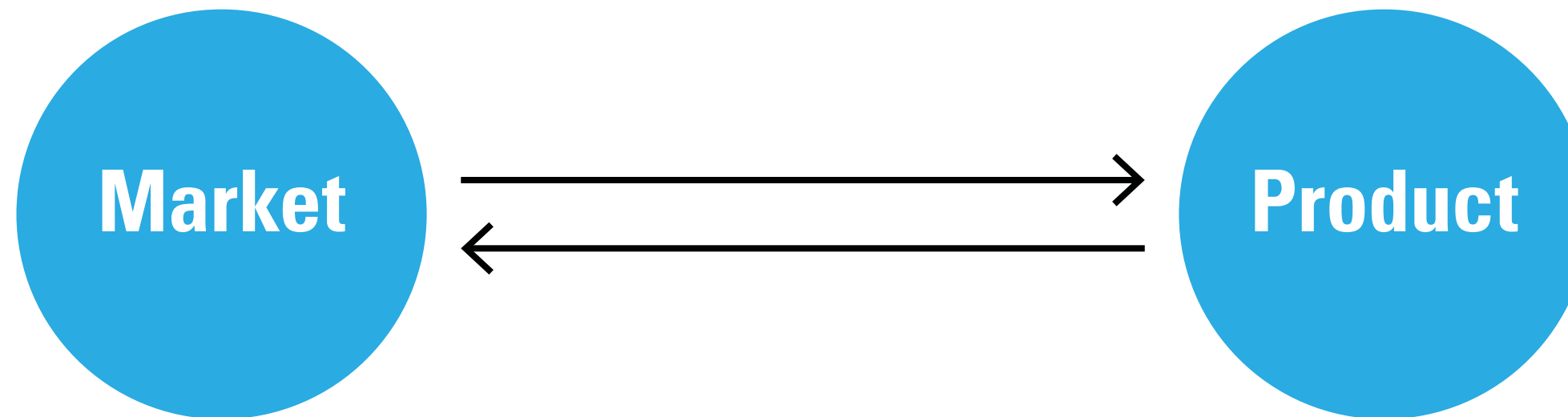
—Christopher Alexander

In Alexander's original model,
the arrow points in both directions
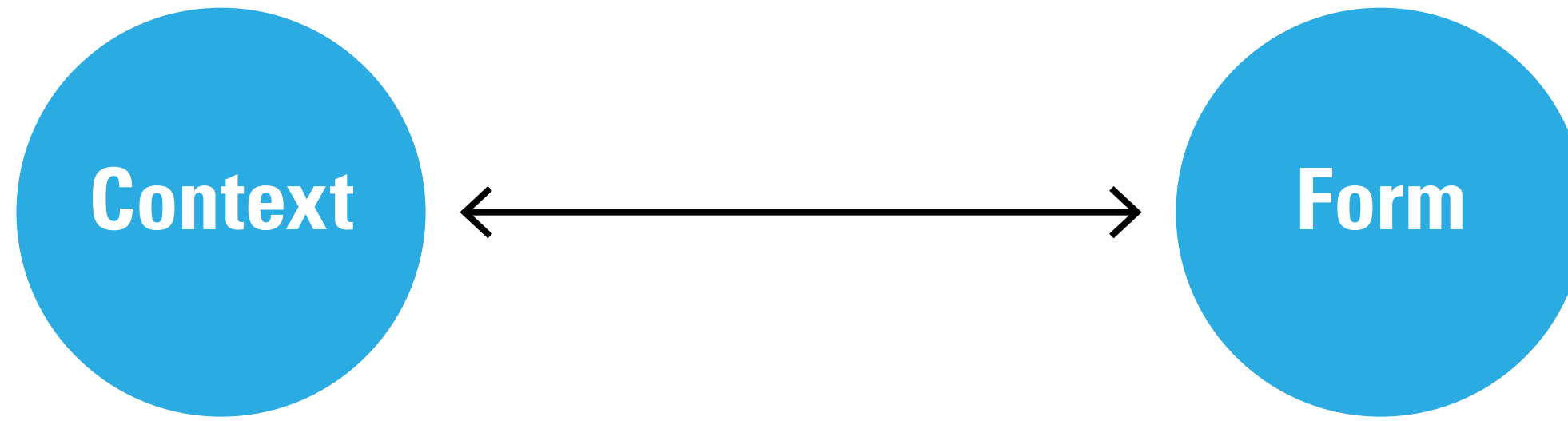
Context ⟷ Form

Two arrows might be more clear;
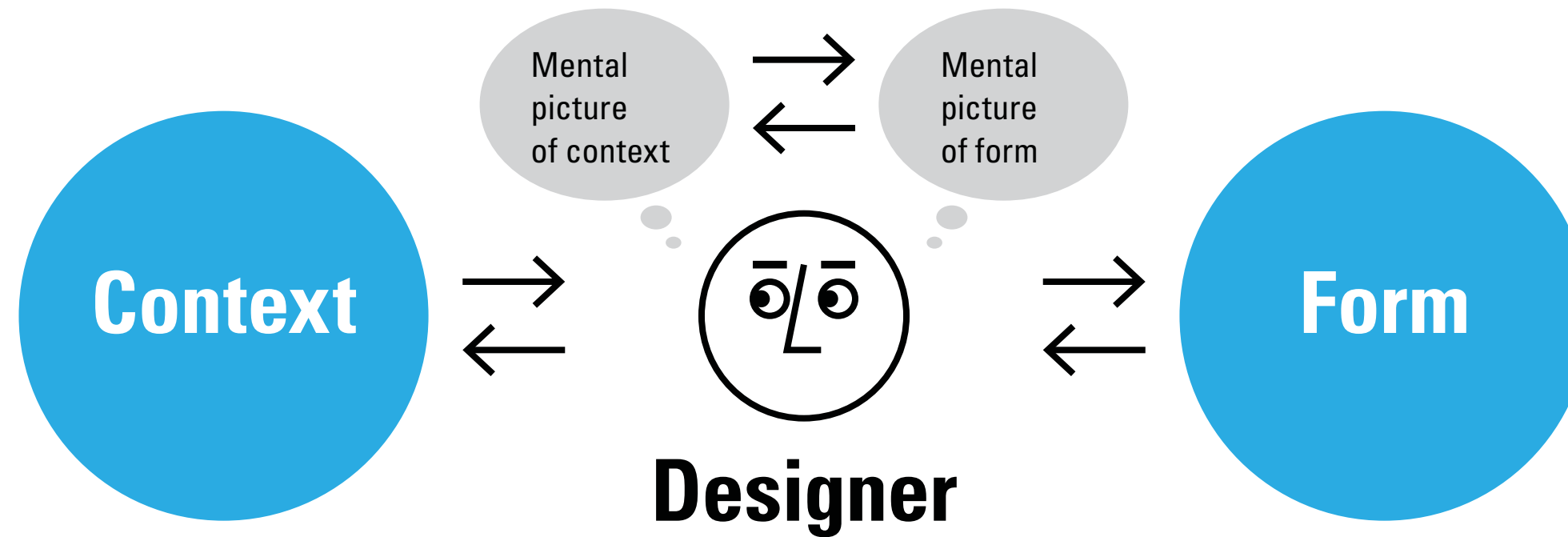context and form interact, co-evolve

In other words,
products have conversations with markets:
the market teaches the product,
and the product teaches the market

Market

Product

Product stands for simple
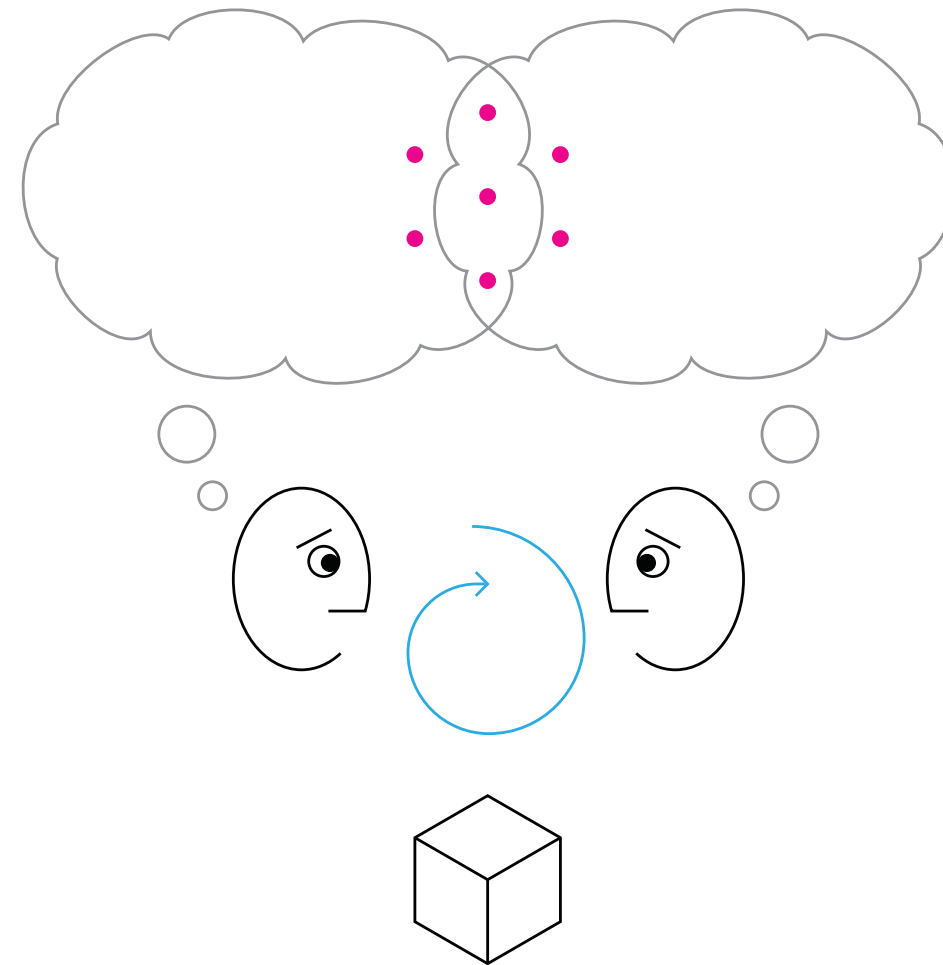products, services,
systems,
and product-service
ecologies.

Something's missing: **the designer, interacting with the situation and materials**

Conversation is aided by **showing what we mean,**
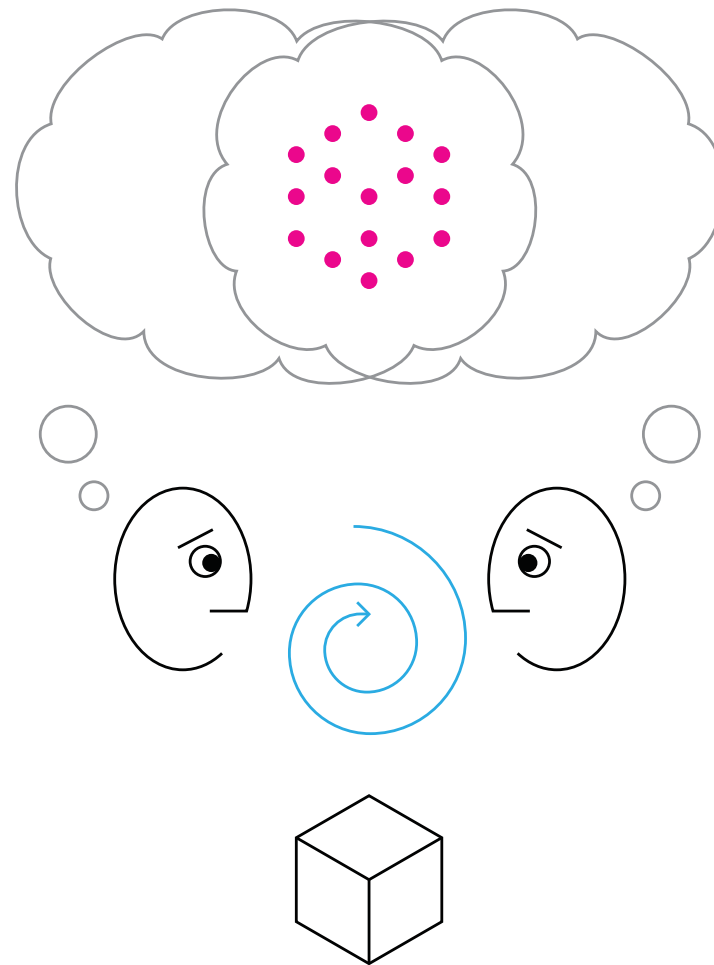e.g., sketches, schematics, prototypes, etc.

Sketches   Schematics   Prototypes
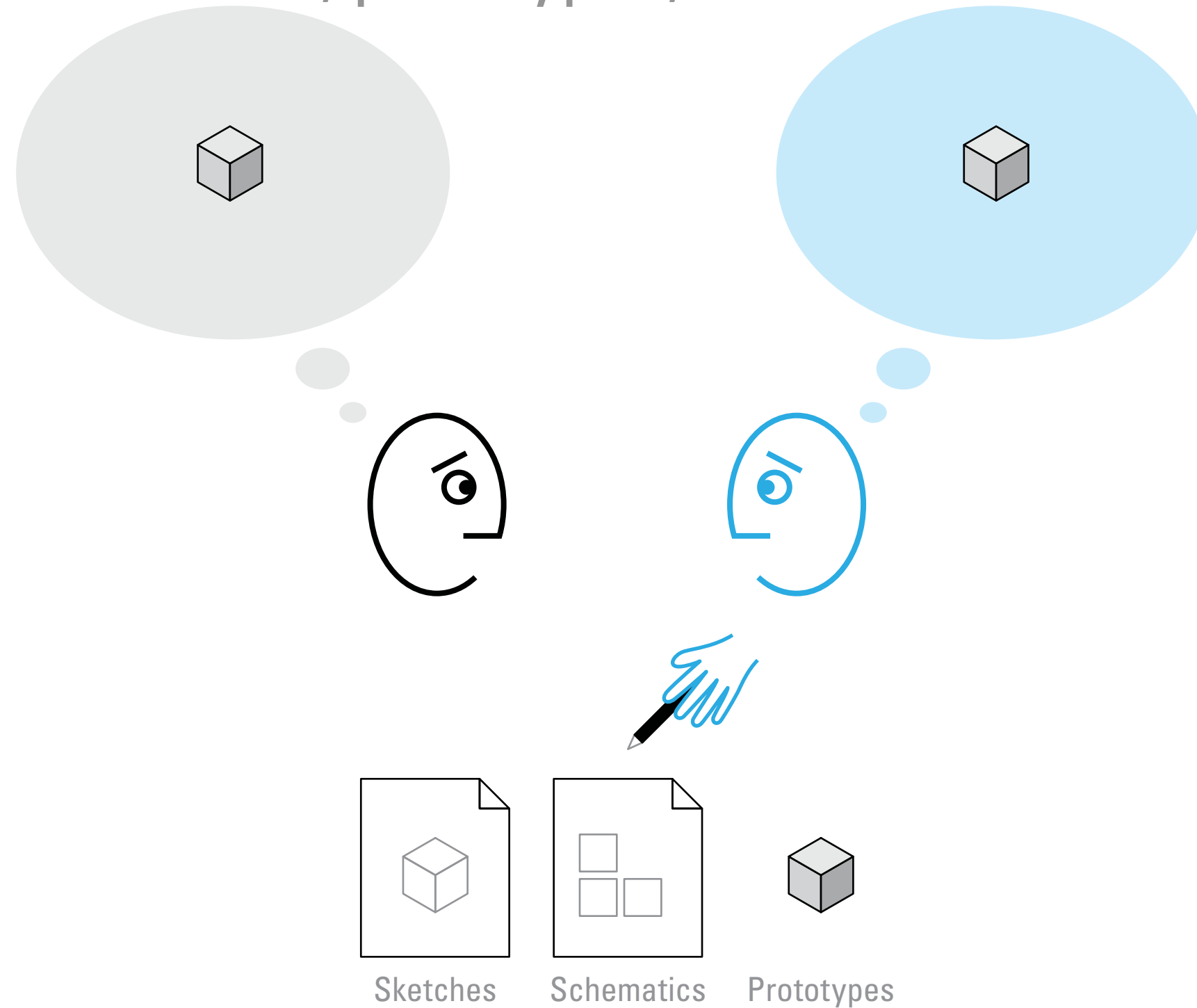
We describe conversation
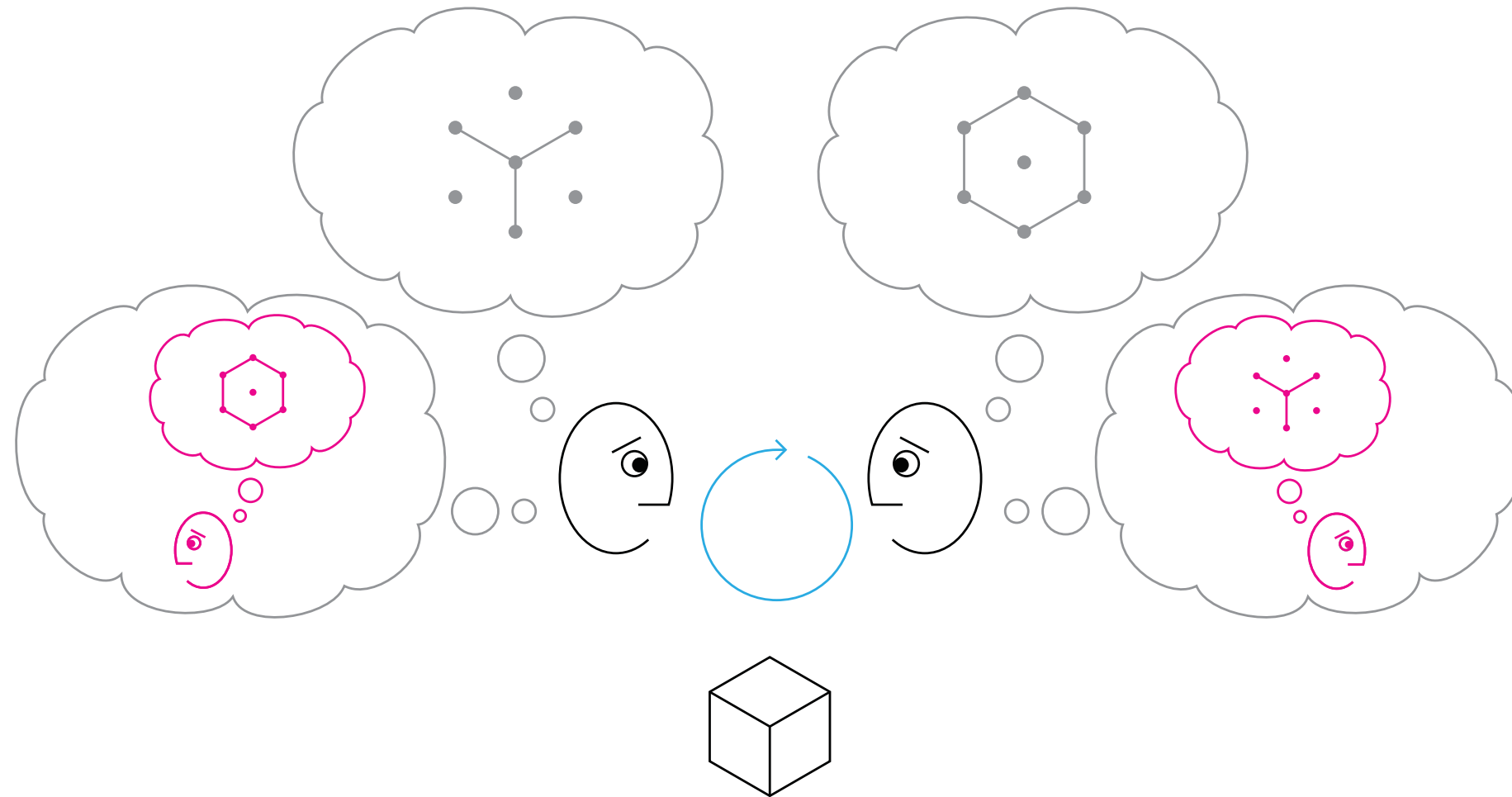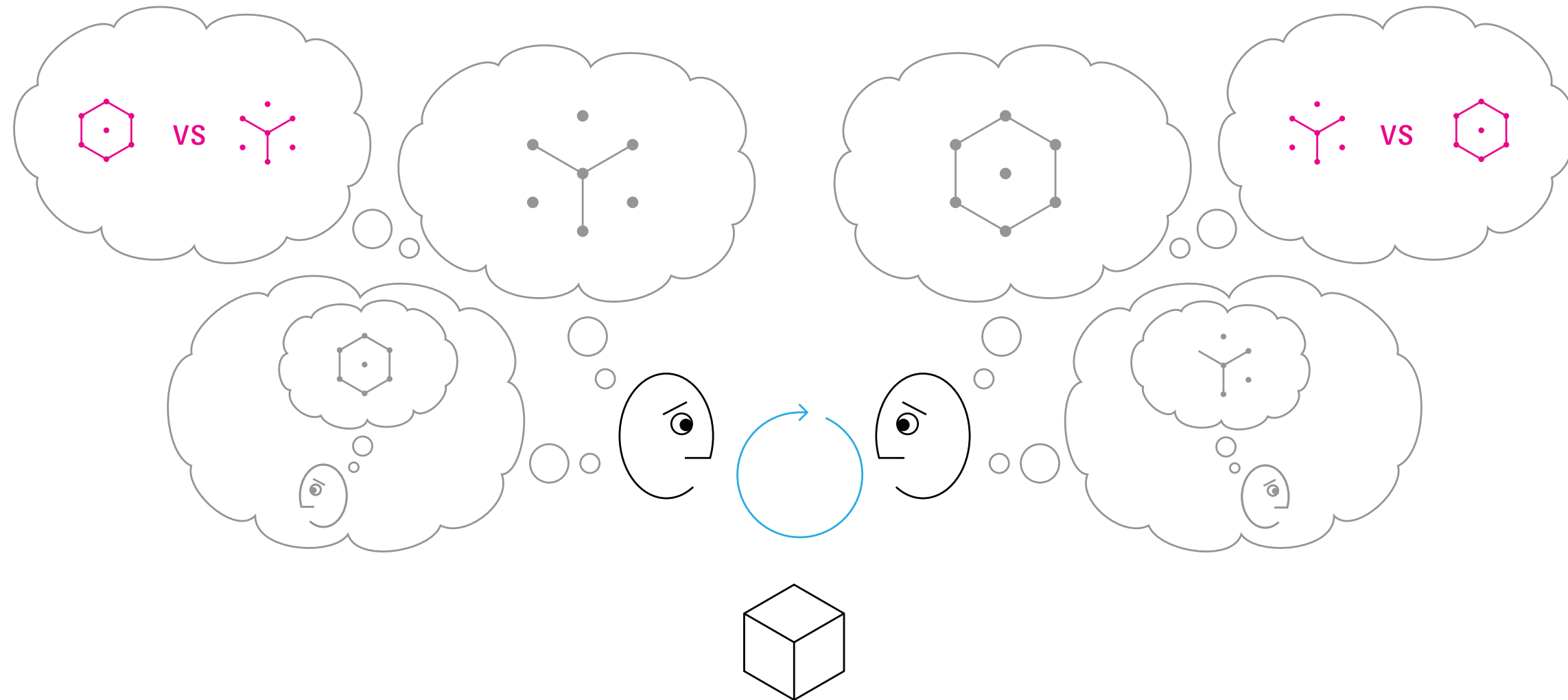# *as if* we are creating a shared mental model...

...*as if* our mental models are converging.

But 'sharing' is shorthand for a more complex process in which we form a mental model of out interlocutor's mental model of the topic at hand,...

...and **compare it to our own model** in order to confirm sufficient agreement on relevant areas to continue the **conversation**.

# Sociologist Donald Schön describes these **conversations**

"A designer... shapes the situation,
...the situation 'talks back,'

In a good process of design,
the designer reflects-in-action
on the construction of the problem,
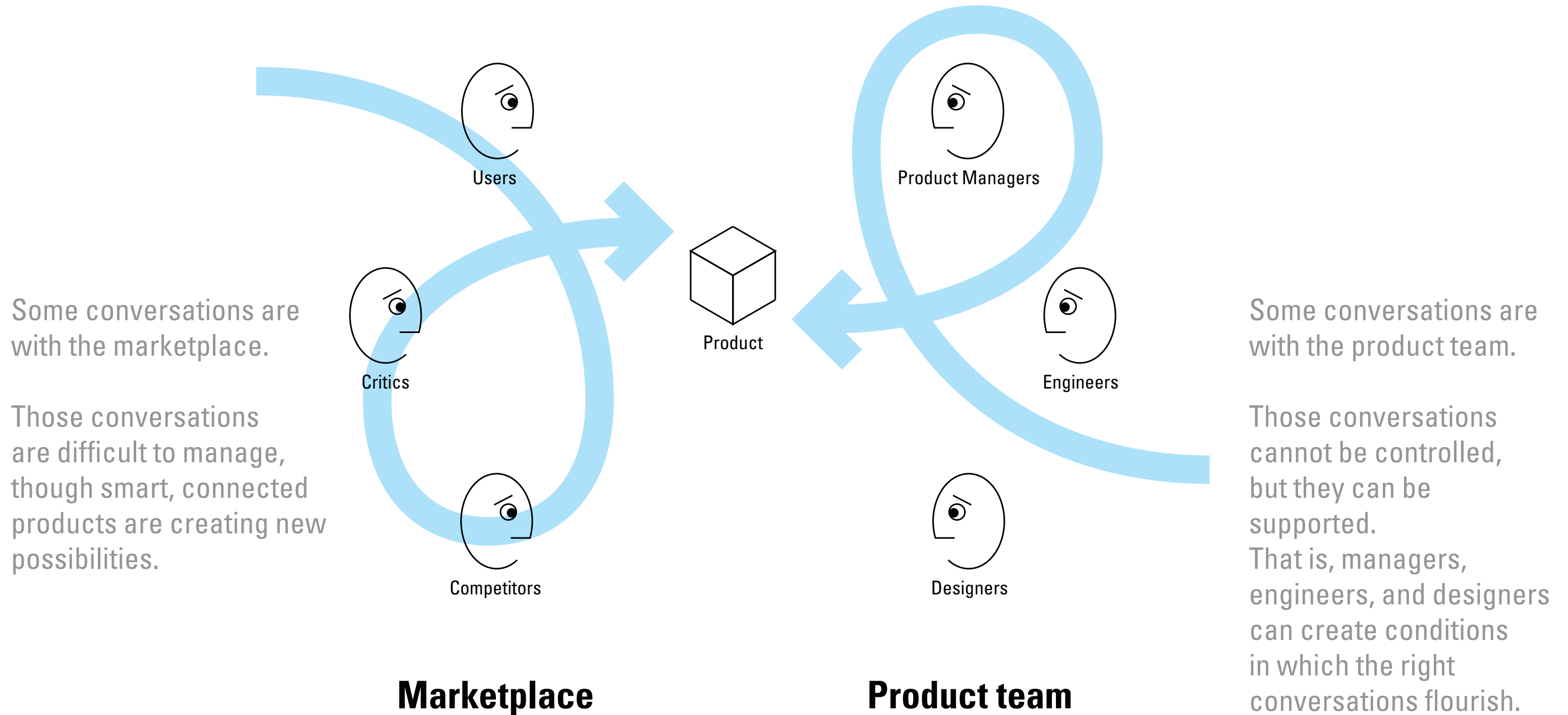*the strategies of action,*
or the model of the phenomena..."
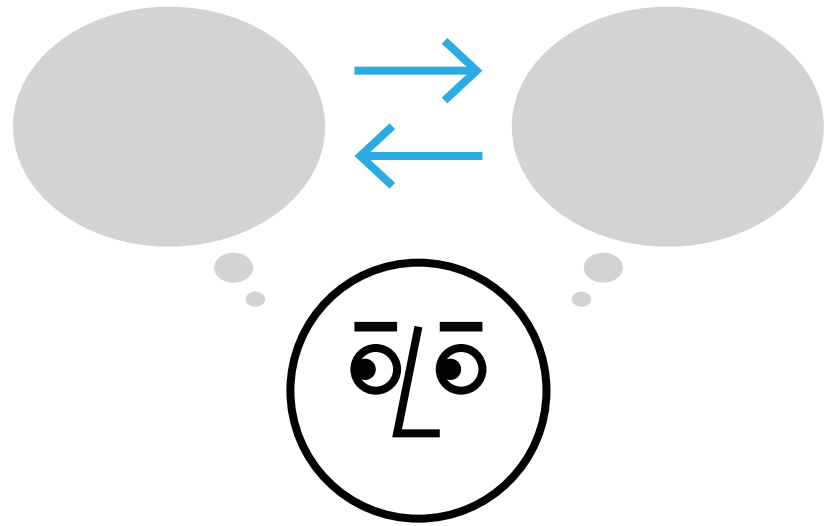
—Donald Schön, The Reflective Practitioner, 1984

Designers rarely work in isolation;
they're often engaged in conversation
with clients, engineers, suppliers, and many others
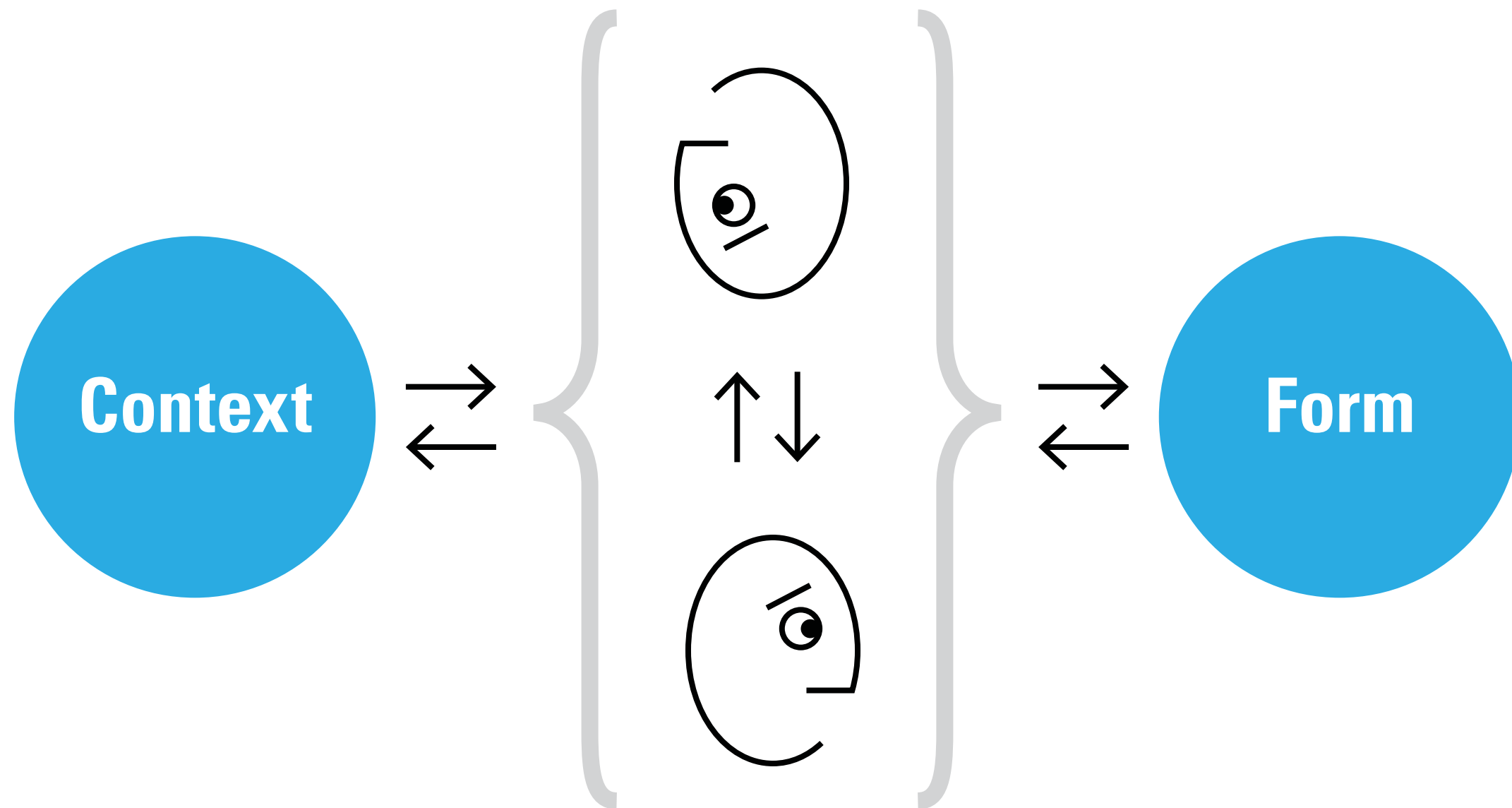
"Providers" are **constantly in conversation** with "consumers;" services are co-created at the point of delivery

Users

Product Managers

Some conversations are with the marketplace.

Those conversations are difficult to manage, though smart, connected products are creating new possibilities.

Critics

Product

Engineers

Some conversations are with the product team.

Those conversations cannot be controlled, but they can be supported.
That is, managers, engineers, and designers can create conditions in which the right conversations flourish.

Competitors
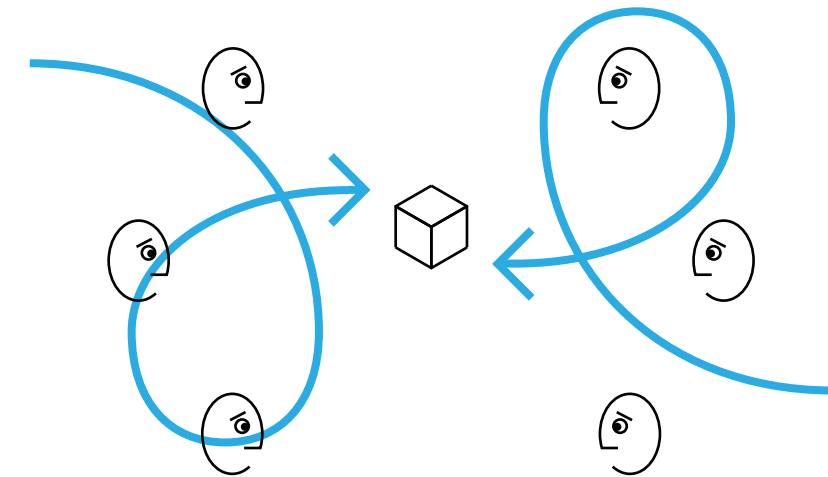
Designers

Marketplace

Product team

Conversation takes place in **three domains**

Between you and yourself,
e.g., a soccer player weighs
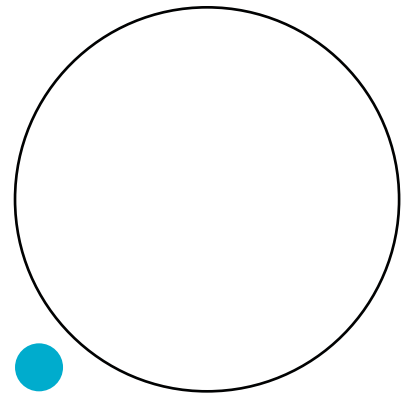options for a kick
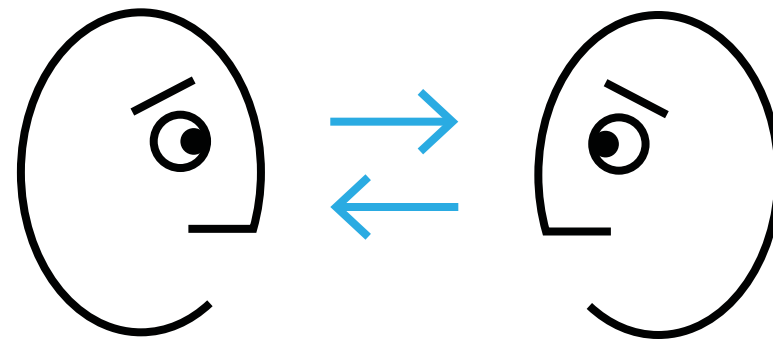
Between you and another person,
e.g., two players pass the ball
back and forth

Between one group and another,
e.g., two teams interact
throughout a match

The quality of the conversation depends on **the relationship between a design group and the organization** that it supports.
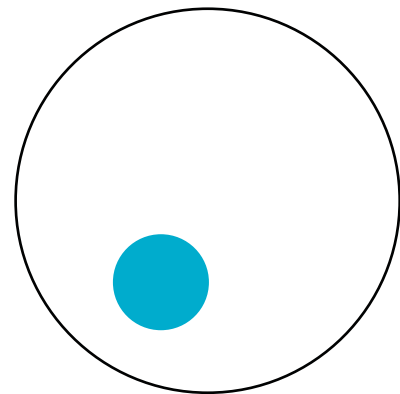
Separate

Design as external resource

Design thinking and methods
have no continuous presence
in the organization.

They are add-ons,
limited to traditional problems:
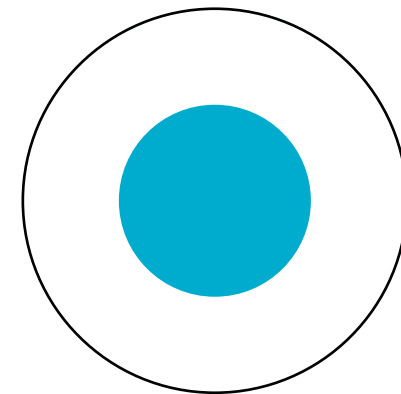form, communication, function.

Peripheral

Design as part of the organization

Design thinking and methods
practiced somewhere within
the organization.

They apply to specific
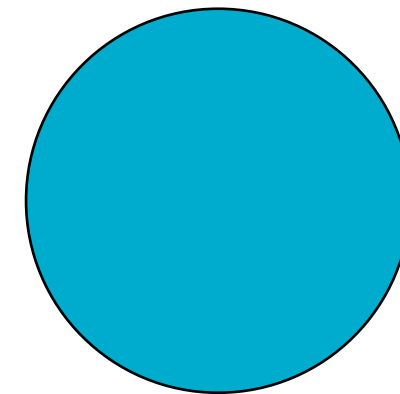products and services.

Central

Design at the core
of the organization

Design thinking and methods
are highly visible and
take a central position.

They unify products and
services across an organization;
apply to corporate design
and brand strategy.

Integrated

Design integral to all aspects
of the organization

Design thinking and methods
are being applied at an
organization's top level
as means to inquire into
a wide range of organizational
problems with the aim to
develop integrated solutions.

—Sabine Junginger, 2009

Special thanks to
Jamie Ikeda

hugh@dubberly.com