Object identification over time:

A core problem for AI and organisms

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Three components

That is an *object*
(the figure-ground problem)

That is *this kind* of object
(the classification or categorization problem)

This now is the *very same object* as that then
(the persistent individual problem)

Two questions

How do we do it?
(no cheating in the explanation!)

How can we get machines to do it?
(no cheating in the implementation!)

No cheating?

Assuming that what we adult humans regard as “objects” are somehow given in advance by Nature is cheating.

Providing a machine with a category hierarchy, a collection of templates, or a set of prior probabilities for object types is cheating.

Why is this cheating?

Quantum theory provides no mechanism for the objective emergence of classical objects.

Developmental and visual neuroscience suggest that motion detection is primary and categorization is derivative.

(claims to the contrary notwithstanding)

What people see

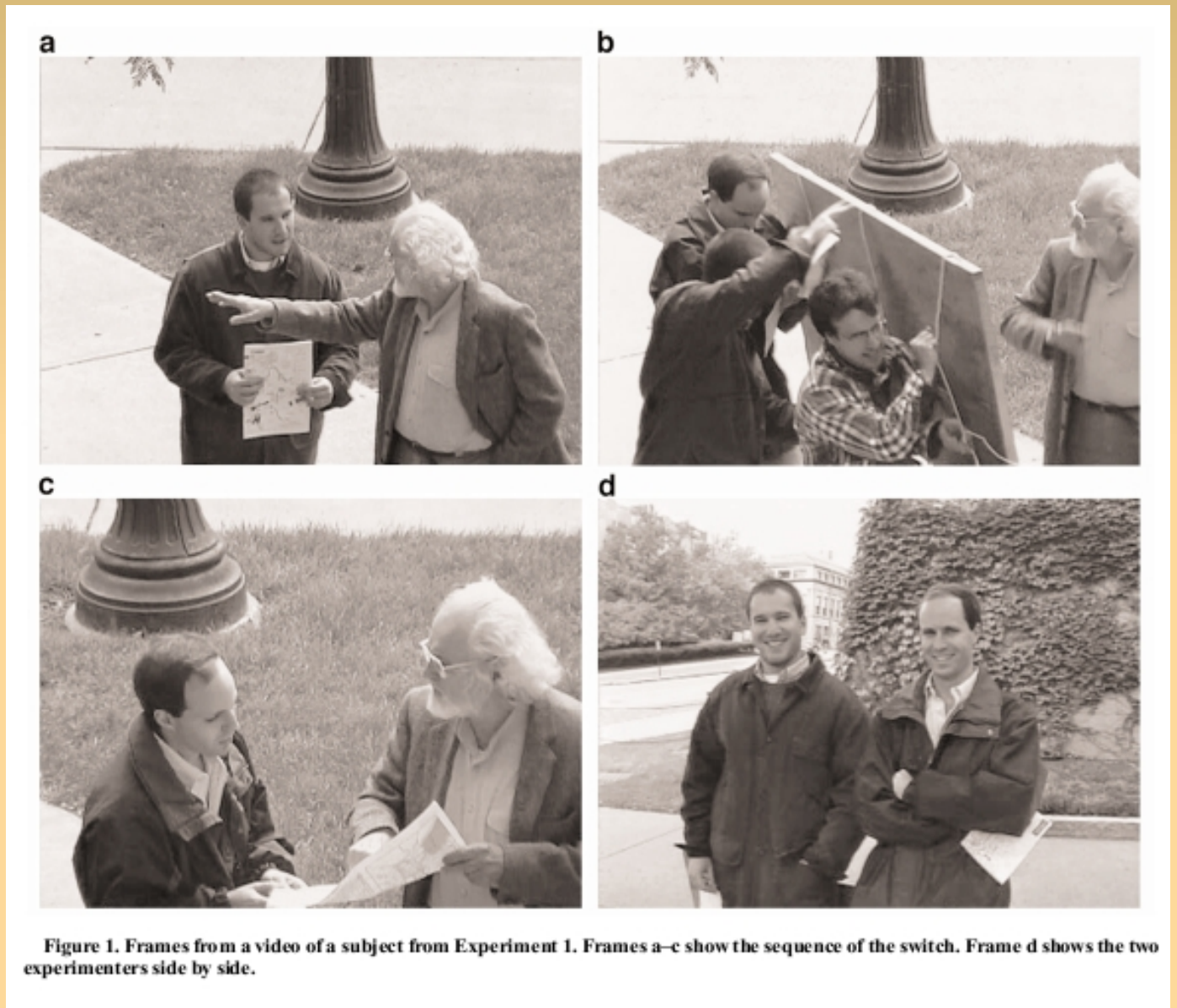


Figure 1. Frames from a video of a subject from Experiment 1. Frames a–c show the sequence of the switch. Frame d shows the two experimenters side by side.

D. Simons & D. Levin, Psychonom. Bull. Rev. 5 (1998) p 646.

We have to ask ...

What does a newborn see?
What does an insect or a fish see?
What would a Martian see?

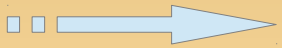
How does a machine actually experience the world?

What's happening here?

>login: fredtheuser
>password: F47%!GM#!

Fred

We know perfectly well ...



fredtheuser	F47%!GM#!	Fred Foo	....
bobtheuser	KXW&92%fr	Bob Bar	....
....	....	....	....

But *we* implemented this data structure.

That's cheating!

What happening here?

Not this ...

Block

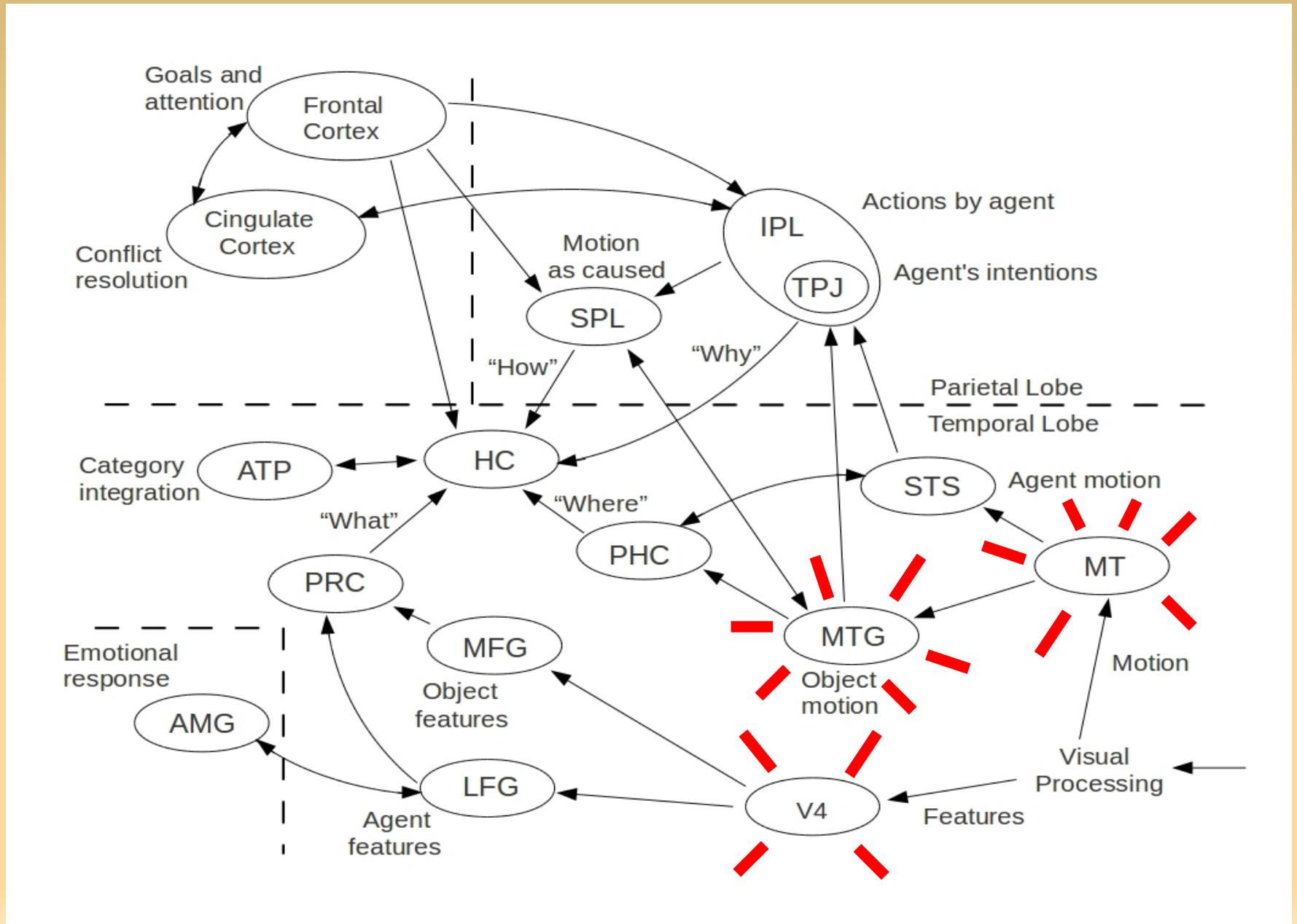
Unlikely ...

Thing

Maybe ...

Interesting

We know this happens



Do (3 month) infants see ...

Moving persistent objects?

Moving objects, no inferred persistence?

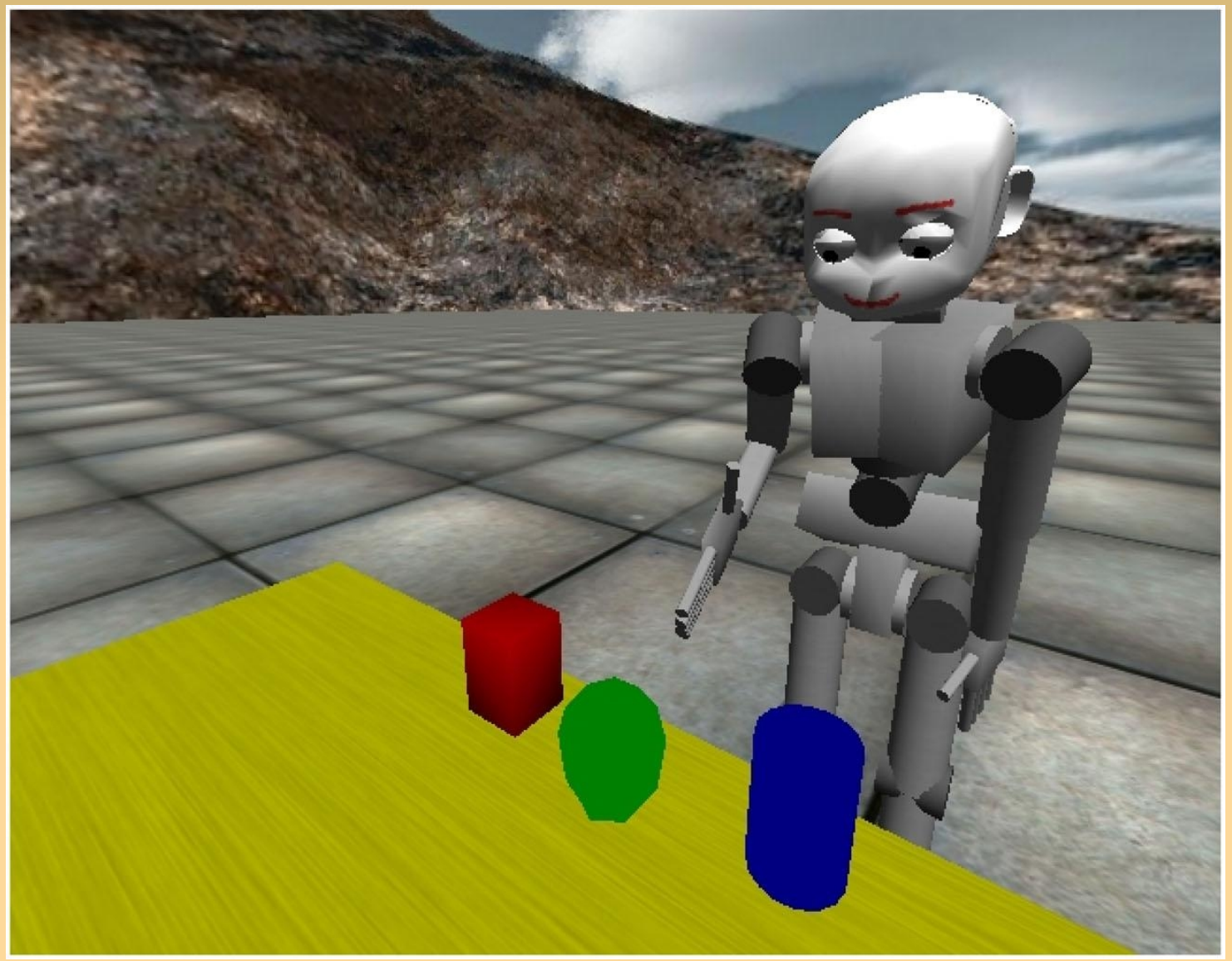
Moving features without “objecthood”?

Just “interestingness”?

We don't know

And what about kittens or fish or spiders?

“Interestingness”?



I. Farkaš et al., Front. Neurorobotics 6 (2012) 1.

Developmental robotics

Do shape from motion, shape from shading, texture and color boundaries, etc. plus Bayesian inference give us objects?

Do intrinsic motivation, slopes of learning curves, and body-based constraints define "interestingness" well enough?

Is the test of manipulation ability enough?

There's still a *user interface* question

“The perceived world is a species-specific user interface to the real world”
(D. Hoffman).

“Thing” and “persistent thing” are rough-and ready approximations of reality.

This is consistent with the interaction-dependent generation of classical information from quantum information.

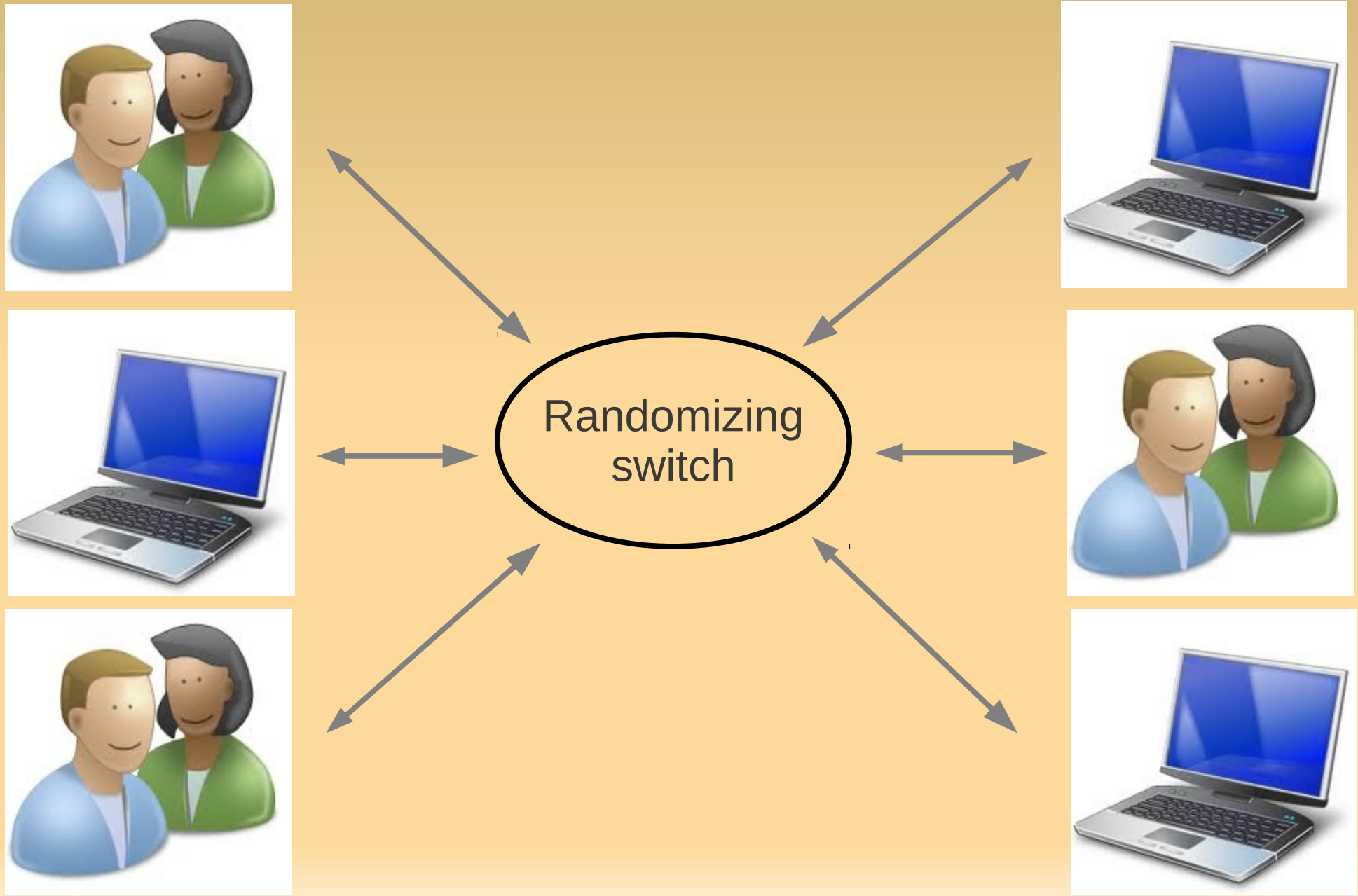
Viewing AI systems as users

A computer-vision system or a natural-language understander is the computer's user interface for input from the world.

We have to ask:
What kind of “perceived world” do given sensors, learning methods and “interestingness” measures build?

What kinds of actions does this inferred “world” afford?

A symmetric TT with identification?



Thank you

Questions?