



Minimal Theory of Mind Joint Action

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A black and white photograph of two young children, a boy and a girl, standing side-by-side against a dark background. The boy, on the left, has light-colored hair and is wearing a patterned long-sleeved shirt under dark overalls. The girl, on the right, also has light-colored hair and is wearing a dark top with small floral patterns. They are both smiling and looking towards the camera.

challenge

Explain the emergence, in evolution or development, of full-blown theory of mind cognition.

A black and white photograph of two young children, a boy and a girl, standing close together and smiling. The boy, on the left, has light-colored hair and is wearing a patterned long-sleeved shirt under dark overalls. The girl, on the right, also has light-colored hair and is wearing a dark top with a subtle pattern. They appear to be in a playful or happy mood.

challenge

Explain the emergence, in evolution or development, of full-blown theory of mind cognition.

puzzle

Theory of mind *abilities* are widespread

18-month-olds point to inform, and predict actions based on false beliefs

(Liszkowski et al 2006)

(Onishi & Baillargeon 2005;
Southgate et al 2007)

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Scrub-jays selectively re-cache their food in ways that deprive competitors of knowledge of its location

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question

What could infants, chimps and scrub-jays represent that would enable them, within limits, to track others' perceptions, knowledge, beliefs and other propositional attitudes?

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Theory of mind *abilities* are widespread

Representing perceptions, knowledge states and beliefs is hard

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- (a) conceptual sophistication
 - takes years to develop
 - development tied to acquisition of executive function and language
 - development facilitated by training and siblings

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(b) scarce cognitive resources

- attention
- working memory

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challenge

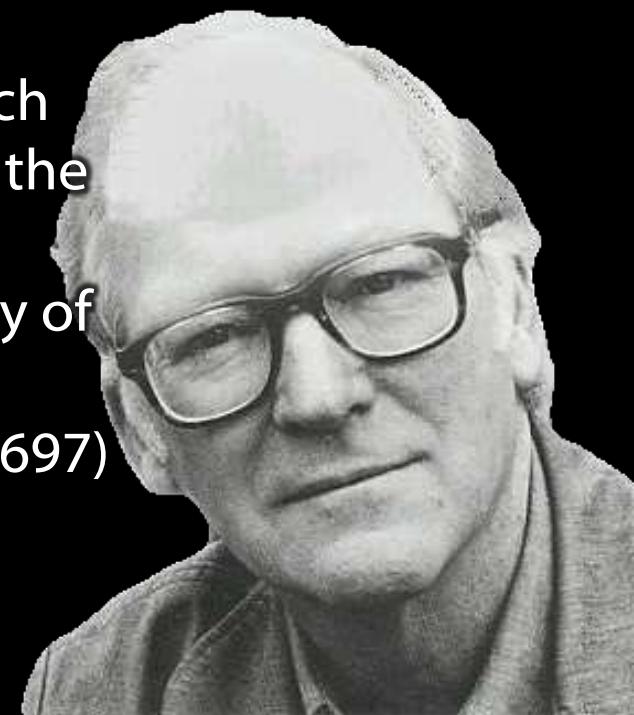
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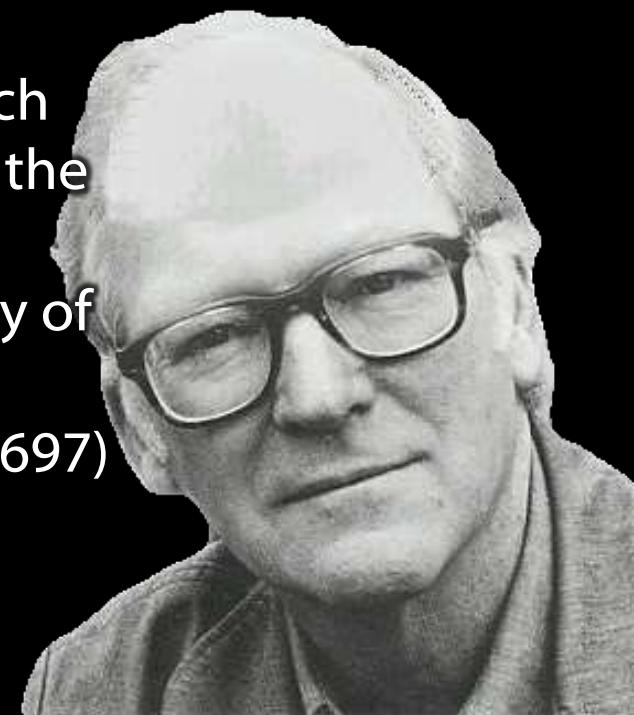
“We are stuck with our two main ways of describing and explaining things, one which treats objects and events as mindless, and the other which treats objects and events as having propositional attitudes. I see no way of bridging the gap”

(Davidson 2003:697)



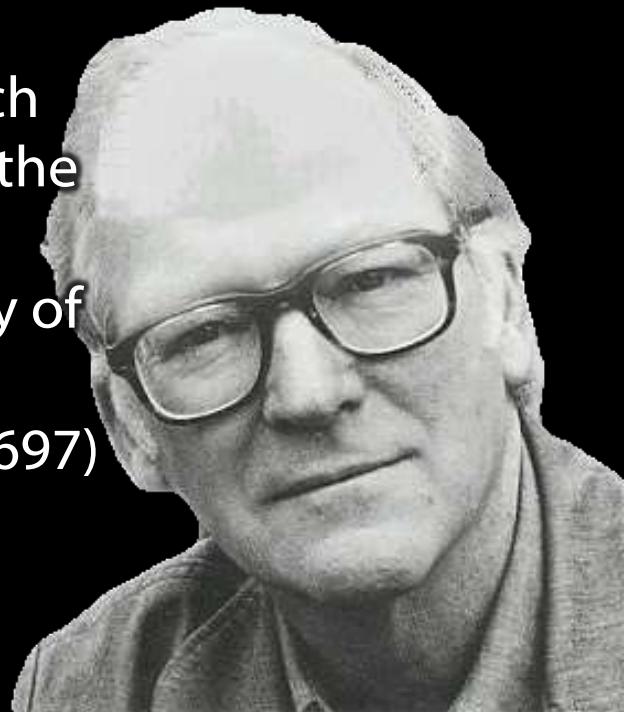
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Propositional attitude

Relational attitude

Propositional attitude

e.g. believes that ...

e.g. intends that ...

e.g. knows that ...

Relational attitude

e.g. excited by ...

e.g. encountered ...

e.g. wants apple juice

Propositional attitude

e.g. believes that ...

e.g. intends that ...

e.g. knows that ...

arbitrarily nestable
contents

uncodifiably complex
effects on action

permit mistakes about
identity and existence

Relational attitude

e.g. excited by ...

e.g. encountered ...

e.g. wants apple juice

no contents

parameter-setting
effects on action

enable tracking
limited range of true
and false beliefs

Propositional attitude

e.g. believes that ...

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arbitrarily nestable
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parameter-setting
effects on action







Your *field* = a set of
objects related to you by
proximity, orientation,
lighting and other factors



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proximity

orientation

lighting

barriers

trajectory

Your *field* = a set of objects related to you by proximity, orientation, lighting and other factors

You *encounter* an object = it is in your field



proximity *orientation*

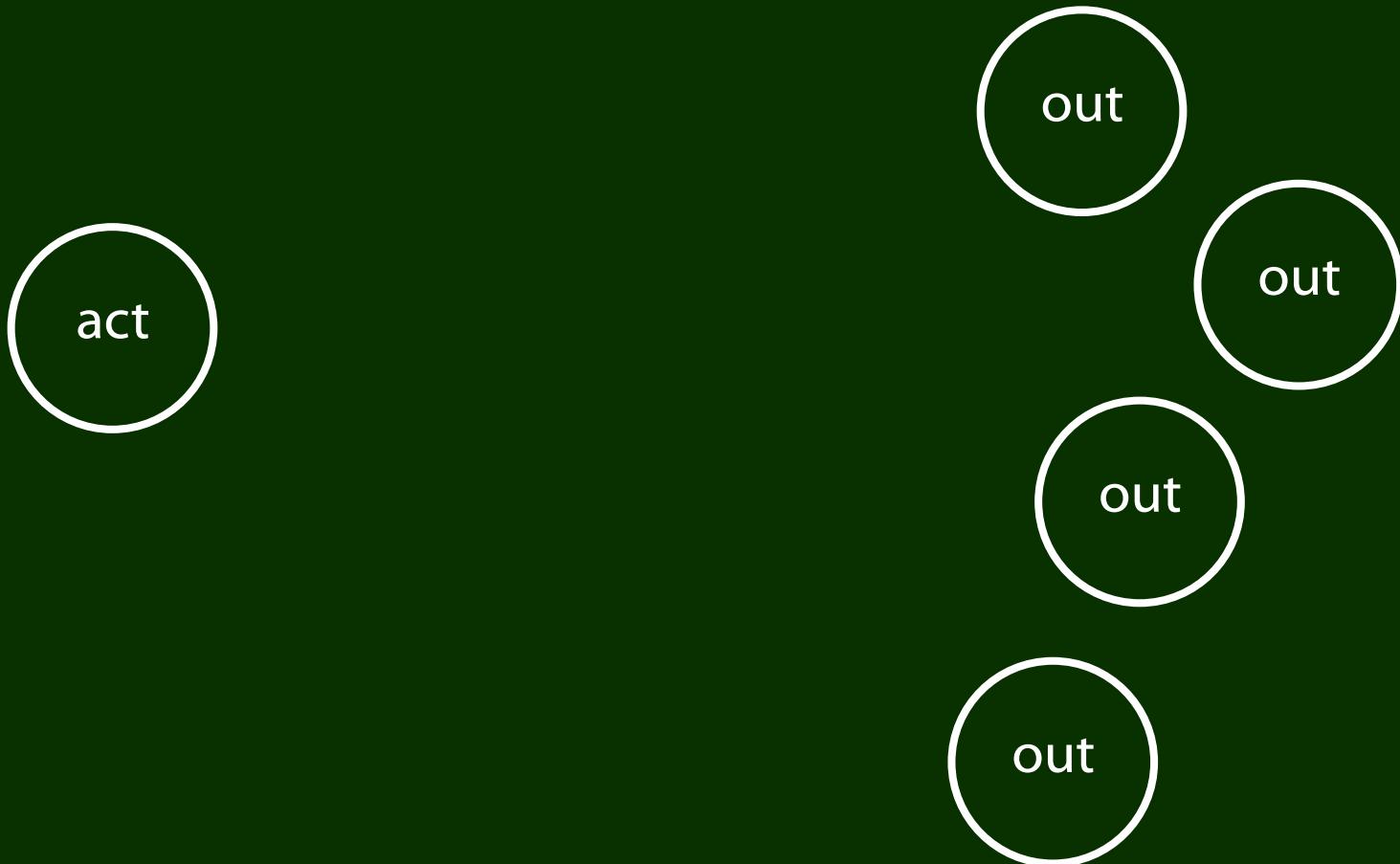
lighting

barriers

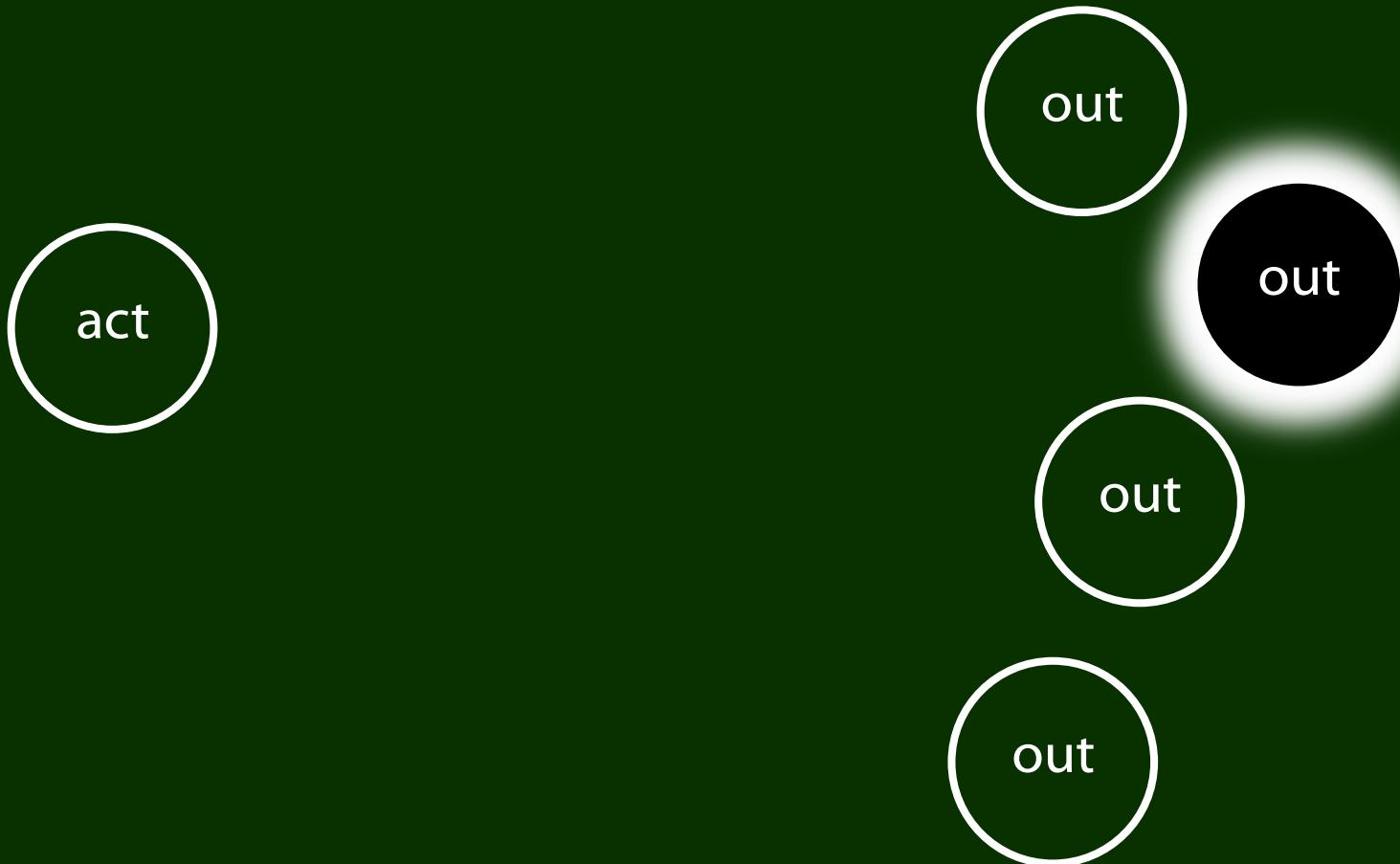
trajectory

Detour
Goals are not intentions

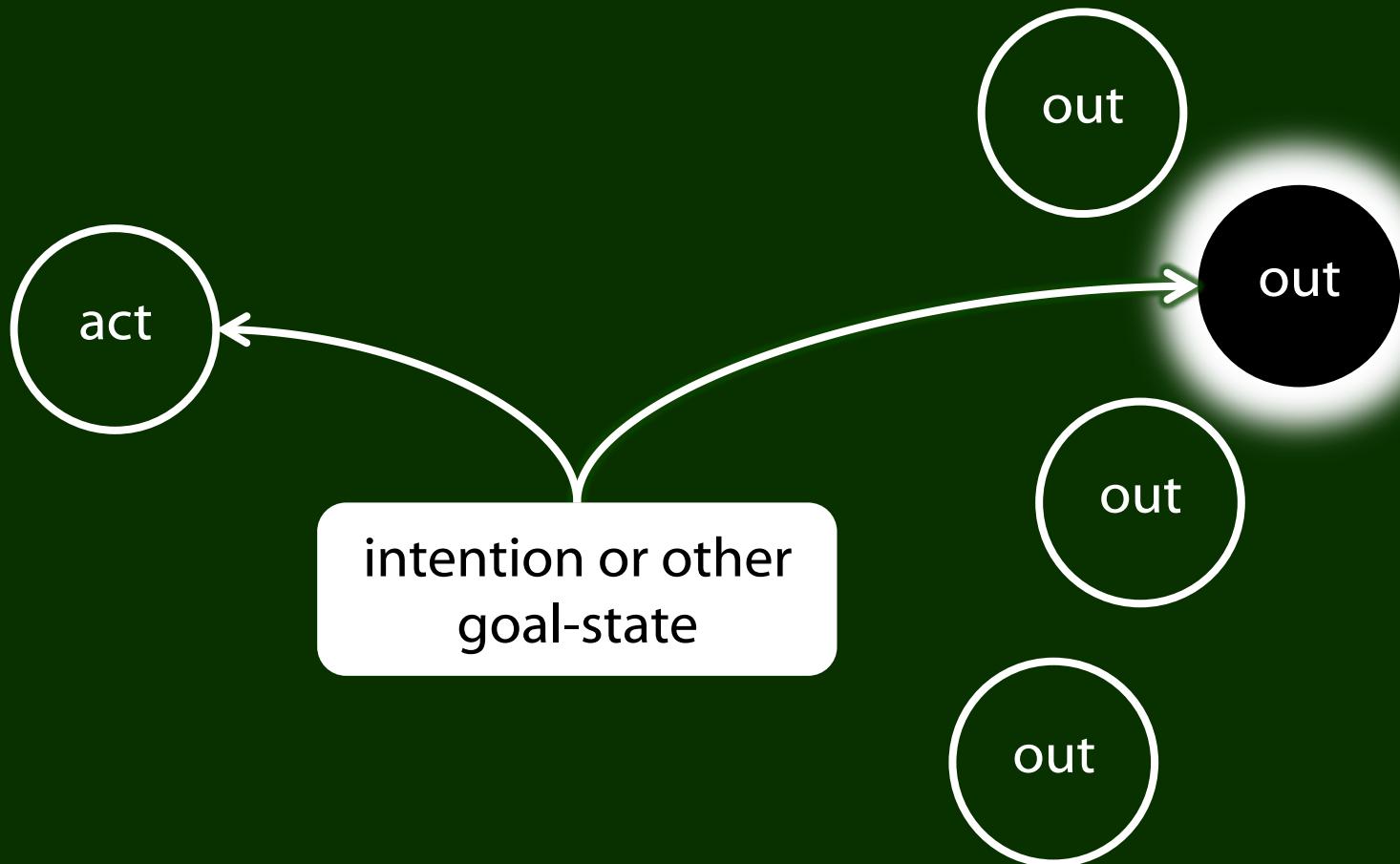
What is the relation between an action and the goal (or goals) to which it is directed?



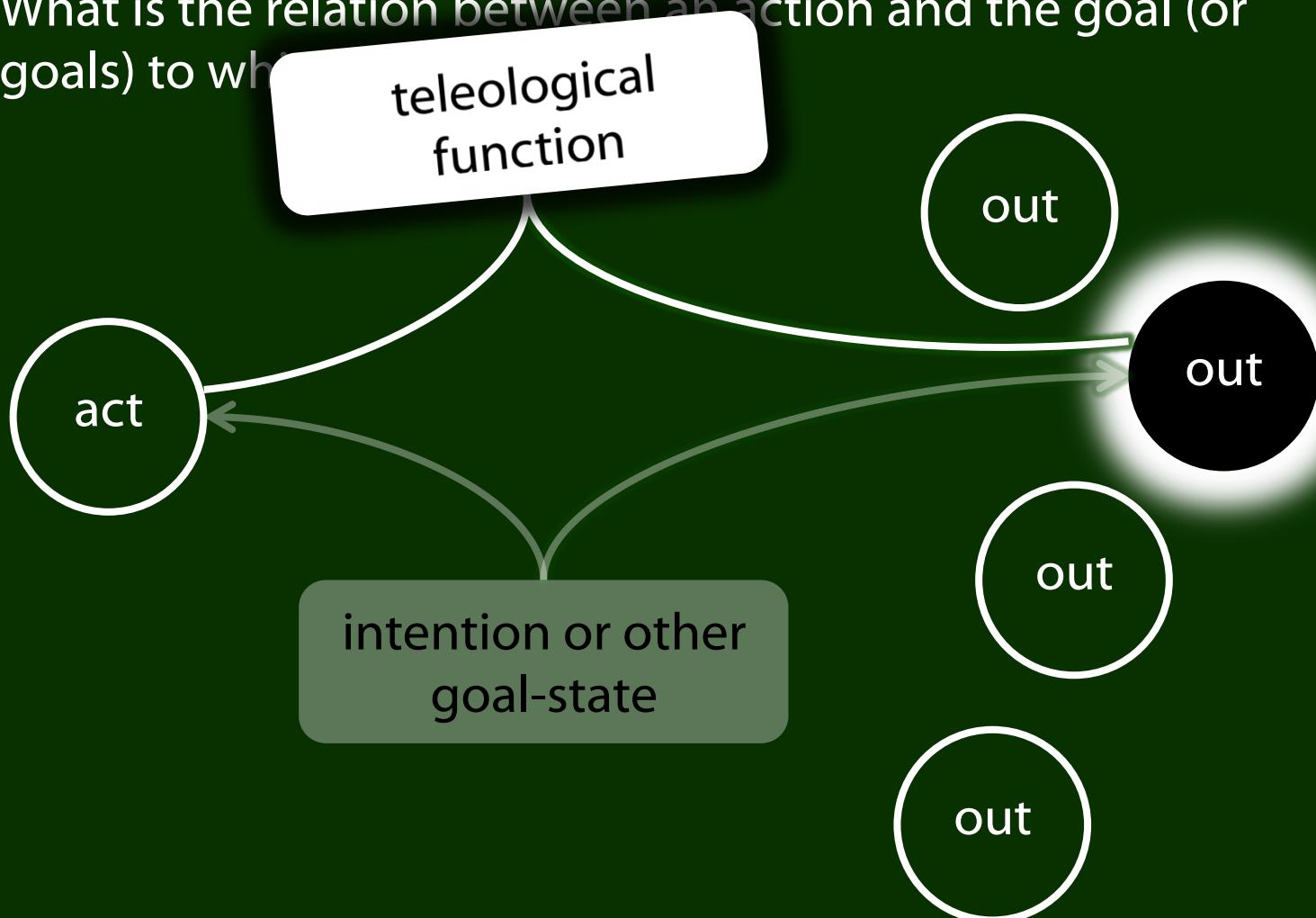
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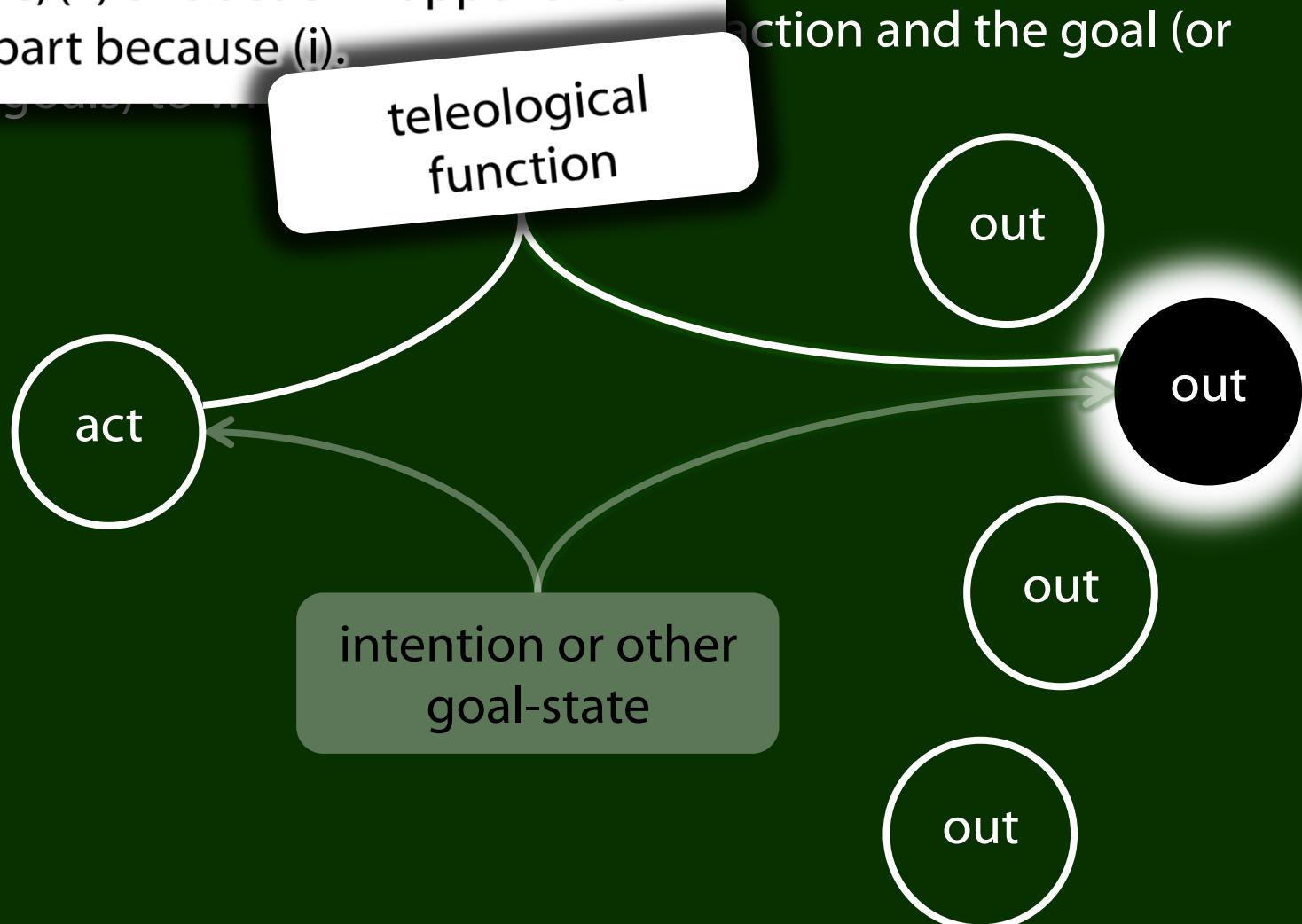
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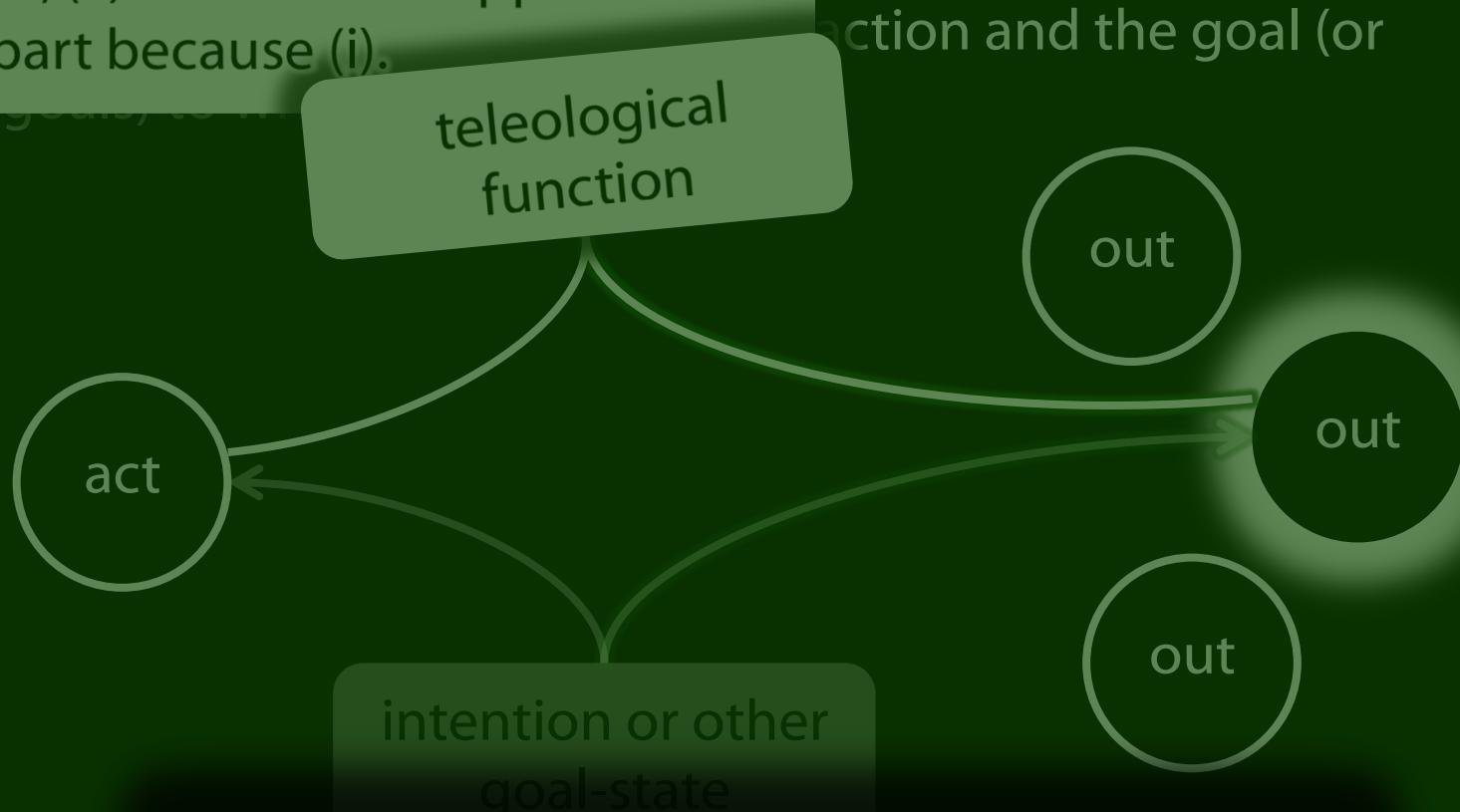
What is the relation between an action and the goal (or goals) to which it is related?



(i) in the past, actions of this type have caused outcomes of this type; (ii) this action happens now in part because (i).



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It is possible to represent goal-directed actions without representing intentions.

End Detour

Your *field* = a set of objects related to you by proximity, orientation, lighting and other factors

You *encounter* an object = it is in your field



proximity *orientation*

lighting

barriers

trajectory

Your *field* = a set of objects related to you by proximity, orientation, lighting and other factors

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Principle 3: one can't goal-directedly act on an object unless one has encountered it.



proximity



orientation



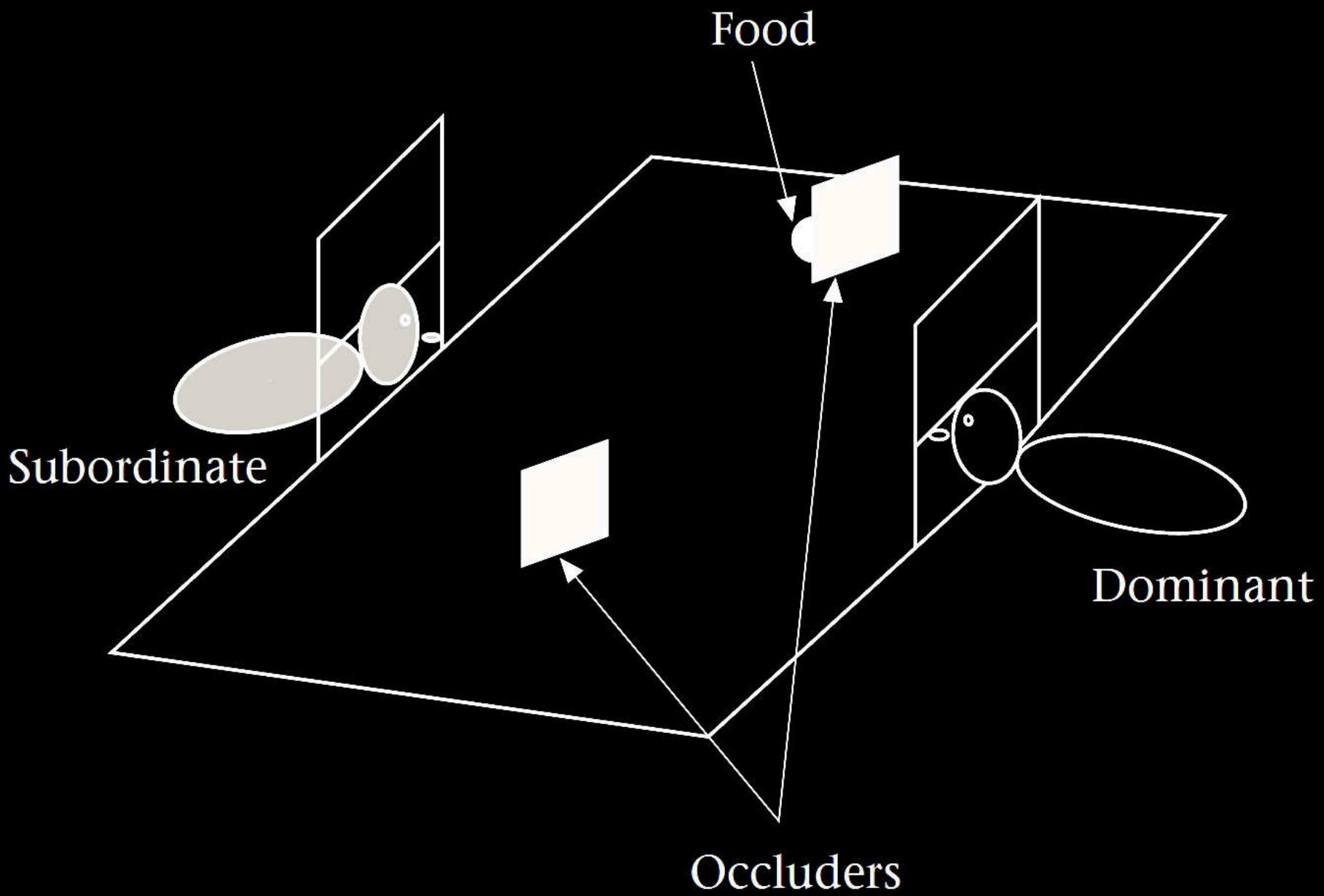
lighting



barriers



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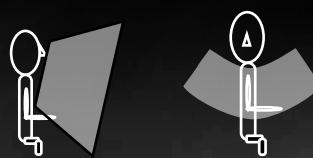
trajectory

Your *field* = a set of objects related to you by proximity, orientation, lighting and other factors

You *encounter* an object = it is in your field

You *register* an object at a location \leq you most recently encountered the object at that location

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proximity

orientation

lighting

barriers

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Principle 4: correct registration is a condition of *successful* action.

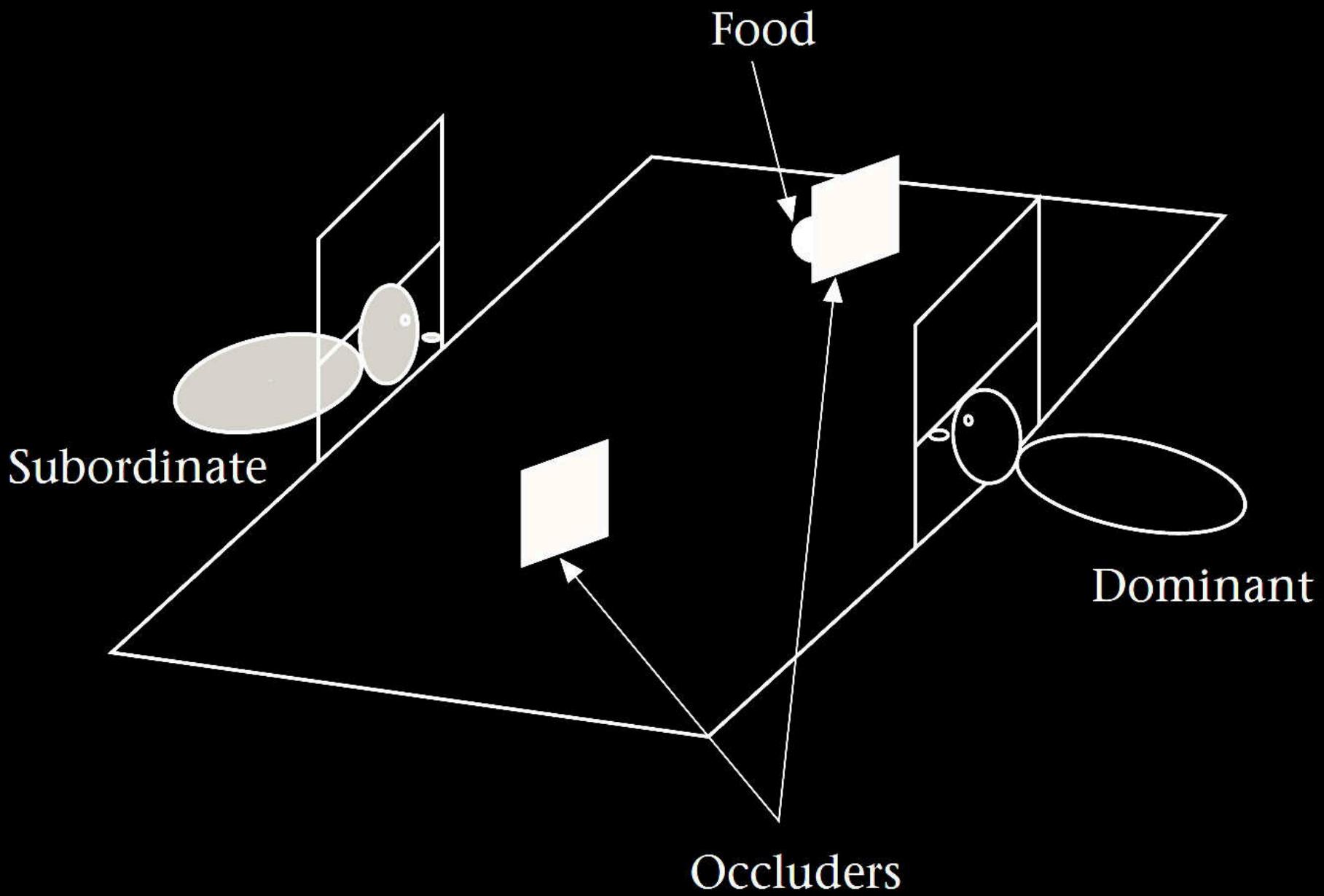


proximity

orientation

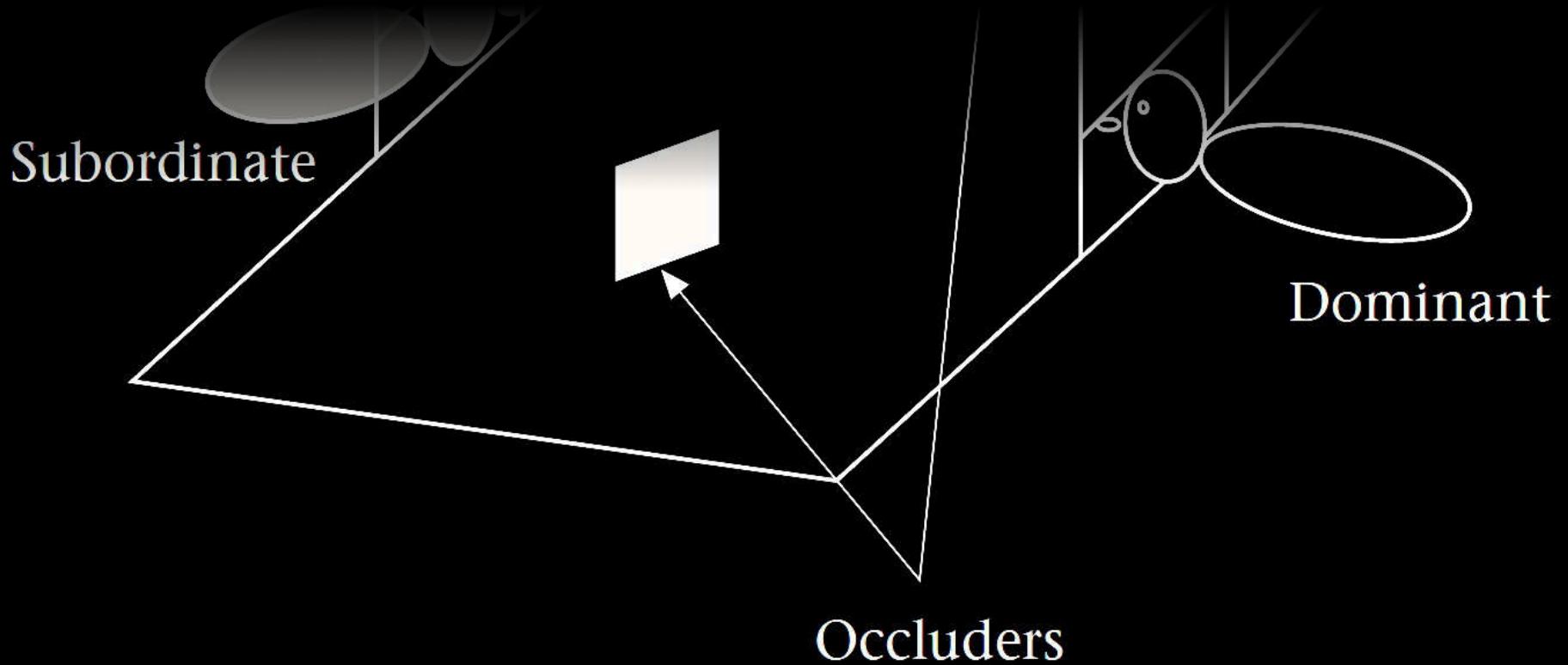
barriers

trajectory



“chimpanzees understand ... intentions ... perception and knowledge ... Moreover, they understand how these psychological states work together to produce intentional action”

(Call & Tomasello 2008:191)



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“our [typical adult humans’] fundamental conception of what it is to know that P is itself an explanatory conception [...] we think of S’s knowledge that P as something that can properly be explained by reference to what S has perceived or remembered or proved or ...”
(Cassam 2007:356)



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Principle 5



proximity orientation lighting

barriers

trajectory

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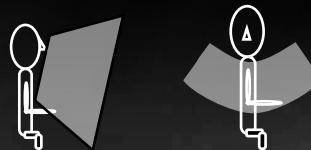
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Principle 4: correct registration is a condition of *successful* action.

Principle 5: when an agent performs a goal-directed action and the goal specifies an object, the agent will act as if the object were actually in the location she registers it at.



proximity



orientation



lighting



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A black and white photograph of two young children, a boy and a girl, standing close together and smiling. The boy is in the foreground, wearing dark overalls and a light-colored shirt. The girl is behind him, wearing a dark dress with a small floral pattern. They appear to be in a park or outdoor setting.

challenge

Explain the emergence, in evolution or development, of full-blown theory of mind cognition.

puzzle

What could infants, chimps and scrub-jays represent that would enable them, within limits, to track others' perceptions, knowledge, beliefs and other propositional attitudes?

signature limits

1



2



3



belief: $2 \approx 3$

registration: $2 \not\approx 3$

belief: $1 \not\approx 2$

registration: $1 \approx 2$





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"the unique aspects of human cognition ... were driven by, or even constituted by, social co-operation"

(Moll & Tomasello 2007)

"perception, action, and cognition are grounded in social interaction"

(Sebanz & Knoblich 2008)

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The existence of abilities to engage in joint action partially explains how full-blown theory of mind cognition emerges in evolution or development (or both)

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tidying up the toys together

(Behne et al 2005)

cooperatively pulling
handles in sequence to
make a dog-puppet sing

(Brownell et al 2006)

bouncing a ball on a large
trampoline together

(Tomasello & Carpenter 2007)

pretending to row a boat
together

Joint action: an event with two or more agents which, taken as a whole, is directed to a goal.

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failed reach



point



source: Hare & Tomasello (2004)

The problem of opaque means

your-goal-is-my-goal

your-goal-is-my-goal

1. We are about to engage in some joint action* or other
2. I am not about to change my goal.

Therefore:

3. Your actions also will be directed to this goal.

[*in at least the minimal sense associated with distributive goals]

failed reach



point



source: Hare & Tomasello (2004)

failed reach



point



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“to understand pointing, the subject needs to understand more than the individual goal-directed behaviour. She needs to understand that ... the other attempts to communicate to her ... and ... the communicative intention behind the gesture”

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failed reach



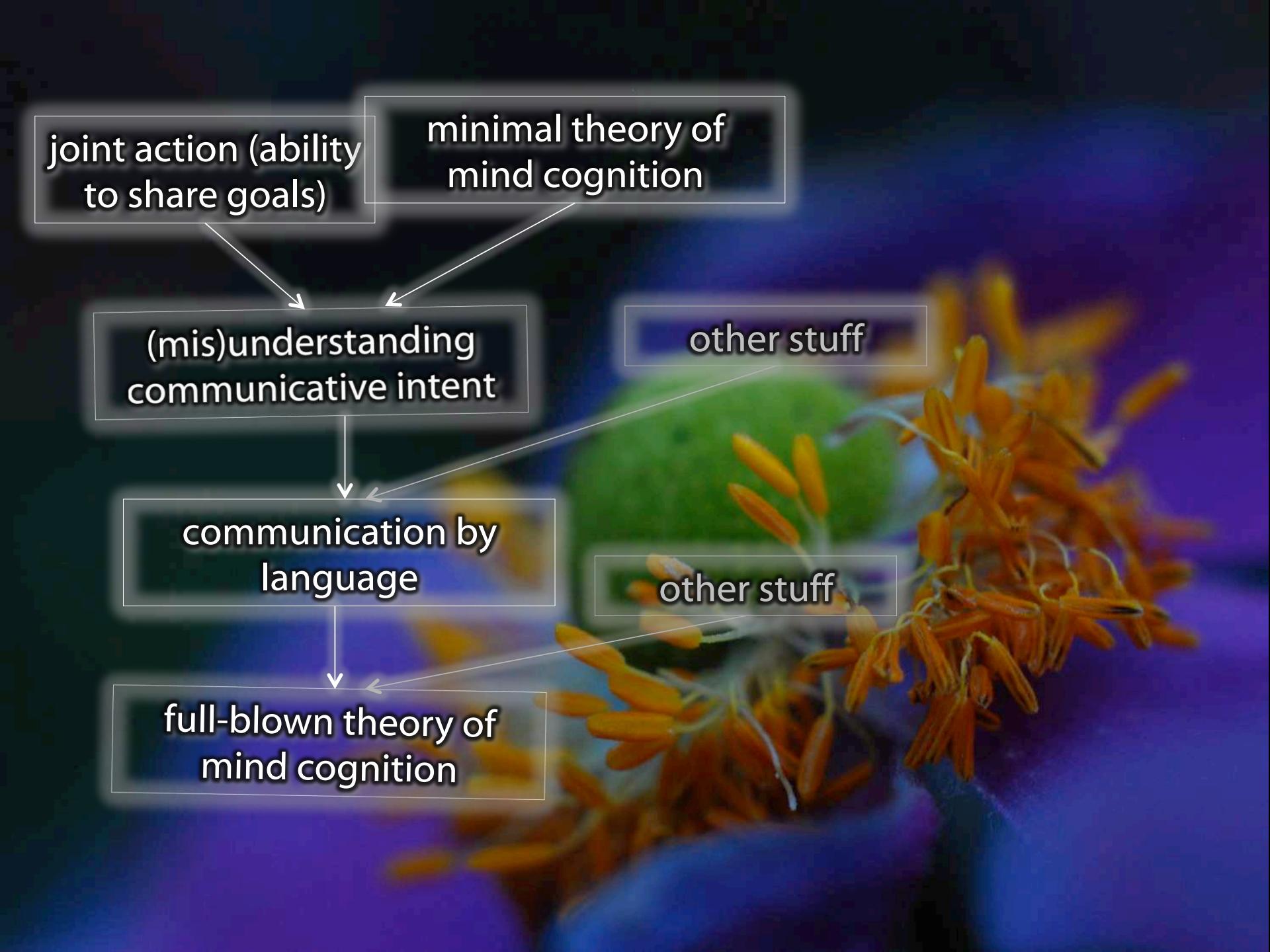
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joint action (ability
to share goals)

minimal theory of
mind cognition

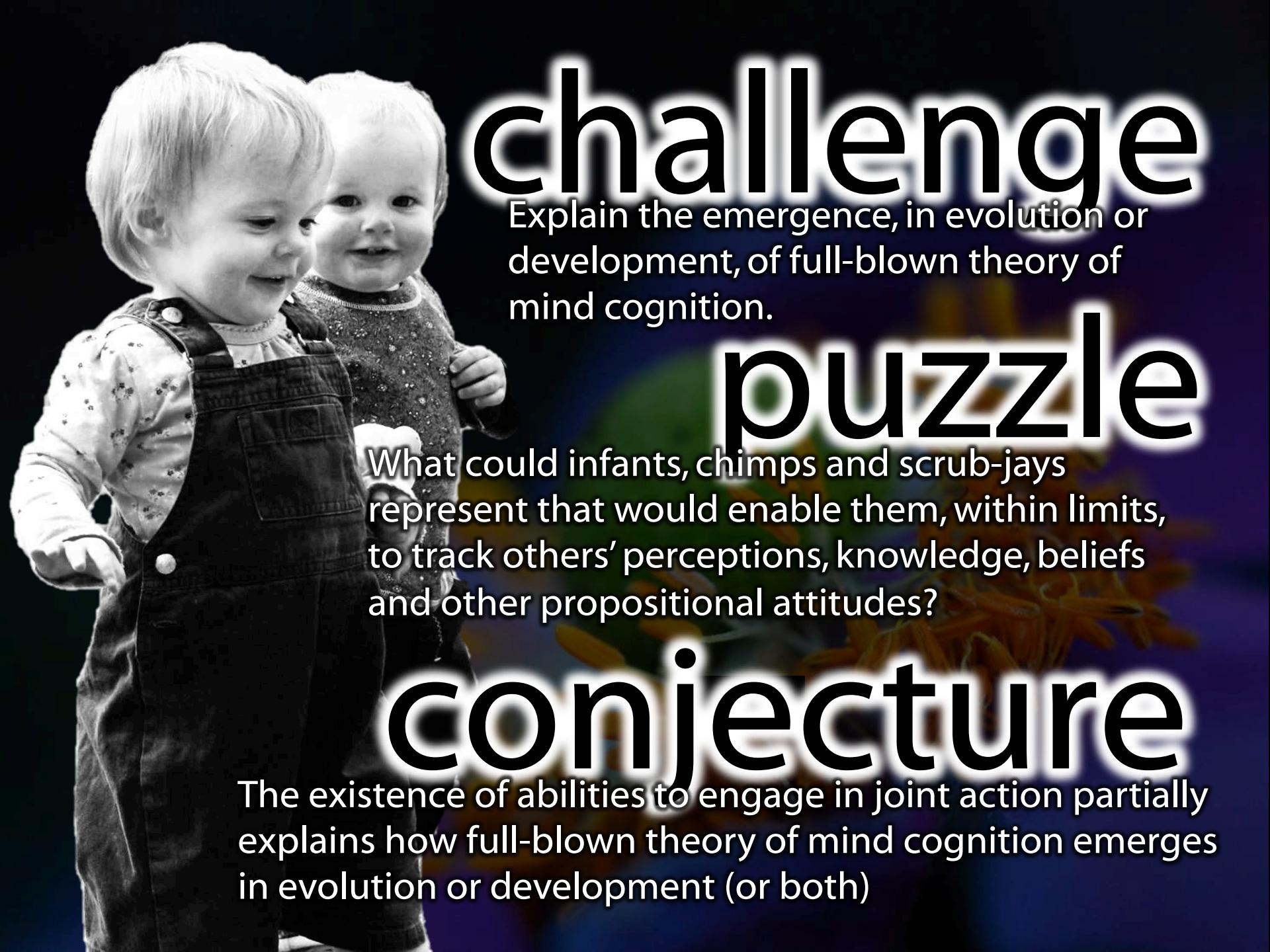
(mis)understanding
communicative intent

communication by
language

full-blown theory of
mind cognition

other stuff

other stuff

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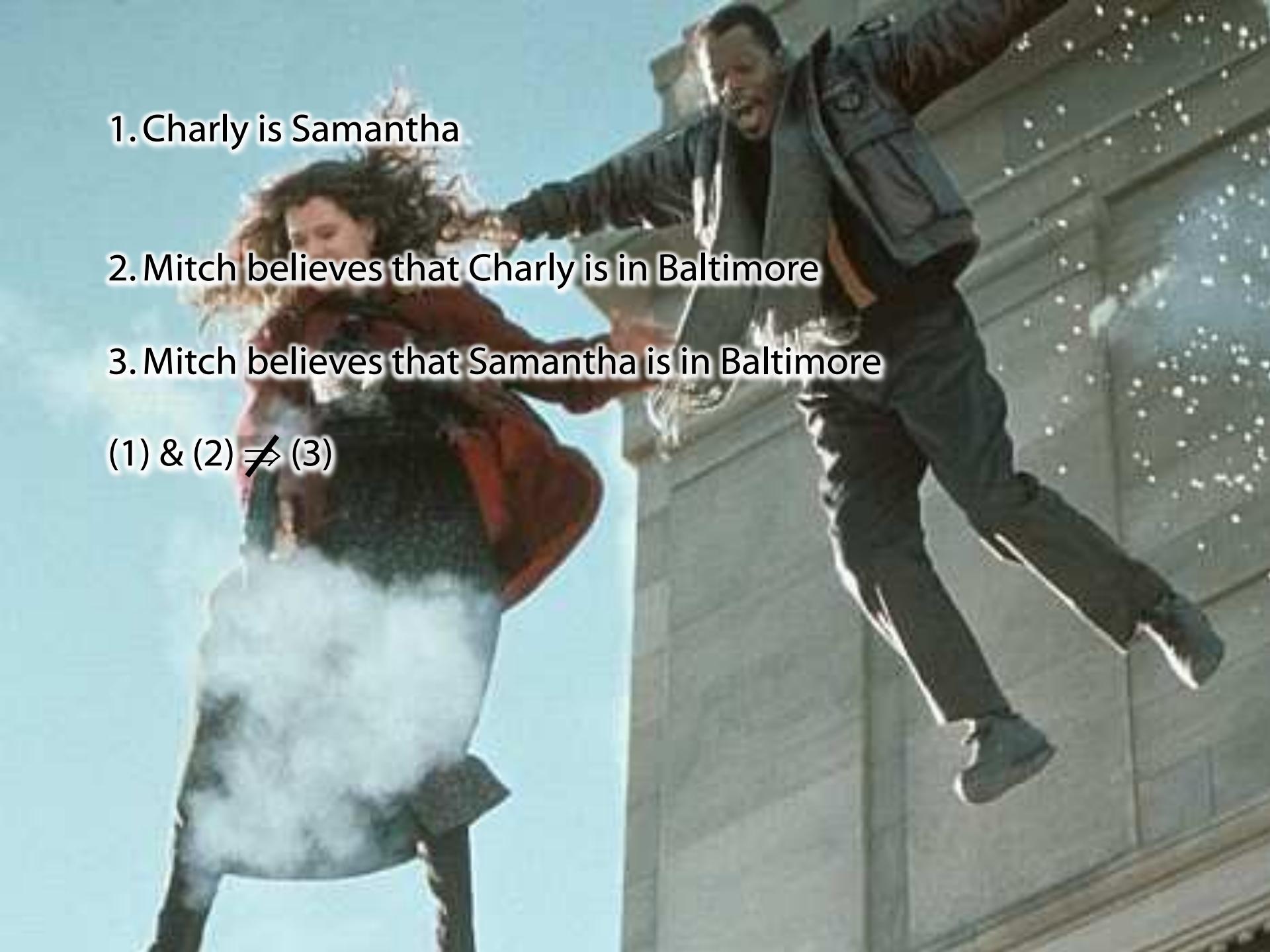
signature limits

1. Charly is Samantha

2. Mitch believes that Charly is in Baltimore

3. Mitch believes that Samantha is in Baltimore

(1) & (2) $\not\Rightarrow$ (3)



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 2. Mitch believes that Charly is in Baltimore
 3. Mitch believes that Samantha is in Baltimore
- (1) & (2) $\not\Rightarrow$ (3)
4. Mitch registers <Charly, Baltimore>
 5. Mitch registers <Samantha, Baltimore>
- (1) & (4) \Rightarrow (5)

Subjects represent
registration only

pass

fail

Subjects represent
beliefs

pass

pass

False belief
about location

False belief
about identity

Rubio, Richardson & Butterfill



Rubio, Richardson & Butterfill



Rubio, Richardson & Butterfill



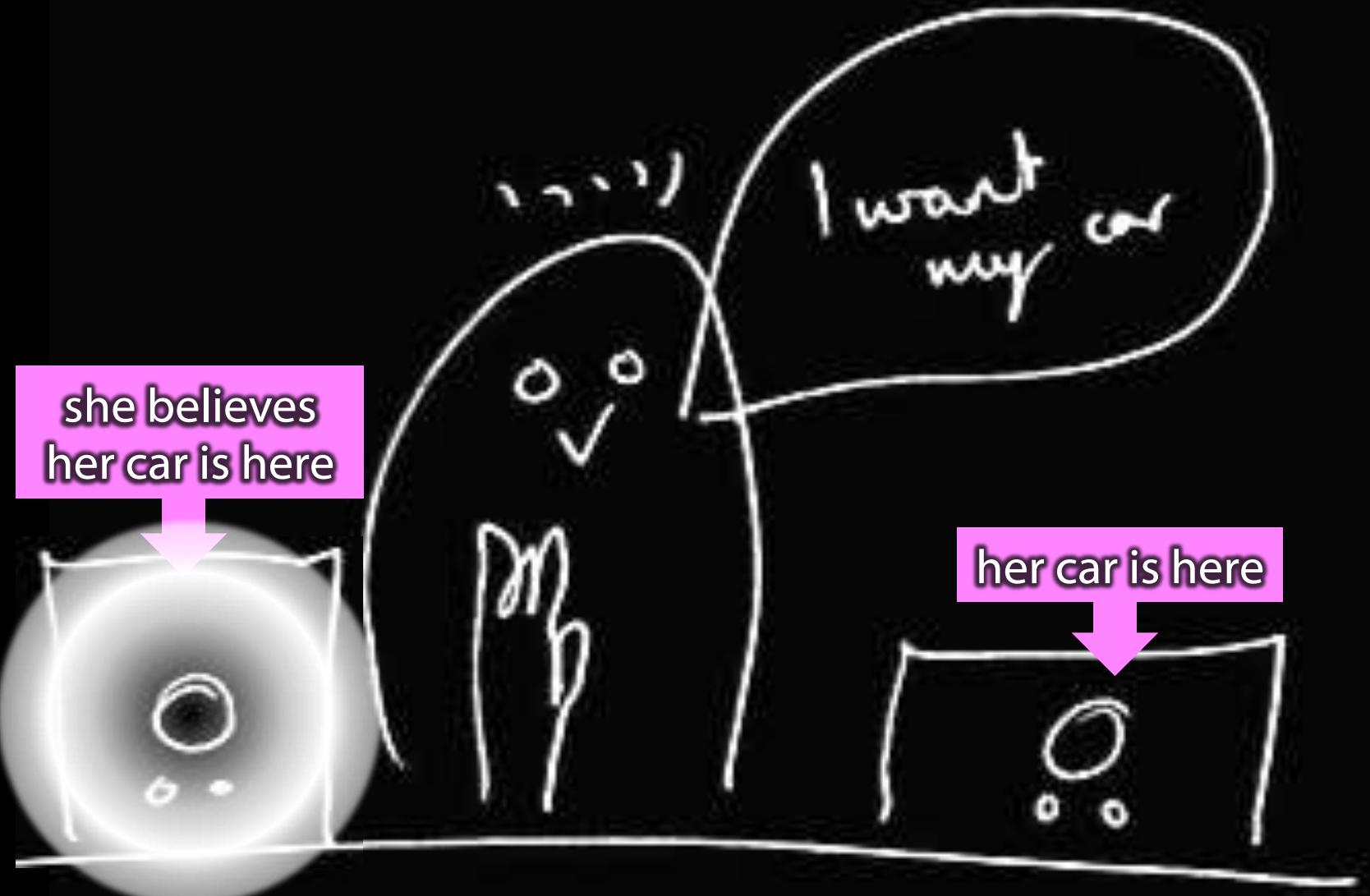
Rubio, Richardson & Butterfill



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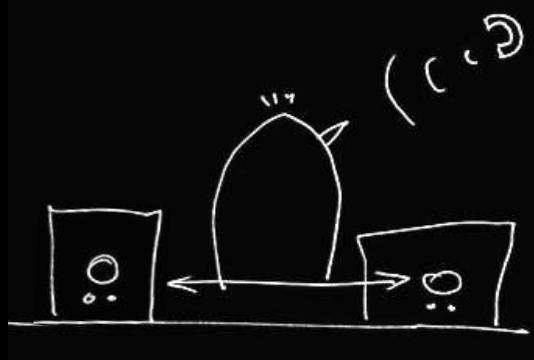
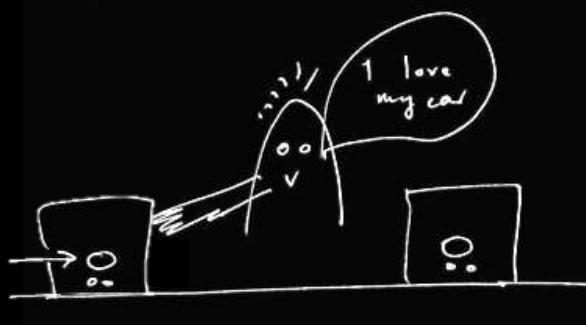
Rubio, Richardson & Butterfill

we predict Ss
will look here
she believes
her car is here

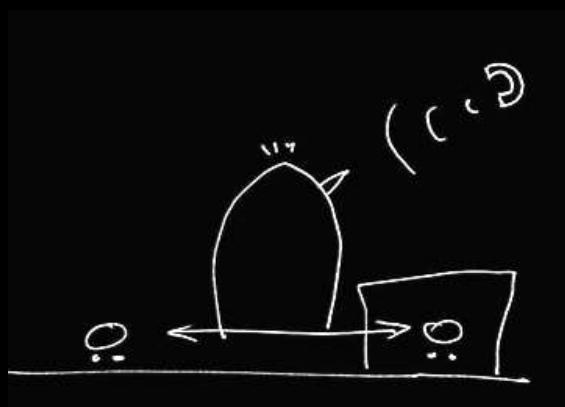
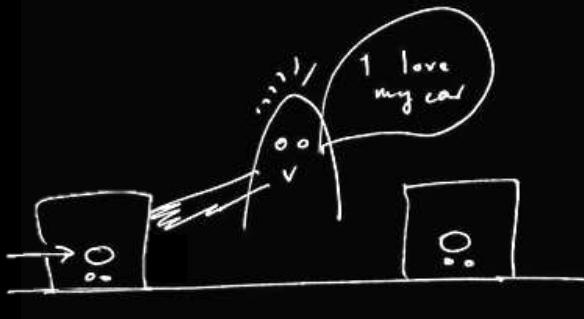
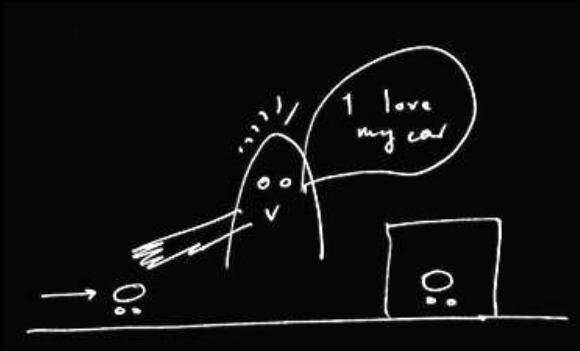
I want
my car

her car is here

Rubio, Richardson & Butterfill



Rubio, Richardson & Butterfill

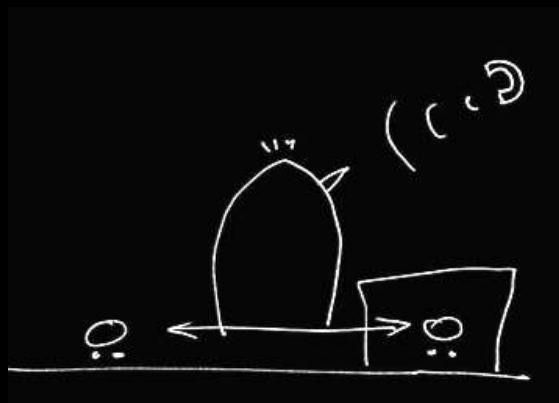


Rubio, Richardson & Butterfill

2



3



Rubio, Richardson & Butterfill

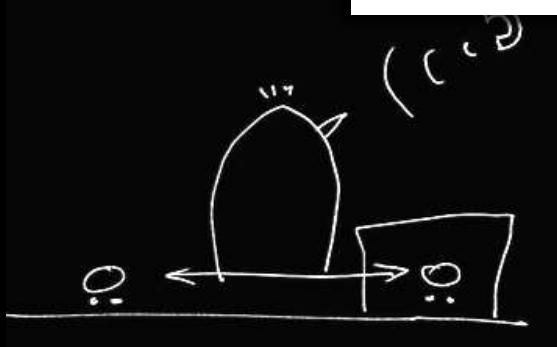
2



3



belief: $2 \approx 3$



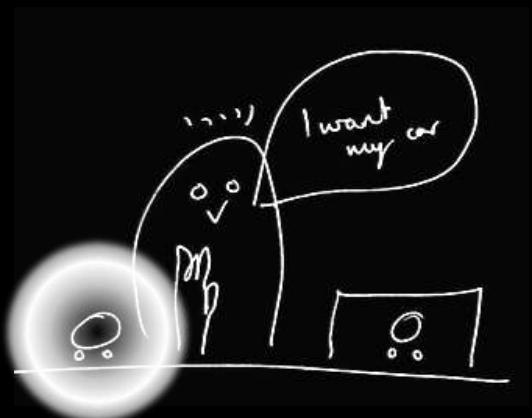
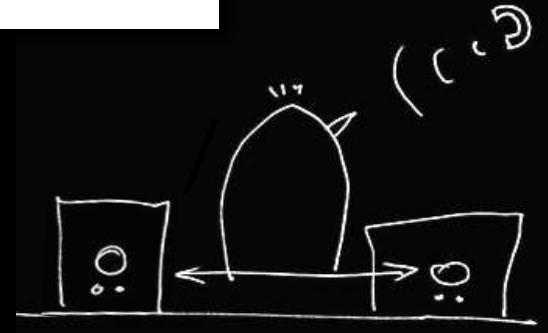
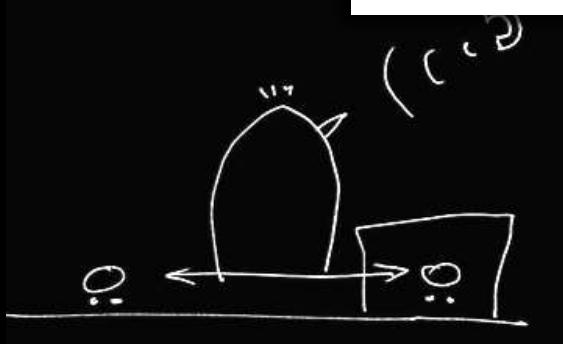
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3



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Rubio, Richardson & Butterfill



2



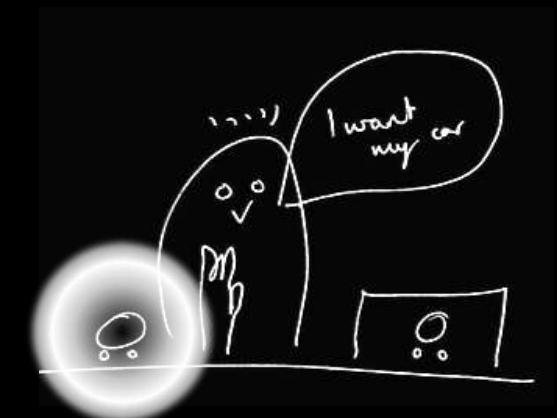
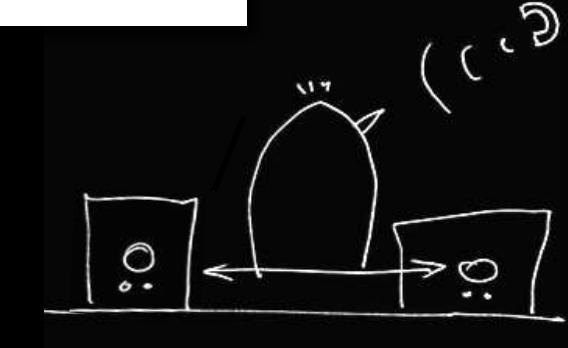
left right

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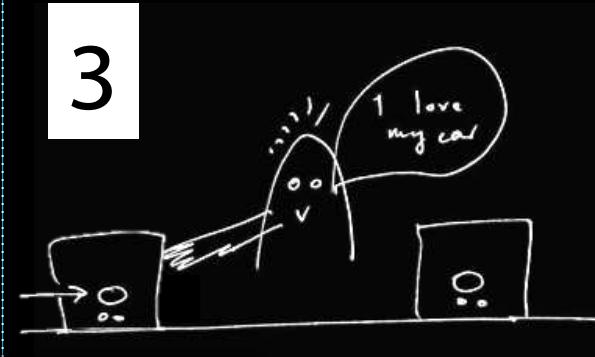
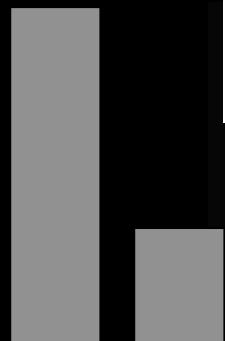
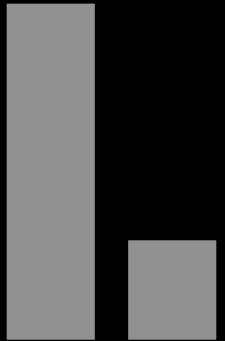
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belief: $2 \approx 3$



Rubio, Richardson & Butterfill



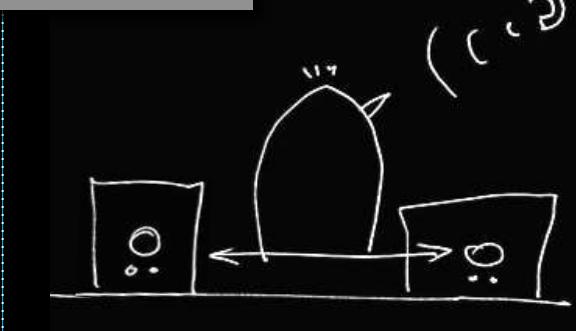
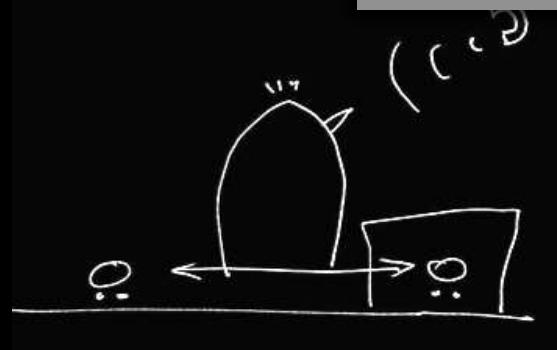
left right

2

left right

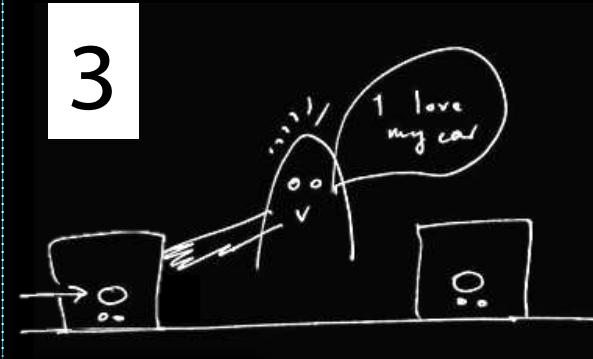
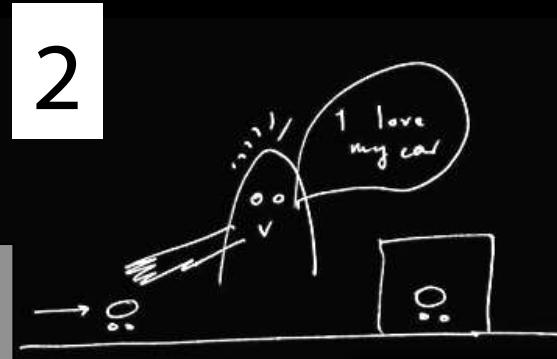
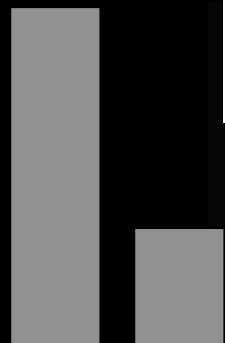
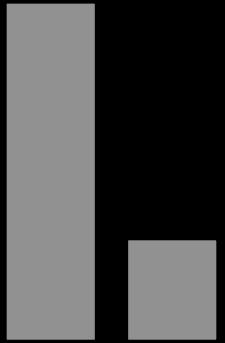
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belief: $2 \approx 3$



registration: $2 \not\approx 3$





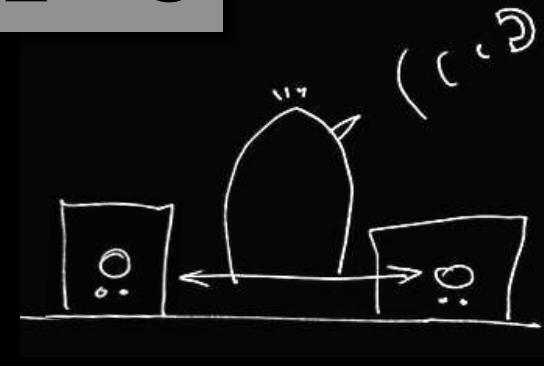
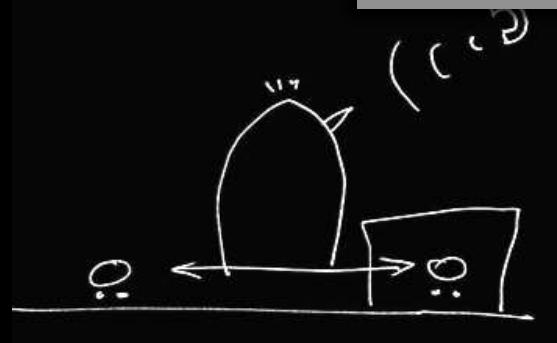
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left right

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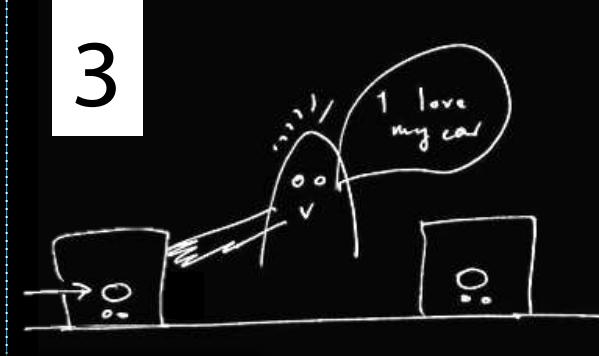
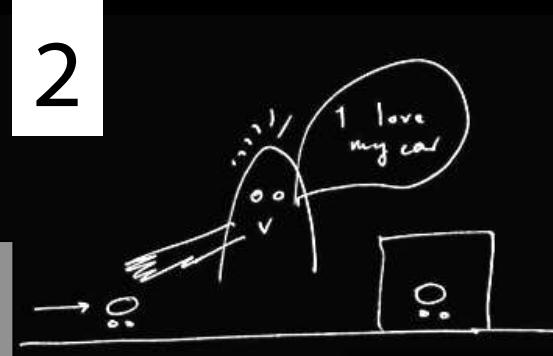
belief: $2 \approx 3$



registration: $2 \not\approx 3$



Rubio, Richardson & Butterfill



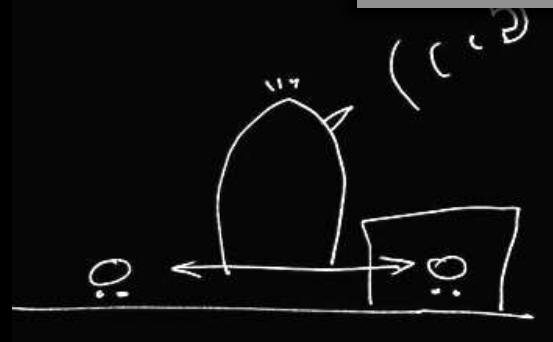
left right

2

left right

3

belief: $2 \approx 3$



registration: $2 \not\approx 3$



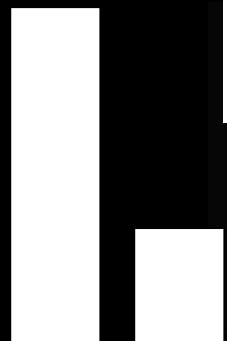
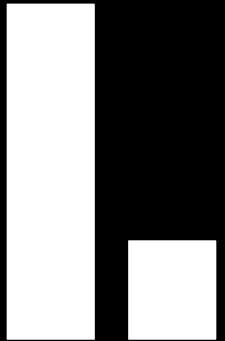
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Rubio, Richardson & Butterfill



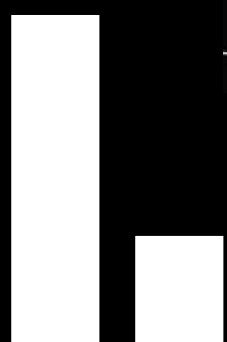
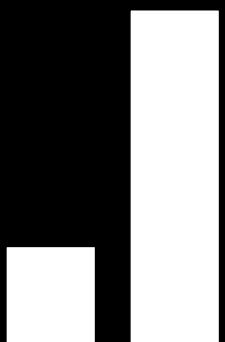
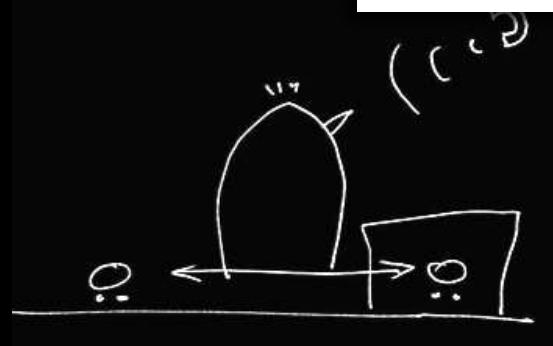
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left right

2

3

belief: $2 \approx 3$



registration: $2 \not\approx 3$

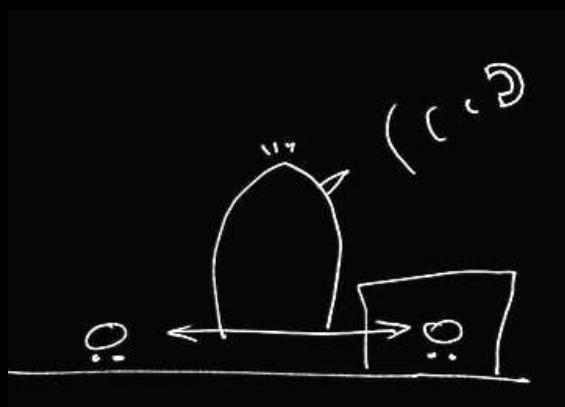
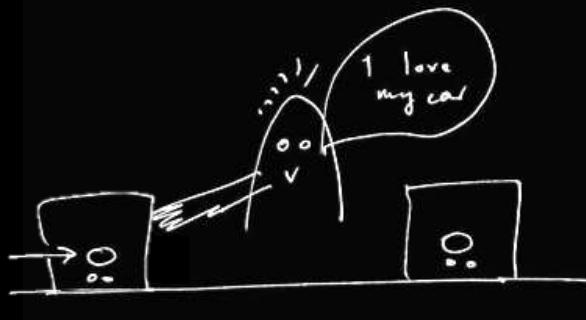
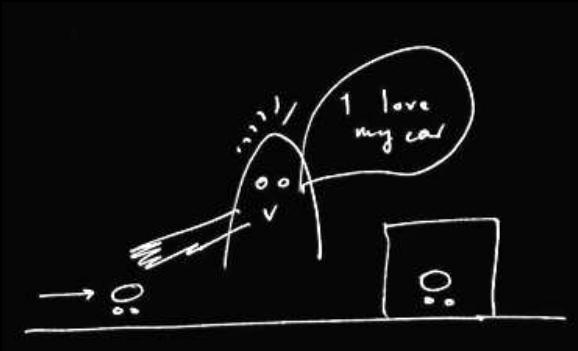


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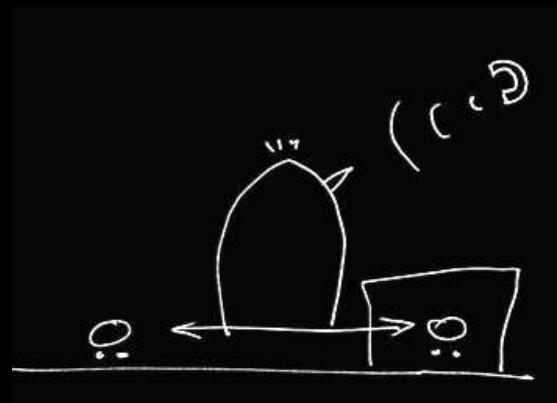
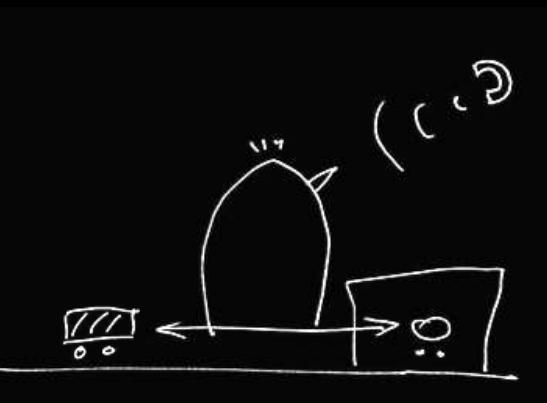
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Rubio, Richardson & Butterfill



Rubio, Richardson & Butterfill

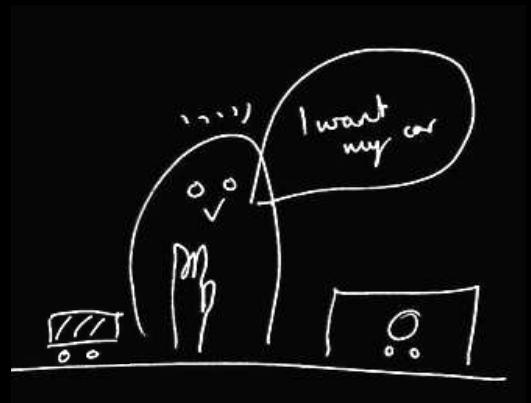
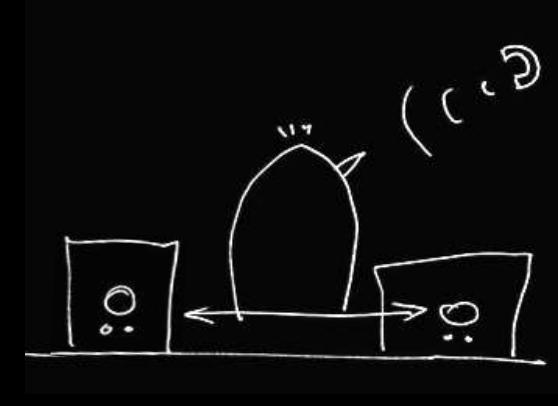
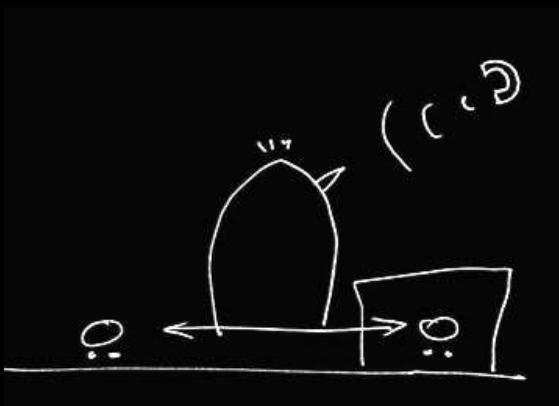
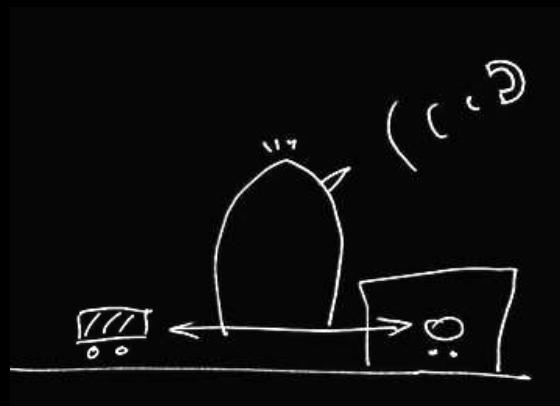
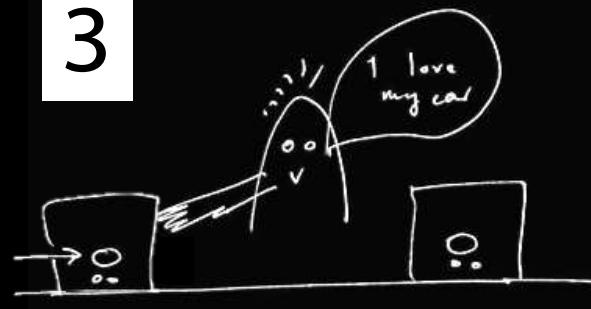
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3



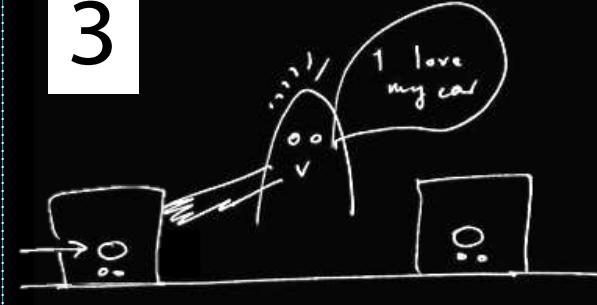
1



2



3



belief: $2 \approx 3$

registration: $2 \not\approx 3$

belief: $1 \not\approx 2$

registration: $1 \approx 2$

