

How to construct a Minimal Theory of Mind

s.butterfill@warwick.ac.uk



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

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 overalls, and the girl is behind him, wearing a patterned dress. They appear to be in a joyful, playful mood.

challenge

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

conjecture

We need to understand how theory of mind cognition could come in degrees.

“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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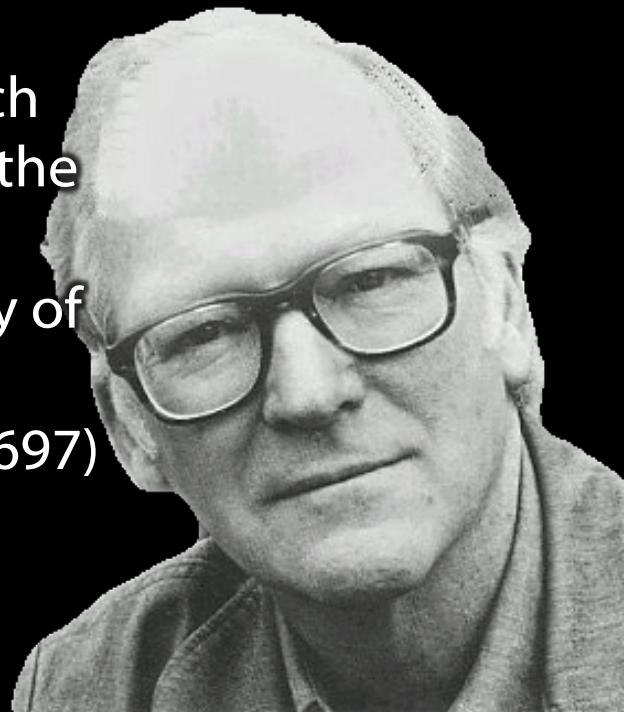
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obstacle

Grasp of everyday psychological concepts like belief, desire, knowledge and intention is all-or-nothing.

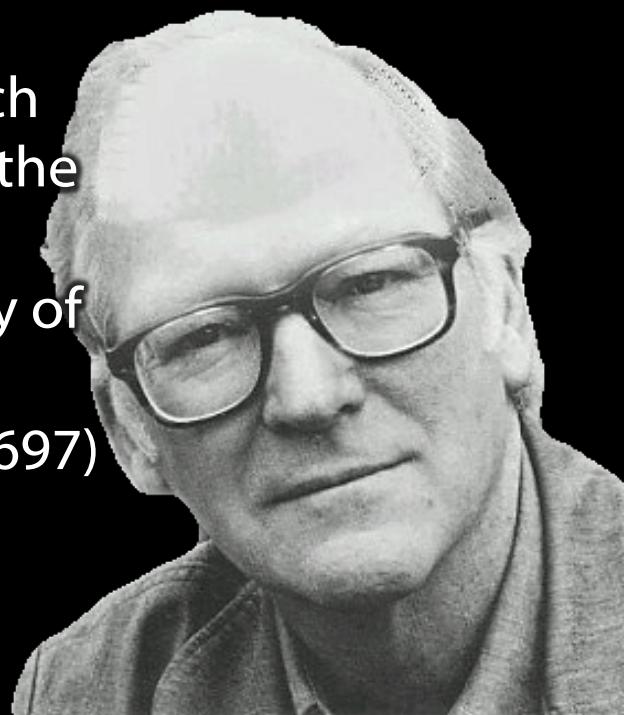
“We are stuck with our two main ways of describing and explaining things, one which treats objects and events as mindless, and the other which treats objects and events as having propositional attitudes. I see no way of bridging the gap”

(Davidson 2003:697)



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puzzle

Theory of mind *abilities* are widespread



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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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Chimpanzees conceal their approach from a competitor's view, and act in ways that are optimal given what another has seen

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(b) scarce cognitive resources

- attention
- working memory

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Propositional attitudes ...

cause actions

resemble “intervening variables” linking environment to behaviour

have contents which may be true or false

have contents which may refer to non-existent entities

are involved in uncodifiably complex causal interactions

have contents which are individuated by senses, not only by referents

are associated with normative requirements

are individuated in terms of their interlocking roles in causal and normative explanations of thought and action

...

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?

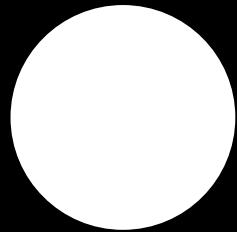
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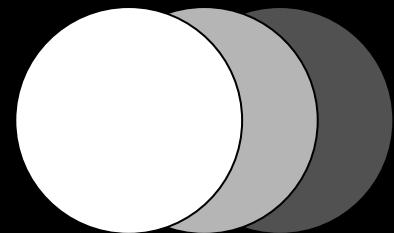
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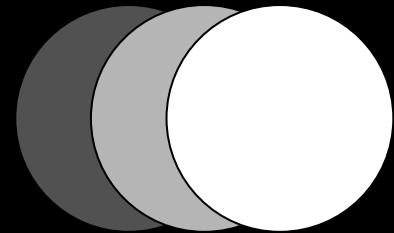
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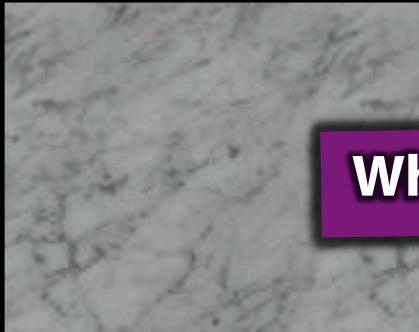
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Where is the ball?



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?



Where is the ball?

puzzles

What could enable chimps and jays represent that knowledge about others' perceptions, beliefs and other propositional attitudes?

RT / looking time



Other's belief
True

Other's belief
False

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?



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?

challenge

Explain the empirical evidence for evolution or development of the capacity of mind cognition.

puzzle

What could infants, chimps and other primates know about the world? What would enable them, within limits, to learn about the world? How do they learn about the world? What are the limitations, if any, on what they can learn about the world?



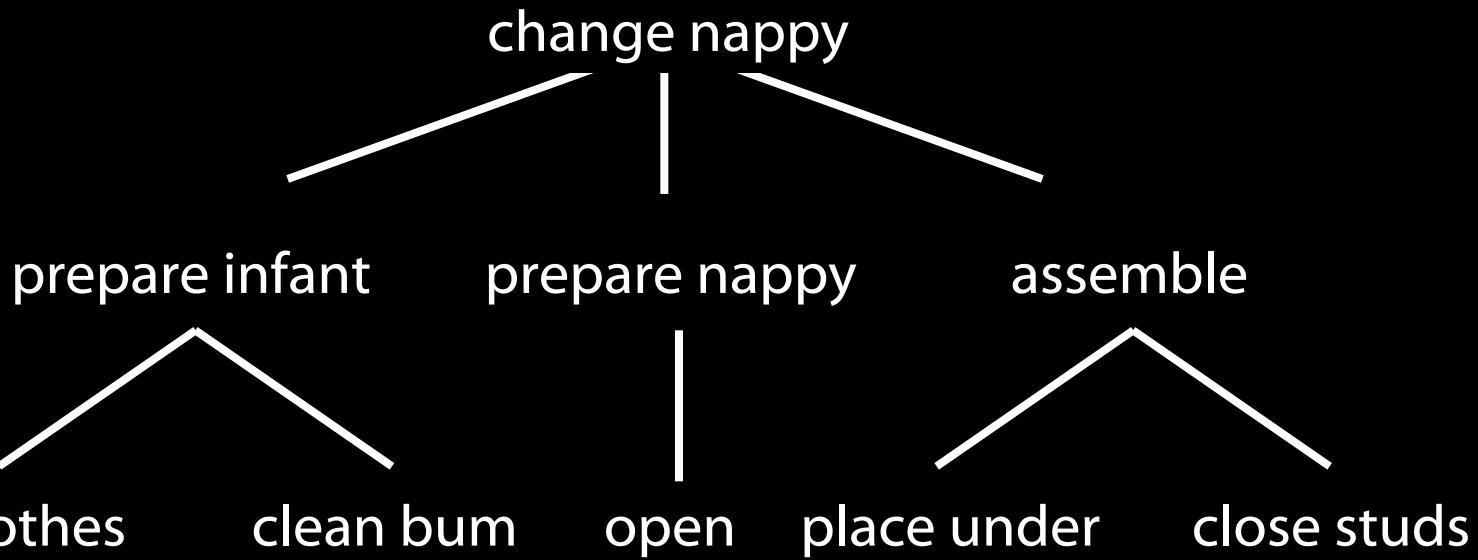


change nappy

plans

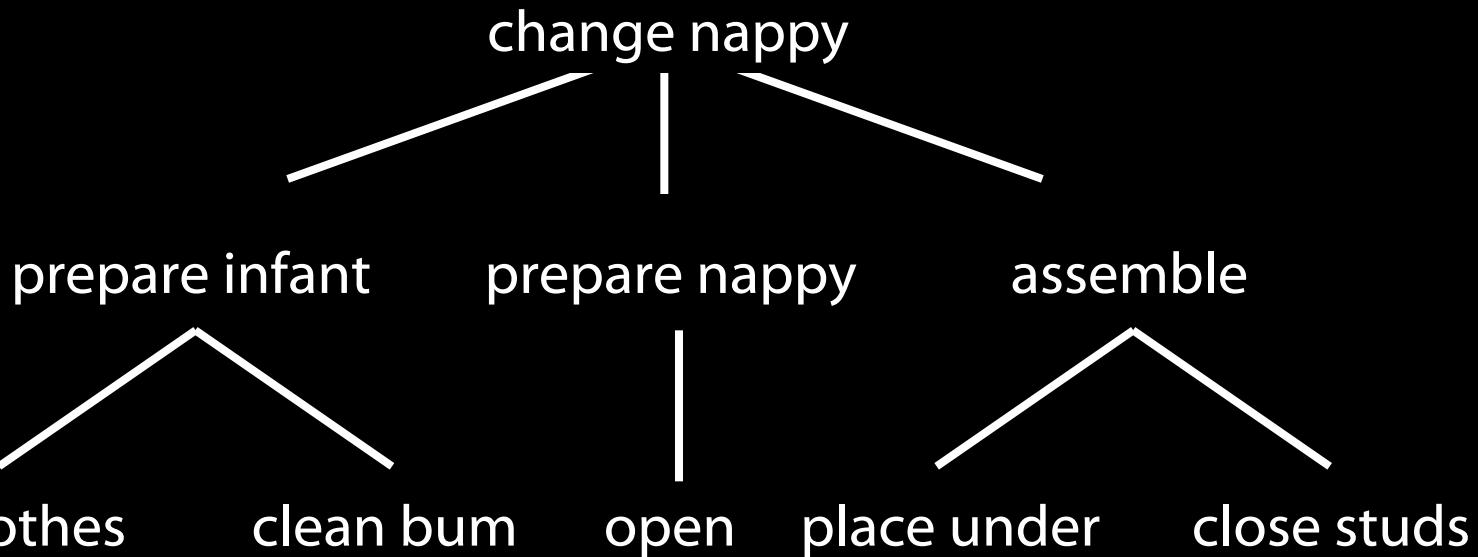


plans



goals

plans



goals

./reach X/ /grasp X/ /grasp Y/ /pull Y/ /scoop X/ /Y out of X/ ...

motor action

plans



goals

strip clothes clean bum open place under close studs

motor action

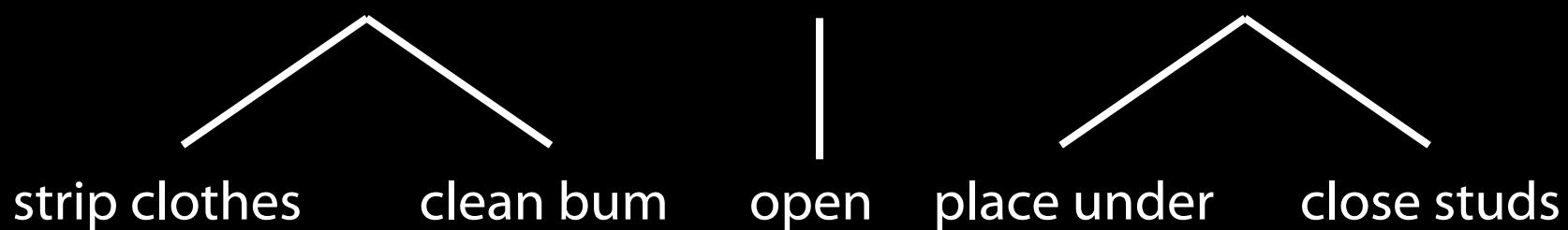
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[reach-left-hand X] [left-wholehand-grasp X] [right-wholehand-grasp ...]

plans



goals



motor action

. /reach X/ /grasp X/ /grasp Y/ /pull Y/ /scoop X/ /Y out of X/ ...

[reach-left-hand X] [left-wholehand-grasp X] [right-wholehand-grasp ...

motion



plans

goals

motor action

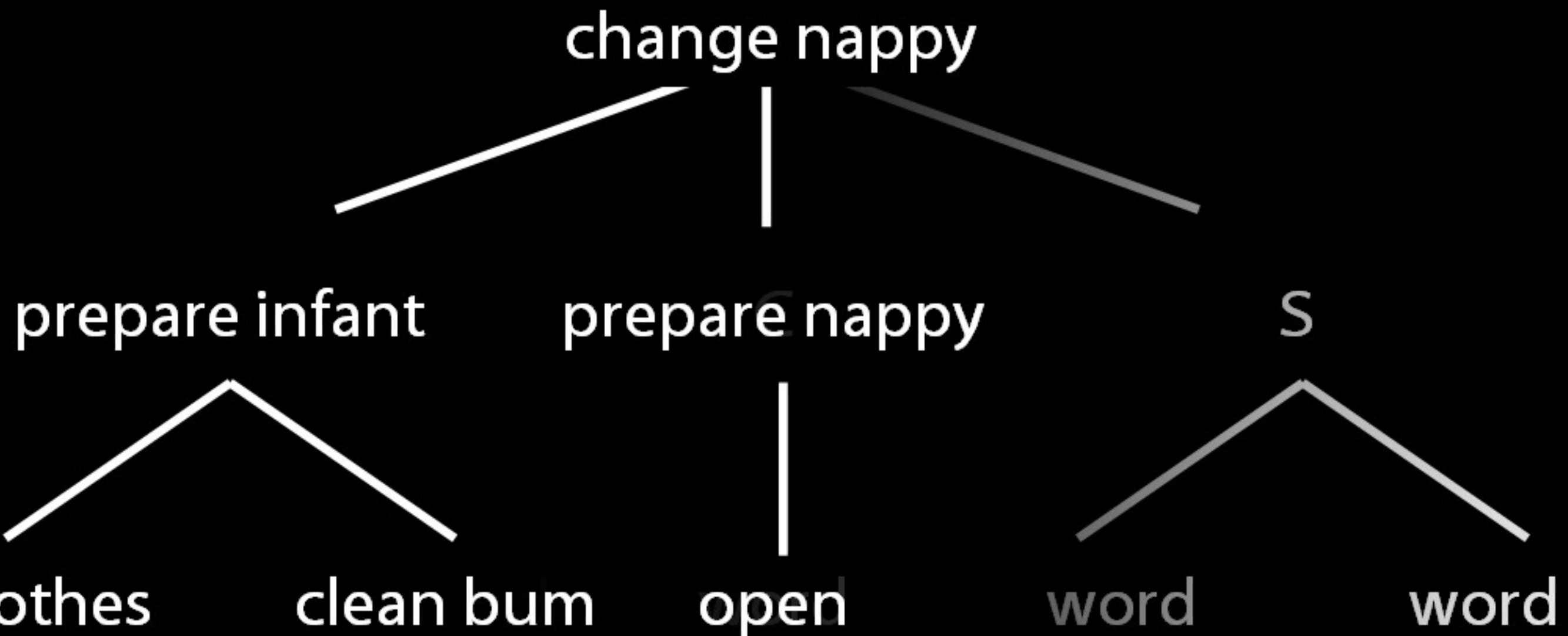
motion

clauses

words

motor action

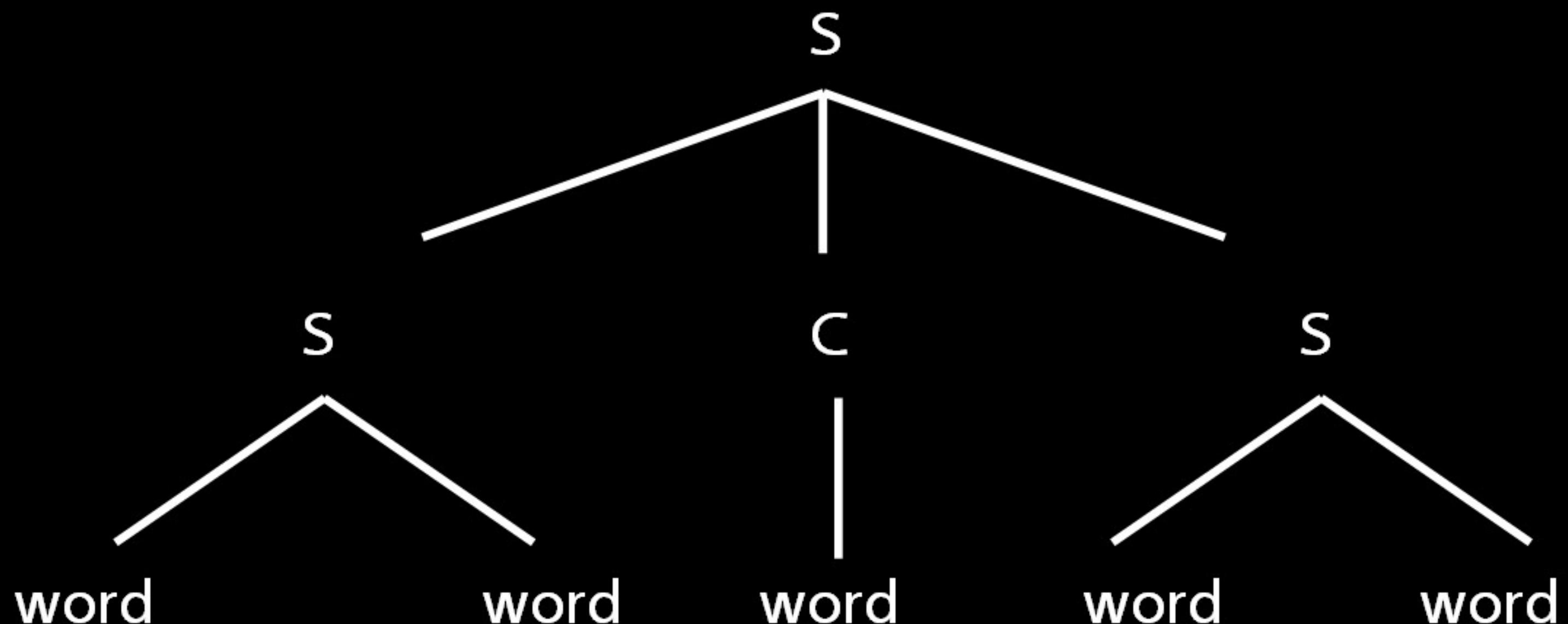
sound



/reach X/ /grasp X/ /grasp Y/ /e//n//d//l//i//l//i//k//r//a//i//d

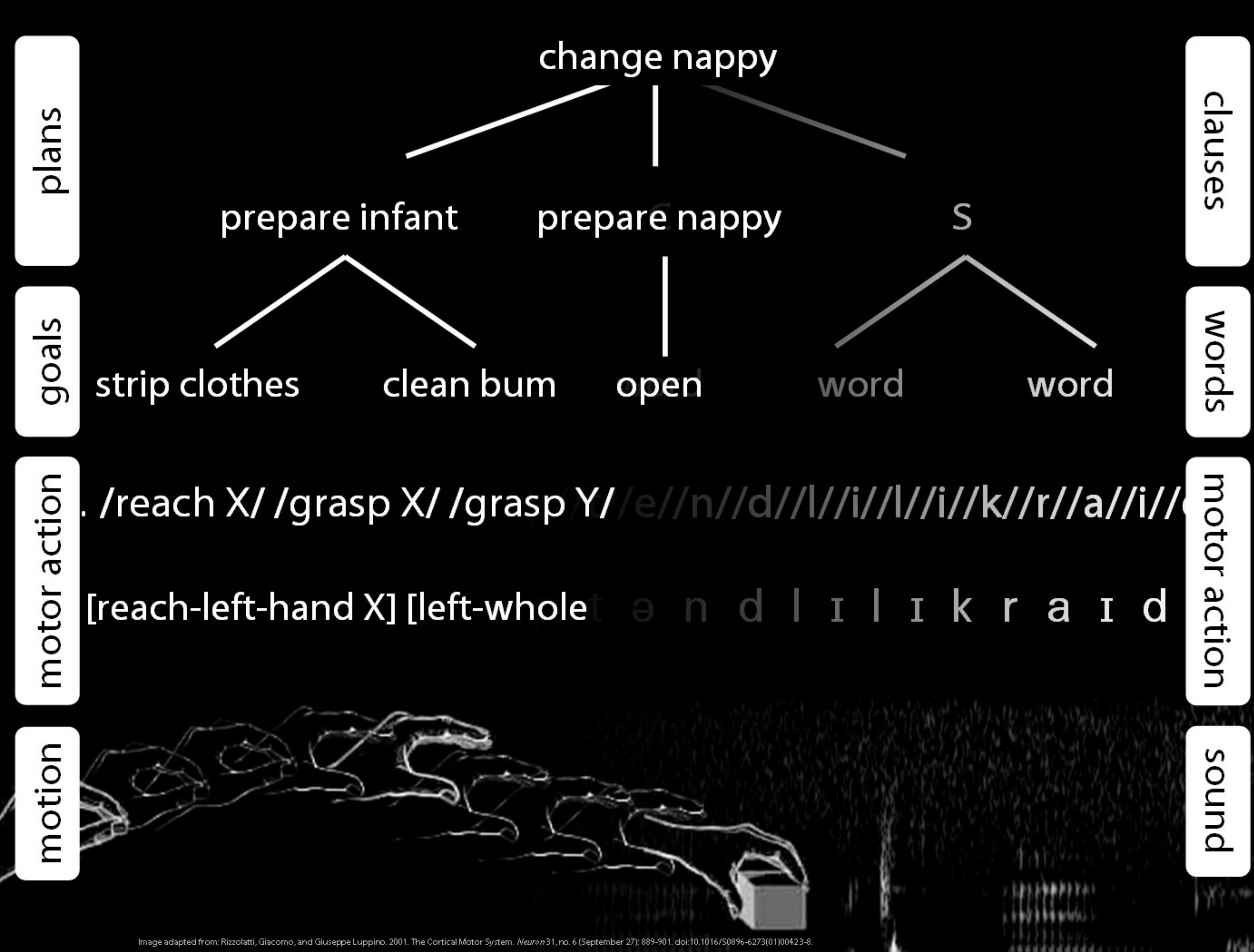
[reach-left-hand X] [left-whole t θ n d l i l i k r a i d]





/i//z//e//b//e//l//s//l//e//p//t//e//n//d//l//i//l//i//k//r//a//i//d//

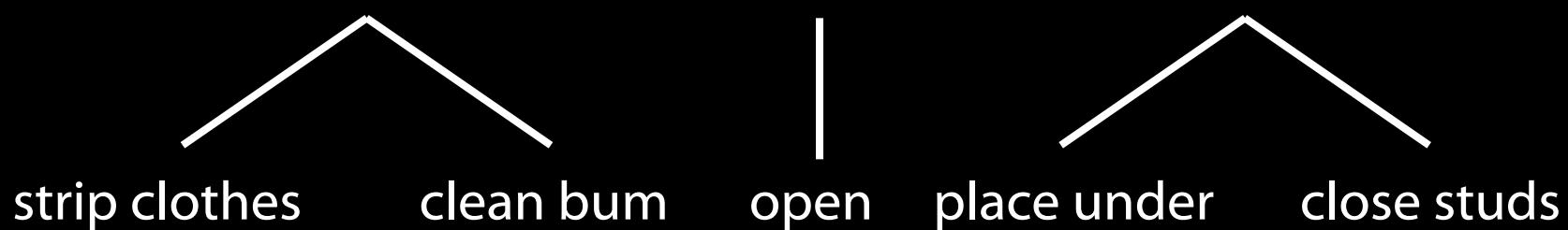
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plans



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motor action

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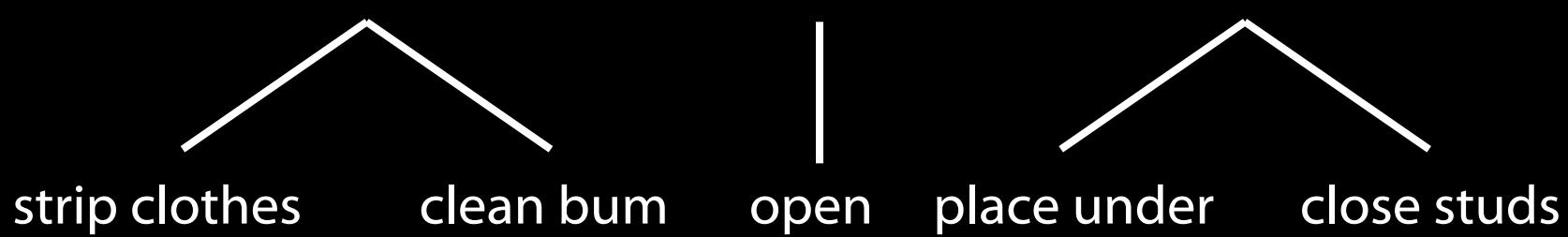
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plans



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motor action

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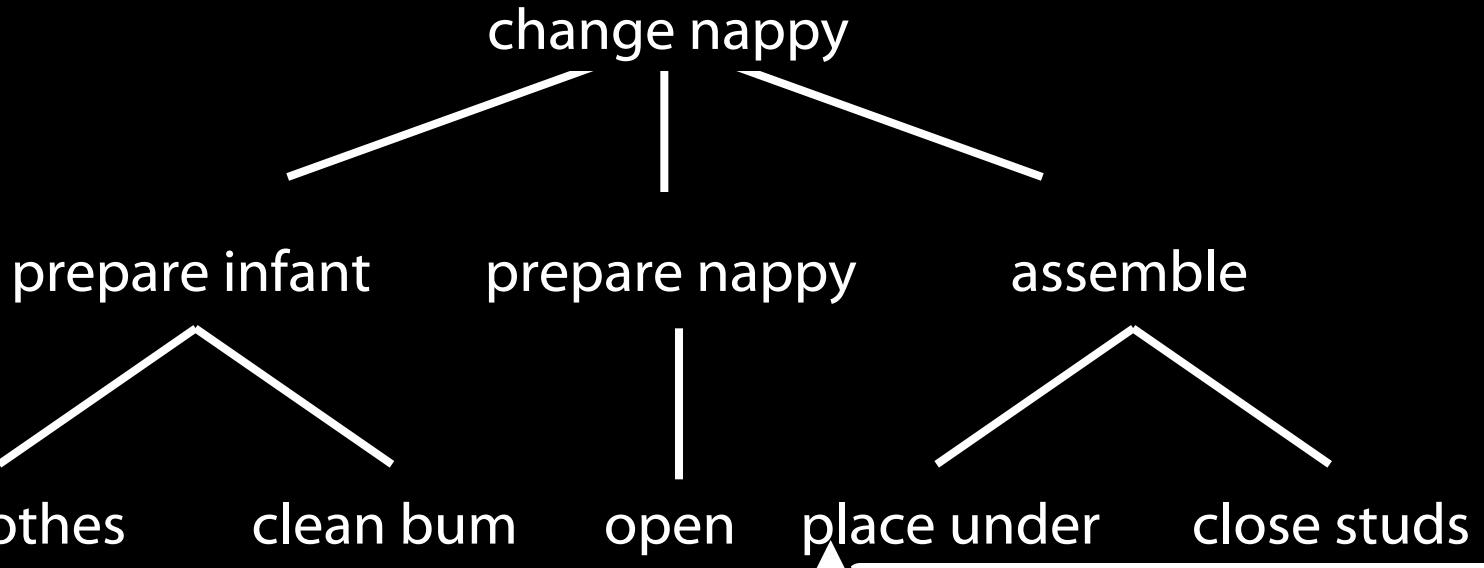
[reach-left-hand X] [left-wholehand-grasp X1] [right-wholehand-grasp ...]

motor emulation

motion



plans



goals

strip clothes clean bum open place under close studs

motor action

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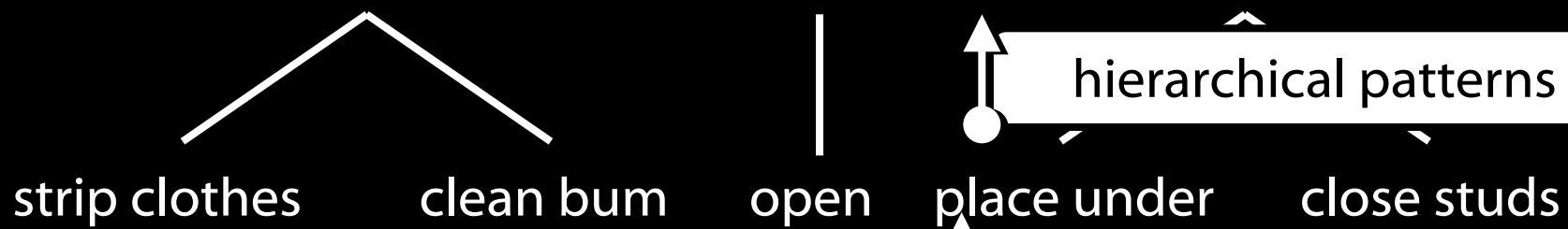
motion



plans



goals



motor action

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motion



plans



goals

strip clothes clean bum open place under close studs

object-directed actions

/reach X/ /grasp X/ /grasp Y/ /pull Y/ /scoop X/ /Y out of X/ ...

motor action

[reach-left-hand X] [left-wholehand-grasp X] [right-wholehand-grasp ...]

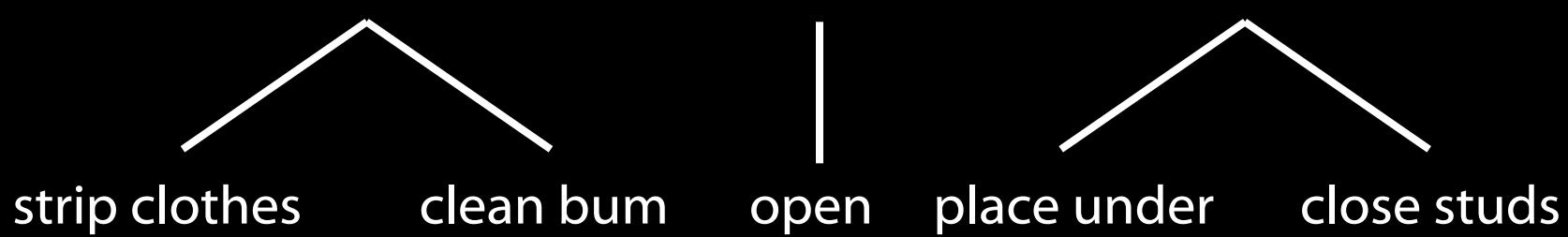
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motion





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

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Detour
Goals are not intentions

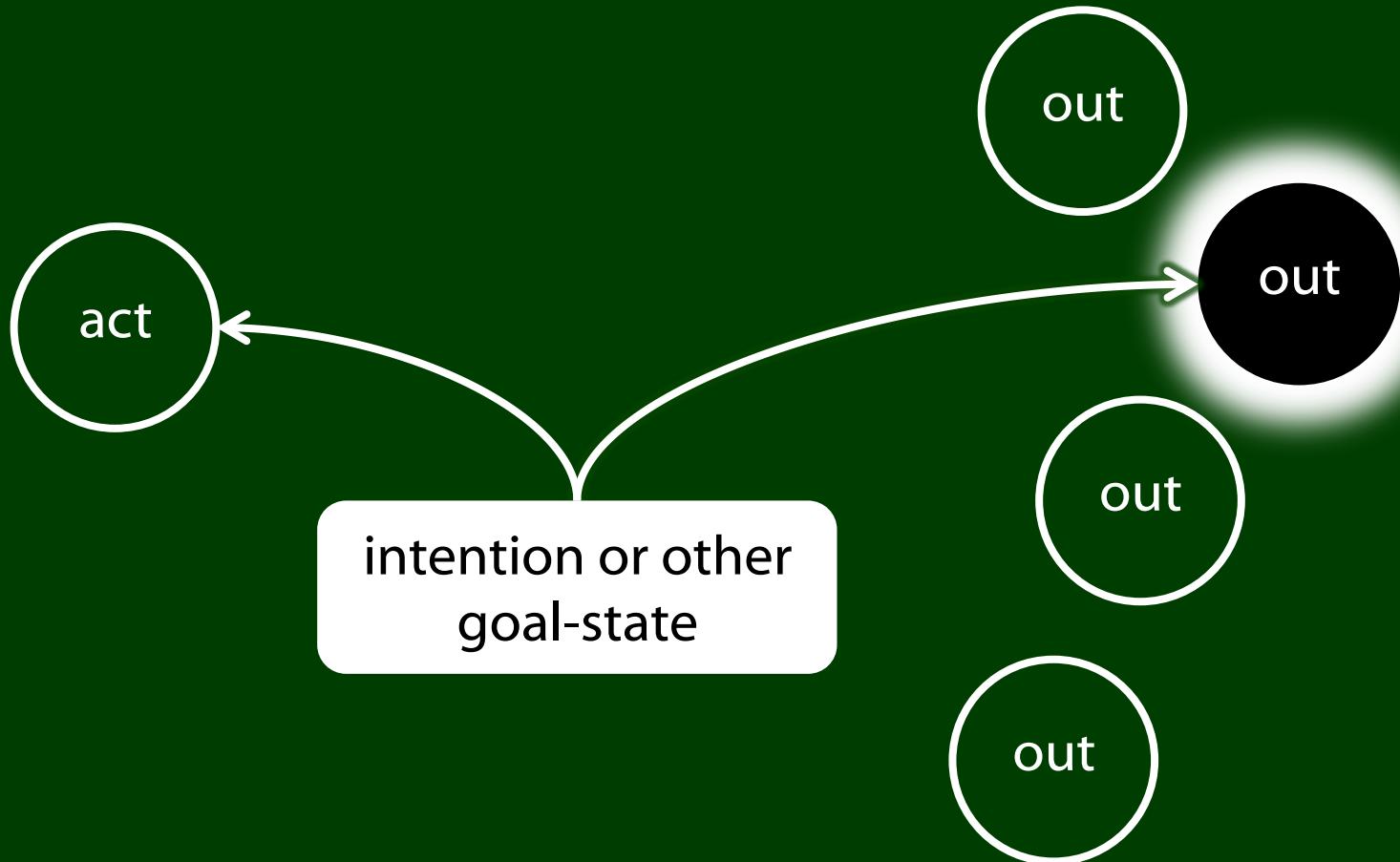
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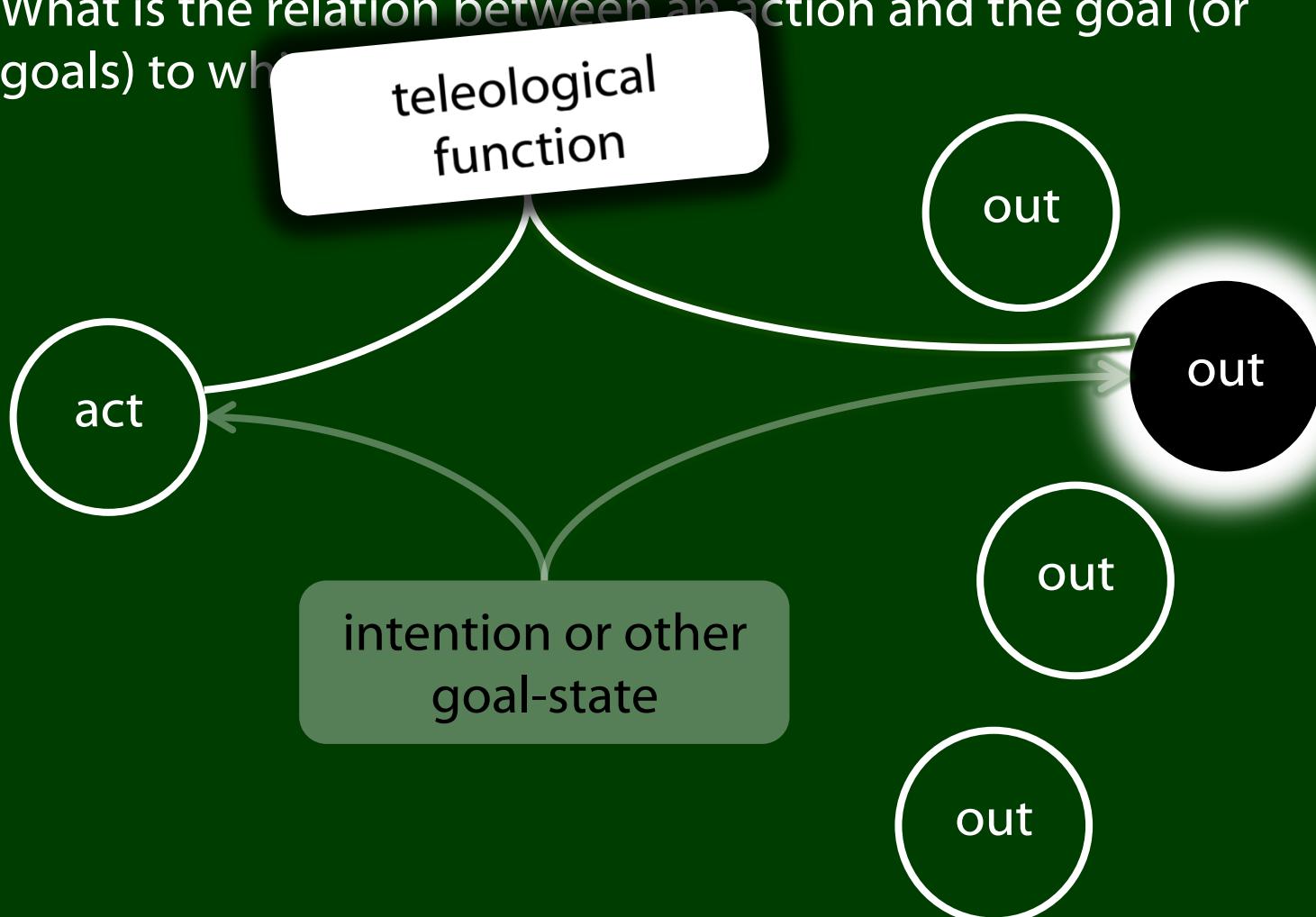
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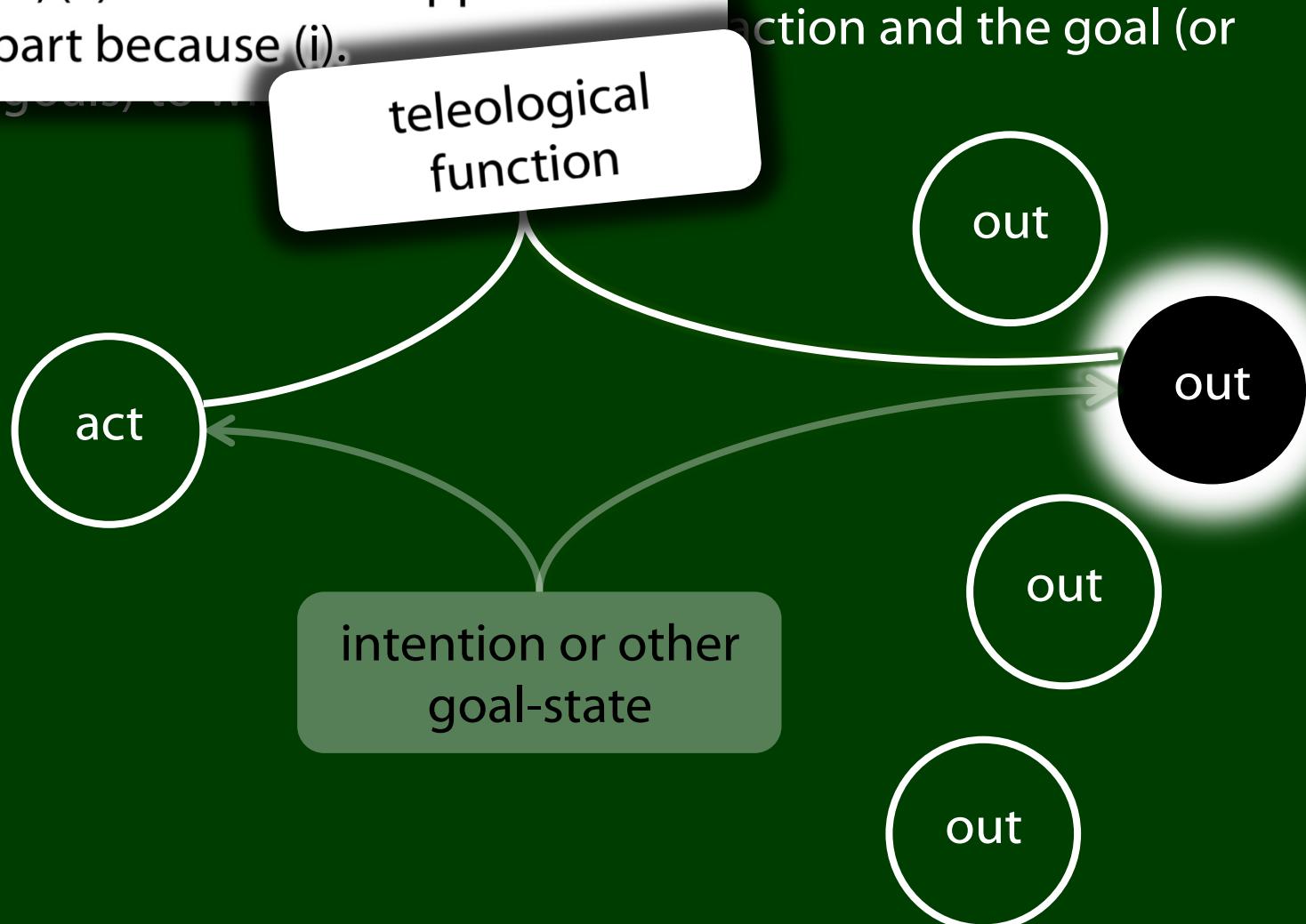
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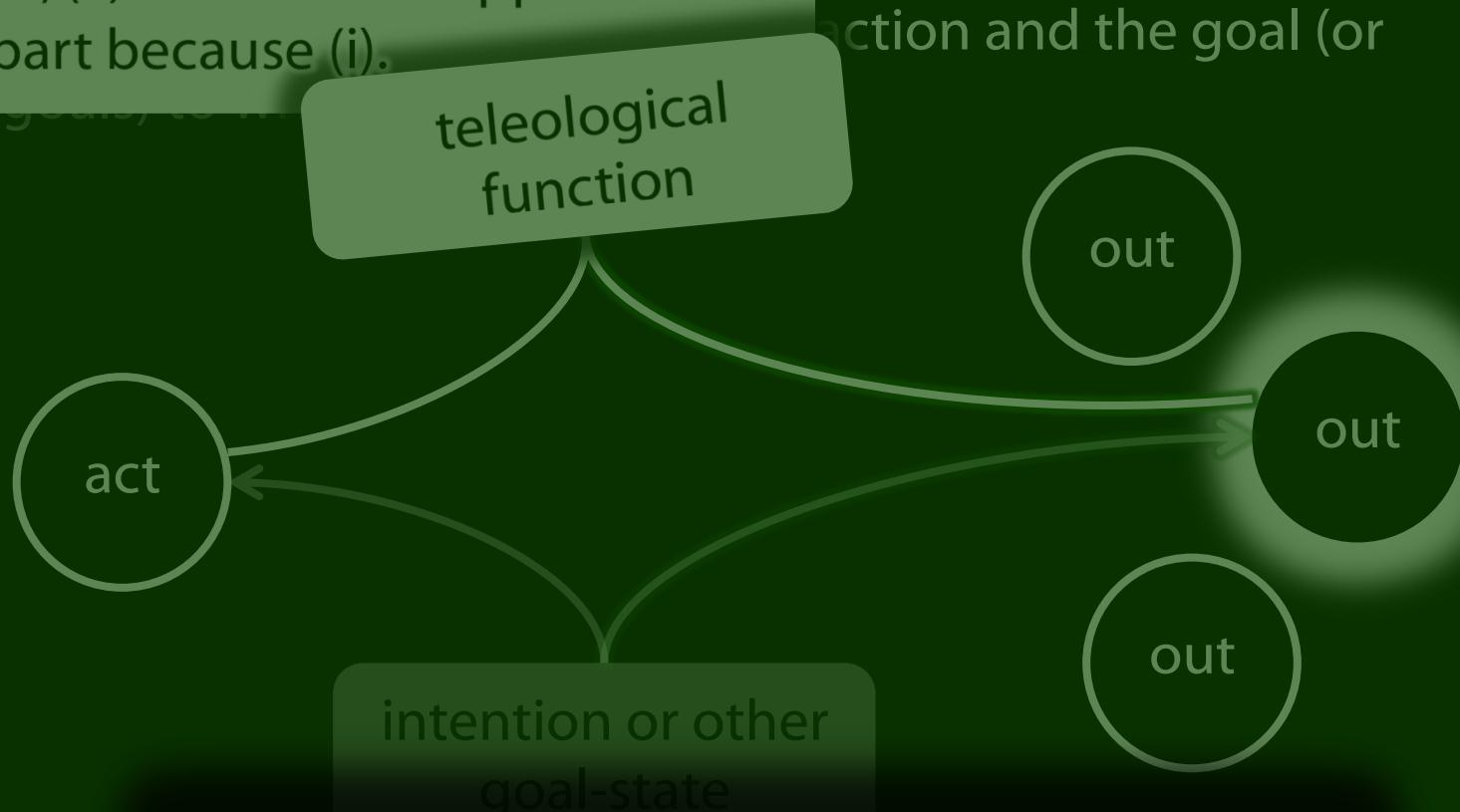
What is the relation between an action and the goal (or goals) to which it is related?



(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

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



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orientation

lighting

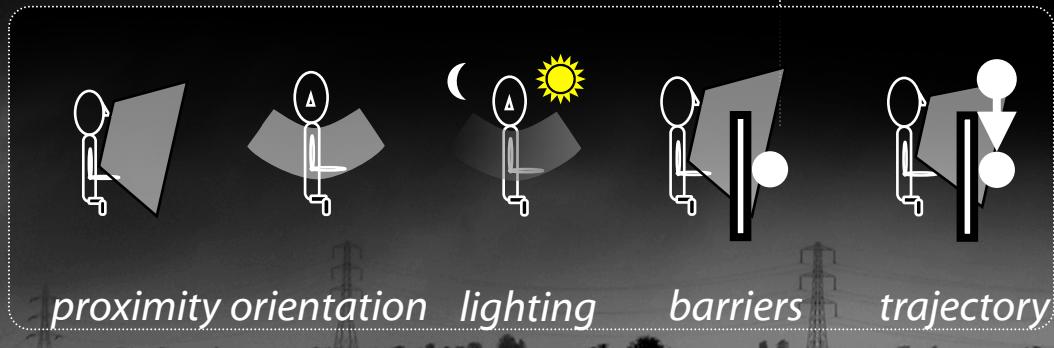
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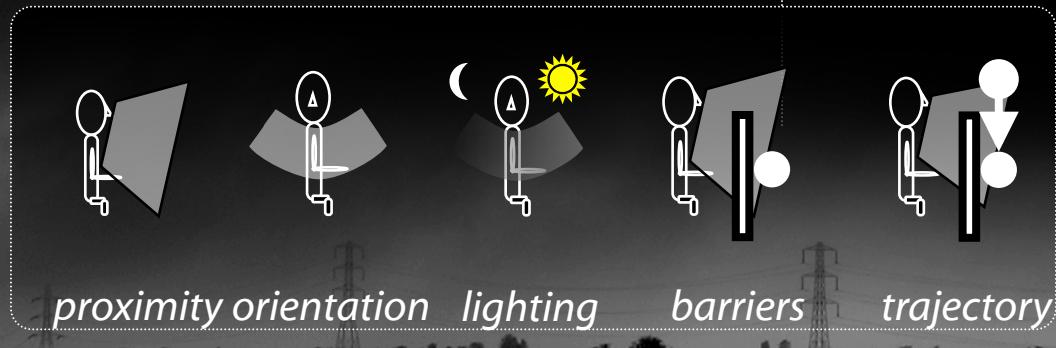


Your *field* = a set of objects related to you by proximity, orientation, lighting and other factors

“children could ... think about what the other person saw rather than what they saw”

(Flavell, Shipstead & Croft 1978: 1210)

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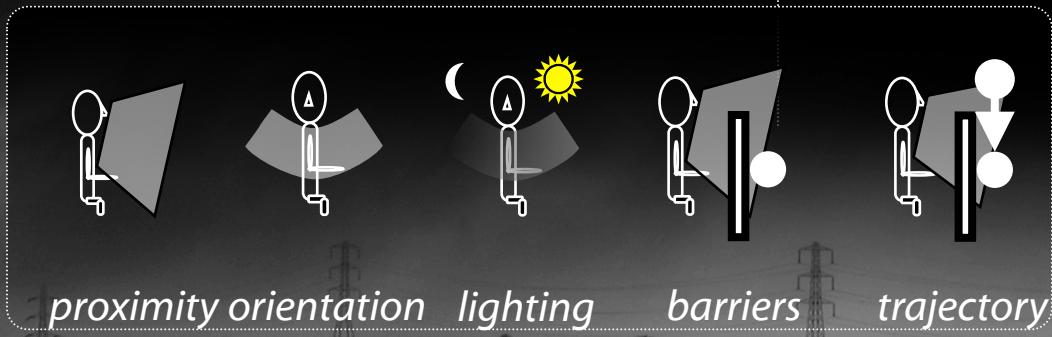


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Your *field* = a set of objects related to you by proximity, orientation, lighting and other factors

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

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



proximity orientation



lighting



barriers



trajectory



source: Liszkowski et al (2008)





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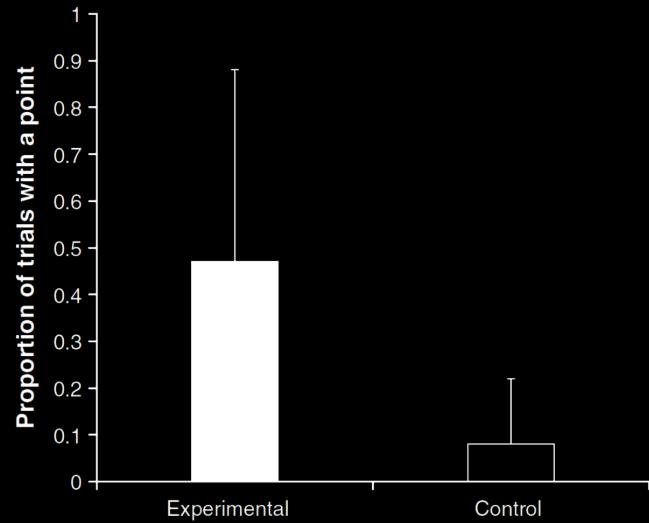
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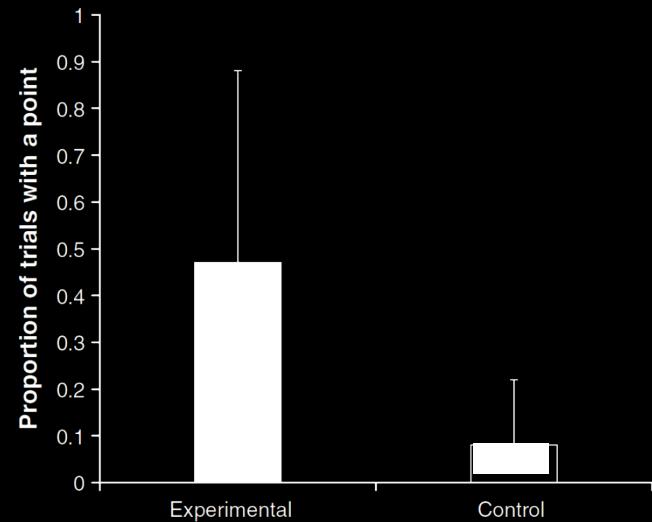
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barriers

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“Helping by informing inextricably involves ... an understanding of others’ goals and ... of others’ ignorance.”

(Liszowski, Carpenter & Tomasello 2008: 738-9)



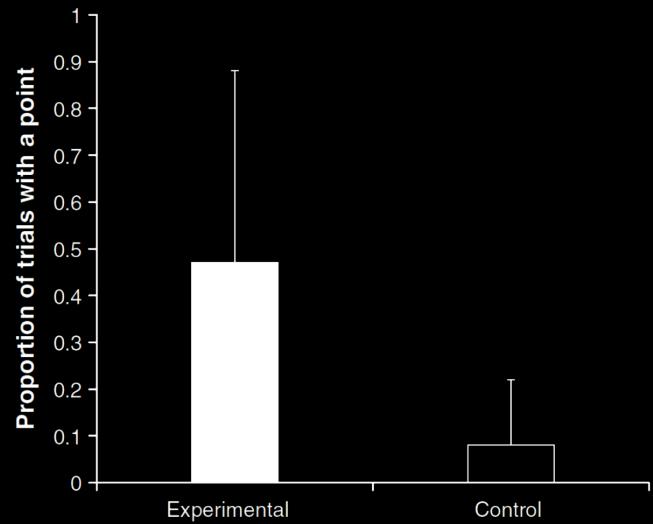
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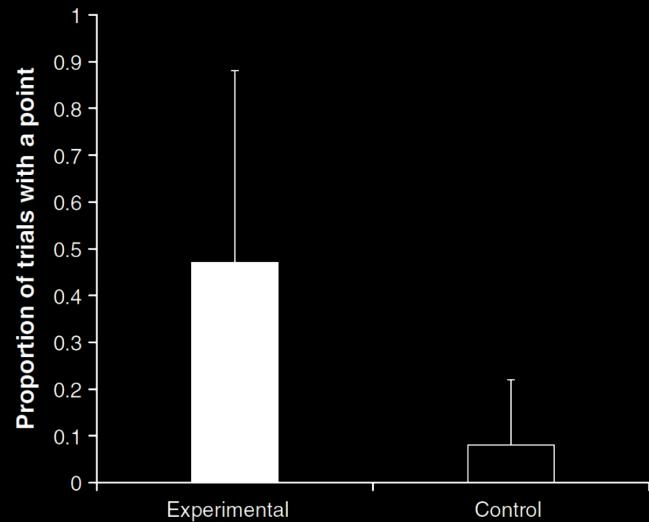
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proximity orientation



lighting



barriers



trajectory

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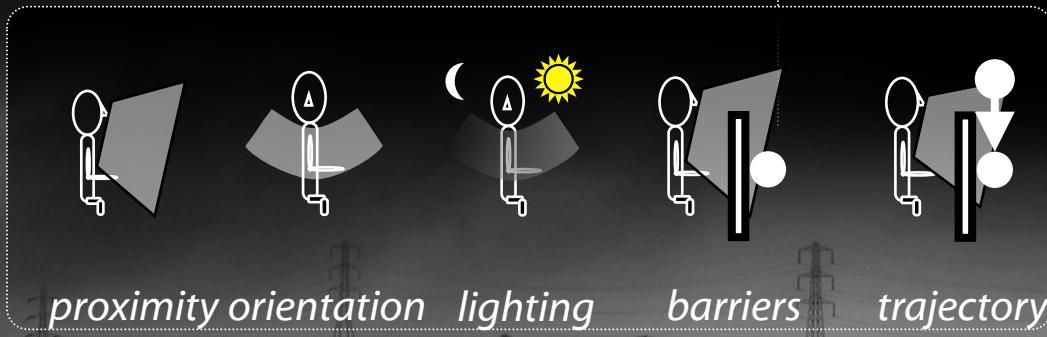
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Principle 5



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 <= you most recently encountered the object at that location

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

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



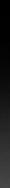
orientation



lighting



barriers



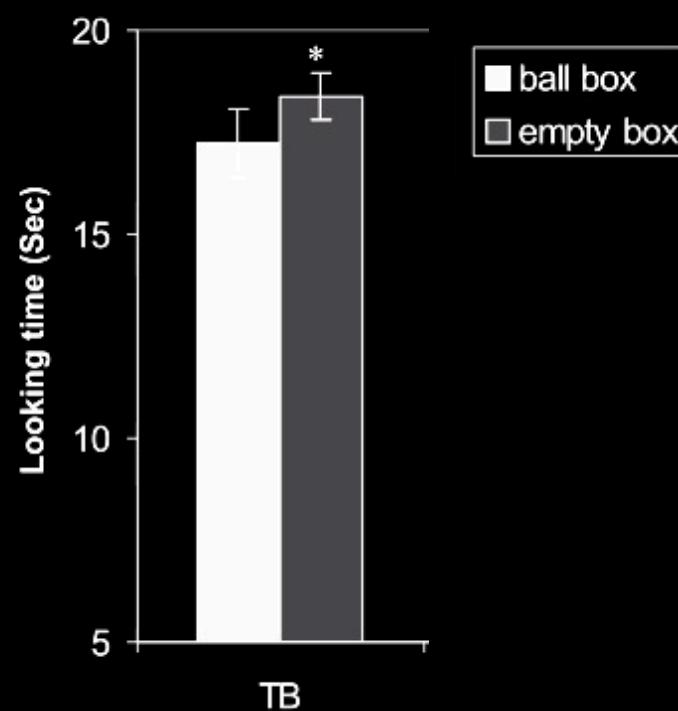
trajectory



source Träuble, Marinovic, & Pauen (2010)



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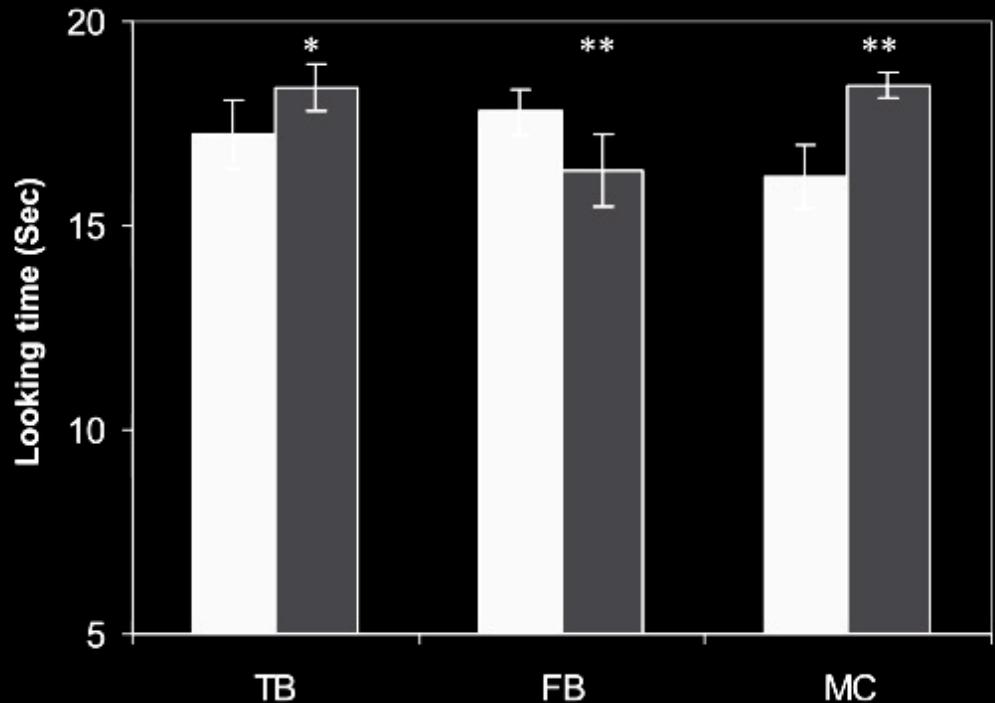
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orientation



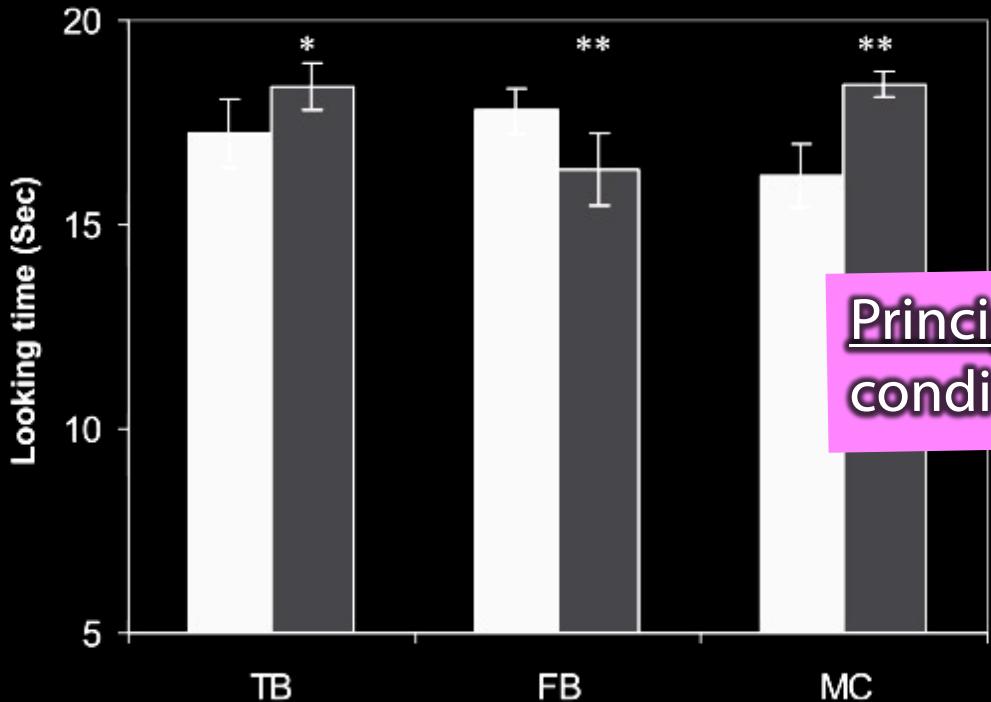
lighting



barriers



trajectory



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



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Propositional attitudes ...

cause actions

resemble “intervening variables” linking environment to behaviour

have contents which may be true or false

have contents which may refer to non-existent entities

are involved in uncodifiably complex causal interactions

have contents which are individuated by senses, not only by referents

are associated with normative requirements

are individuated in terms of their interlocking roles in causal and normative explanations of thought and action

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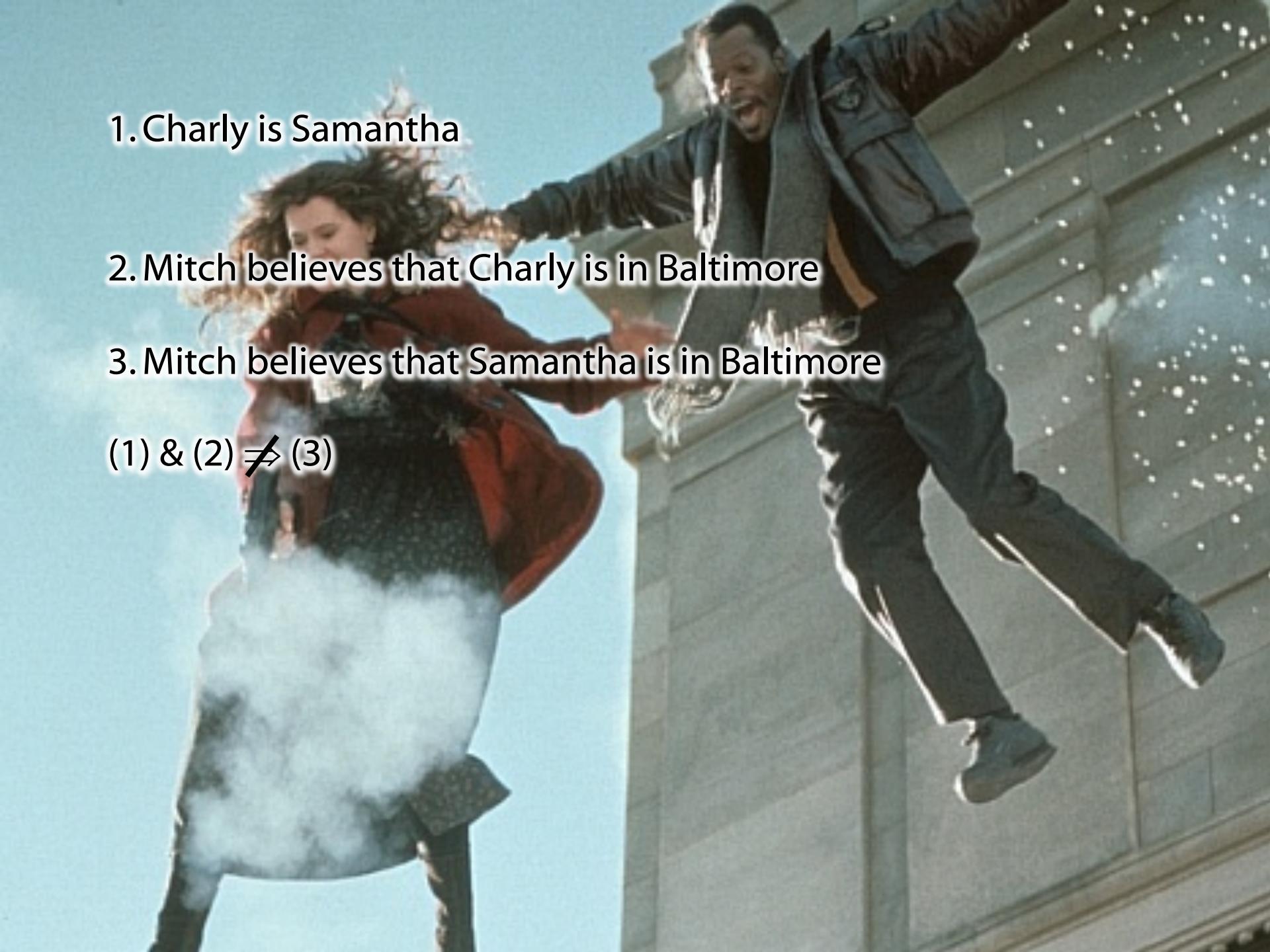
signature limits

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

pass

fail

Subjects represent
beliefs

pass

pass

False belief
about location

False belief
about identity











Subjects represent
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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?

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joint action (ability
to share goals)

minimal theory of
mind cognition

understanding
communicative intent

communication by
language

full-blown theory of
mind cognition

other stuff

other stuff



"We ... use the acronym ToM, to refer to any cognitive system, whether theory-like or not, that predicts or explains the behaviour of another agent by postulating that unobservable inner states particular to the cognitive perspective of that agent causally modulate that agent's behaviour."

(Penn & Povinelli 2007:732)

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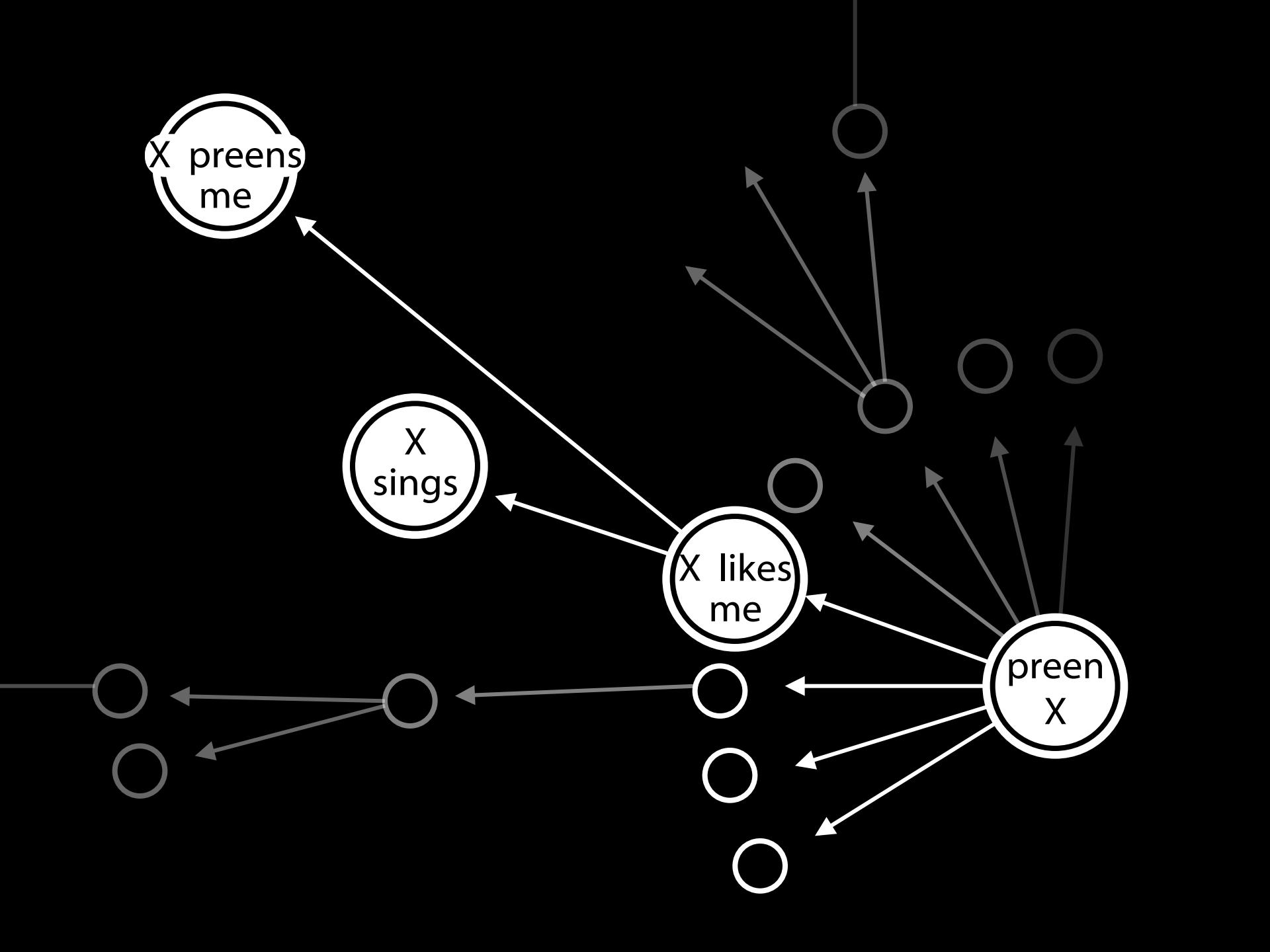
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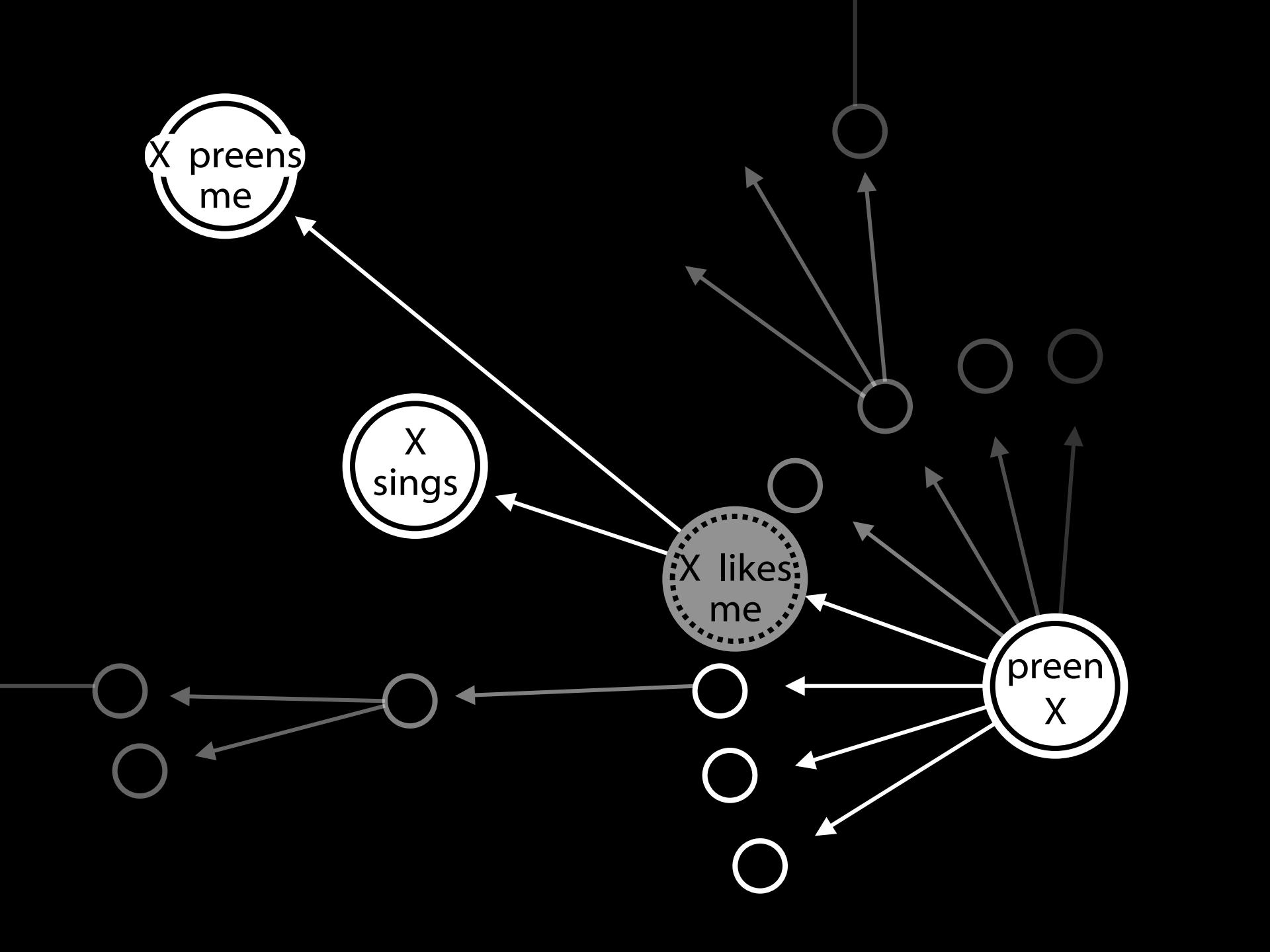
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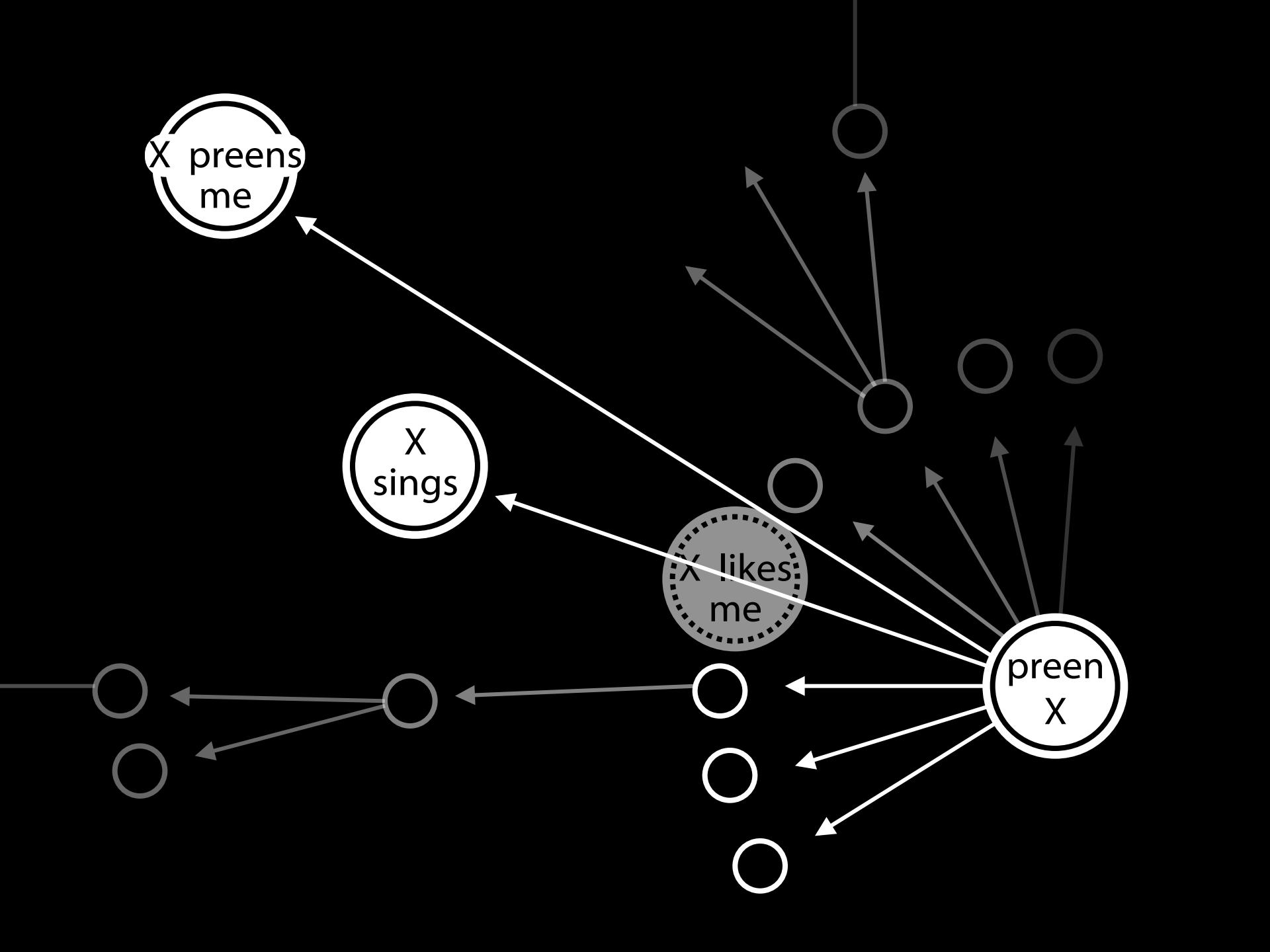
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“chimpanzees understand ... intentions ... perception and knowledge ... Moreover, they understand how these psychological states work together to produce intentional action”

(Call & Tomasello 2008:191)



“our fundamental understanding of [...] knowledge is that it is something whose possession by an individual can properly be explained by reference to [...] ways of coming to know.”

(Cassam “What is Knowledge?”, forthcoming)

