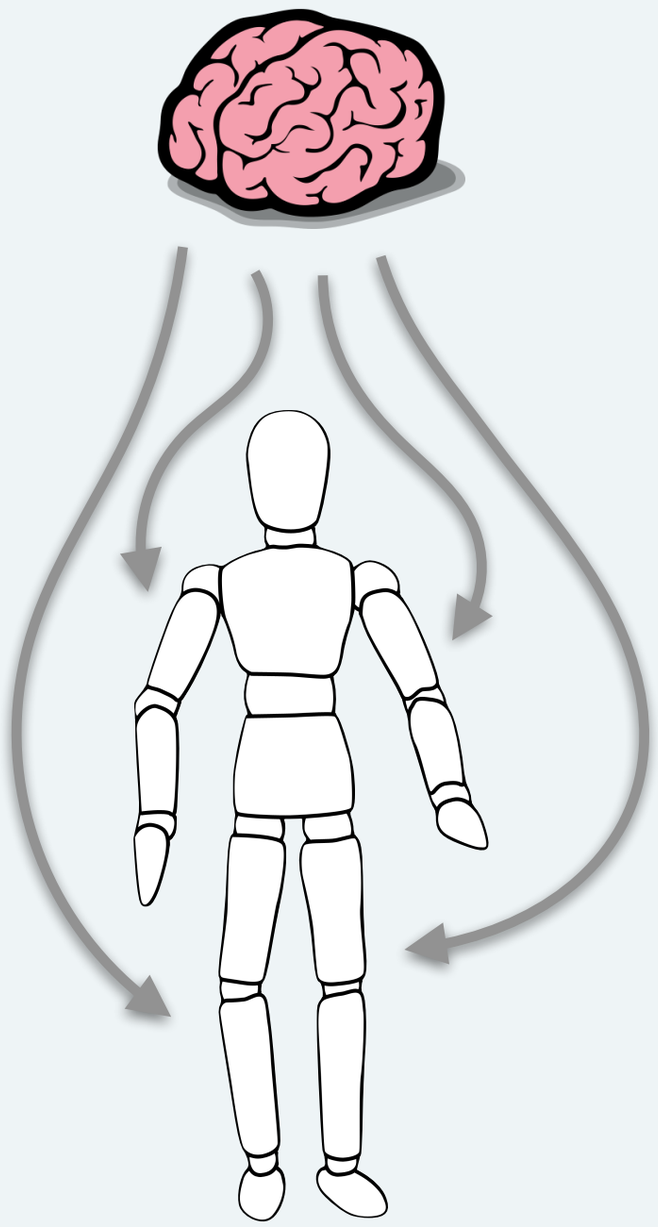
COGS300

Embodied Cognition

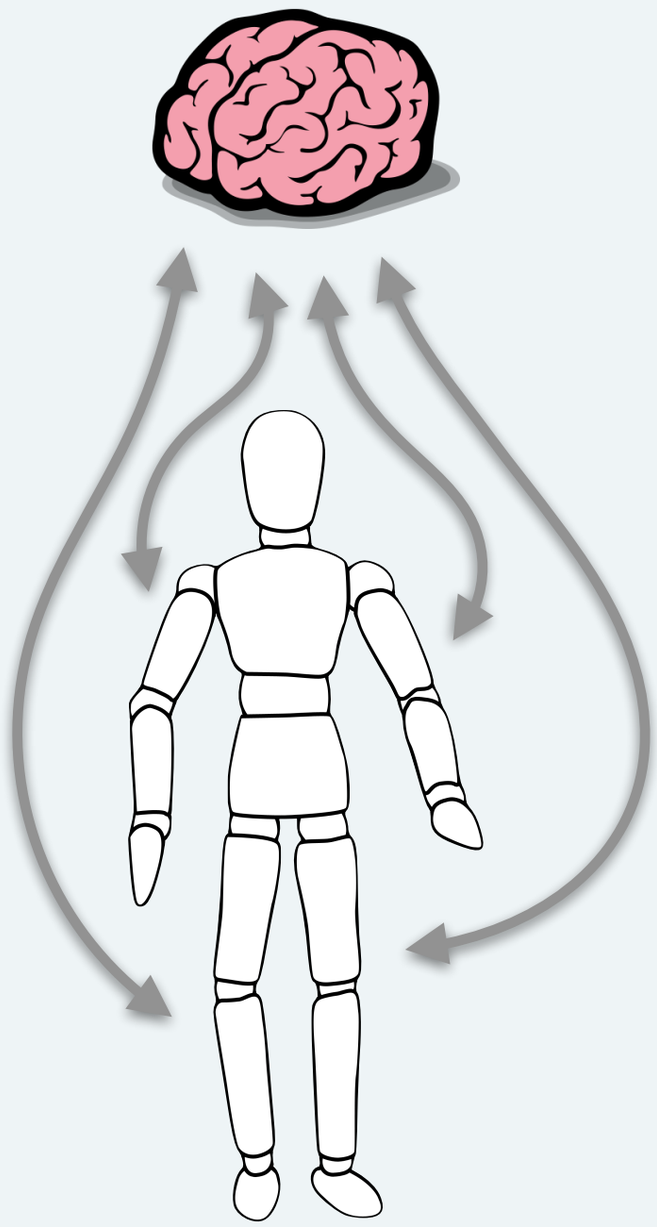
Instructor: Márton Sóskuthy
marton.soskuthy@ubc.ca

TAs: Daichi Furukawa · Victoria Lim · Amy Wang
cogs.300@ubc.ca

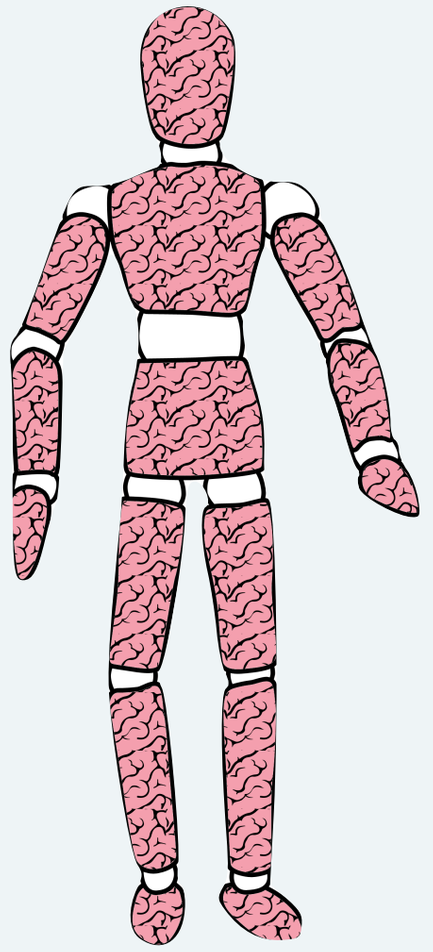
traditional “disembodied” cognitive science



body-cognition interactions (next week!)



radical embodied cognition (replacement hypothesis)



General style of argumentation

Algorithmic walking

“Passive walker”

complex problem described in terms of cognitive processes operating on abstract mental representations

→

reduces to simpler problem when viewed in the context of the body & environment – no need for complex processes & representations

General style of argumentation

1. **What is the task?**
   Coordinate limb movements to achieve bipedal locomotion

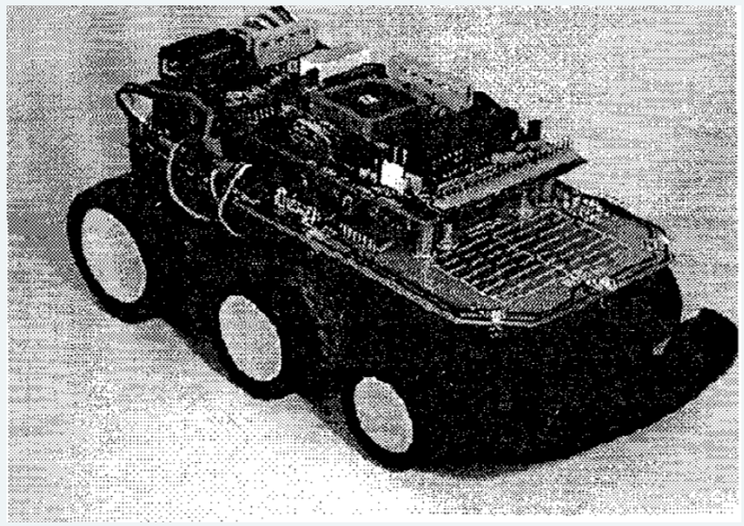
2. **What resources does the organism have?**
   Natural "springiness" of joints, skeleton, muscles; counterbalancing via arm swing; limited degrees of freedom in e.g. knee flexion; etc.

3. **How can these resources be deployed to solve the task?**
   Watch the video in the previous slide…

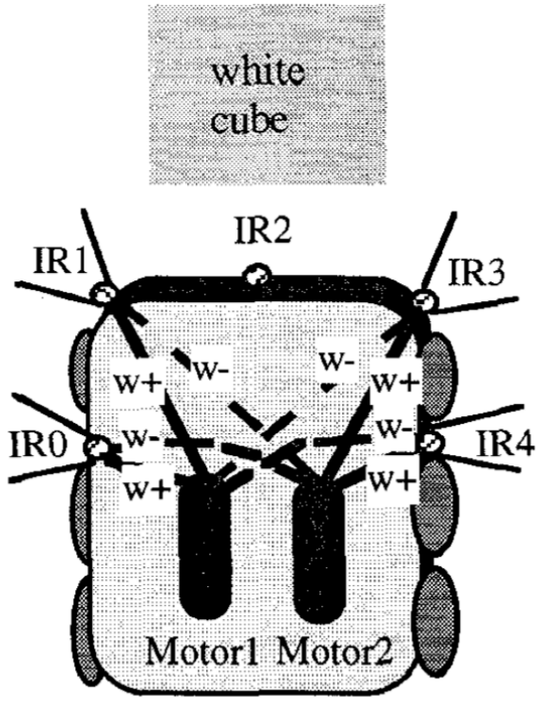
4. **Any evidence that this is actually how the task is solved?**
   (Not sure! But there is little doubt that human locomotion involves more than algorithmic joint-angle control.)

Tidy robots

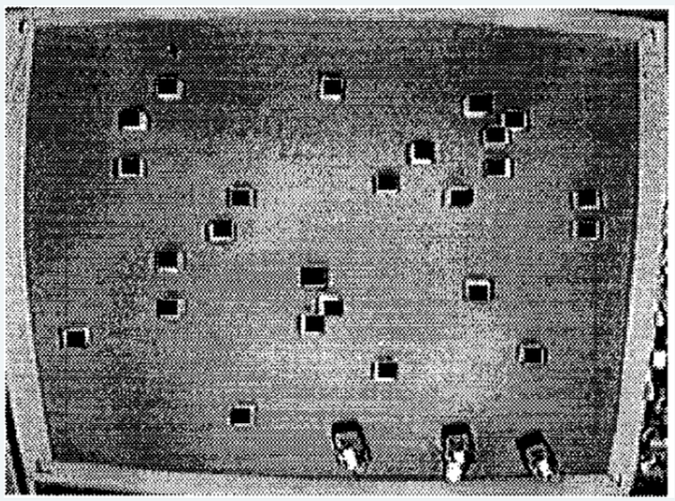
“Didabots”



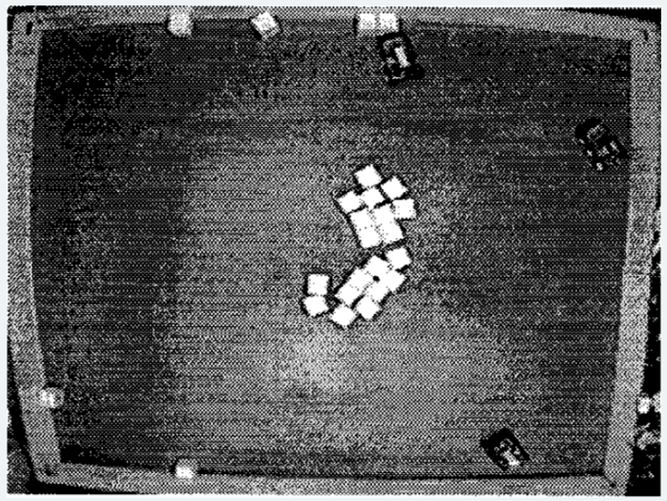
Control schematic



Initial setup



After “tidying”



Maris, M., & Boeckhorst, R. (1996). Exploiting physical constraints: heap formation through behavioral error in a group of robots. In *Proceedings of IEEE/RSJ International Conference on Intelligent Robots and Systems. IROS'96* (Vol. 3, pp. 1655-1660). IEEE.

Flocking behaviour (boids)

1. **Separation**
2. **Alignment** https://www.youtube.com/watch?v=V4f_1_r80RY
3. **Cohesion**

Outfielder problem

1. **What is the task?**
   “The fielder’s task is to move themselves so that they arrive at the right place at the right time to intercept a fly ball.”

https://www.youtube.com/watch?v=BVBaKspcadQ

Outfielder problem

1. **What is the task?**
   “The fielder’s task is to move themselves so that they arrive at the right place at the right time to intercept a fly ball.”

Traditional explanation

Predicting trajectory of ball using initial direction, velocity & angle.

→ Mental representation of the future location of the ball.

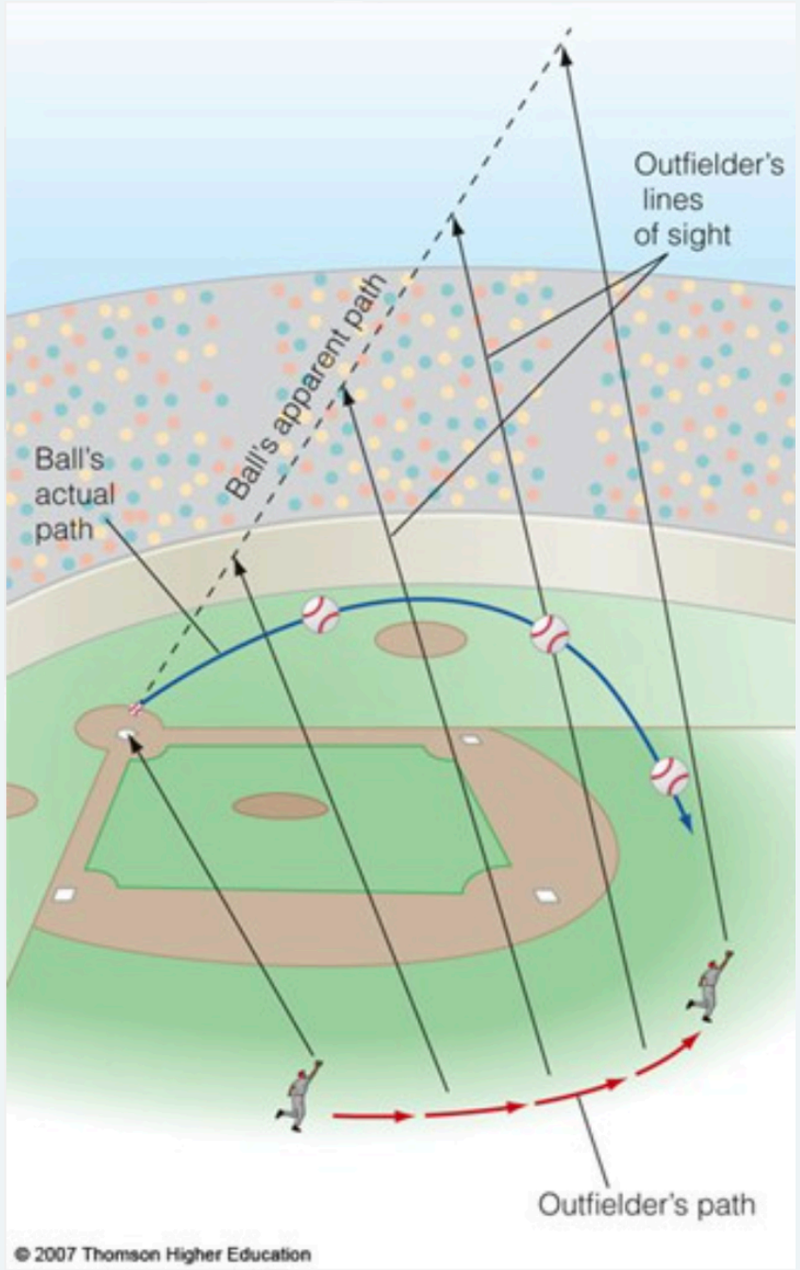
Outfielder problem

2. **What resources does the organism have?**
    - *noisy estimates of distance / direction / velocity / speed (propagating through projection!)*
    - *continuous kinematic information (→ infer underlying dynamics)*
    - *ability to detect kinematic information*
    - *ability to locomote*

Outfielder problem

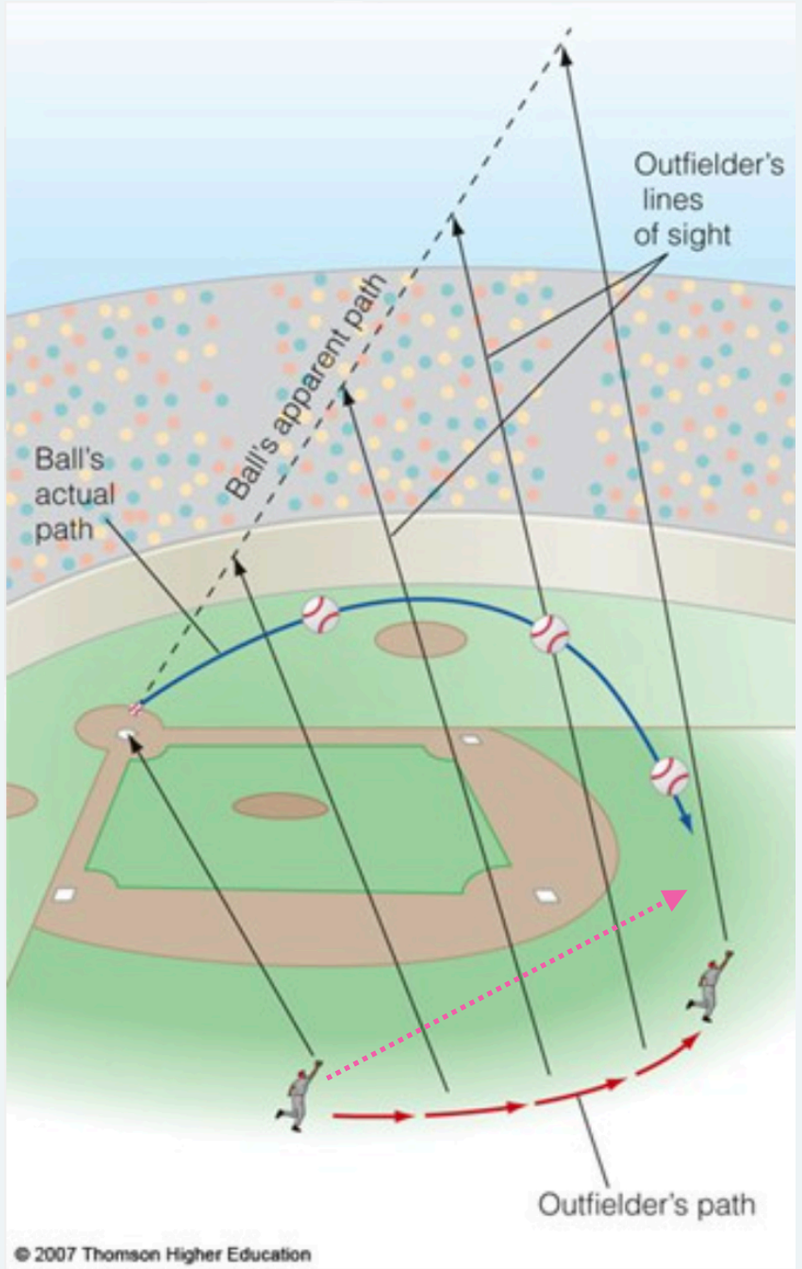
3. **How can these resources be deployed to solve the task?**

   - *heuristic solution: using perception & movement to offset some aspect of complex kinematics*
   - *linear optical trajectory…*



Outfielder problem

4. **Any evidence that this is actually how the task is solved?**
    - *prediction-based solution predicts a straight path*
    - *real paths are typically curved!*



How do humans perceive AI art and its creative works? Is it considered less or more "artistic" and "creative" than human-made art (literary, visual, auditory)? For example, how would we react if we didn't know that the song to compare R and Python was written by an AI?

A-not-B problem

1. **What is the task?**

   Find attractive object hidden in location B after it has already been hidden twice in location A. (age: 8-12 months)

https://www.youtube.com/watch?v=IhHkJ3InQOE

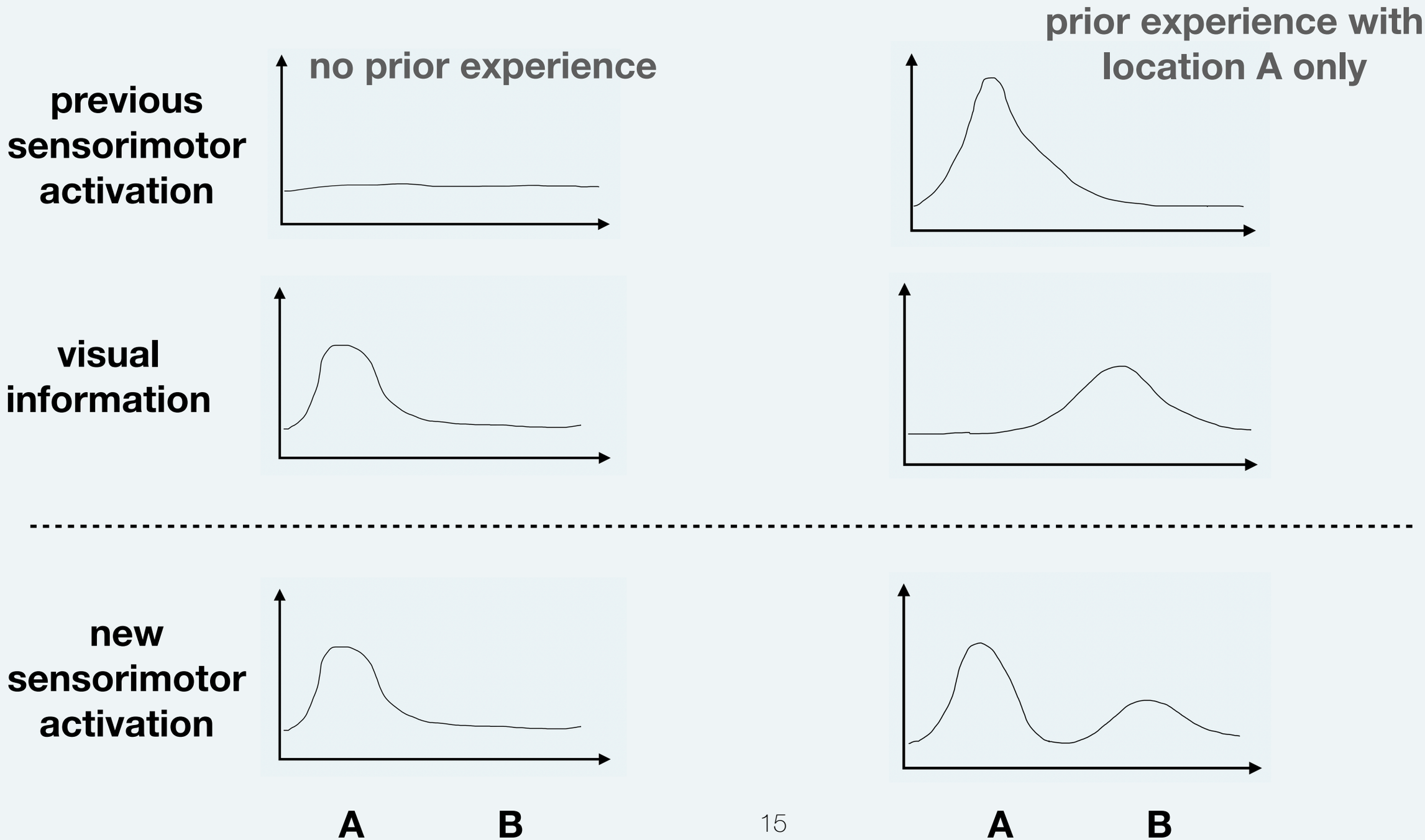
A-not-B problem

2. **What resources does the organism have?**
    - *visual input*
    - *activations in the sensorimotor cortex from previous reaches (~ a memory of those reaches)*
    - *visual attention & ability to perform visually guided reaches*

A-not-B problem

3. **How can these resources be deployed to solve the task?**

   - *“memories” of previous reaches + visual information interact to create a new reach*



A-not-B problem

4. **Any evidence that this is actually how the task is solved?**
    - *model makes new predictions:*
    - *error should occur even if object isn't hidden*
    - *error can be reproduced in older children too if the task is sufficiently complex*