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Ontological Design for Robotics

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ONTOLOGICAL DESIGN FOR ROBOTICS

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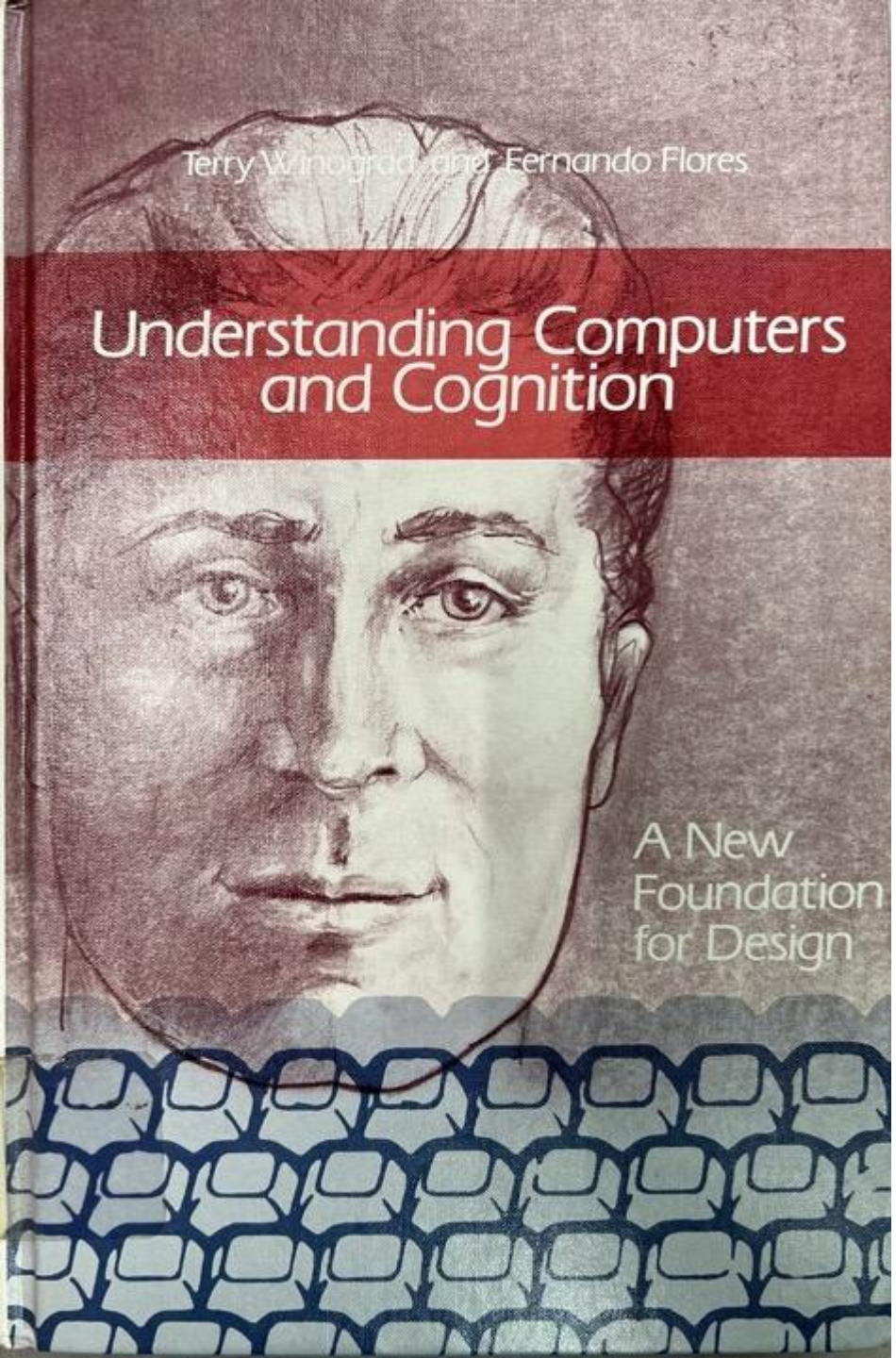


Ontological Design

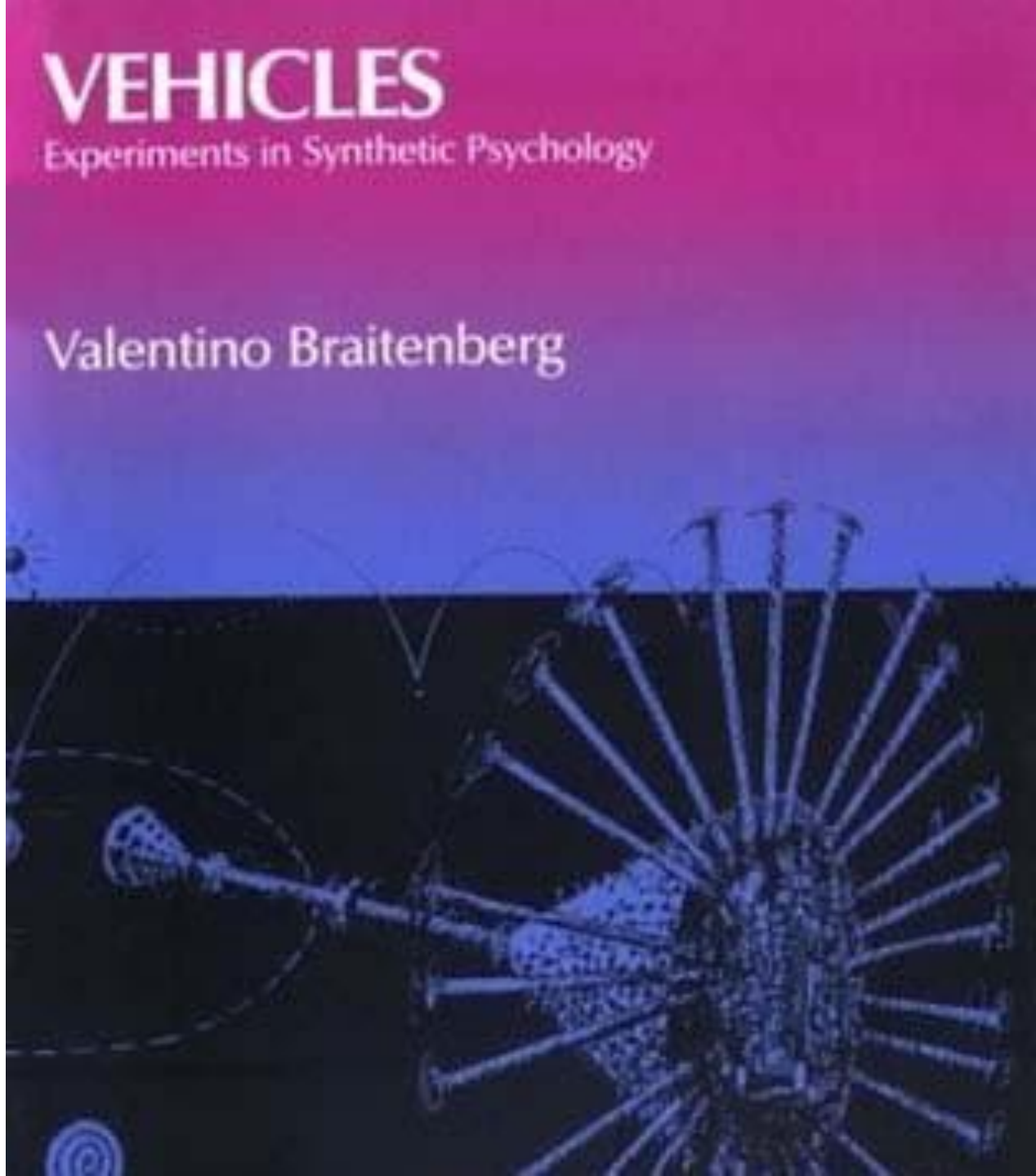
+ constructs a world of possibilities
+ ontological character of *things* emerges from experience
+ Observer centric
+ tools talk for themselves… through conversation
+ Robots bring agency

– No formal / predefined ontology

Vehicles of Thought

“This is an exercise in fictional science, or science fiction, if you like that better. Not for amusement: science fiction in the service of science.”

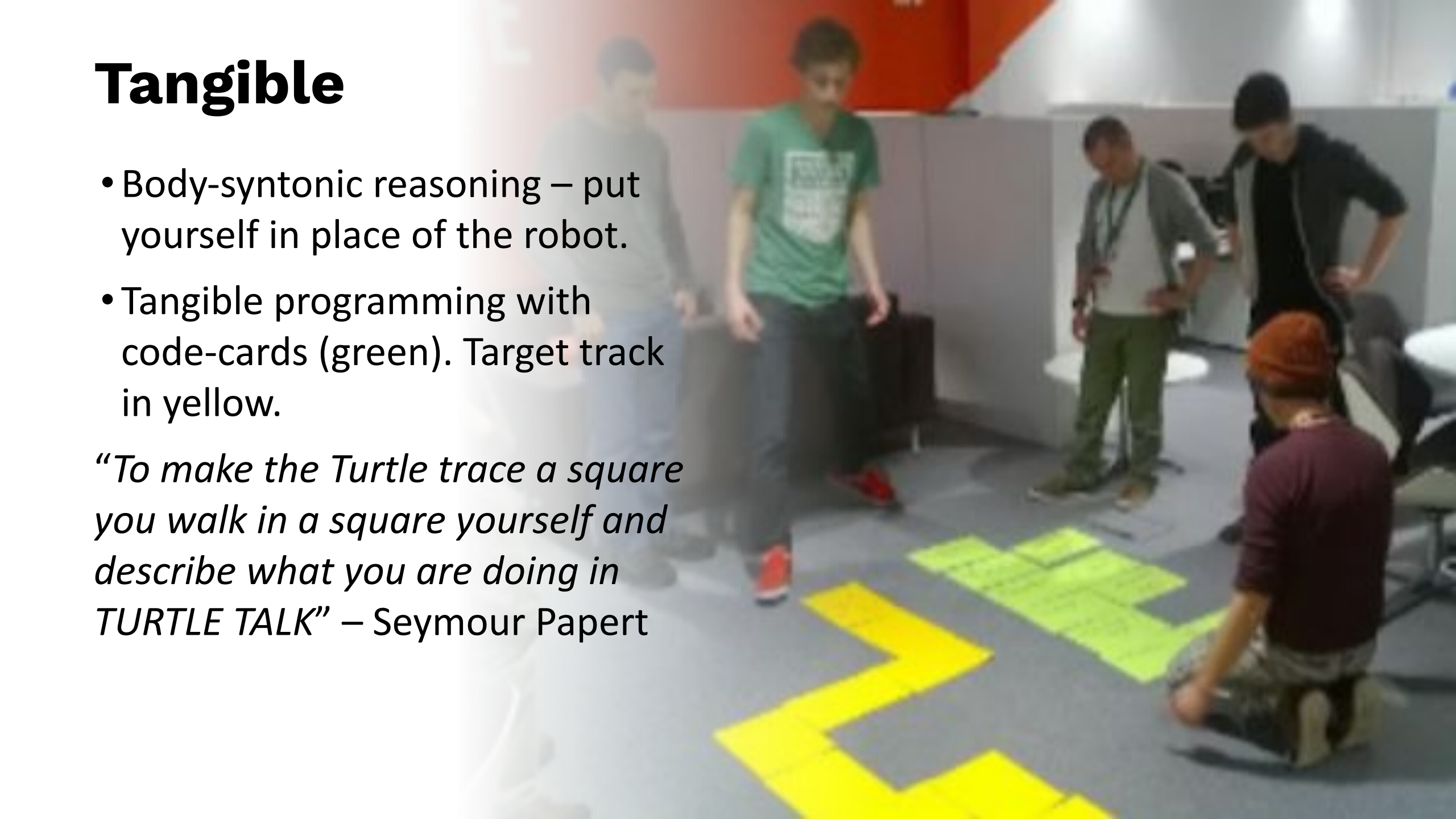
– Valentino Braitenberg (1984)



Tangible

- Body-syntonic reasoning – put yourself in place of the robot.
- Tangible programming with code-cards (green). Target track in yellow.

"To make the Turtle trace a square you walk in a square yourself and describe what you are doing in TURTLE TALK" – Seymour Papert



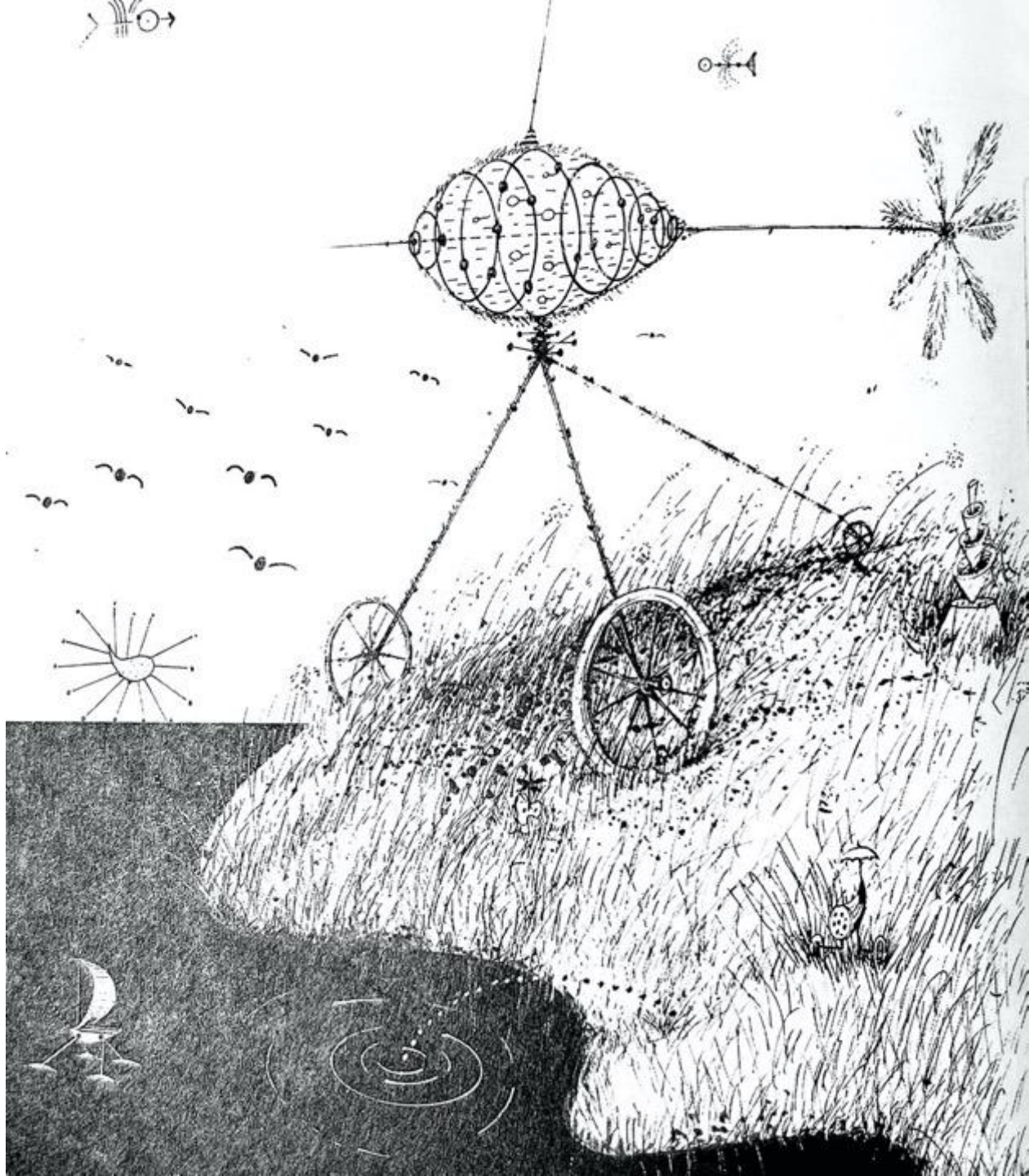
Enactive: being in the world

- Cognition arises through a dynamic interaction between an individual and its environment.
- “How does the robot perceive its world?”
- How do the physical affordances of the environment shape the phenomenology of the robot?

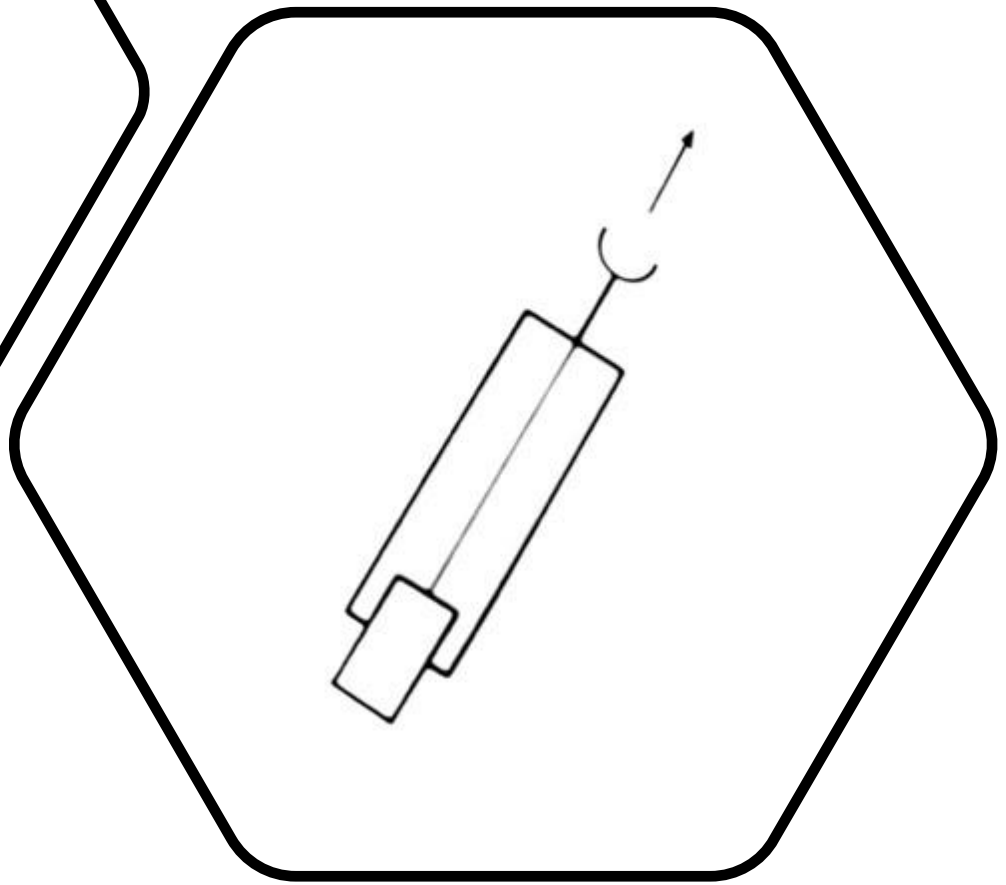
Vehicle 1: Getting Around

Vehicle 1 has one sensor and one motor.

- The **motor** is anything that can provide a propulsive force, not just electric motors.
- The **sensor** can be of any kind of analogue detector.

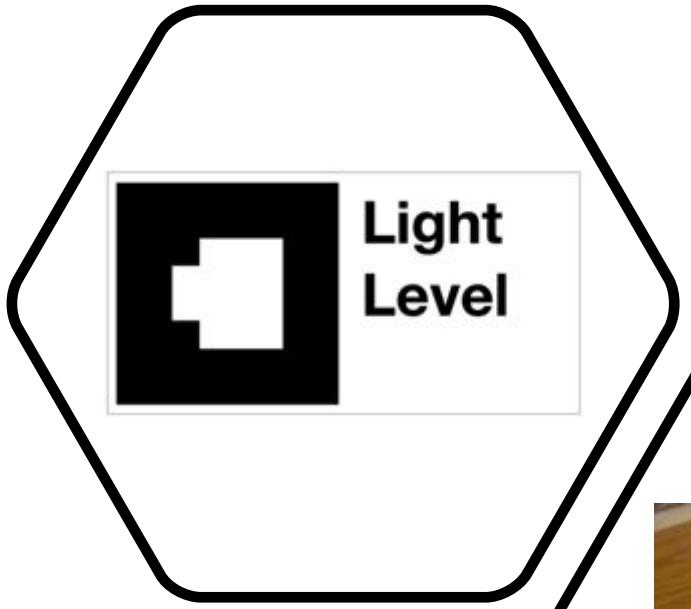


Vehicle 1



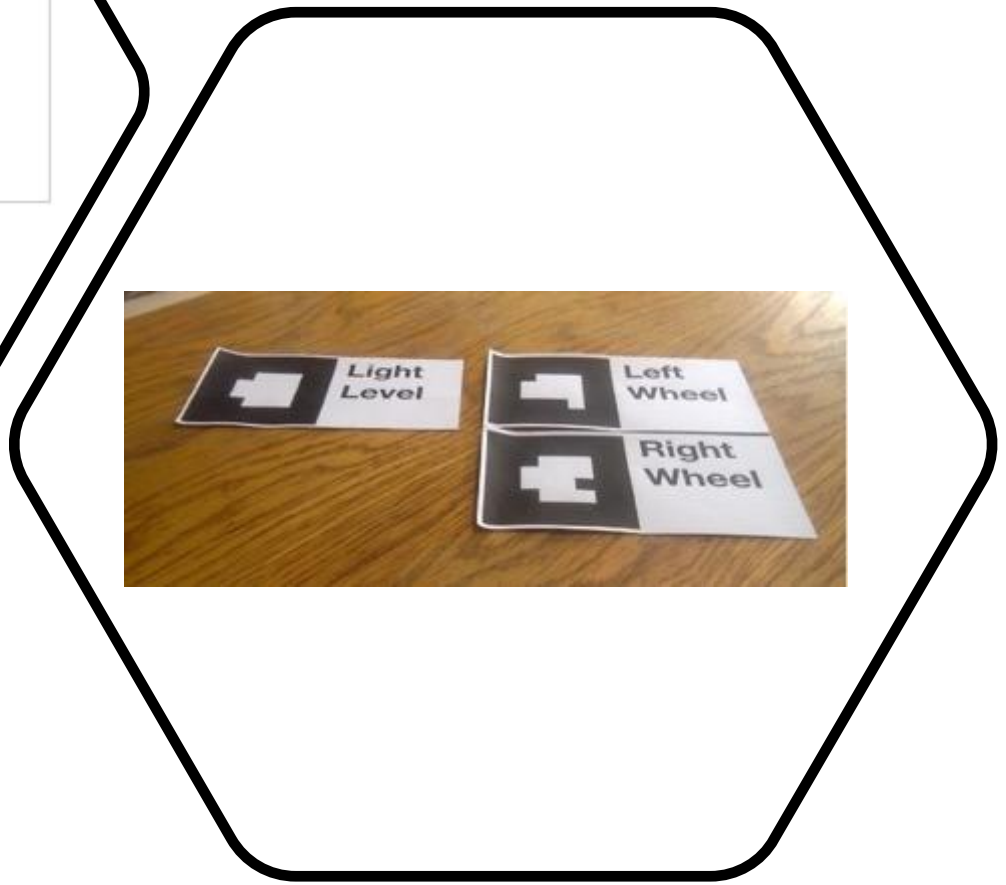
•The signal is conveyed from the sensor to the motor by a **nerve fibre**, causing the motor to vary continuously in its output.

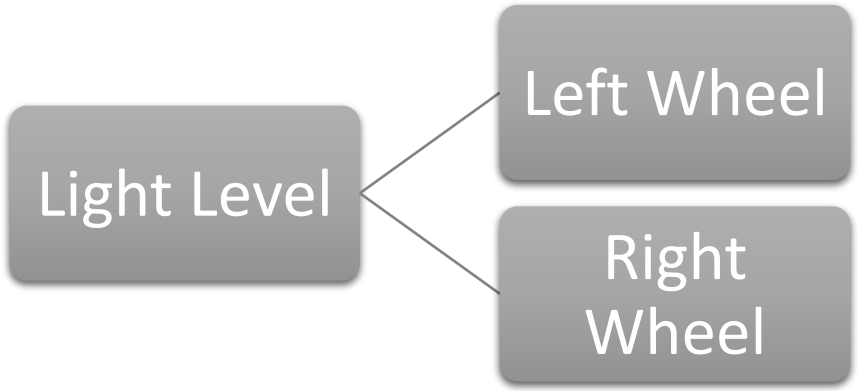
“*The more there is of the quality to which the sensor is tuned, the faster the motor goes*” – Braitenberg.



Fiducial Code Cards

- The brighter the light, the faster it goes.

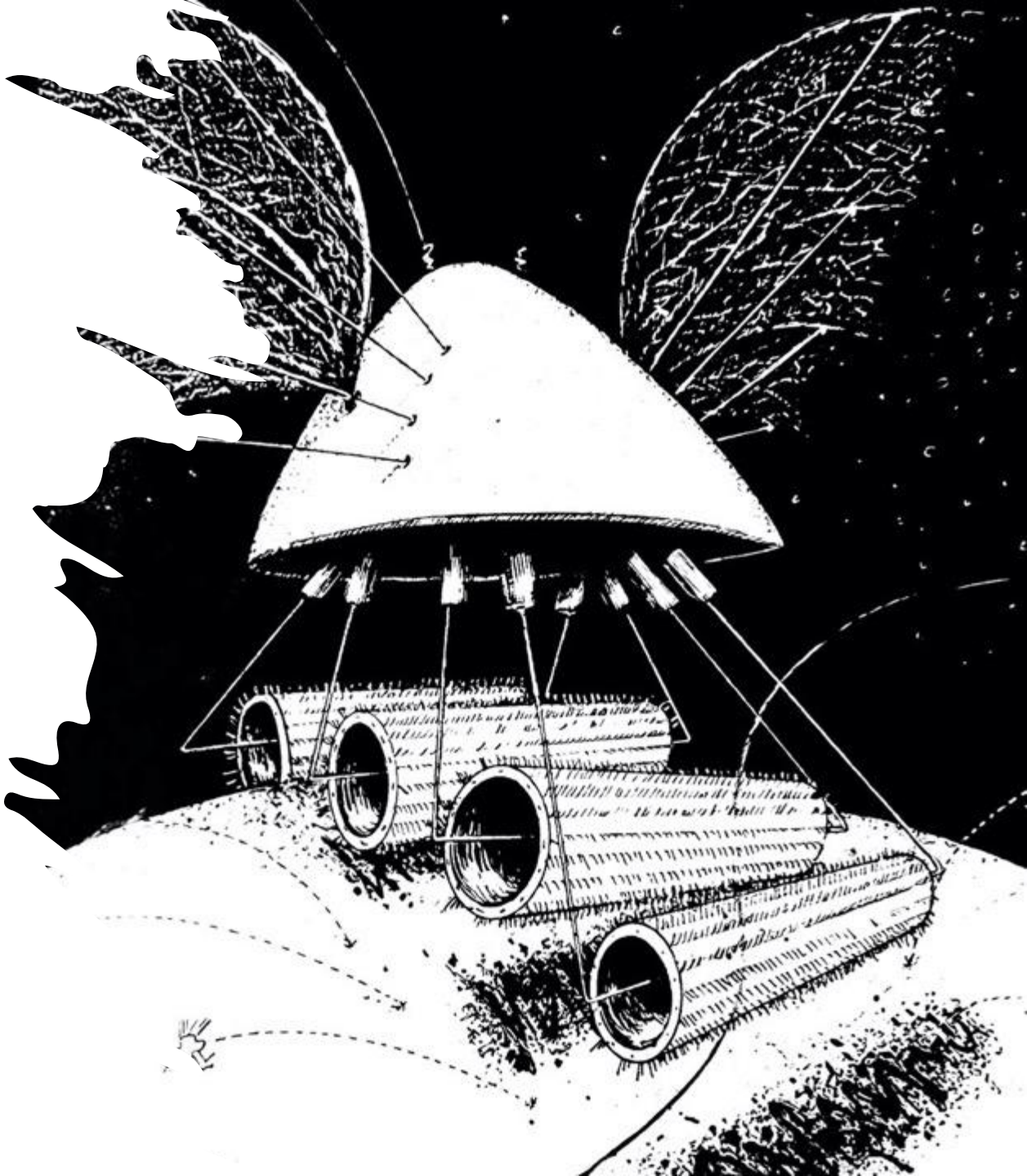




Vehicle 2:
Fear & Aggression

Vehicle 2 equips our robot with a **fight or flight** response to light.

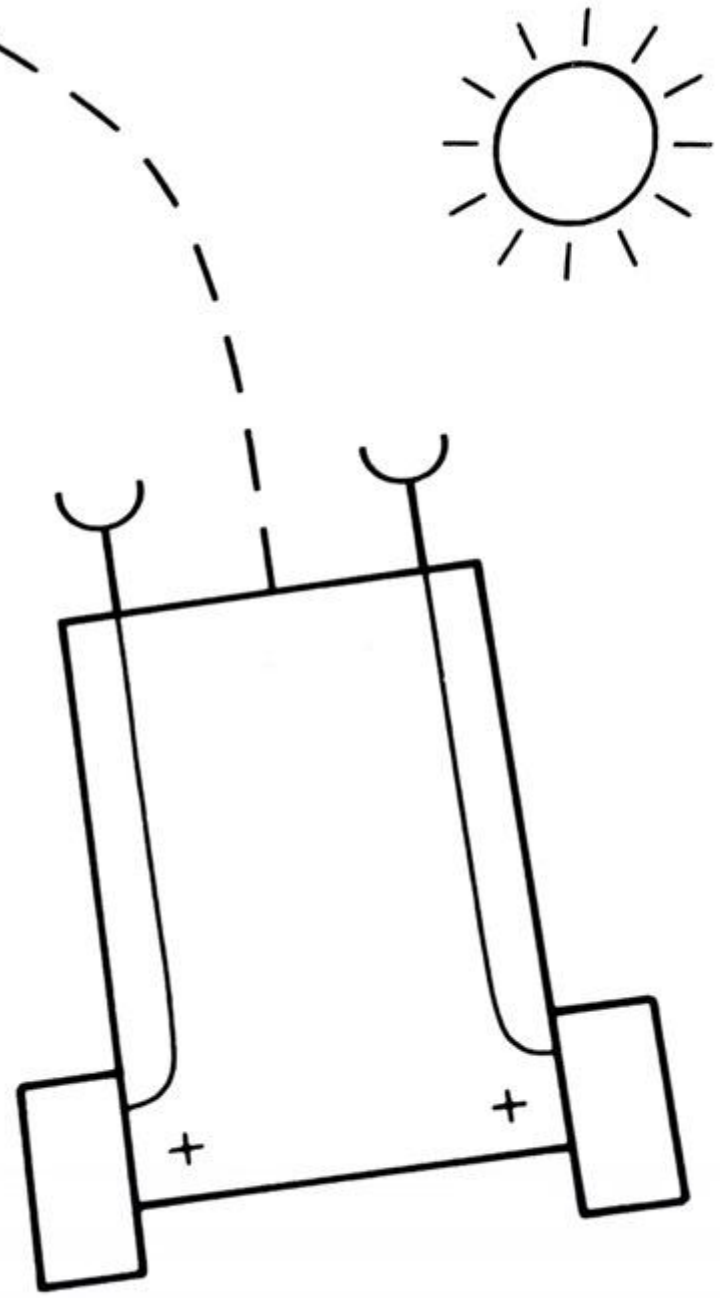
“It flees from light in fear, or heads towards it in a way that might be considered aggressive.”
– Braitenberg



Vehicle 2a: Fear

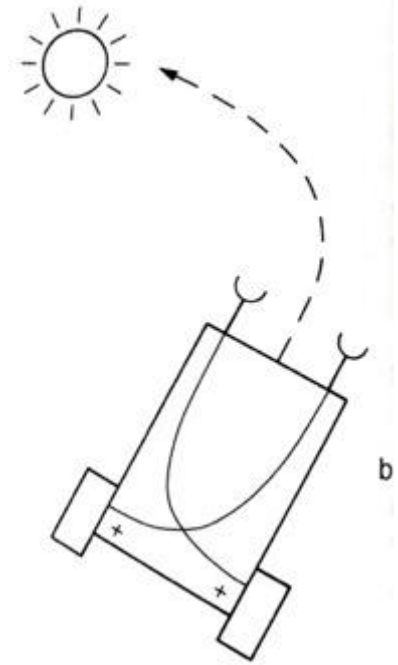
- Two eyes, and two motors.
- '+' indicates an **excitatory** connection.

Vehicle 2a is averse to light, veering away from it, *“escaping until it safely reaches a place where the influence of the source is scarcely felt. Vehicle 2a is a **coward**, you would say.”*
– Braitenberg

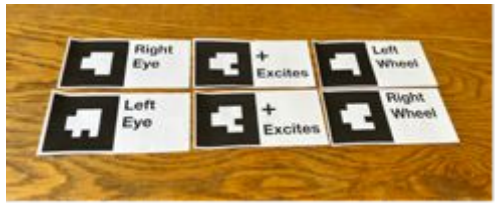


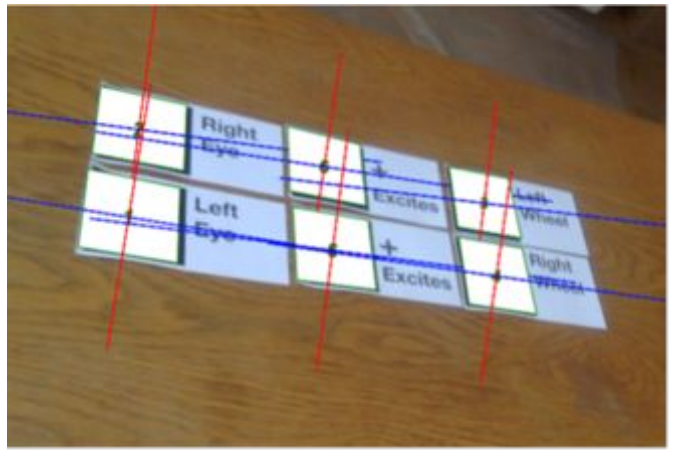
Vehicle 2b: Aggression

*“Vehicle 2b. It, too, is excited by the presence of sources, but resolutely turns toward them and hits them with high velocity, as if it wanted to destroy them. Vehicle 2b is **aggressive**, obviously.”*
– Braitenberg



Augmented Reality



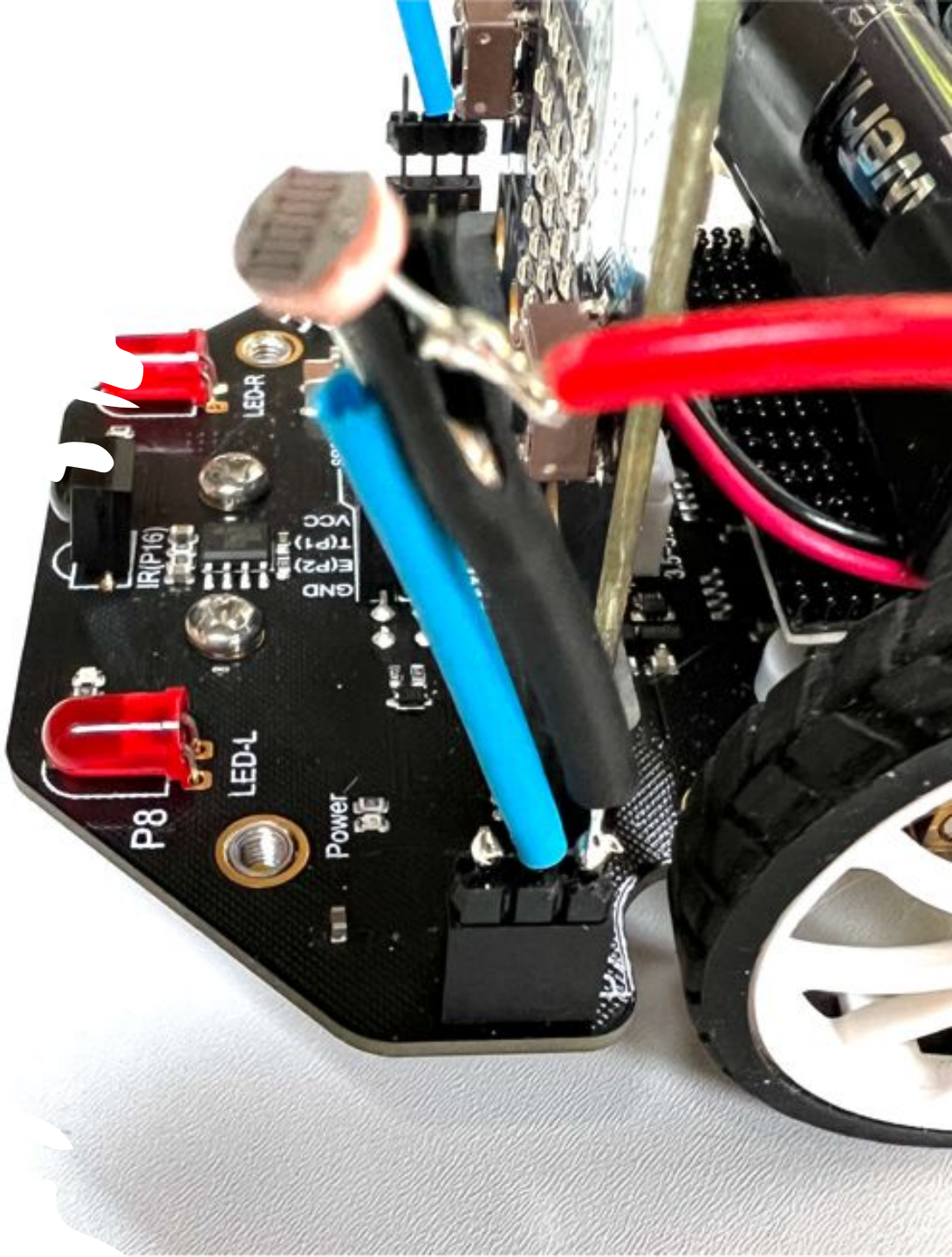


- Cards aligned orthogonally
- Augmented reality feedback
- Vehicle **2b** connects each sensor to the motor on the **opposite** side.

Right Eye	+ Excites	Left Wheel
Left Eye	+ Excites	Right Wheel

Relational

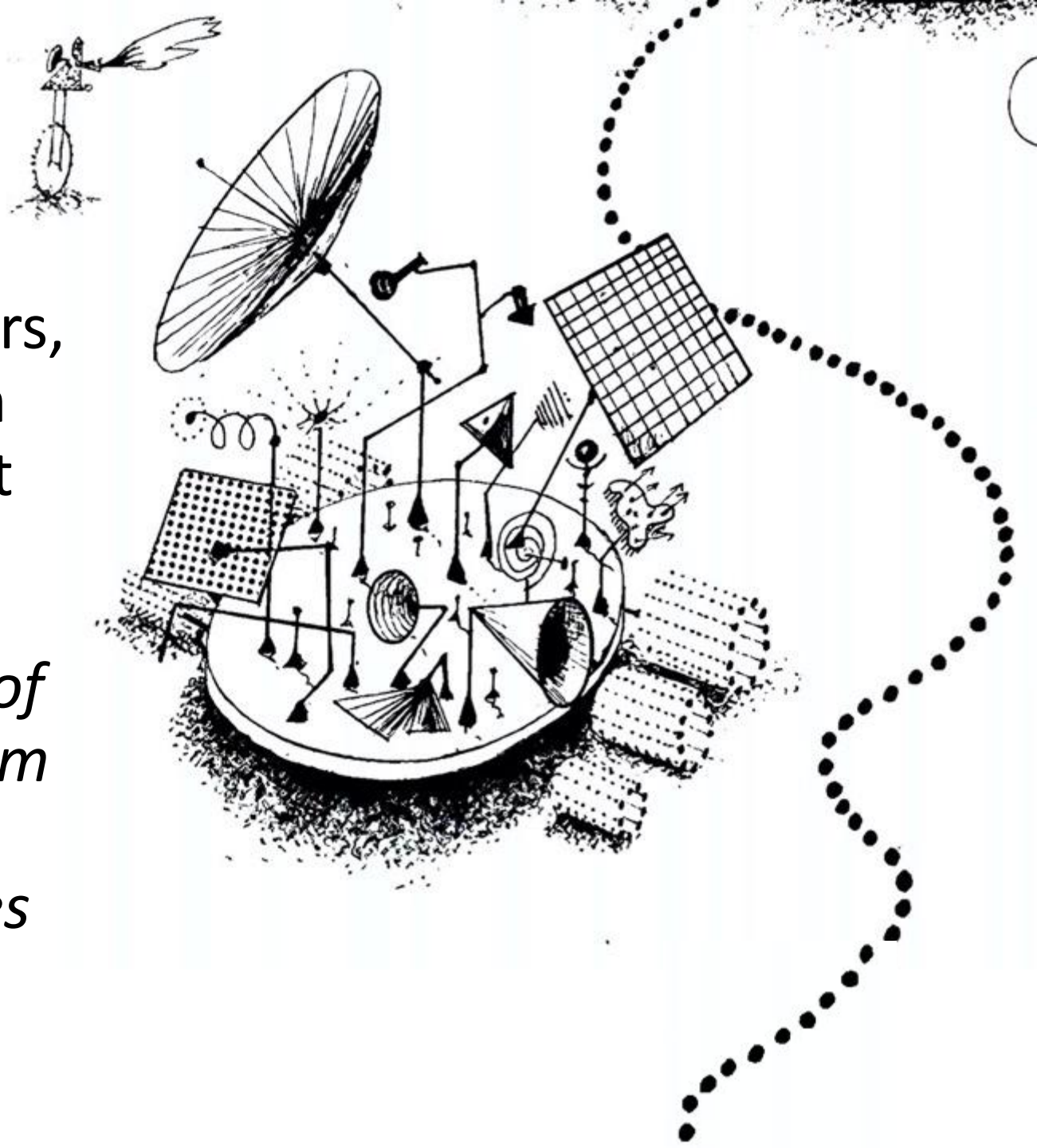
- If the light is brighter on one side of the vehicle, the motor on that side runs faster causing it to head towards the light.
- Positive phototaxis
- *We observe purposeful behaviour and goals.*



Vehicle 3: Love

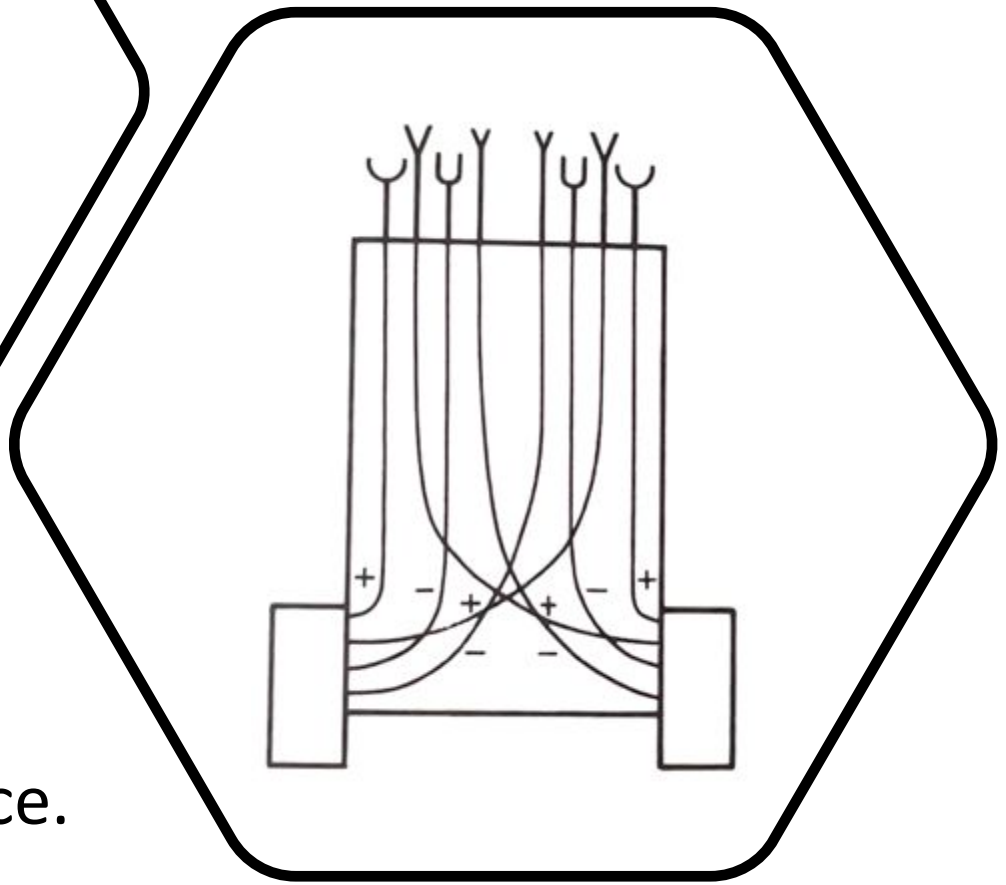
Some sensors **inhibit** the motors, causing Vehicle 3 to slow down and bask in the sunshine that it loves.

"If you consider the possibility of strong and weak influences from the sensors to the motors, you realize that the variety becomes even greater." – Braitenberg



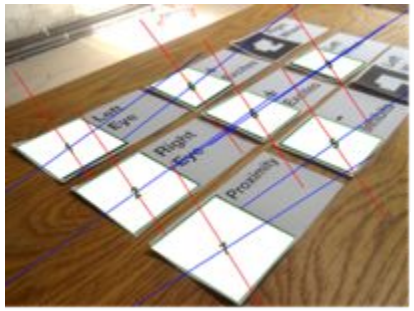
Vehicle 3c

- Multi-sensorial
- '-' indicates an **inhibitory** connection.
- +ve & -ve inputs are *summed* together.
- Bat-like sonar enables obstacle avoidance.

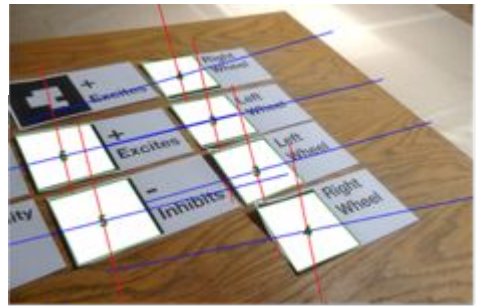


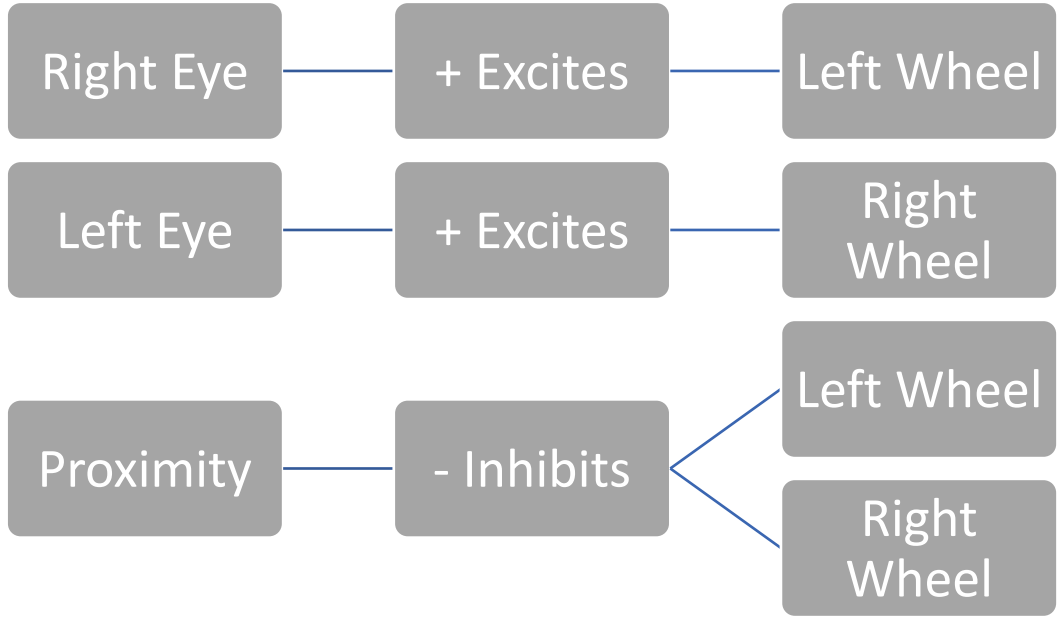
Stitch-up

- A new proximity sensor **inhibits** the motors, causing Vehicle 3 to slow down.



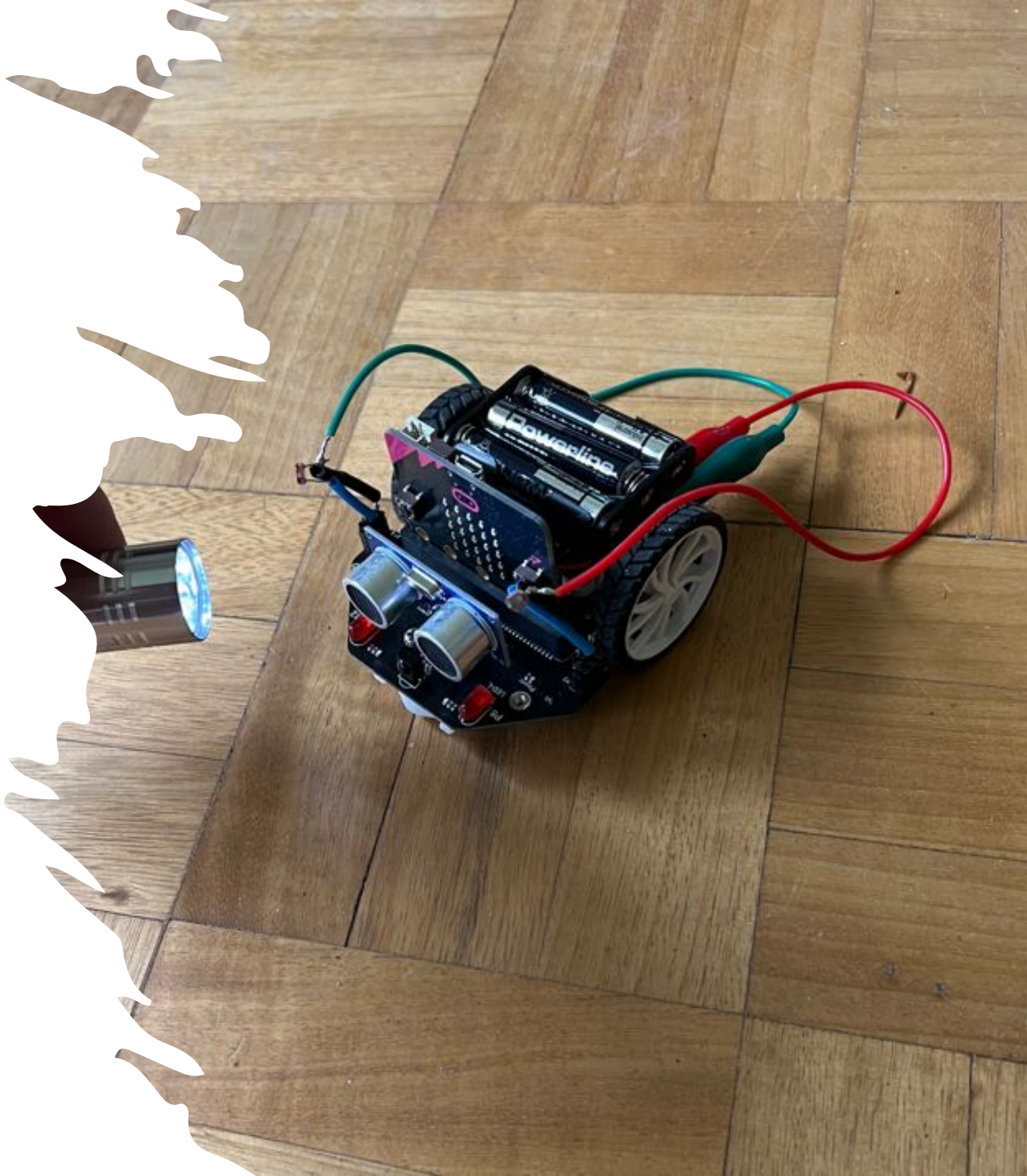
+





Contextual

- Vehicle 2 has *no freedom* to choose.
- Repeatable contexts enable behavioural variety
- The ability to act or not to act, requires inhibition as well as excitation.
- *Vehicle 3 avoids obstacles and approaches us hesitantly*



“The Triumph of Cybernetics”, Glushkov Institute of Cybernetics, Kyiv