

# New Perspectives on Intelligence





# Intelligence: The Chinese Room and Turing



## Another Perspective on Intelligence

- Braitenberg's book, “Vehicles: Experiments in Synthetic Psychology” discusses ideas about the
  - evolution of
  - intelligence to guide
  - interaction with a
  - complex world.



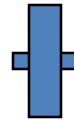


## The Parts of Vehicles

- Body



- Wheel



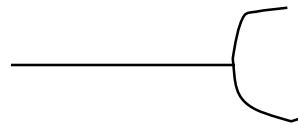
- Motor



- Connection



- Sensor

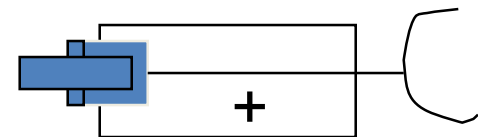


- Type of Activation + -



# Vehicle 1

- **Configuration**
  - One sensor and one motor.
- **Reaction**
  - The greater the sensor input, the faster the motor goes.
- **Behavior**
  - The vehicle will move in the direction in which it happens to be pointing.
  - It will speed up and slow down depending on the sensor data.
- **BUT**
  - Physical forces, such as friction, will cause it to deviate from its course.
- **Observation**
  - Over time, the vehicle will appear to move in a complicated trajectory without apparent reason.
- **Vehicle 1 is restless!**

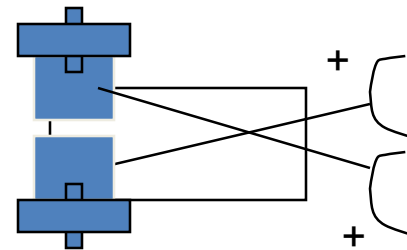
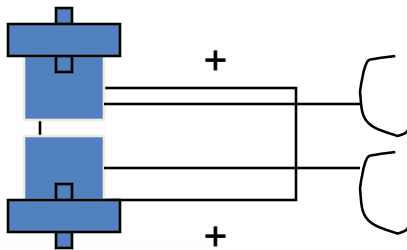




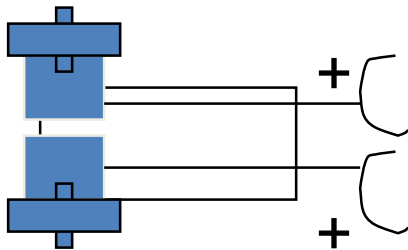
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## Vehicle 2

- **Configuration**
  - Two sensors (one on each side) and two motors (left and right).
- **Two types of vehicles:**
  - 1. each sensor is connected to the motor on the same side
  - 2. each sensor is connected to the motor on the opposite side
- **Reaction**
  - The greater the sensor input, the faster the motor goes.



# Vehicle 2: Type 1

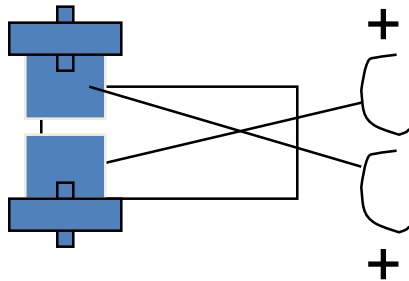


- **Behavior**

- The vehicle will spend more time in the places where there is less sensor input and will speed up when exposed to higher concentrations.
- If the sensor input source is directly ahead, the vehicle may hit it.
- If the source is to one side, the vehicle will turn away from the source.



## Vehicle 2: Type 2



- **Behavior**

- If the sensor input source is directly ahead, the vehicle may hit it (same as type 1).
- If the source is to one side, the vehicle will turn towards the source and may eventually hit it.





## Vehicle 2: Types 1 and 2

- Observation
  - Type 1 vehicles dislikes sensor data sources and become restless in their vicinity and tend to avoid them (*cowardly*).
  - Type 2 vehicles are excited by the presence of sources, turn toward them and hit them at high velocity (*aggressive*).

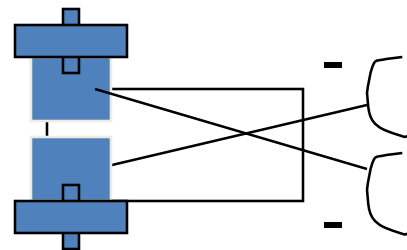
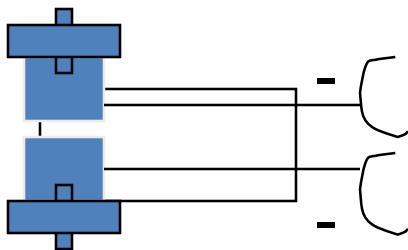




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## Vehicle 3

- **Configuration**
  - Two sensors (one on each side) and two motors (left and right).
- **Two types of vehicles:**
  - 1. each sensor is connected to the motor on the same side
  - 2. each sensor is connected to the motor on the opposite side
- **Reaction**
  - Inhibition:
    - The greater the sensor input, the slower the motor goes.
    - The weaker the sensor input, the faster the motor goes.

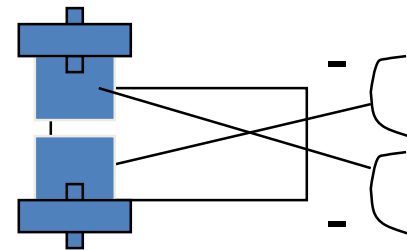
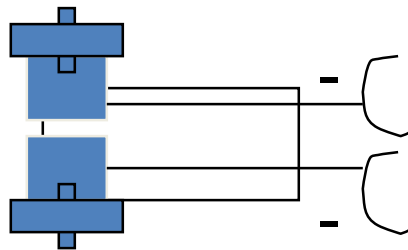
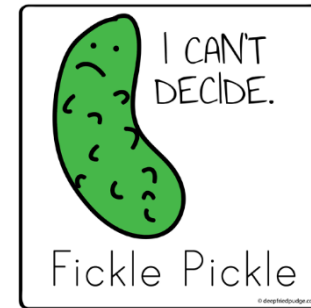


## Vehicle 3: Type 1 and 2

- **Type 1**
  - Behavior
    - The vehicle will come to rest facing the source.
- **Type 2**
  - Behavior
    - The vehicle will come to rest facing away from the source.
    - It will not stay there long; any slight perturbation will cause it to drift away from the source.
- **Types 1 and 2**
  - Observation
    - Type 1 vehicles love the source.
    - Type 2 vehicles are explorers.



## Anthropomorphism



# Vehicle 3: Type 3

- **Configuration**
  - Four pairs of sensors (for different environmental factors) and two motors.
  - The sensors are connected in the following manner:
    - 1.first pair (light) to motors with uncrossed excitatory connections
    - 2.second pair (temp) to motors with crossed excitatory connections
    - 3.third pair (O<sub>2</sub>) to motors with crossed inhibitory connections
    - 4.fourth pair (organic matter) to motors with uncrossed inhibitory connections



## Vehicle 3: Type 3

- **Behavior and Observations**

- Dislikes light bulbs --> turns towards them and tries to destroy them.
- Dislikes high temperatures --> turns away from hot places.
- Prefers a well-oxygenated environment and one containing many organic molecules, since it spends much of its time in such places.
- Moves elsewhere if the supply of O<sub>2</sub> or organic matter runs low.
- It would appear that this little creature has both values and knowledge.



## Vehicle 4

- Behavior and Observations
  - A vehicle might navigate towards a source and then turn away from it when the sensory input reaches a set point.
  - The vehicle may appear to "circle" or orbit the source in some fashion.
  - This behavior has some of the characteristics of animal instincts.
- Configuration
  - Similar to Vehicle 3, but the activation of a sensor will make the corresponding motor run faster (slower), but only up to a point at which the speed of the motor reaches a maximum (minimum). Beyond this point, if the sensor is further stimulated (more or less) then the speed will start to decrease (increase).



## Vehicle 4

- Configuration
  - Similar to Vehicle 3, but the influence of the sensor on the motor is no longer smooth; it has breaks.
  - Some levels of input do not cause any activity.
  - There might be smooth changes of motor activation for certain ranges of sensor input with abrupt changes in between.
  - No activation up to a threshold level.
  - Increasing activation beyond the threshold starting with a fixed minimum.
- Behavior and Observations
  - The thresholds of sensory input necessary for motor activation give the appearance of decision-making.







# Vehicles Explained



Braitenberg Vehicles



# Bad Robot-Screwing with Expectation

