

Modeling the development of mirror neurons

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Problem

Solution

Motivation

Our inspiration comes from neuroscience: in particular, mirror neurons. This is a class of neurons found in the monkey's frontal cortex (area F5). A particular mirror neuron is activated both when the monkey executes an action and when it observes the same action performed by somebody else. Mirror neurons can be related to gesture recognition, language, and learning by imitation.

Facts

F5 contains two classes of neurons: canonical and mirror. Both classes respond when object-directed actions are executed.

Canonical neurons respond to the presentation of an object according to the potential grasp types the object affords.

Mirror neurons respond to an observed action in accordance to the grasp type.



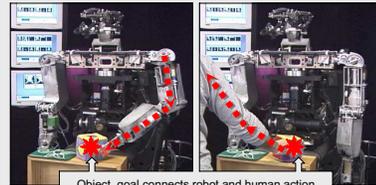
Question: How do mirror neurons develop?

Answer: Two stage hypothesis: learn about objects and then imitate the goal of an action if directed towards the same object.

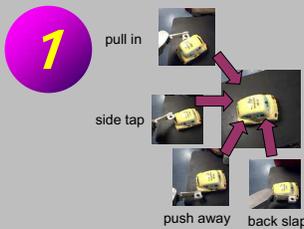
Our solution

We used poking and prodding as a precursor to full-blown manipulation

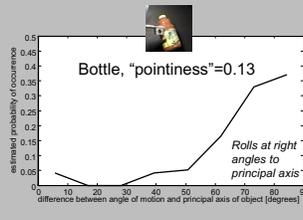
- 1 Learn about object affordances (canonical neurons)
- 2 Interpret observations on the basis of affordances (mirror)
- 3 Poke/push objects according to their affordances
- 4 Mimicry



Object, goal connects robot and human action

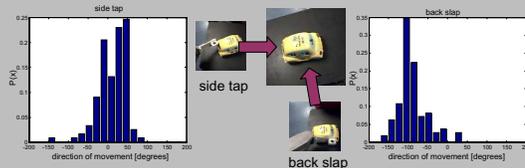


Motor vocabulary



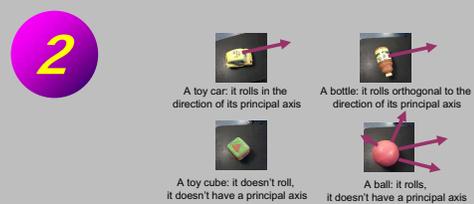
Learn about object affordances

The affordance considered is the direction of movement with respect to the object's principal axis



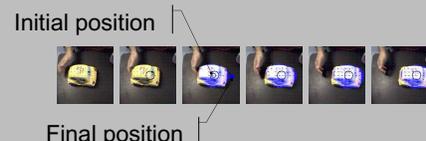
Learn the "geometry" of poking

E.g. poking from the left causes the object to move to the right



2

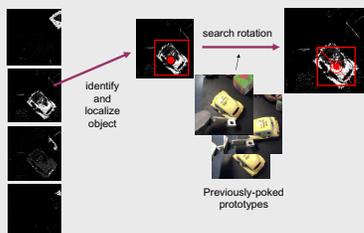
Clustering



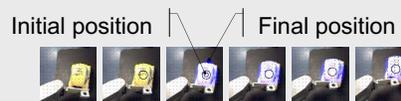
Interpreting observations

A foreign manipulator (human) pokes an object. The direction of movement is compared with the object affordance

- 3 **Exploiting affordances during poking**
When a known object is presented to the robot, it chooses the appropriate action to make the object roll



Example 1



Example 2

- 4 **Mimicry**
The robot mimics the observed action trying to fulfill the goal rather than an actual movement

Acknowledgments:

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