ADAPT

Some future work or, rather, a collection of ideas

Paris, Jan 21st, 2003

I'll start with…

- Presenting a robotic experiment, with some assumptions
- I won't claim this is completely true for infants/humans, and it's not even the way we'd need to be doing things in Adapt
- ...consider it as inspiring
- In the hope of generating a lot of discussion

Assumptions

- Visual skills: use motion to detect object boundaries, attentional system to guide the robot's visual attention
- No hand, only poking and prodding
- Body self-image: i.e. simple reaching and visuo-motor coordination
- I imagine to jump to our conceptual stage of "playing with objects"

This is work borrowed from another project

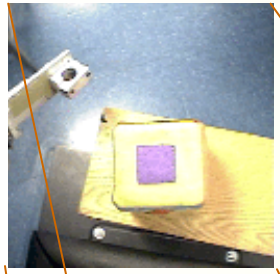
- t_0: motion segmentation + body self-image
- t_1: learning something about objects
- t_2: interpreting actions performed by others

- Glue: exploiting causal understanding (in some not too deep sense)

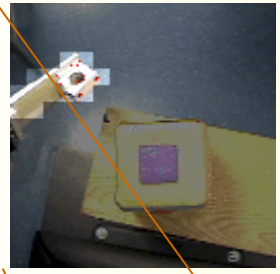
Various snapshots

- Timidly touching an object…
- Poke to understand poking
- What does an object afford?
- Detecting others

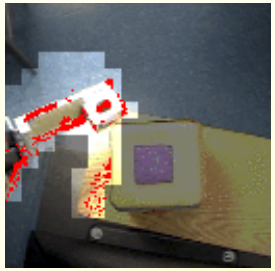
Objects come to existence because they are manipulated



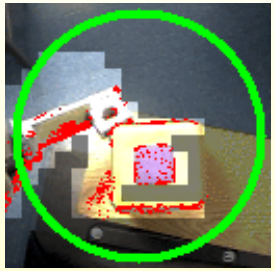
Fixate target



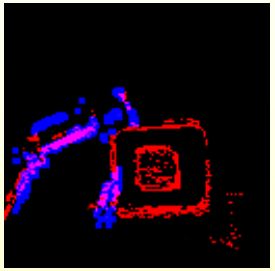
Track visual motion…



(…including cast shadows)

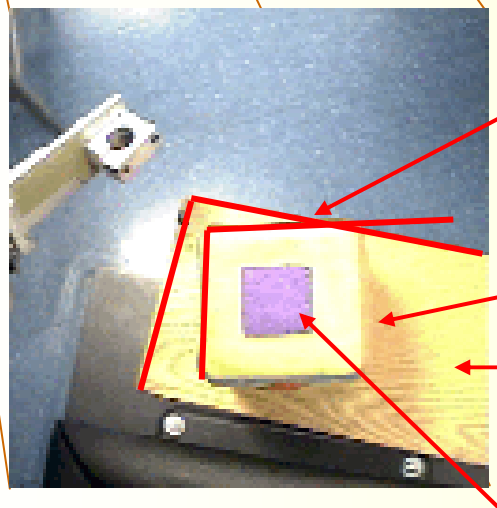


Detect moment of impact



Separate arm, object motion

Segment object



Which edge should be considered?

Maybe some cruel grad-student glued the cube to the table

Color of cube and table are poorly separated

Cube has misleading surface pattern

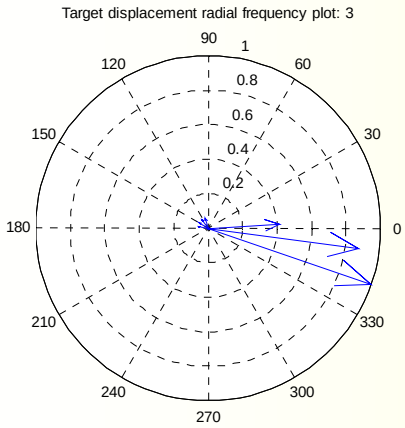
- Timidly touching an object…
- Poke to understand poking
- What does an object afford?
- Detecting others

Simplest Form of Manipulation

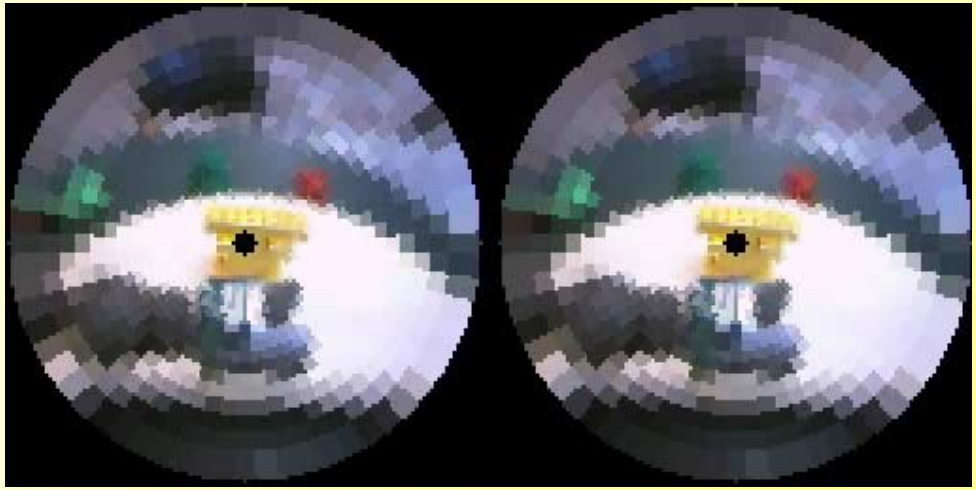
- What is the simplest possible manipulative gesture?
  - Contact with object is necessary; can't do much without it
  - Contact with object is sufficient for certain classes of affordances to come into play (e.g. rolling)
  - So can use various styles of poking/prodding/tapping/swiping as basic manipulative gestures
  - (if willing to omit the *manus* from manipulation…)

Push to understand pushing

- Act first to learn



- Ready to push!



- Timidly touching an object…
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- What does an object afford?
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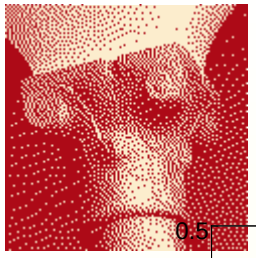


Preferred direction of motion

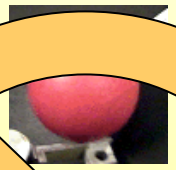
Bottle, “pointiness”=0.13

Rolls at right angles to principal axis

Car, “pointiness”=0.07

Rolls along principal axis

Cube, “pointiness”=0.0



Ball, “pointiness”=0.02

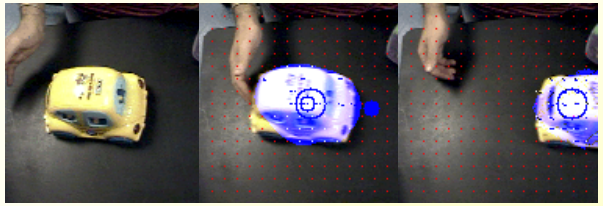
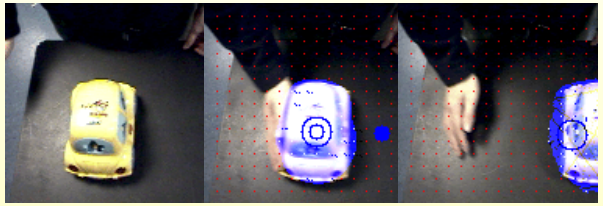
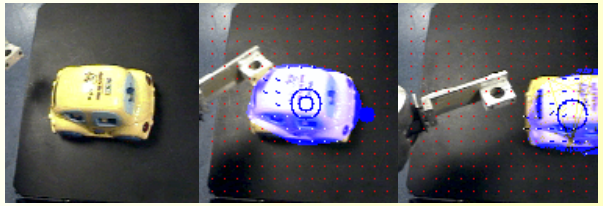
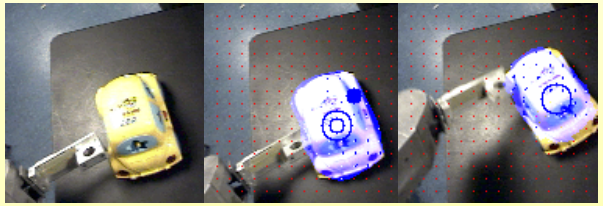
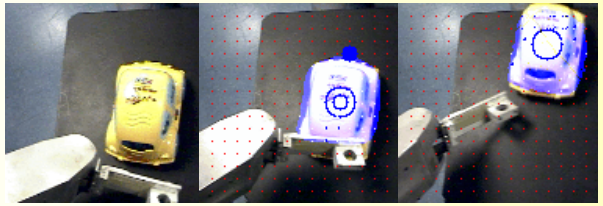
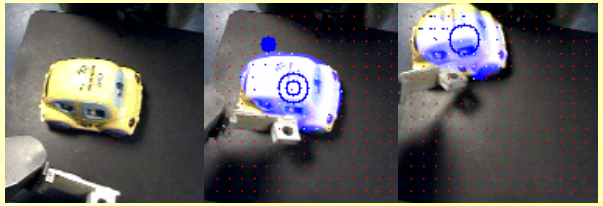
estimated probability of occurrence

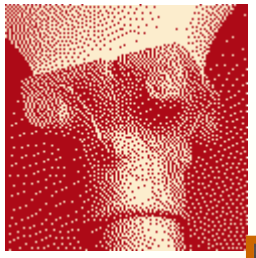
difference between angle of motion and principal axis of object [degrees]

Behavior: poking according to affordance

- Timidly touching an object…
- Poke to understand poking
- What does an object afford?
- Detecting others

Interpreting observations

	Invoking the object's natural rolling affordance	Going against the object's natural rolling affordance
Demonstration by human		
Mimicry in similar situation		
Mimicry when object is rotated		



Behavior: mimicry

... and because we are not willing to omit the “manus” from manipulation!

A bit of hardware improvement

- Glue a bunch of tactile sensors to the robot hand (fingertips, palm, etc.)
- Of course, if we had a nice high-resolution touch sensor, it would be much better!

A bit of a plan

- t_0: Imagine we have some visual skill (e.g. ability to gather some visual information), and some motor exploratory skills as well (e.g. different grasp types)
- t_1: Explore object manipulation with tactile, visual, and proprioceptive (finger positions) information
  - How do we put this things together?
  - Not only sensory but also motor info can be used
  - What set of objects does make sense to use?
  - Shall we test for transfer of information between modalities?
- t_2: If it's relevant for the project, use this knowledge, for instance, to imitate

What do we need to understand?

- What information do need to participate into the object representation?
- How to put things together? Where do we start from (definition of t_0)?
- Which are the developmental rules?
- Which are the design principles?
- What if we test the system with objects with conflicting properties?

What do we expect to get

- Theory and principles
- Hints about how a certain "representation" evolves under certain rules and interaction with the environment

Feedback please!