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Bottom up development of a robot’s basic socio-cognitive abilities for joint action

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Inspired from Child Development and Human Behavioral Psychology

Identified key Challenges from Human-Robot Interaction (HRI) and Social Robotics perspectives

Discovered basic blocks for socio-cognitive capabilities for Joint action

Developed generic frameworks to elevate the robot’s reasoning capabilities of:
- Perspective Taking
- Effort Analysis
- Affordance Analysis
- State Analysis

Which further facilitates developing frameworks for planning joint tasks:

- for day-to-day interactive manipulation
- for behaving
- for shared planning

Real interaction scenario PR2 robot and two humans

Visible regions by different levels of effort

Reachable regions by different levels of effort

Mightability (Might be able to) Analysis: Effort-based visual-spatial perspective taking [1]

Elevating socio-cognitive capabilities by combining perspective taking, effort and affordances [2]

Inter-Agent affordances: what an agent might be able to do for other agent

Agent-Object affordances: what an agent might be able to do with objects

Verifying the affordance estimated by the robot from the human’s perspective to take the object, which is currently hidden from the human.

To give: PR2 robot is giving the object by estimating effort, visibility, reachability and graspability

Planning day-to-day HRI tasks [5]

To hide: PR2 robot hiding the object from human’s perspective

Planning day-to-day HRI tasks [5]

To show: PR2 robot is showing the object by analyzing from the human’s perspective

Planning day-to-day HRI tasks [5]

The robot estimates the comfortable hand-over position and proactively reaches out to take the object from the human. Reduces human effort and confusion in the joint task.

Shared plan generated by the robot to clean the table, reducing each individual’s effort