

# ***Think & Talk Node***

## ***University of Plymouth***

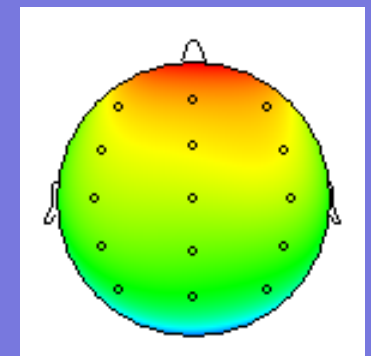
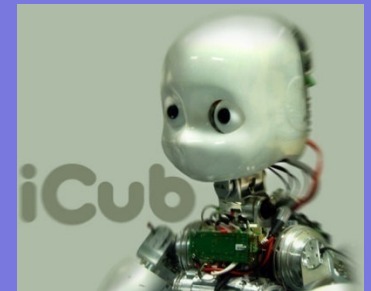
**Angelo Cangelosi**

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# *Centre for Robotics and Neural Systems (CRNS)*



- Research Areas
  - Neuroinspired and cognitive robotics
  - Humanoid robotics
  - Computational neuroscience
- UK RAE2008
  - 100% international research (25% world-leading)
  - 13 out of 81 UK computing departments
- UK and FP7 Funding
  - €20M+, Coordination: ITALK, SCANDLE, ALIZ-E
- PhD Nodes
  - ISTC-CNR Rome (Nolfi, Tecchio)



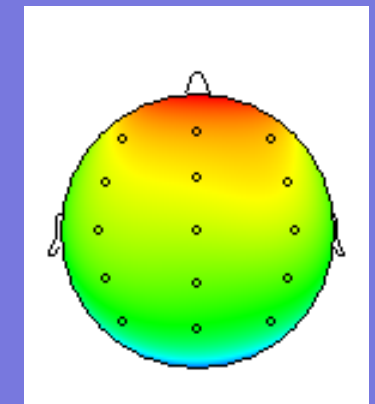
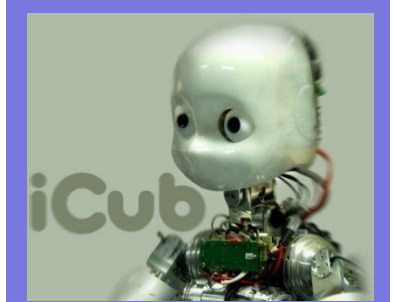
# ***People and Labs***

- Adaptive Behaviour and Cognition lab
  - Cangelosi, Belpaeme, Marocco
- Intelligent Robotics lab
  - Bugmann, Culverhouse
- Brain and Cognition Modelling lab
  - Borisyuk
- Neural Computation lab
  - Wennekers
- Visualisation lab
  - Stuart
- Auditory lab
  - Denham
- SensoriMotor lab
  - Harris



# ***Adaptive Behaviour and Cognition lab***

- Adaptive Behaviour and Cognition
  - Cognitive **developmental robotics**
  - Humanoid robots
  - Embodied cognition and modelling
  - **Interdisciplinary** collaboration with psychologists and cognitive neuroscientists
- Research Areas
  - **Language** learning
  - Action, language, **cognitive integration**
  - Active vision in autonomous/space robots
  - Neuro-robotics
  - Evolutionary computation and robotics



# ***ITALK***

## ***Integration and Transfer of Action and Language Knowledge in Robots***

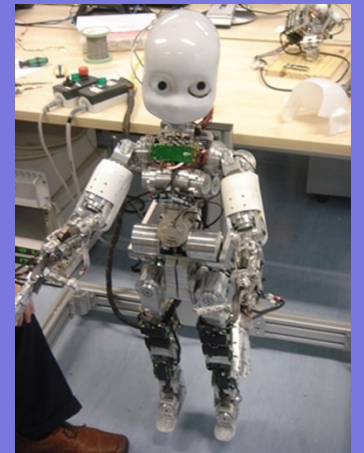
- **Vision**

*The parallel development of action and social interaction permits the **bootstrapping of language capabilities**, which on their part enhance cognitive development*

*Developmental robotic approaches based on the integration of action, social interaction and language have fundamental **technological implications** for designing communication in robots*

- **Large Integrating Project (IP)**

- Cognitive Systems and Robotics (ICT Challenge 2)
- Coordinated by Plymouth University
  - 6 UK and EU universities, 2 USA/Japan universities
- Grant of €6.25 Million
  - 75% research funding
  - 100% management funding



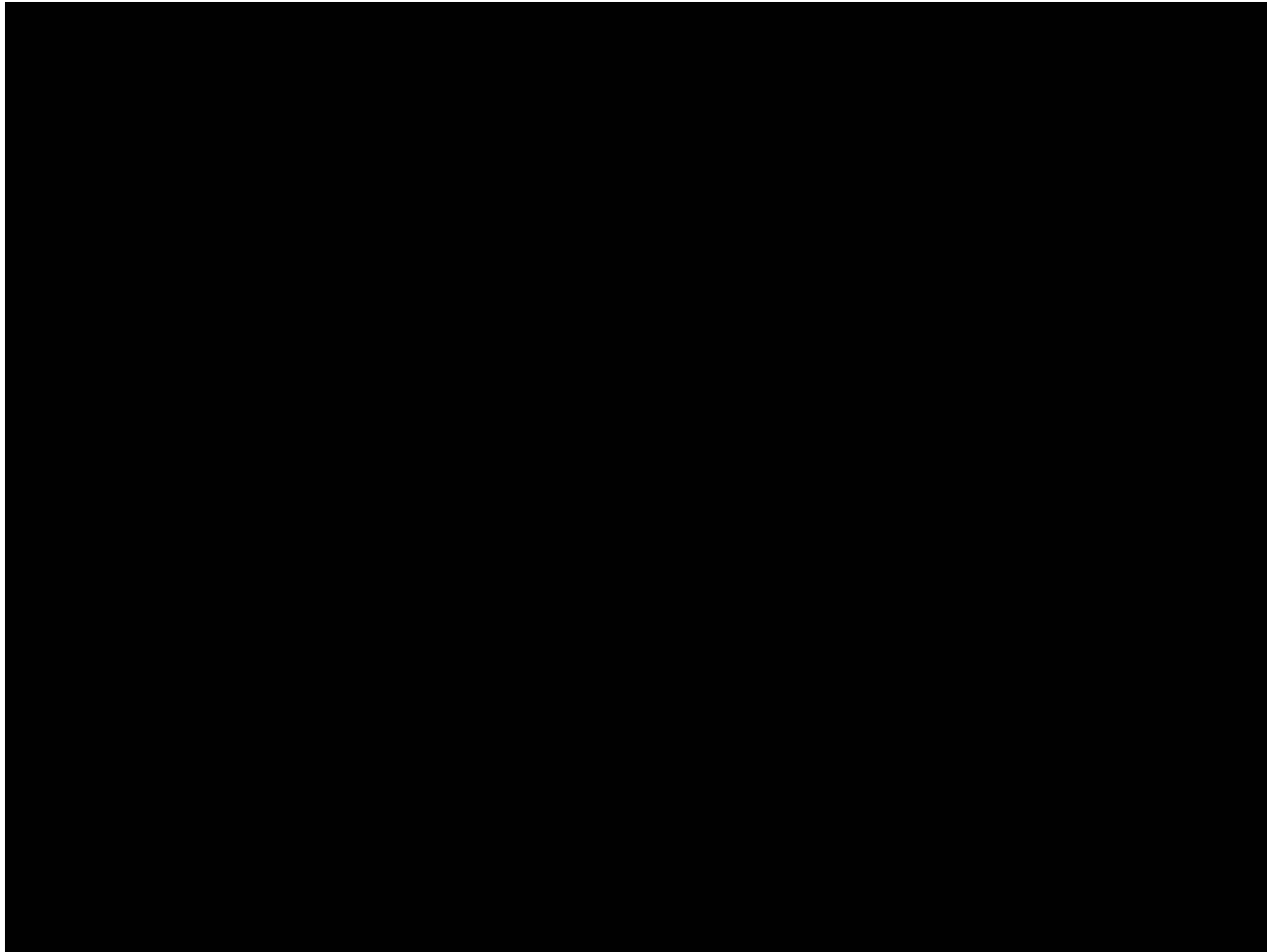
# ***Modelling Biases in Categorisation and Language Learning***

- Linda Smith challenges the idea that names are associated to the thing being attended to when the name is heard



***Gavagai***

# ***Baldwin 'Modi' Experiment***



# *The 'Modi' Experiment*

Step 1:



Step 2:



Step 3: **MODI**



Click to the  
left  
and say "Modi"

Step 4:



Step 5:

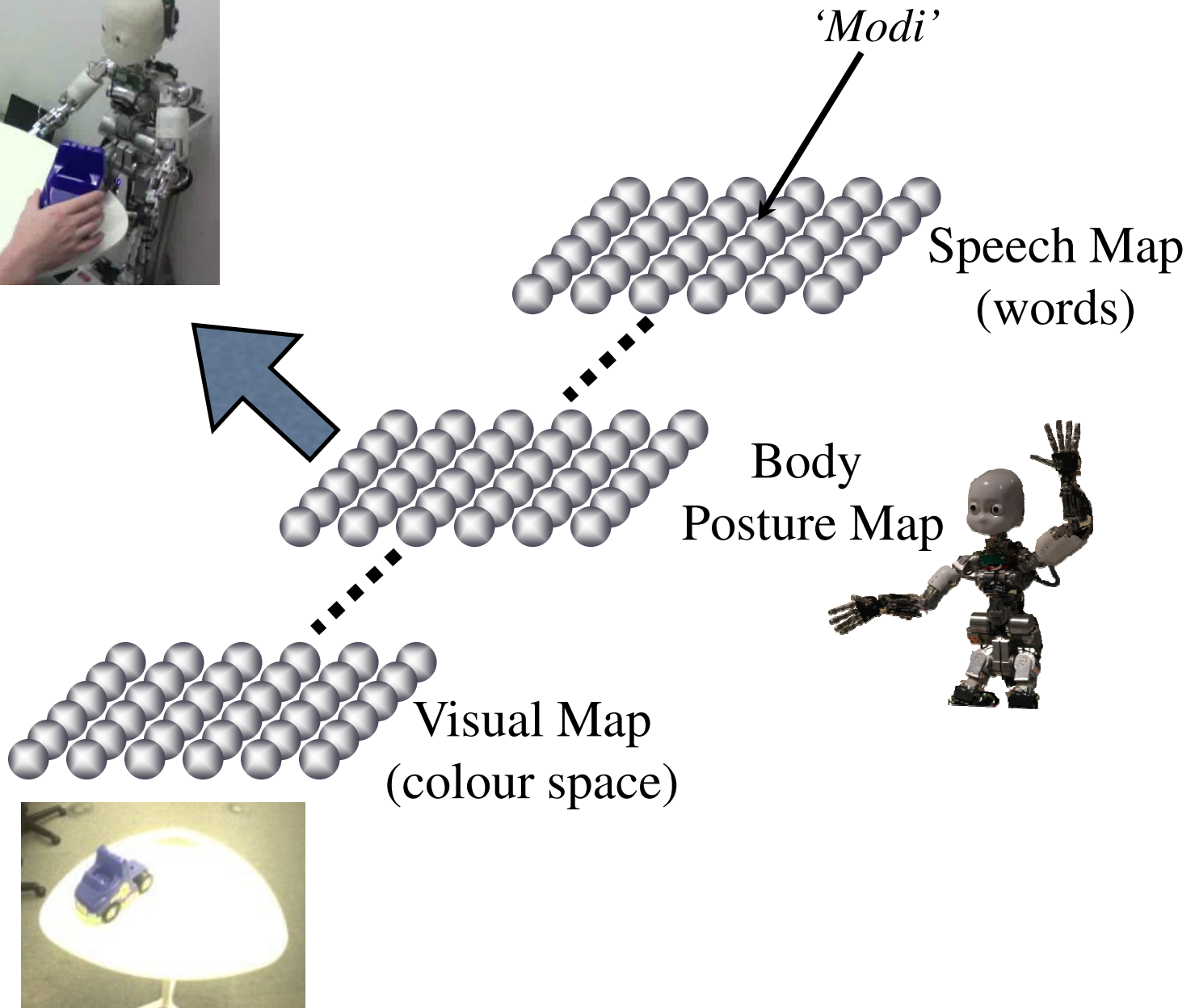
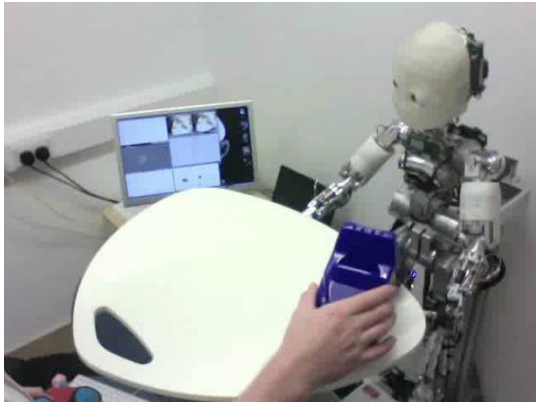


Step 6:

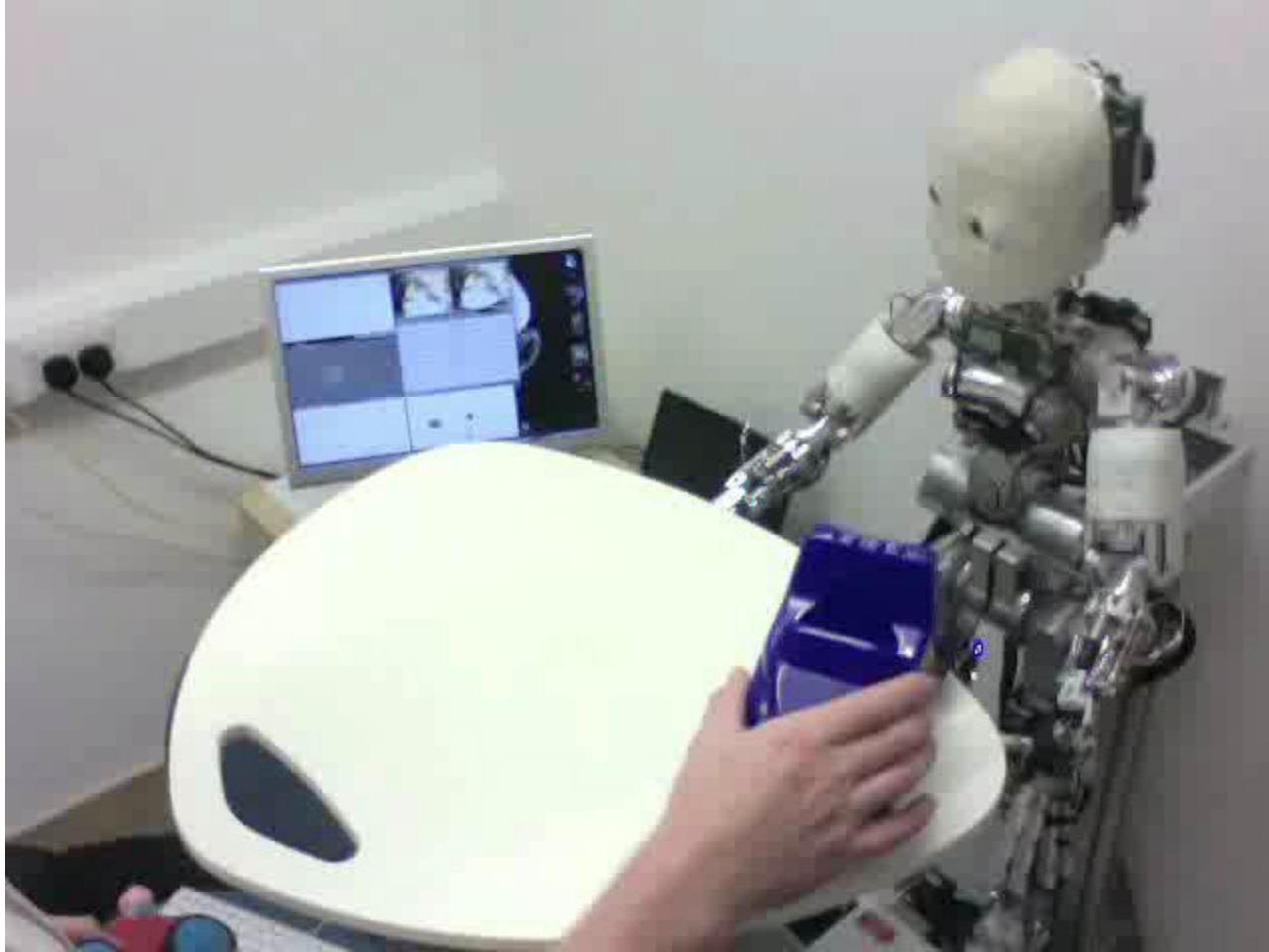


Where is the modi?

- 68% choose the spatially linked object



# ***The iCub 'Modi' Experiment***



Morse, Belpaeme, Cangelosi & Smith (submitted)

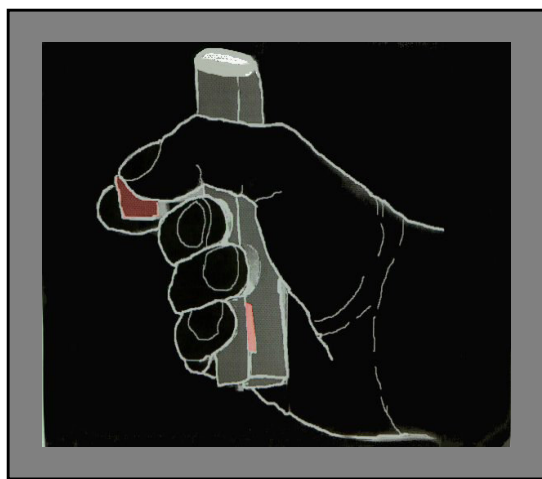
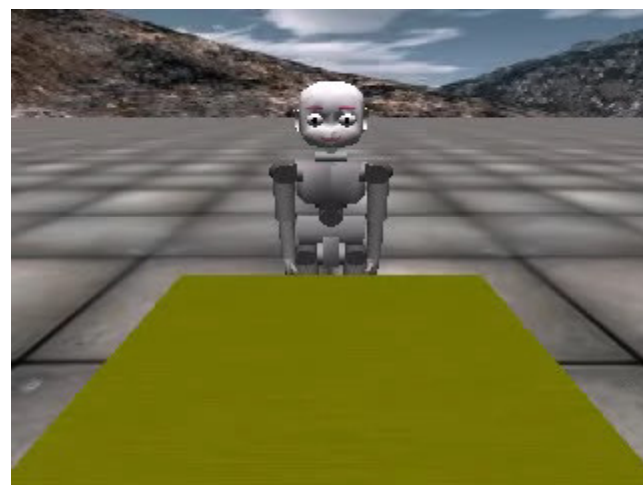
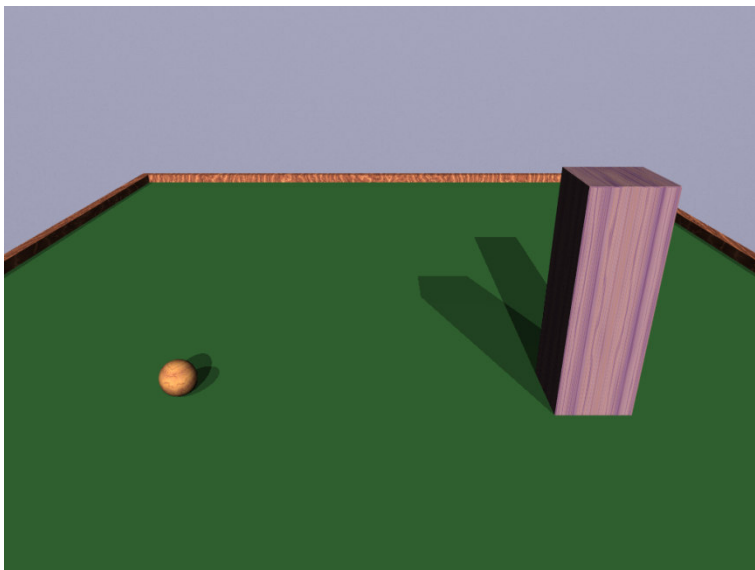


# Vision Action Language Unified by Embodiment

- RCUK Cognitive Systems Foresight
  - Co-funding EPSRC, ESRC, BBSRC
  - Methods: Robotics, psychology, neuroscience
- Investigators
  - Computing (Cangelosi) + Psychology (Rob Ellis)
  - Dundee: Martin Fischer (Psychology)
- Advisors/Collaborators:
  - Glenberg (Arizona, USA), psychology
  - Metta & Sandini (IIT, Genoa), robotics
  - Gosling (UoP), EEG neuroscience

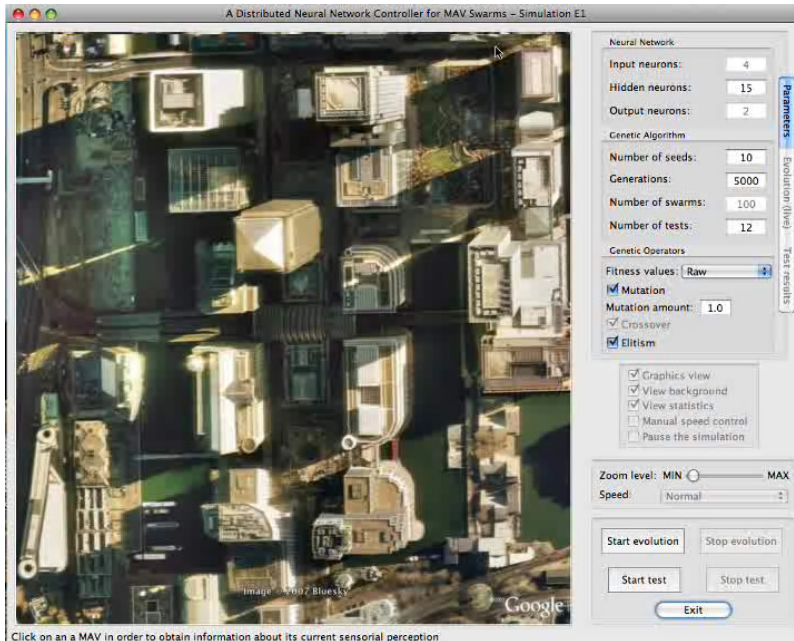


# VALUE: Grasping in humans and robots





# Mars Robot and Unmanned Air Vehicles



Communication in UAV swarm  
(Ruini & Cangelosi, FUSION-2008)

with L. Perlovsky (Harvard)



Active vision in autonomous Rover  
(Peniak, Marocco & Cangelosi, ASTRA-ESA 2008)

# ***Research @THINK&TALK node***

- THINK&TALK node:
  - ~
    - "The bootstrapping of higher-order cognitive capabilities such as conceptualisation, language, reasoning and planning resulting from the complex, dynamic interaction of the developing motivational, sensorimotor and social skills."
- Focus on embodied **higher-order cognition**
  - The emergence of **symbol composition** capabilities (ESR12, Task 7.1).
  - The grounding of **abstract categories** (ESR13, Task 7.2)
  - Dialogue and interactive alignment for **cooperative decision making** (ER3, Task 7.5)

# ***ESR12: Symbol Compositionality***

- Emergence of embodied symbols
  - *New research will address the following questions: How can continuous behavioural patterns (e.g. action and perceptual categories) form discrete conceptual representations? How can such discrete representation become independent from their analogical representation and be handled in an abstract symbol manipulation system? How can such a symbol system be used for various symbol-based compositional tasks (e.g. language, number knowledge, reasoning)*
- Collaboration within RobotDoc
  - SUNDERLAND, UPPSALA, RIKEN

# ***ESR13: Grounding of Abstract Concept***

- From sensorimotor to abstract grounding
  - *How can robots use sensorimotor categories (e.g. concept of space, internal feelings/emotions) to indirectly ground abstract concepts (e.g. time, happiness). What kind of metaphorical mechanisms are used to combine words? How can the symbol grounding mechanism be extended to generate and ground abstract categories?*
- Collaboration within RobotDoc
  - SKOVDE, ZURICH, IIT

# ***ER3: Interactive Alignment for Cooperative Decision Making***

- Joint decision making and negotiation
  - *Many of the processes involved in a communicative/cooperation tasks (e.g. intention recognition, mutual alignment, action coordination) are increasingly found to function automatically and be grounded in lower levels. New experiments on communication between robots, and humans and robots, will investigate how interactive alignment can be achieved during social collaboration on a shared problem solving and decision making activities (e.g. on a joint object manipulation/assembly task). What mechanism can be designed to control dynamic alignment capabilities?*
- Collaboration within RobotDoc
  - BIELEFELD, HONDA, YALE
  - ER to be hired in Autumn 2010