The Meaning of Actions: Motor Functions, Intentions and the Brain

The Meaning of Actions theme at the Pufendorf IAS

1. The overall goal of the project is to study how actions and intentions are represented in the human brain. The standard view of actions is that they are driven by goals or intentions in combination with beliefs. Yet, the relations between actions and goals are deeply problematic. Theoretical and empirical results show that actions are sometimes not driven by goals at all or by goals that are quite different from what we imagine.

2. We have an intuitive conviction that most common actions are guided by our intentions, but this is probably to some extent an illusion. A phenomenon called choice blindness has been discovered that can be used to investigate the cognitive architecture of intention and cognitive control. Choice blindness is the failure to detect mismatches between intention and outcome in simple decision tasks.

As a first main line of the project, we pursue the studies of such illusions further, since they can reveal the mechanisms of how we ascribe intentions for actions to ourselves and to others. In this context, the wider social context of action will also be considered. Humans seem to be alone in forming joint intentions in the sense that the intentional actions of one individual are coordinated with those of another individual. Such alignments allow humans to achieve more advanced forms of cooperation than other animals.

3. Joint intentions are also basic for human communication. Human language is to large extent a question of coordinating our inner models of the world. Linguistically, there is a strong connection between actions and verbs. Therefore, the coordination of action can be studied by how the brain handles verbs. Brain imaging studies show that when verbs relating to the movements of body parts are interpreted by a listener, the corresponding areas of the motor cortex are activated.

A second central theme of the project is how actions are represented in language. We will start out from a model of the semantics of verbs based on conceptual spaces. This model will be tied to neurological models of how verbs are processed.

4. Another way to investigate how actions are represented in the brain is to design robots that can interact with humans. To do this, it is necessary for the robot to understand the goals and intentions of the humans. Since commands to the robots involve verbs, a semantic model of the meaning of verbs is a sine qua non for successful communication.

A third research venue concerns mental simulations of actions and their possible use in robotics. Currently, great efforts are made to develop companion robots. So far the research has focussed on technology, making the robots perform actions such as taking things out of a refrigerator. In the future, a central part of a robot's social capacity will be its ability to read the intentions of its user.

To accomplish this we need a better understanding of how actions are controlled in humans. We will investigate the requirements of a robot architecture for the perception of human intentional movements. We will also look at movements that communicate an intention to act, in particular, in the context of human-robot communication.

5. The subject area of the project is highly interdisciplinary, involving researchers from psychology, cognitive science, computer science, rehabilitation engineering and neuroscience. The project runs from September 2011 to April 2012. The project leaders are professor Christian Balkenius and professor Peter Gärdenfors.

Researchers within the Meaning of Action

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Symposium on Reading Intentions: From children to robots

The 2-day symposium brings together researchers from scientific disciplines ranging from infant development to robotics research, to discuss the mechanisms behind intention reading in humans and robots. How do we understand what other people intend to do? What cues are used and what cognitive mechanisms are necessary? Can intention reading be implemented in robots?

The symposium is free of charge and lunch, coffee, tea, fruit and pastries will be served between sessions.

Please note that applications are necessary and will be accepted on a "first come - first served" basis, since seats are limited. Send your application to eva.persson@pi.lu.se

March 5

Venue: Pufendorf Institute, Main Lecturehall

9:00-9:15 *Welcome: coffee and tea*

9:15-9:45 Christian Balkenius (Cognitive Science, Lund University): Introduction

9:45-10:45 Angelo Cangelosi (Centre for Robotics and Neural Systems, University of Plymouth): Embodied language learning with the humanoid robot iCub

10:45-11:15 *Break: coffee and tea, fruit*

11:15-12:15 Yukie Nagai (Emergent Robotics Laboratory, Osaka University): Reading Intentions from motionese: Analyzing and designing caregiver-infant interaction

12:15-13:15 *Lunch*

13:15-14:15 Paul Hemeren (Cognitive Science, University College, Skövde): The kinematic specification of intentional actions in biological motion

14:15 - 15:15 Lars Hall (Cognitive Science, Lund University): Should we let the intentions out of the box? Evidence from choice and voice blindness

15:15-15:45 *Break: coffee, tea and pastry*

15:45 - 16:45 Giovanni Pezzulo (Institute of Cognitive Sciences and Technology, Rome): Watch the hands to read the mind: using motor simulation for understanding intentions and planning joint actions"

March 6

Venue: Pufendorf Institute, Main Lecturehall

9:00-10:00 Erol Sahin (Computer Engineering, Middle East Technical University, Ankara): Towards robots that can shake hands and talk

10:00-11:00 Magnus Johnsson (Cognitive Science, Lund University): Neural network models of internal simulations

11.00-11.30 *Break: coffee and tea,fruit*

11:30-12:30 Yannis Demiris (Intelligent Systems and Networks Group, Imperial College, London): Embodied simulationist approaches to understanding intentions with assistive robotics applications

12.30-13.30 *Lunch*

13:30-14:30 Ben Kenward (Babylab, Uppsala University): Different levels of intention in infants' production and understanding of actions

14:30-15:30 Elin Anna Topp (Computer Science, Lund University): Generating spatial concept hypotheses by interpreting interaction patterns - Results of a user study

15:30-16.00 *Break, coffee, tea and pastry*

16:00-17:00 Erik Billing (Computer Science, Umeå University) : Cognition rehearsed

17:00-17:15 Peter Gärdenfors (Cognitive Science, Lund University): Conclusion