Embodied cognition and autonomous robotics

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Research goal

- understand how cognition emerges in organism, that is,
  - nervous systems linked to sensors and effectors, immersed in structured environments

Research goal

- understand=discover the theoretical concepts that capture the "laws" (constraints, principles) that characterize cognition, perception, and action
  - uncover such constraints

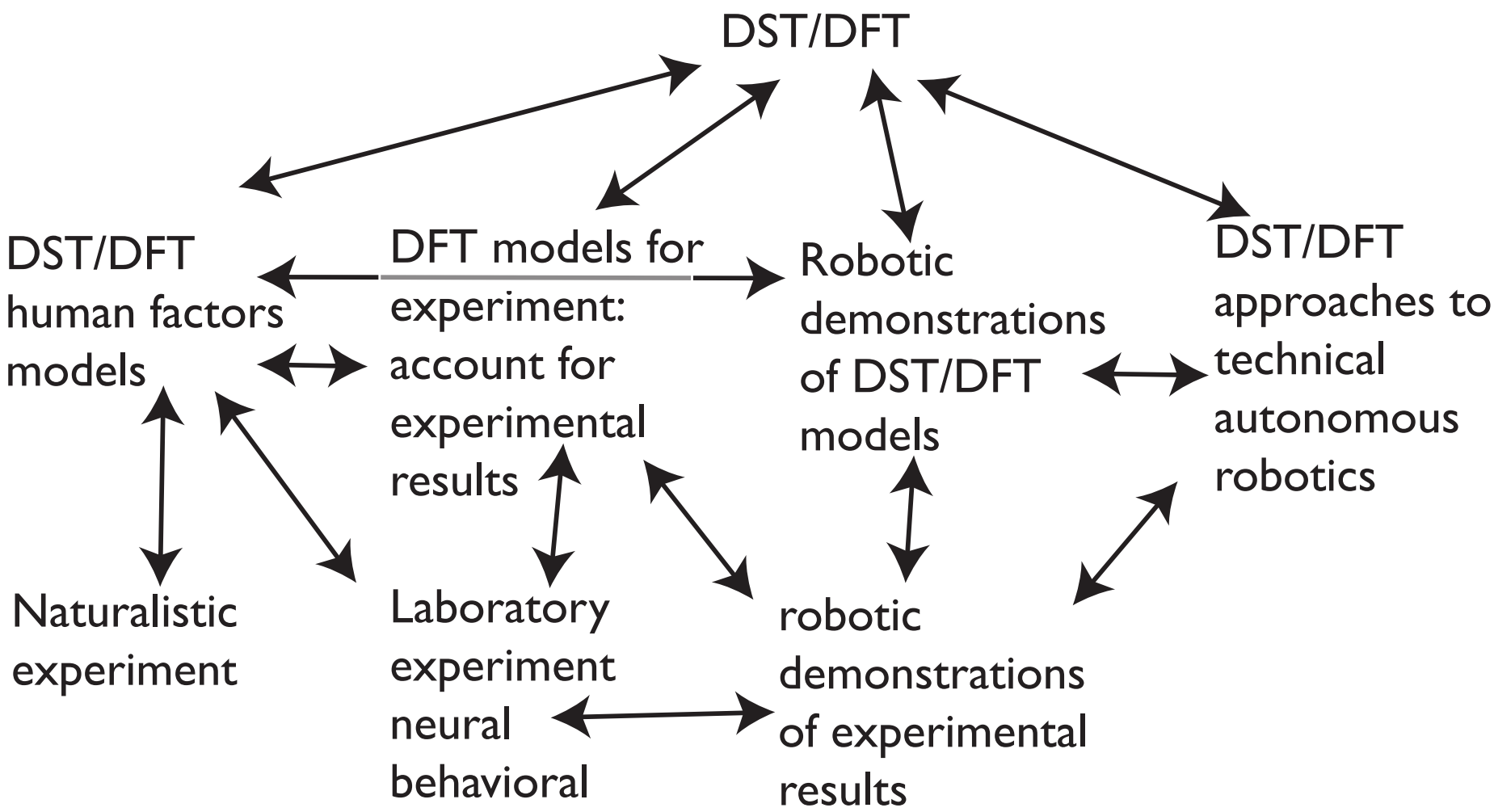
Research goal

- contribute to the empirical foundation of the concepts
  - by linking to empirical data from human behavior and neurophysiology
  - by demonstrating function in autonomous cognitive systems

DFT, neural dynamics

- as the conceptual framework for this research program

The conceptual framework of DFT



Domains

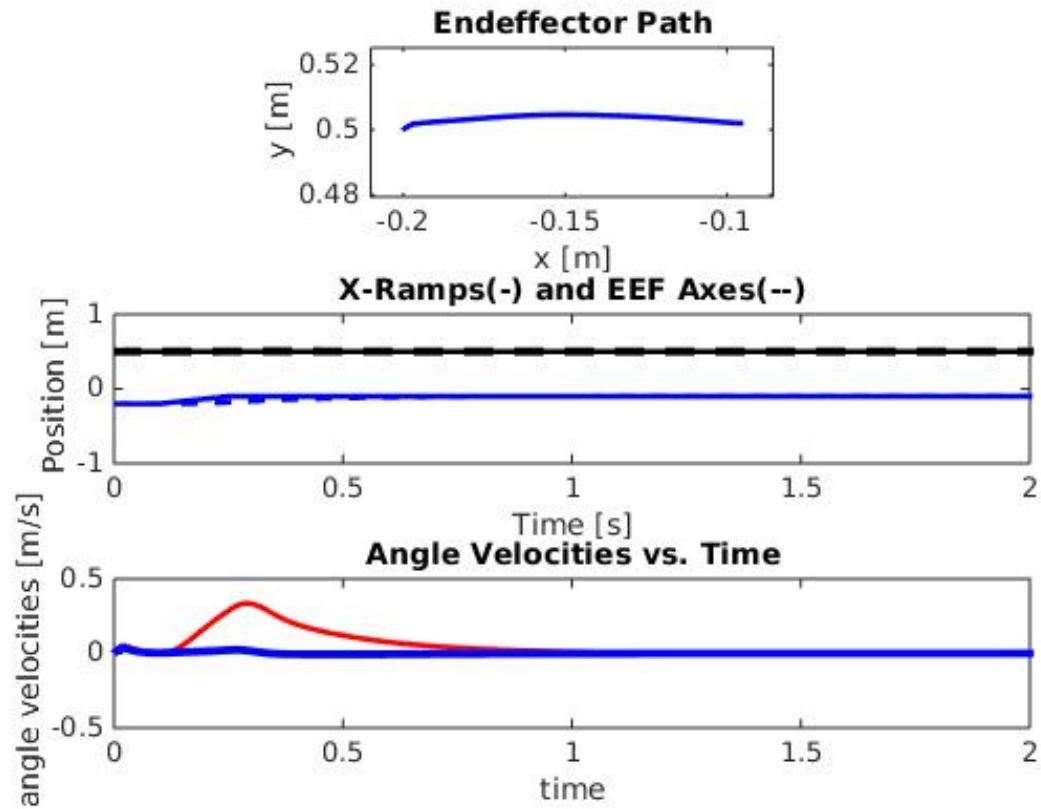
- to probe the power of the concepts, cover "everything"
  - action: motor control, movement planning, coordinate frames
  - perception: visual psychophysics, discrimination, change detection
  - cognition: working memory, scene representations, object representations, pose estimation, sequence generation, sequence memory
  - higher cognition: concepts, grounding language

Approaches

- models to account for experimental data from the literature
- models to account for experimental data from collaborators: contribute to paradigms
- models of our own experimental data
- experiments
- models for autonomous robots/vision systems that demonstrate function

Motor domain: current

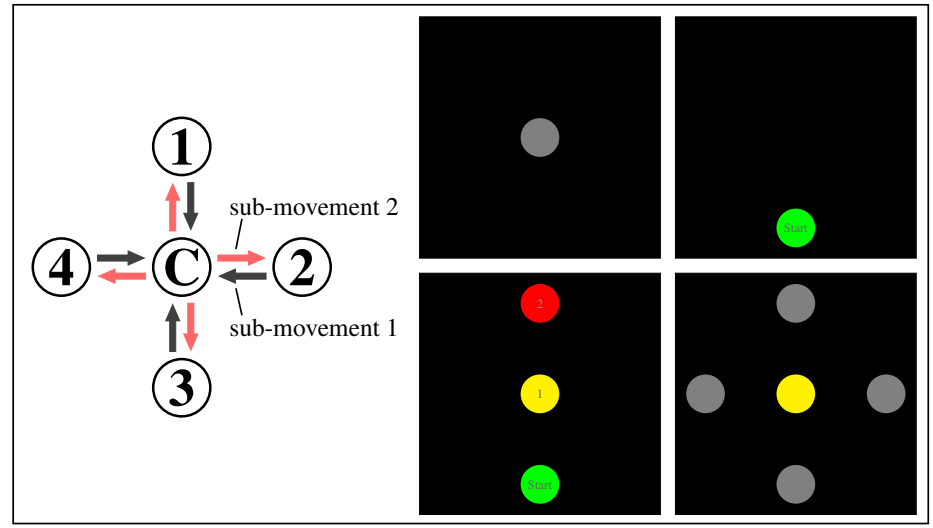
- an integrated account of motor control that takes muscles models into account

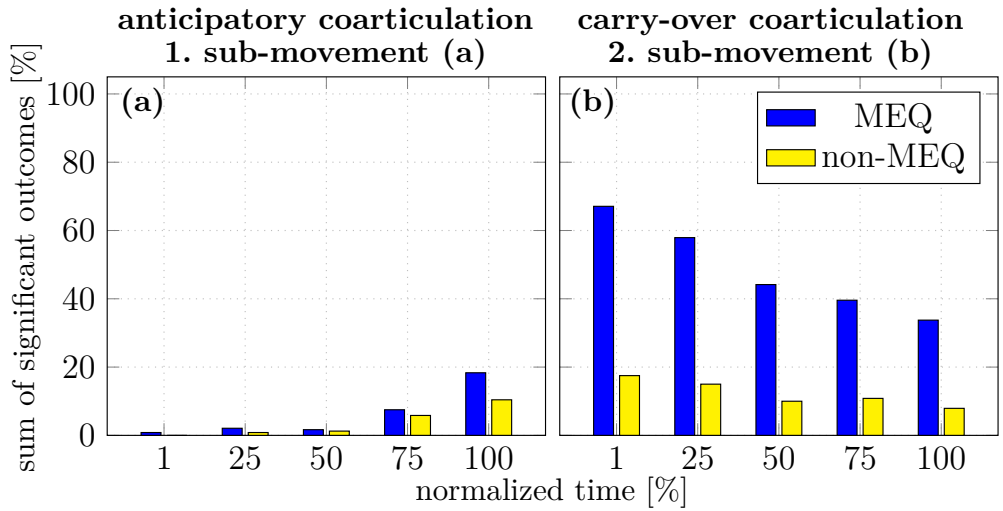


[Rachid Ramadan, Cora Hummert, Jean-Stéphane Jokeit]

Motor domain: current

- Movement sequence and the degree of freedom problem





[Eva Hansen, Cora Hummert]

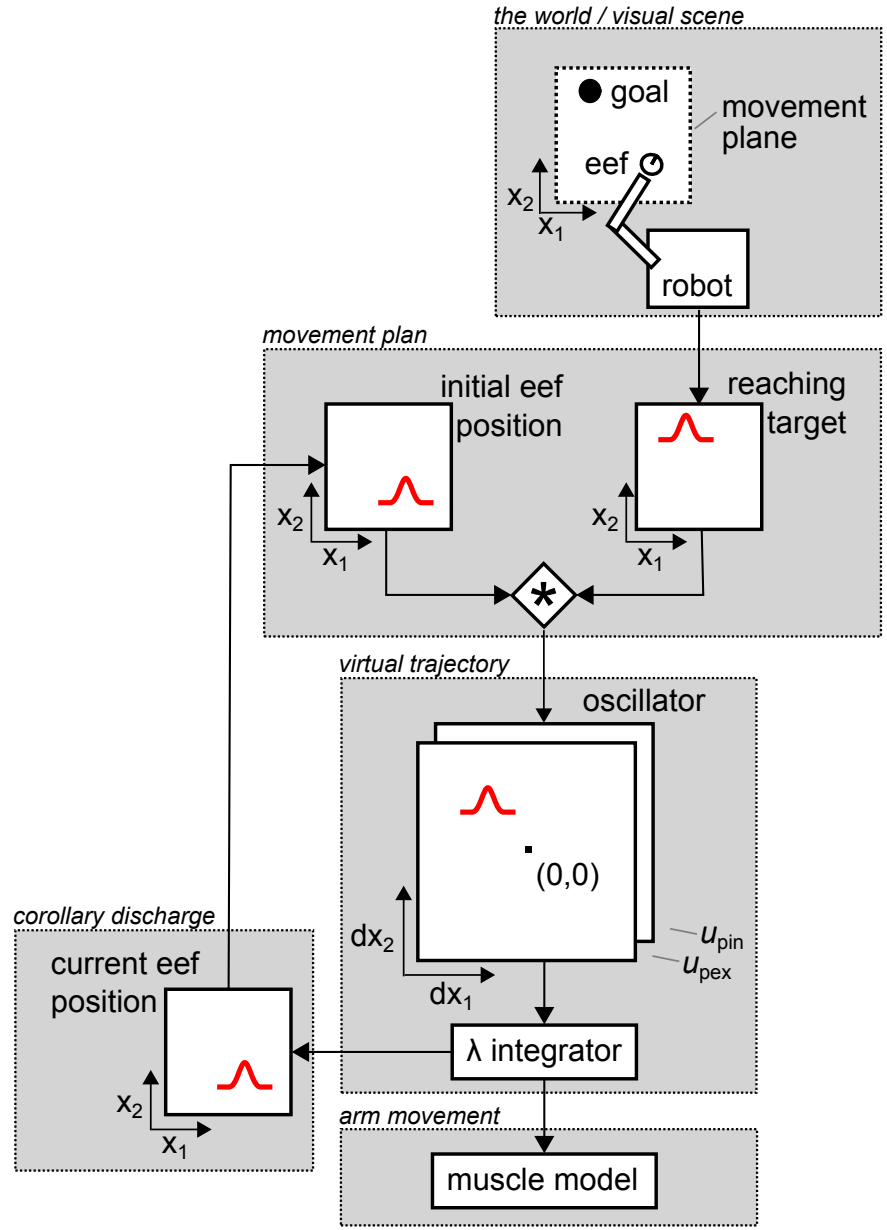
Motor control: current

- Sequence memory

[Cora Hummert]

Object-oriented movement

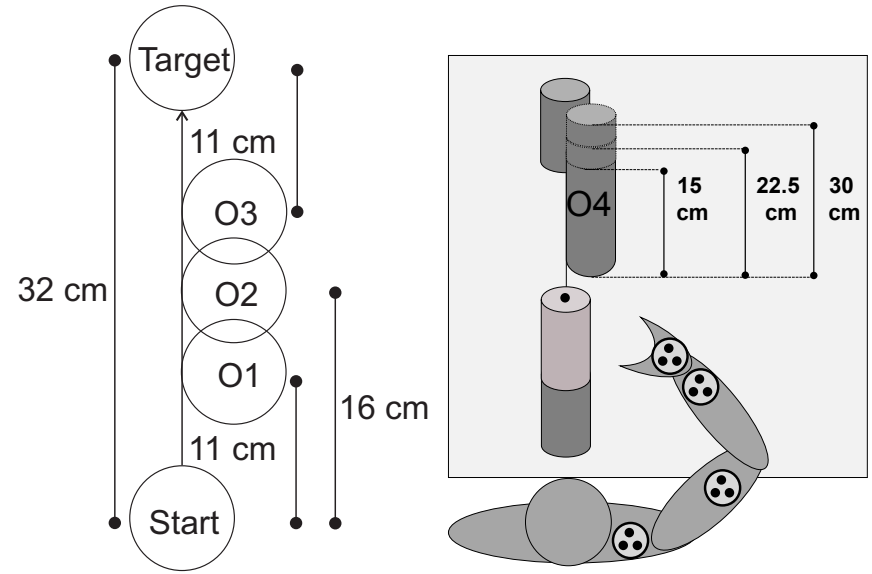
- an integrated model with a developmental perspective

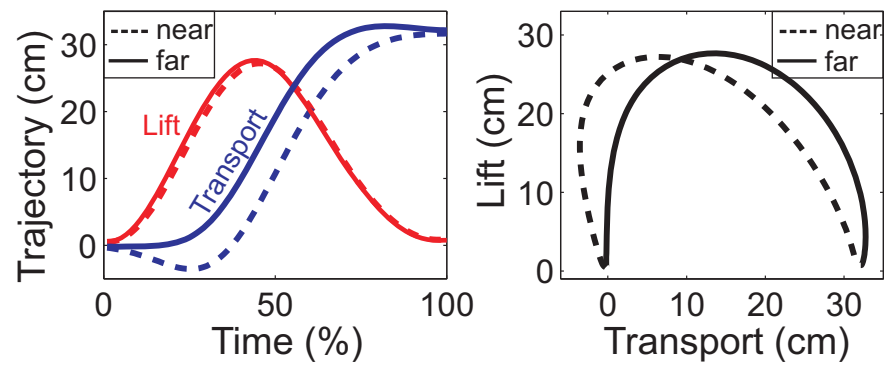


[Jan Tekülve, Stephan Zibner]

Object-oriented movement

- modeling time, constraint integration, obstacle avoidance

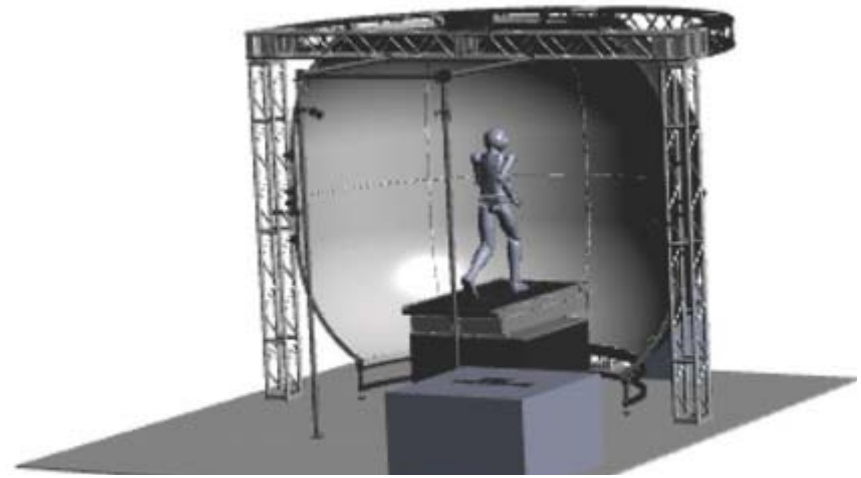


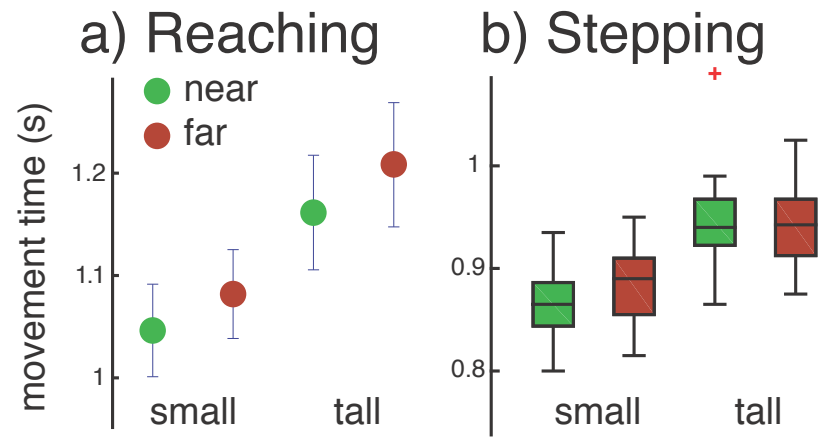


[Jean-Stéphane Jokeit, Britta Grimme]

Locomotion

- modeling integration of stepping, balance, and obstacle avoidance

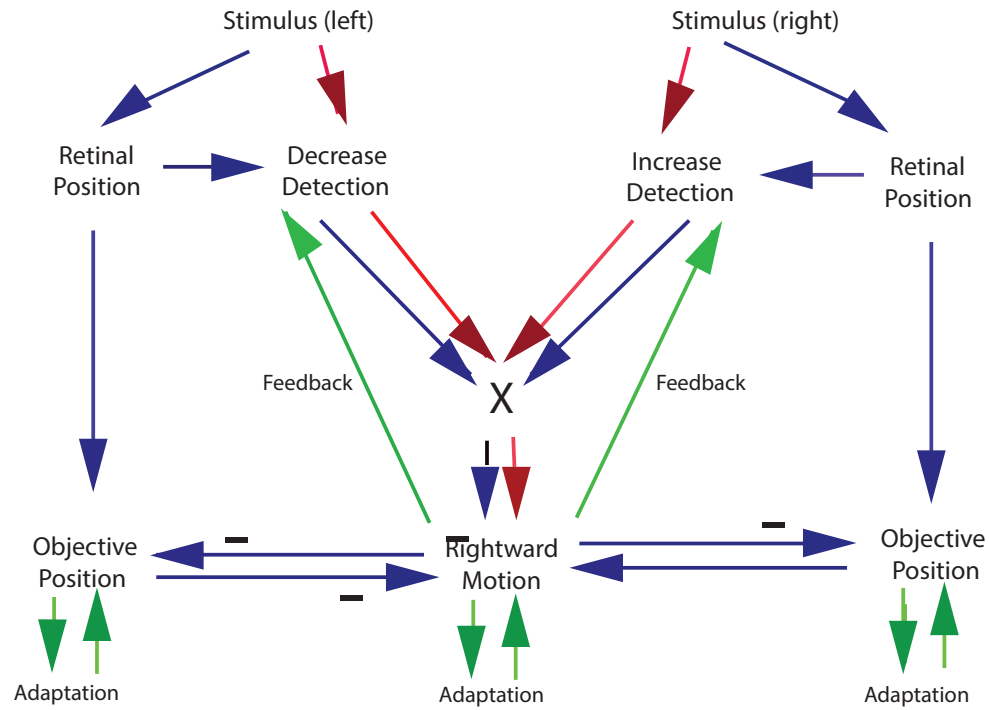




[Hendrik Reimann, John Jeka]

Visual perception

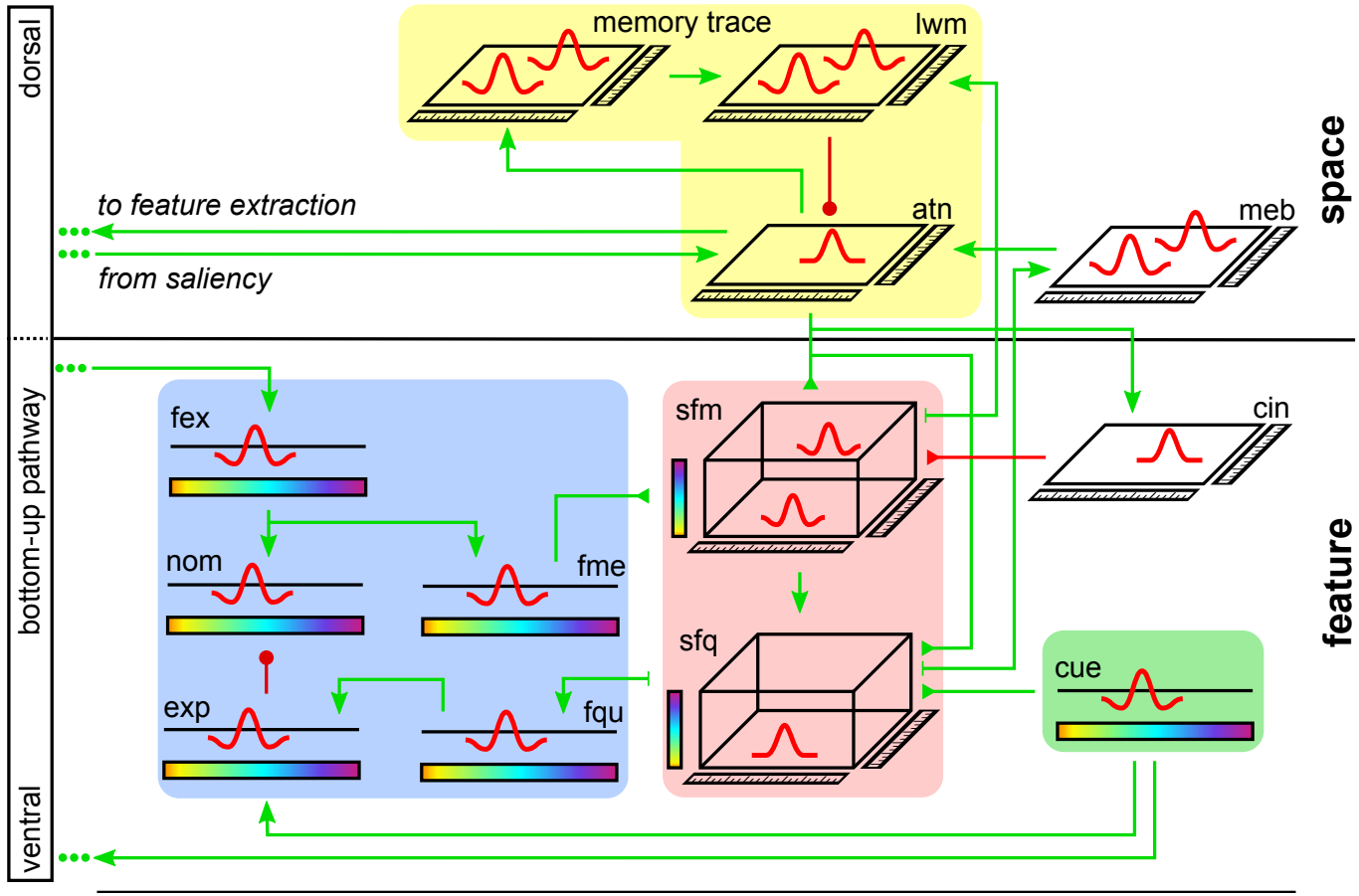
- the counter-change model of apparent motion: interaction with the perception of the scene



[Howard Hock]

Visual cognition: scene perception

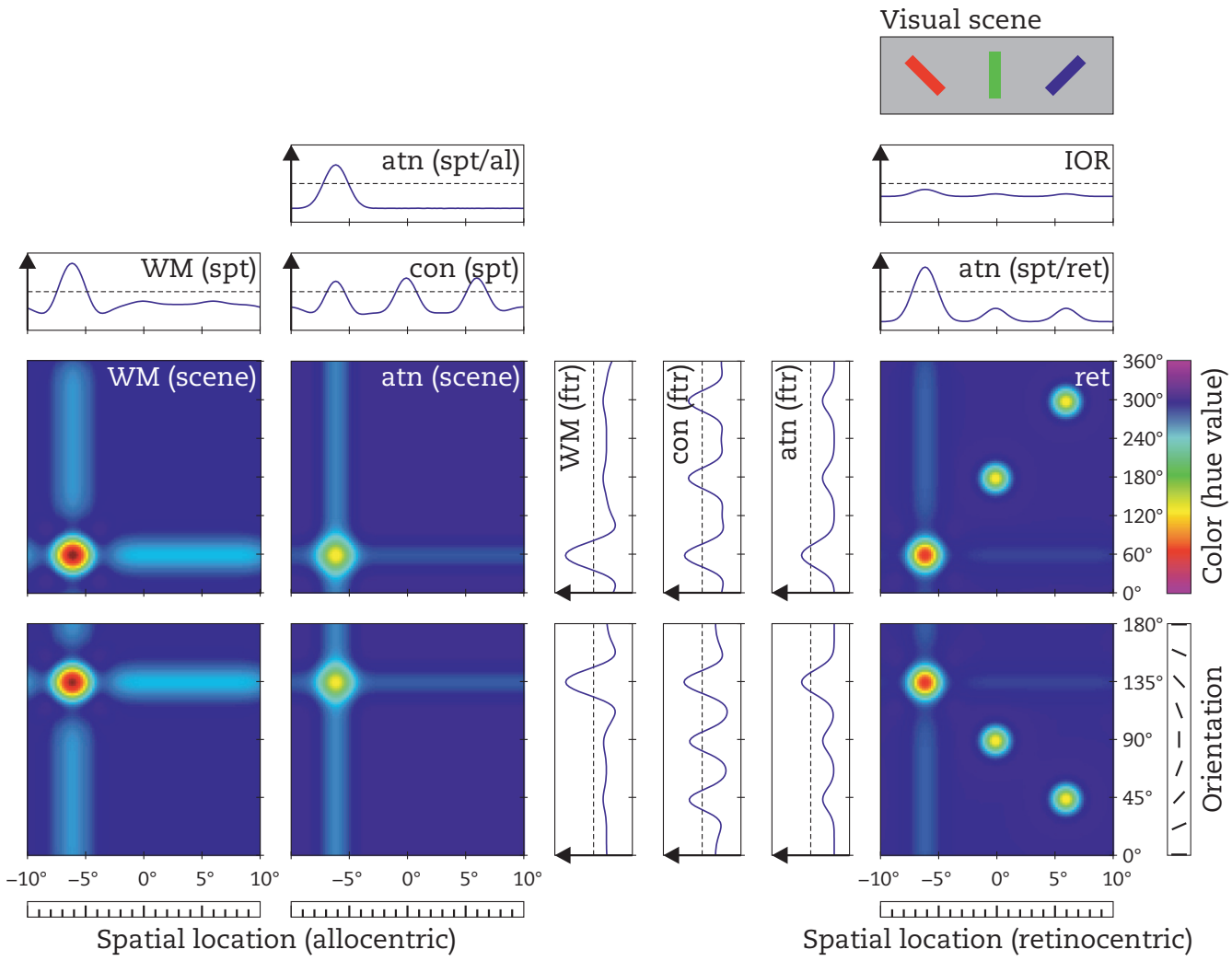
- an account for the maintenance of visual scene memory



[Stephan Zibner]

Visual cognition: binding

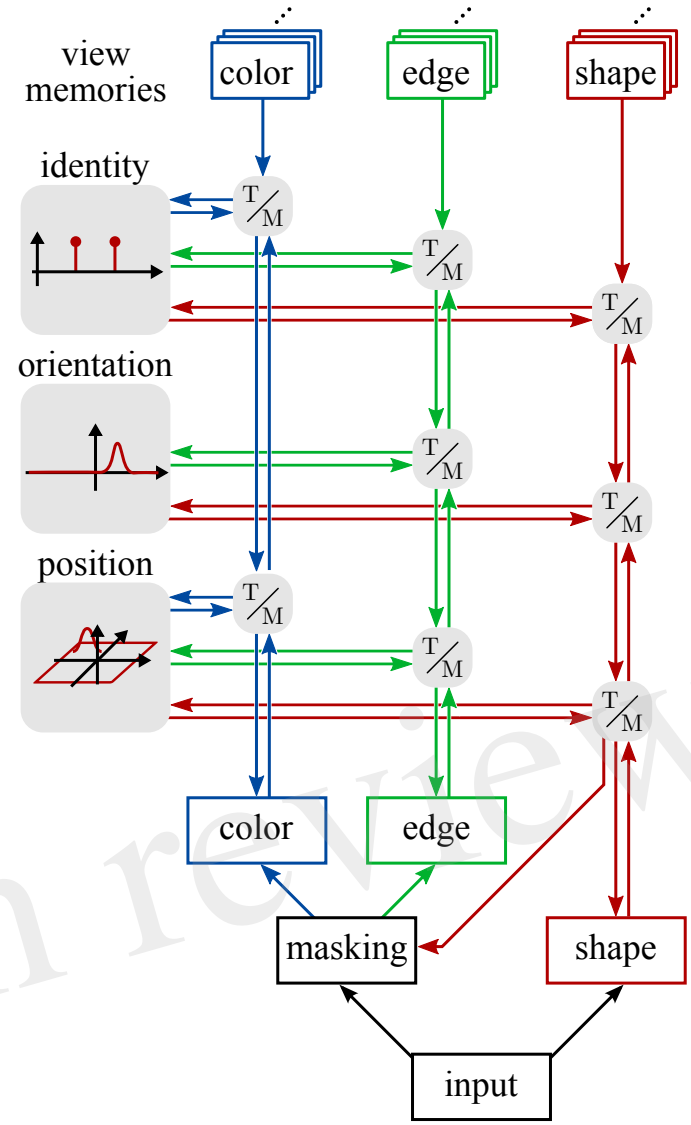
- a neural dynamic account for feature binding



[Sebastian Schneegans, Raul Grieben]

Visual cognition: object recognition

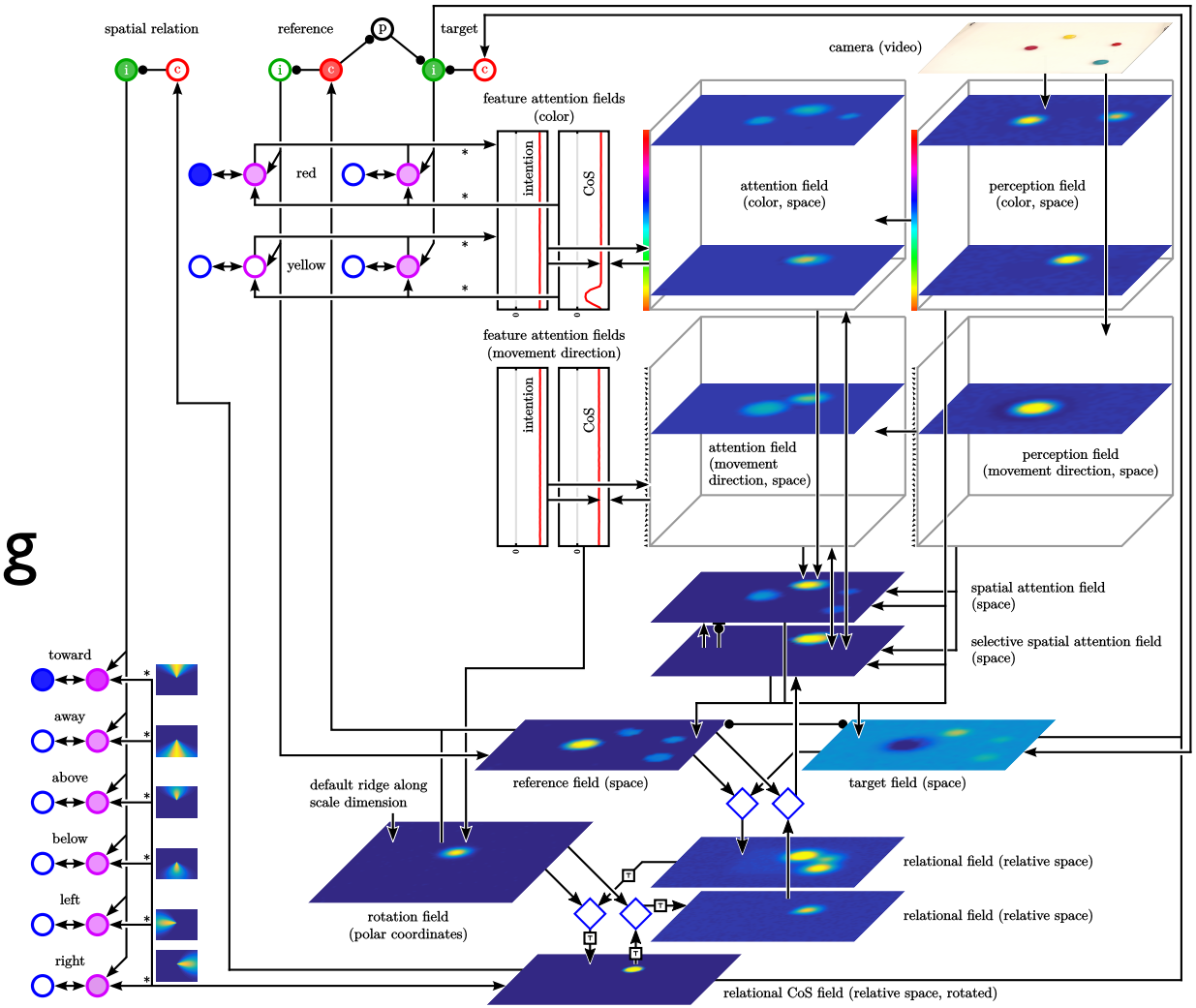
- concurrent object recognition and pose estimation



[Oliver Lomp, Christian Faubel]

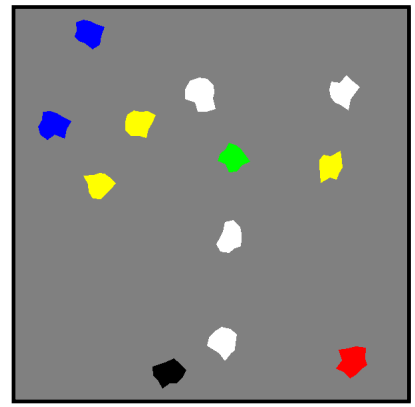
Higher cognition: spatial relations

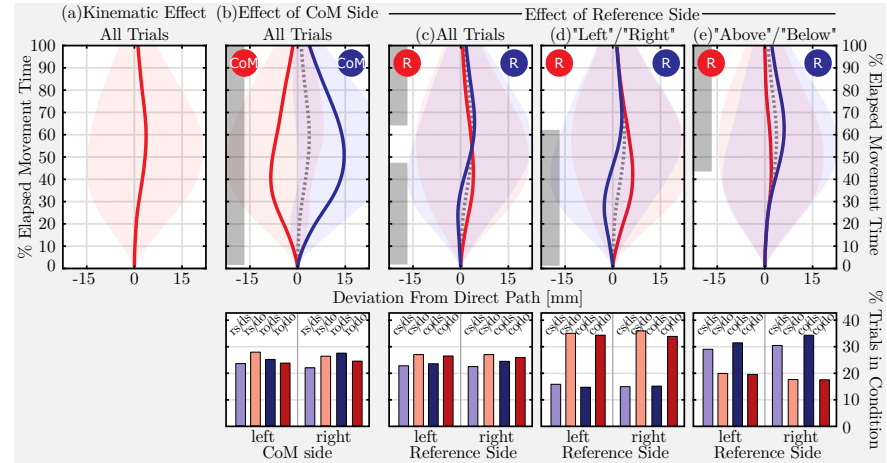
- a neural dynamic model of the perceptual grounding of spatial relations

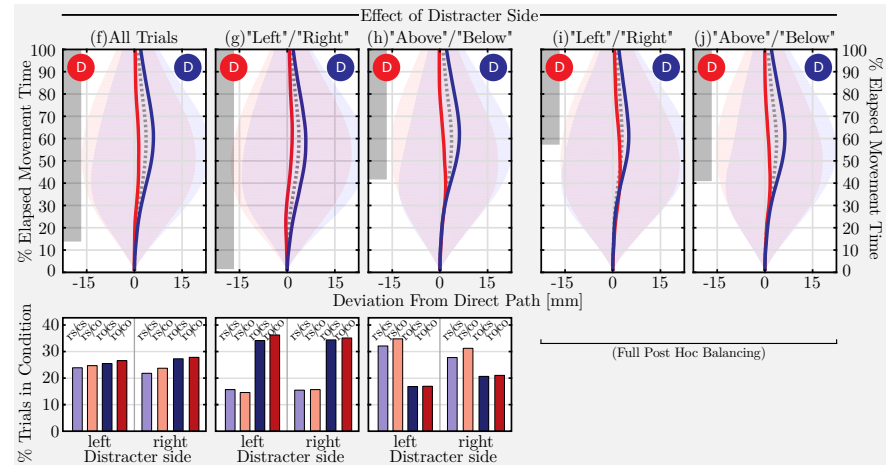


[Mathis Richter, Jonas Lins]

Higher cognition: spatial relations and their link to embodiment





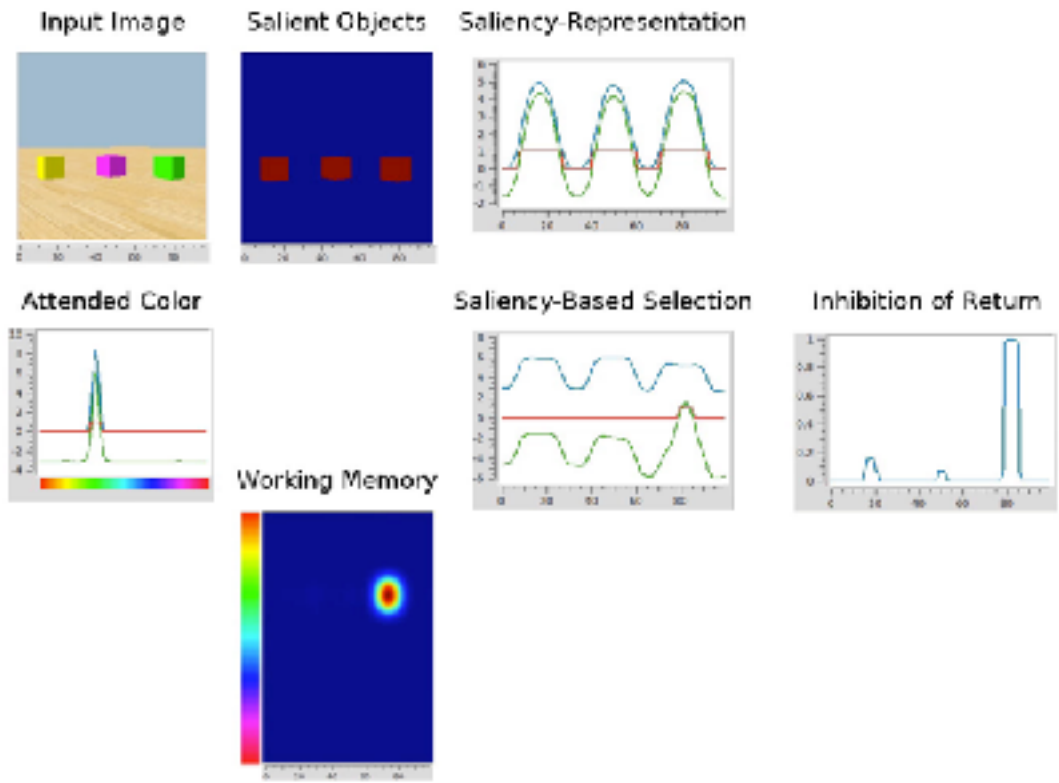


- mouse tracking to probe the grounding of spatial relations

[Jonas Lins]

Integration: Intentional robots

- building a robot demonstration of a neural dynamics of intentionality



[Jan Tekülve]

Research opportunities

- in all domains!