Objectives
Extend the current model [Ruciński et al., 2011] of number-space interactions [Göbel et al., 2011] to account for the following aspects of the SNARC effect:
- co-existence of multiple number-space associations
- binding with response side rather than response hand

Motivations: understand better the process of acquisition of the number concept and how the brain represents and processes numbers.

Number Forms – Associating Numbers with Space
Evidence:
- patients with synaesthesia
- patients with neglect
- neuroimaging
- behavioural effects

Open questions:
- the origins
- the mechanism

SNARC effect [Dehaene et al., 1993]
- Spatial–Numerical Association of Response Codes
- left-sided response faster for small numbers, right-sided for large
- contextual, flexible, various stimuli

Posner-SNARC effect [Fischer et al., 2003]
- numbers cue attention
- small numbers toward left, large toward right
- also flexible

Embodied Developmental Robotic Model of Multiple Number-Space Associations

The Model

Response Layer

“Where?”

Decision Layer

“What?”

Visual map

Number-space association (RSA)

BMU

Visual FOR

Reachable FOR

Reachable arm

Reachable arm

Left arm pose

Right arm pose

Left arm map

Right arm map

Left arm map

Right arm map

Context map

Number (Arabic)

Context

Left arm pose

Right arm pose

Semantic Layer

Model assessment
Model performance is assessed based on behavioural effects. Response times (RTs) of the model are compared with human data. RTs are analysed for the presence of signature of effects such as size and distance effect, SNARC and Posner-SNARC.

About the model
This embodied robotic model is based on previous modelling efforts [Caligiore et al., 2010, Chen & Verguts, 2010, Morse et al., 2010, Ruciński et al., 2011]. Epigenetic approach enables taking into account the effects of “external” factors like body shape, environment or culture.

References


Acknowledgement
Research supported by the EU project RobotDoC number 235065 from the 7th Framework Programme, Marie Curie Actions ITN.

Summary
The model achieves:
- reproduction of the experimental phenomena: size effect, distance effect, SNARC and Posner-SNARC
- properties of SNARC and Posner-SNARC match better with reality
- the first model of context-dependent number-space associations (to the best of our knowledge)

Future work:
- less partitioned development process
- analysis of developmental trajectories
- test predictions with human participants

RobotDoC Initial Training Network
RobotDoC Robotics for Development of Cognition
http://www.robotdoc.org/
RobotDoC is a multi-national doctoral training network for the interdisciplinary training on developmental cognitive robotics. 8 partners from 5 countries train 13 PhDs and 3 post-doc fellows.