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The origin of symbolic numerical knowledge in preschool children – a longitudinal study (research plan)

Introduction

Cardinality principle (CP) - ability to determine the total number of items [2].

~3 – 4 y.o.

Subset-knower → CP-knower

Research question: what brain changes are associated with this transition? We suggest:

interaction

Parietal area?
Left – *number word processing [4]*
Right – *non-symbolic processing [1]*

Frontal area?
General support [3]

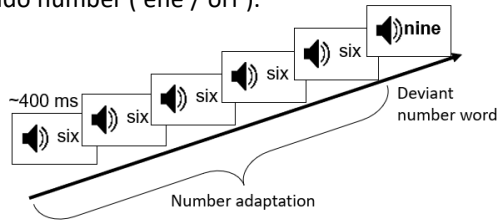
Hypotheses:
CP-knowers > subset-knowers in:

- bilateral frontoparietal activation (left parietal and bilateral frontal regions)

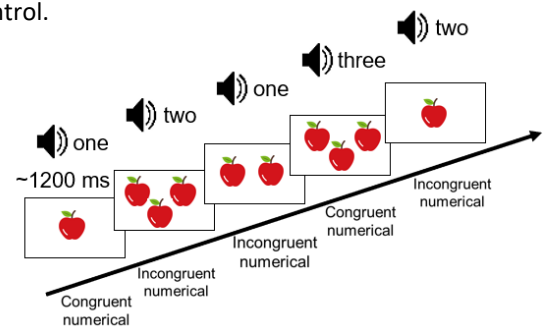
- functional connectivity (between left and right parietal regions and bilateral frontal regions)

Methods – 2 fNIRS-based tasks

Number adaptation (Vogel et al., 2017) – 10 minutes
Block design, in which continuous audio stream of number word 'six' is interspersed by either 'four', 'nine' or a pseudo number ('ene'/'orf').



Numerical incongruency – approx. 6 minutes
Block design, in which children have to tell whether audial signal matches the picture shown. Semantical (in)congruence (e.g. apple vs. banana) will be presented as a control.



Participants

Measurement every year (3 years)
Year I: 150 children, 3 - 3.5 years old
40 CP-knowers + 110 subset-knowers
Year II: 30 subset-knowers, 4 - 4.5 years old
Year III: 10 subset-knowers, 5 – 5.5 years old

Design:
2 (group: CP-knower vs. subset-knower) by 2 (laterality: left vs. right) by 2 (direction: anterior vs. posterior) mixed design.

Expected Results & Discussion

- higher left parietal and bilateral frontal activation in CP-knowers than in subset-knowers – ability to discern number words is better in CP-knowers
- higher frontoparietal functional connectivity in CP-knowers than in subset-knowers – frontoparietal network is at the core of establishing a link between each number word and its quantity.

See the references: