



# Cognitive and Educational Foundations of Preschool Maths: (Not) as easy as 1, 2, 3

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# How do young children learn about maths?

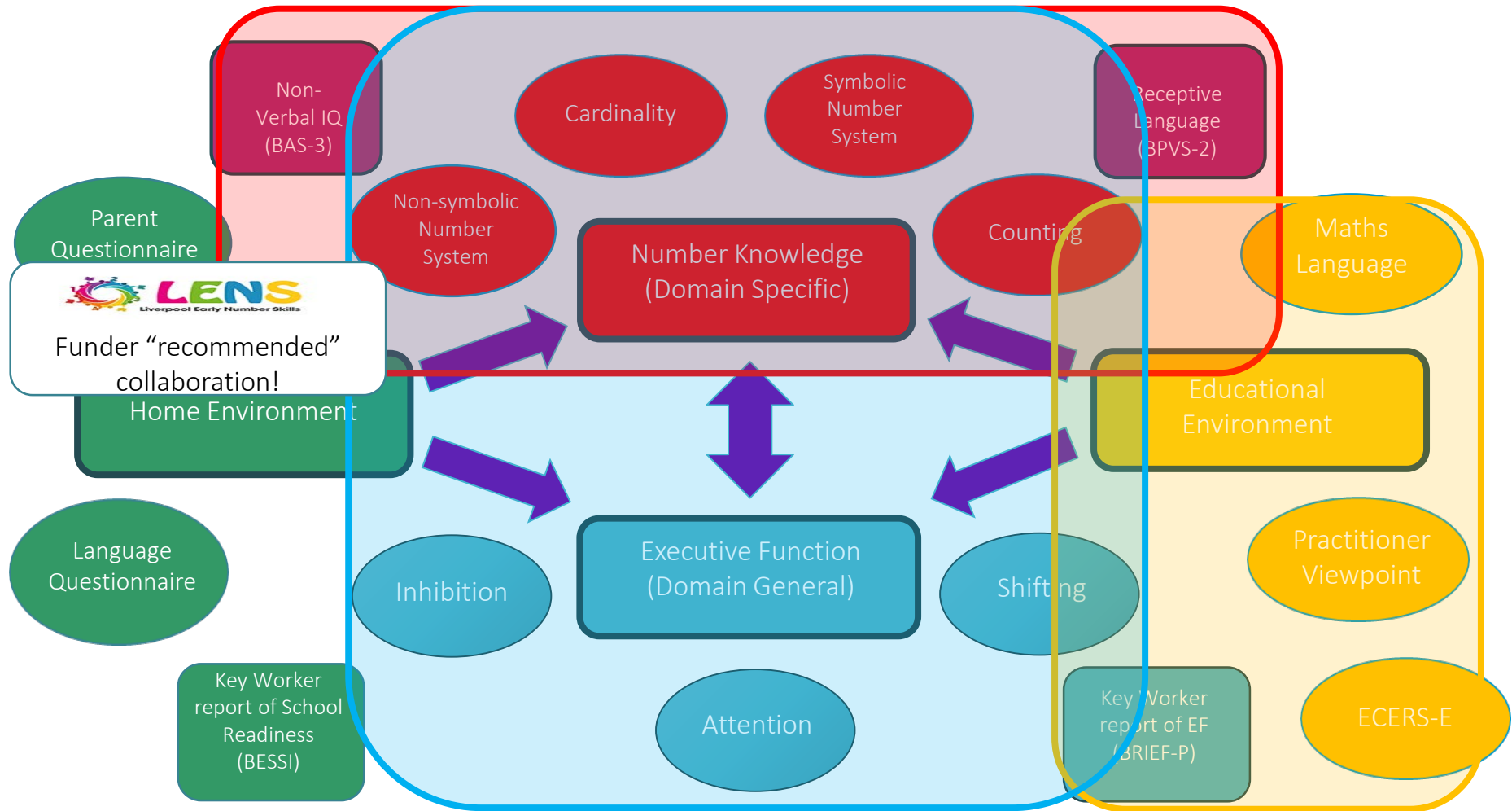


Credit: Mike Siegel/The Seattle Times



Busy classrooms, different attentional states, educator's guidance

# 'Cognitive and Educational Foundations of Preschool Maths: (Not) as easy as 1, 2, 3'



# Participants



Annelot Mills

Cross-sectional sample (N = 231 children, their preschool practitioners and parents) to study age-related differences [no time today!]



Emma Dove

Children

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Mean SES deprivation decile = 7.62 (range: 2-10; 10 being the least deprived).



Megan von Spreckelsen



# Part I – Early number skills:

## Child-level differences

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How can we measure early number skills?

1. Cardinal knowledge:  
Give a Number (Give-N) task



2. Counting:  
Counting amounts

# Part I – Early number skills:

## Child-level differences

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3. Counting High (up to 100)

4. Naming Numbers

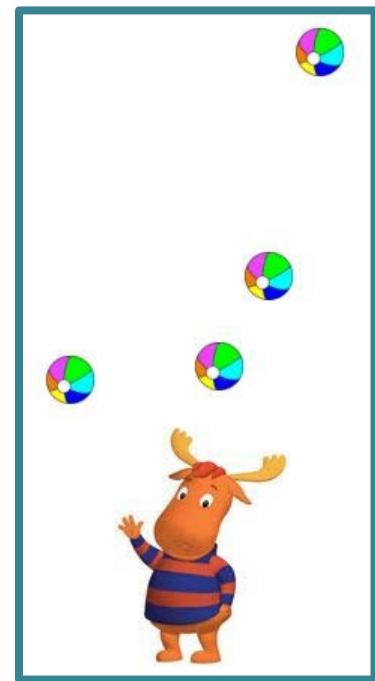
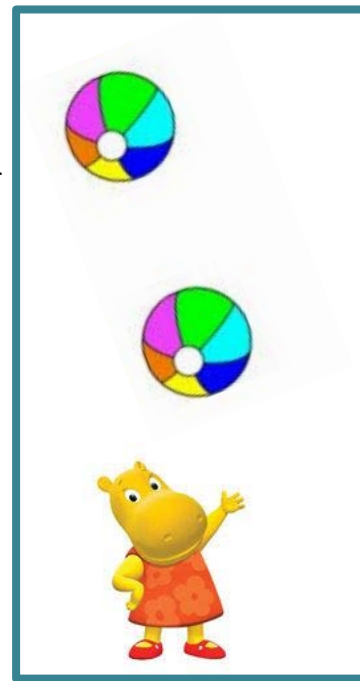
**Symbolic number identification**

e.g. | 2 | 7 | 1 | 8 | 3 | etc.

5. Magnitude Comparison

**Approximate Number Sense**

“Who has more?”



# Part I – Early number skills:

## Child-level differences



Ilse Coolen

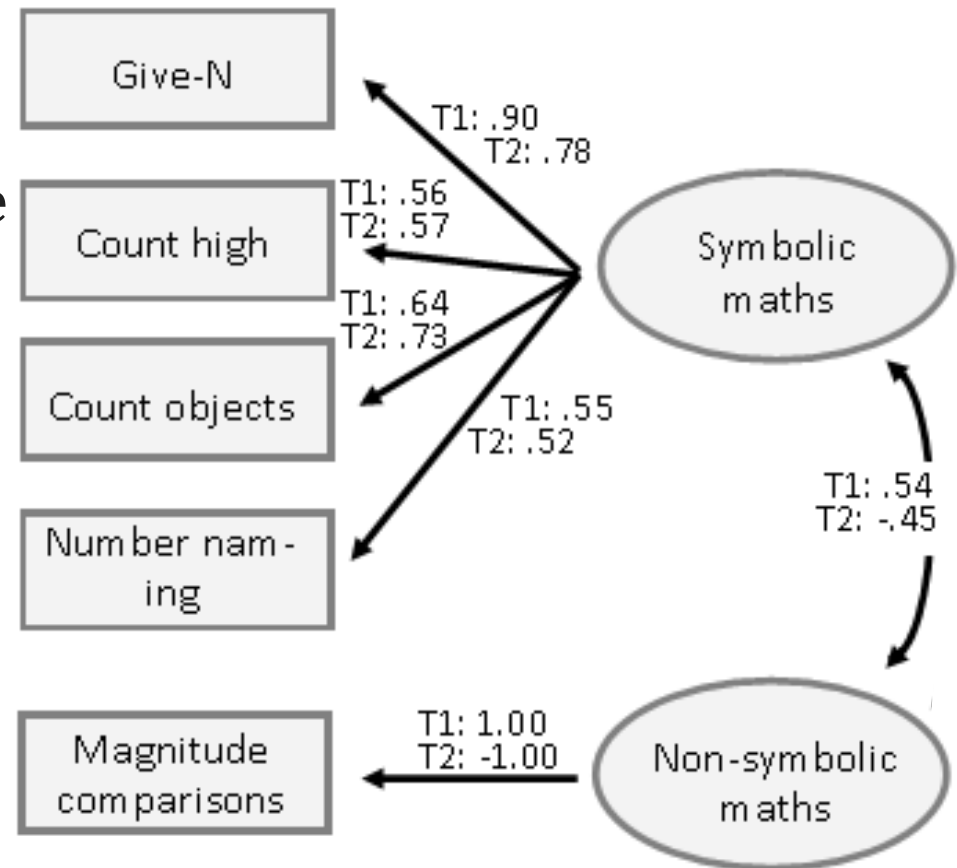
Early maths skills not unitary!

Best fitting models involve separate:

Symbolic maths

Non-symbolic maths

(separate EFA analysis for clarifications)



....and Preschool Environments?

# Part II – Early number skills:

## Exploring the Preschool Math Environment



### Co-developed observations and mixed methods:

1. **Advisory Panel** – Make best links with educators
2. **Teacher talk** – Observations of Maths Language Breadth (Braham & Libertus, 2016)
3. **‘Lunch and Learn’** – With educators and researchers –semi-structured interviews
4. **Structured observation** – Adapted ECERS-E (Sylva, Siraj-Blatchford, & Taggart, 2010)

Overall, *performance* on cardinality (Give N), Counting High and Number Naming tasks were all *higher* for children from *settings* with *higher Observed Maths Language Breadth scores*.



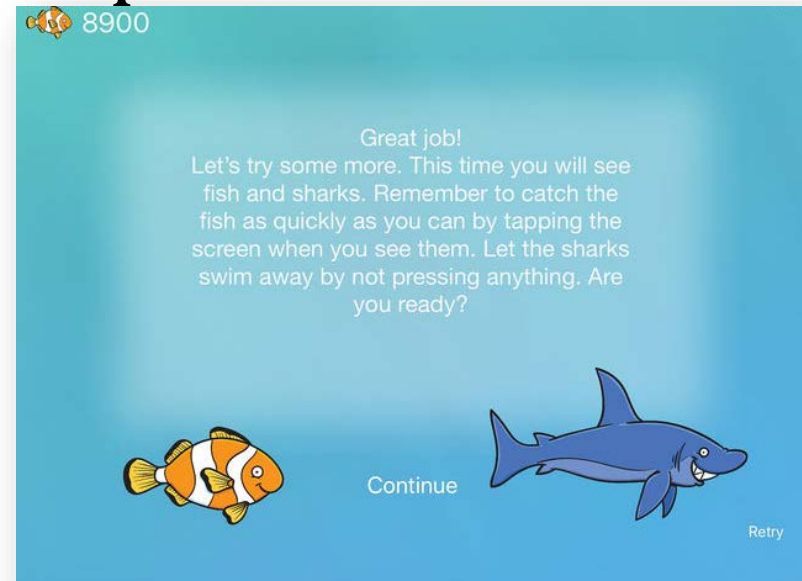
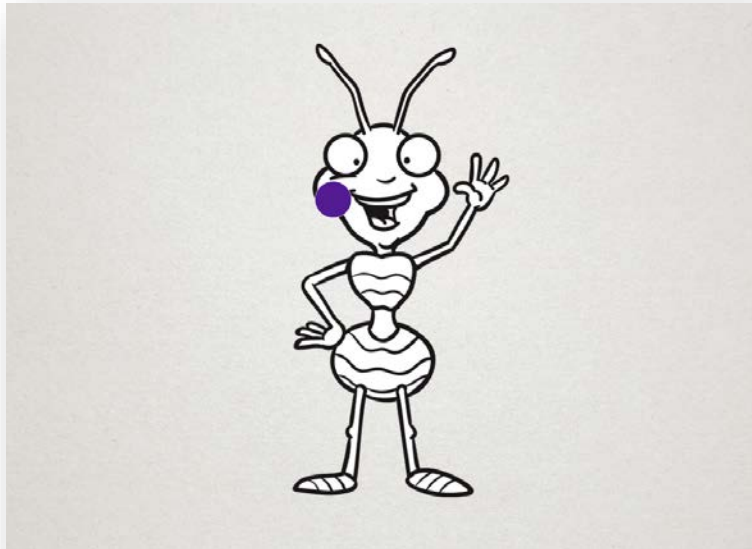
# Part III: Beyond maths skills alone...

## Interplay with Executive Skills

How do we measure them in preschool?

### 1. Go/No-go Task

Inhibition



### 2. Mr. Ant.

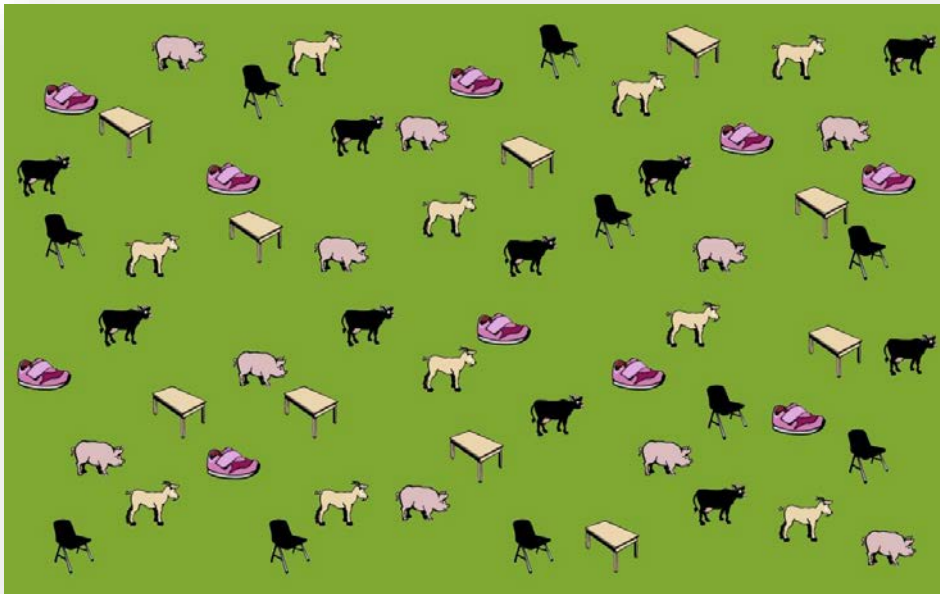
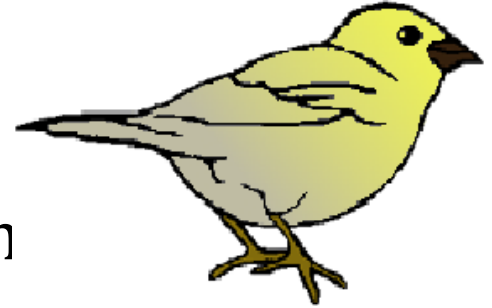
Visuo-Spatial short-term Memory

# Part III: Beyond maths skills alone...

## Interplay with Executive Skills

### 3. Animal Stroop

Shifting Attention to Relevant Dimension



### 4. Cancellation

Selective Attention

Baseline verbal IQ(BPVS) and non-verbal IQ(BAS – Picture simil)

# Part III: Beyond maths skills alone...

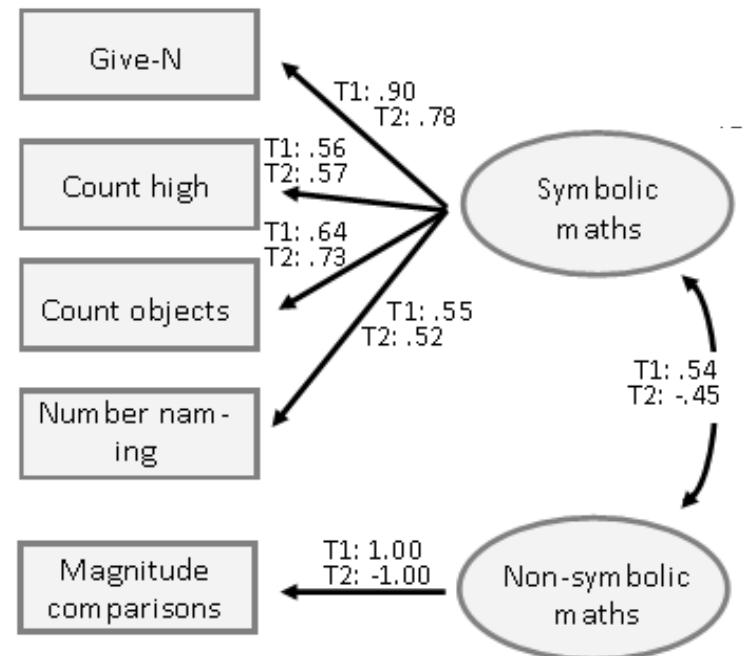
## Interplay with Executive Skills

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Domain-specific measures split:

Symbolic maths

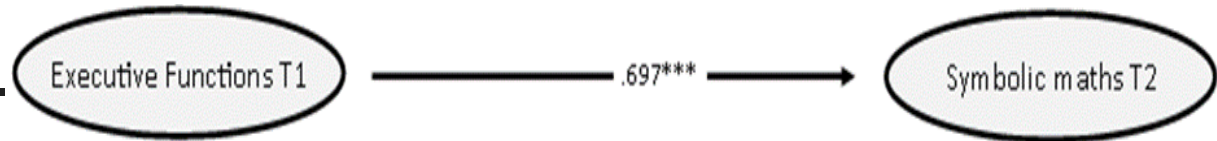
Non-symbolic maths



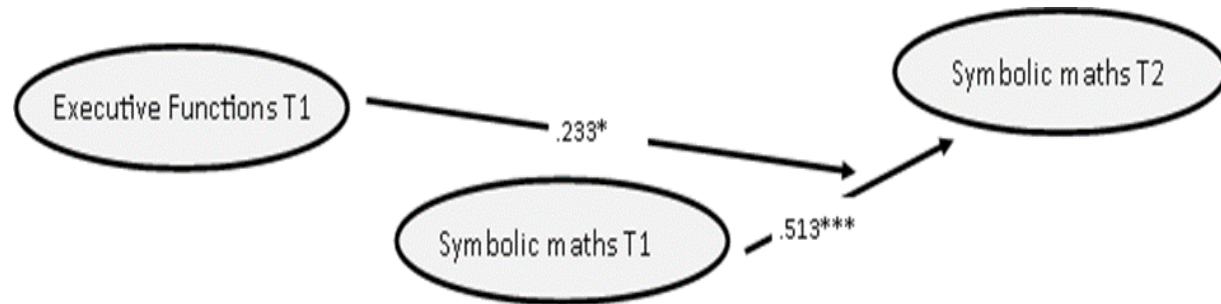
# Part III: Beyond maths skills alone...

## Interplay with Executive Skills

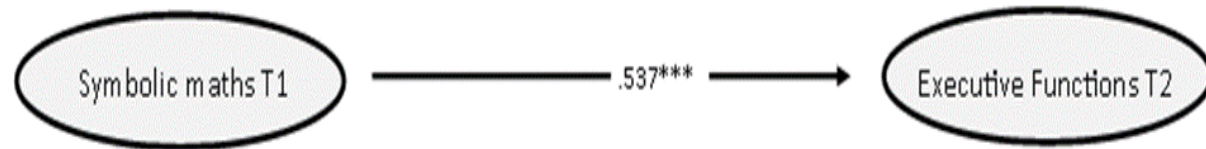
1. Executive skills predict symbolic maths.



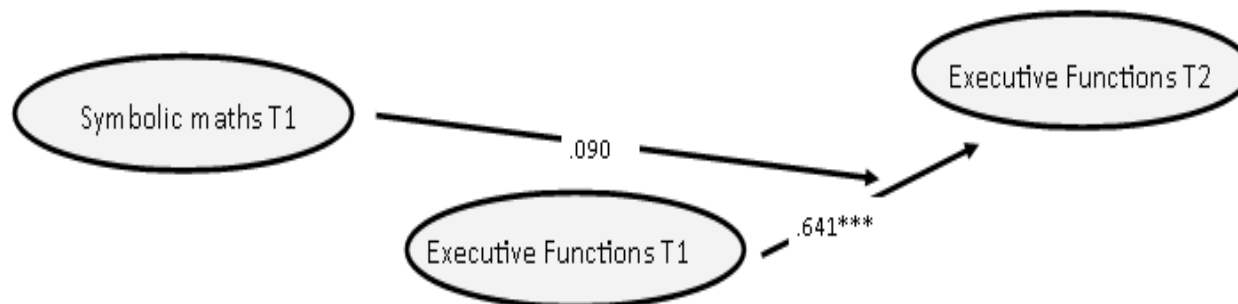
2. Executive skills predict growth in symbolic maths.



3. Symbolic maths predict executive skills.



4. Symbolic maths does not predict growth in executive skills.



# In conclusion thus far: Not as easy as 1, 2, 3...

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1. Non-symbolic and symbolic skills separate even in preschool and preschool practitioners flagged need for / interest in training in broader early maths activities.
2. Domain-general skills are strong predictors of symbolic maths and of growth in maths in preschool (converging with many: e.g., Bull et al., 2008)
3. The relation between domain-general and domain-specific skills is bidirectional, not unidirectional! (see also Fuhs et al., 2014 in the US)

## Immediate future steps:

1. Work with practitioners (see Megan von Spreckelsen)
2. Further longitudinal follow-up (see Annelot Mills!)
3. Understand children “at risk”: EAL? Latent profiles?



# Recommendations

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1. Both general and maths-specific skills need to be considered together in preschool children (→ Policy discussion?).
2. Training for early year practitioners could be adjusted to provide the means to identify strengths / weaknesses in domain-general skills as well as maths-specific skills for their key children (→ Practitioners' input?).
3. New ways of incorporating domain-general skills in maths learning activities, not training the executive or maths in isolation (see Vicky Simms!)

**...injecting executive challenge in everyday  
maths activities...**

# Future of Early Maths Research Funding?

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What should future early maths research look like?

- Collaborative! Leverage data sharing!
- Work in partnership with practitioners and policy makers
- Capture diversity (SES, parental influences, EAL)
- Understand good practice: What are the cognitive ingredients of success for excellent teaching practices?
- Interventions co-developed by cognitive scientists and practitioners, with a view to scaling up (with parents / practitioners?)

# Thank you and...



Thanks to all participating nurseries, schools,  
practitioners, parents and children!

## The Project Team:

### United Kingdom:

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Annelot Mills



Emma Dove



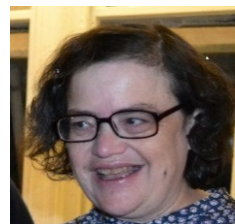
Megan von Spreckelsen



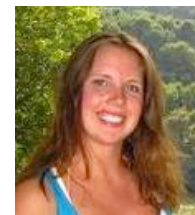
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