Understanding the influence of cognition and the home learning environment on early number skills

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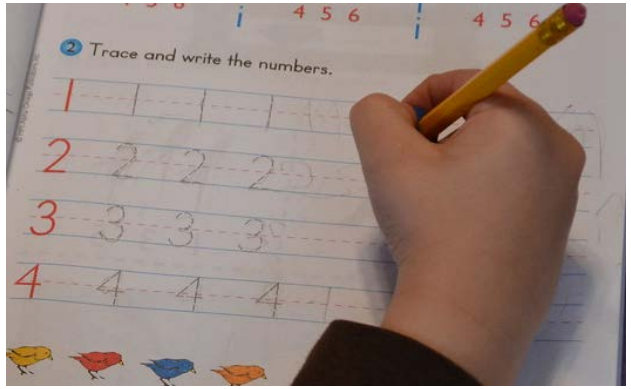
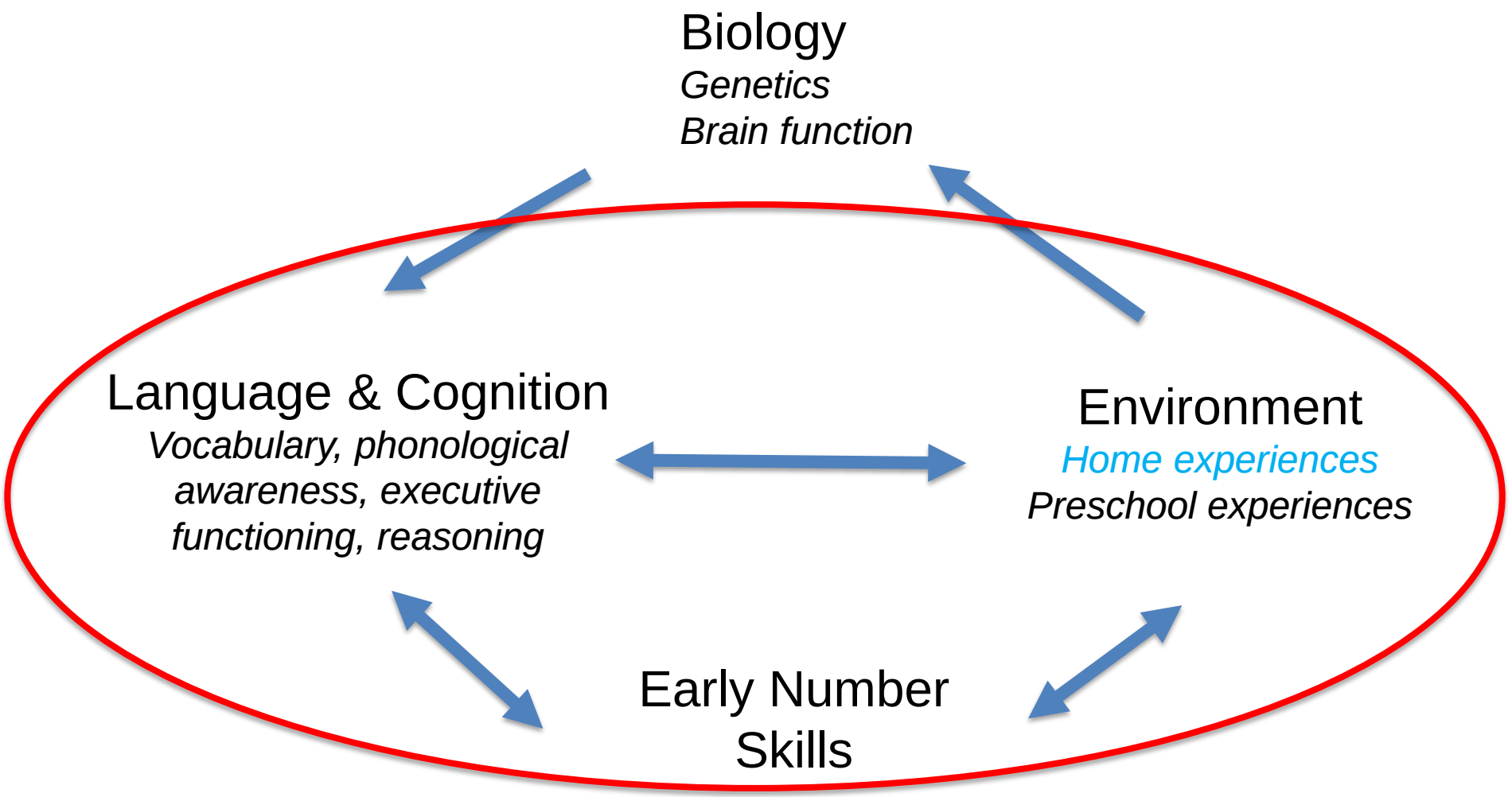
What are early number skills and why are they important?

- Skills relating to number and quantity
- Large individual differences at school entry
- Predict substantial variance in later academic attainment



What could influence early number skills development?



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Core Research Questions

1. To what extent do preschool language and cognitive skills predict growth in early number skills?
2. To what extent do number-oriented and language- and literacy-oriented aspects of the home learning environment predict growth in early number skills?
3. To what extent are the relationships between the quality of the home learning environment and early number skills direct and to what extent are they indirect via the promotion of language skills?

Home Learning Experiences

Language & literacy

Code

Letter-sound interactions

Meaning

Shared reading

Number

The study

	Spring Term Preschool		Summer Term Preschool		Summer Term Reception
Time point	T_{1a}	T_{1b}	T_{2a}	T_{2b}	T_3
Sample size	274	274	266	199	232
Mean age	3:11 (3.6)	4:0 (3.6)	4:3 (3.7)	-	5:3 (3.6)
Measures at this time point	Home learning environment questionnaire	Early number skills assessments	Language and cognitive assessments	Preschool quality observations	Early number skills, mathematics and reading measures

Questionnaire items

Home Number Experiences	Home Literacy Experiences	
Number	Code-focused	Meaning-focused
Is taught the names of **numbers**	Talks about **letter sounds** with an adult	Looks at factual **books**
Writes or traces **number**		Discusses **stories** with an adult
Discusses **numbers or quantity** with an adult	Is taught the **names or sounds of letters**	Is encouraged to choose **books** that interest them to look at with an adult
Is encouraged to point out or identify **numbers** in books		Is encouraged to use **books** to follow-up interests
Completes **number activities** in magazines or workbooks	Forms or traces **letters** or writes their name	Is encouraged to point out or identify pictures in **books**
Plays games that involve **number** cards, dice or a number spinner	Is prompted to identify **letters** in books or the environment	**Discusses** with an adult how things work or what they mean

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Early Number Skills

Cardinal Counting		Numeral Transcoding		Calculation	
Give me X	Counting Objects	Number Recognition	Numeral Reading	Additions	Subtractions

- ✓Core components of the Early Years Curriculum in England (Department of Education, 2013; Testing and Standard Agency, 2017)
- ✓Consistently associated with later mathematical attainment (see Jordan et al., 2007, 2009)
- ✓CFA confirmed 3 factor structure at both time points
- ✓Explained 44% of the variance of a standardised maths test at T_3

Language and cognitive

Language				Nonverbal abilities			
Phonological awareness		**Vocabulary**		**Executive functioning**		**Nonverbal reasoning**	
Rhyme awareness	Alliteration awareness	Receptive vocabulary	Expressive Vocabulary	Big/little Stroop	Fish-shark	Matrices	Picture similarities

✓CFA indicated a 2 factor structure best fit

Path analysis plan

1. A home learning model

   What home learning and demographic factors in preschool predict the early number skills at the end of Reception?

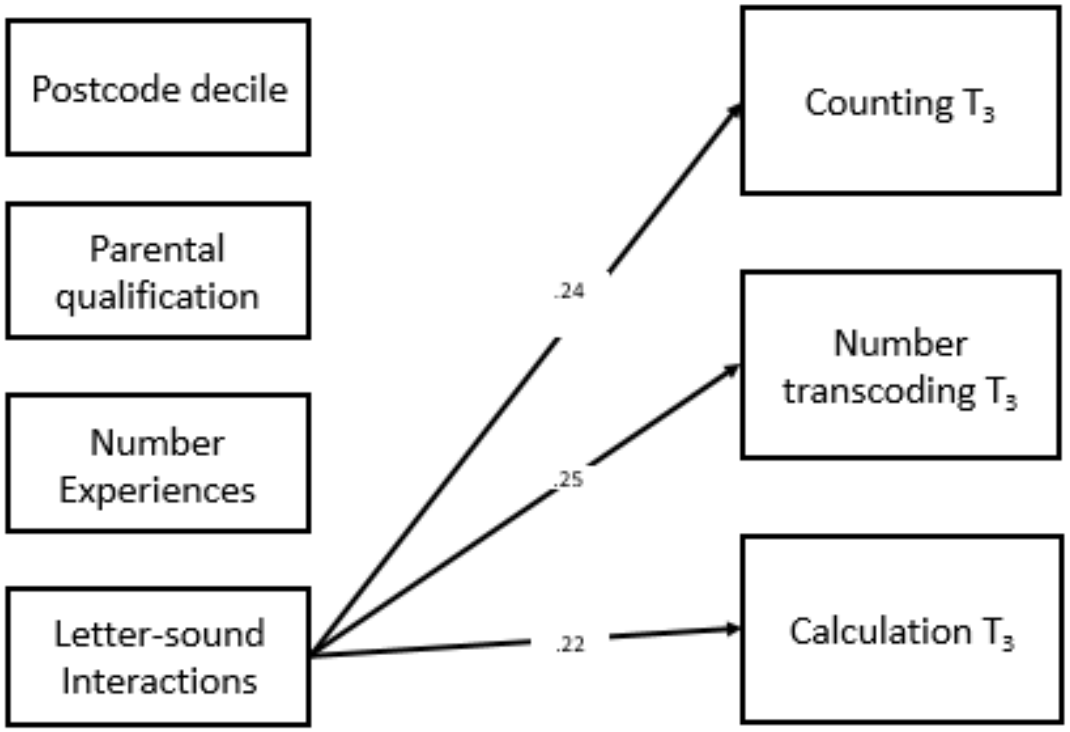
2. A language and cognitive model

   Do language and nonverbal abilities predict growth in the early skills from preschool to the end of Reception?

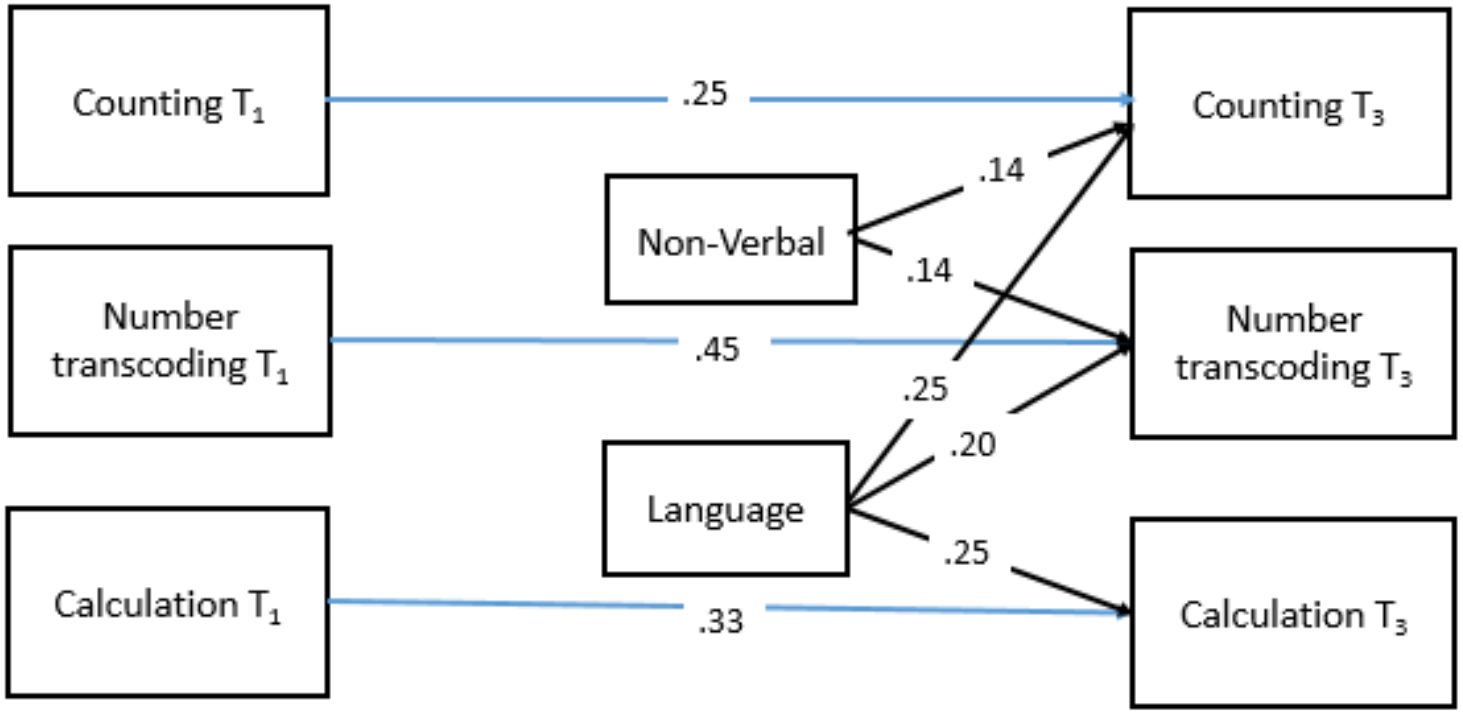
3. A combined model

   Do the home learning experiences precdict growth in the early number skills directly or via their relationship with language skills?

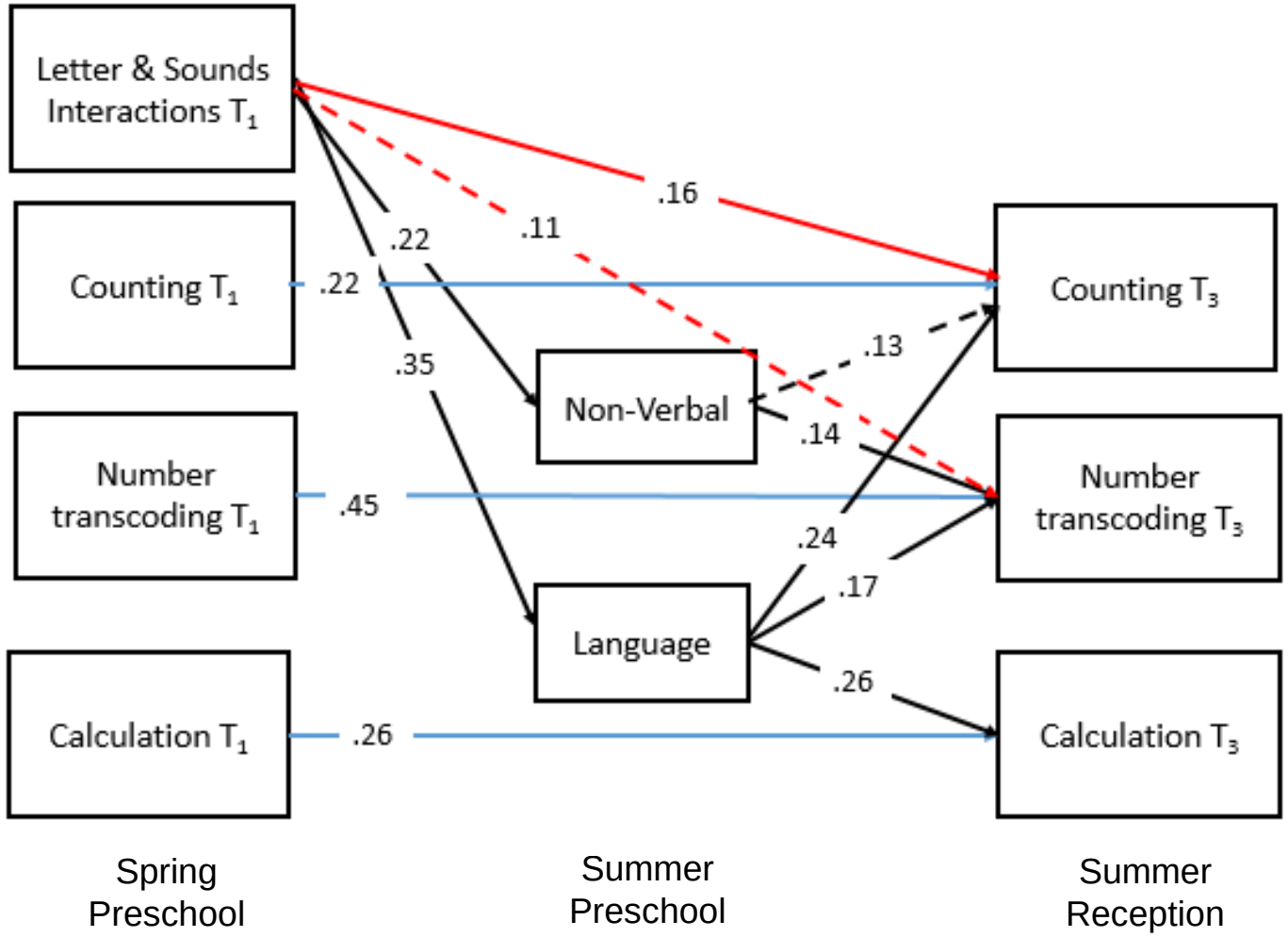
A home learning model



A language and cognitive model



A combined model



Conclusions

1.To what extent do preschool language and cognitive skills predict growth in early number skills?

- Language skills predict growth in counting, number transcoding and calculation
- Nonverbal cognitive skills have a more limited influence counting and number transcoding

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Conclusions

2. To what extent do number-oriented and language and literacy-oriented aspects of the home learning environment predict growth in early number skills?
3. To what extent are the relationships between the quality of the home learning environment and early number skills direct and to what extent are they indirect via the promotion of language skills?

- Only letter-sound interactions (an aspect of code-focused home literacy environment) predict early number skills
- Letter-sound interactions have indirect relationships with all early number skills and a direct relationship with counting skills
  - Developing language
  - Developing symbolic understanding

Conservative models with control for autoregressive effects supports the argument that Letter-sound interactions have a supportive role (particularly for counting rather than merely being a correlate

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Implications

- Preschool language skills are important for the development of early number skills
  - Experiences that support the development of phonological and vocabulary abilities in preschool will support both the development of early number skills and emerging literacy
  - Age-appropriate experiences to promote phonological and vocabulary abilities support **both** literacy and numeracy
- Letter-sound interactions are likely to support phonological and alphabetic understanding
  - In turn this supports early number skills and emerging literacy
- Parents need support:
  - Ideas for age-appropriate, informal letter-sound interactions. How can they integrate discussions about letters and sounds into their child's everyday experiences
  - Confidence in their alphabetic knowledge

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Future directions

- Why is there no independent impact of number experiences?
  - Too infrequent to have an impact?
  - Too basic?
    - Relationships stronger with ‘advanced’ scales
    - Needs assessing controlling for autoregressive effects (cause or response)
- Assessing the impact of strategies to promote parental letter-sound interactions
  - Can we increase the frequency of these interactions?
  - Does it have an impact on children’s phonological awareness, alphabetic knowledge and early number skills?
  - RCT gold standard

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In memoriam

Dr Catherine Willis