

Mathematical Difficulties in Children with Developmental Language Disorder: A Scoping Review

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Introduction

Successful learning in academic subjects is largely dependent on a child's ability to understand and use oral and written language, placing children with developmental language disorder (DLD) at risk for learning difficulties. Mathematics is an academic subject that involves both verbal and non-verbal representations¹.

- Number transcoding, counting, arithmetic, and story problems rely on verbal representations of numbers.
- Number lines, magnitude comparisons, and conceptual tasks tend to minimize verbal demands.

It remains unclear whether mathematical difficulties in children with DLD are specific to tasks with high verbal demands, or extend to tasks relying on other types of numerical representations.

Research Question: How do children with DLD perform relative to typically developing (TD) children on mathematical tasks with demands in verbal and non-verbal domains?

Method

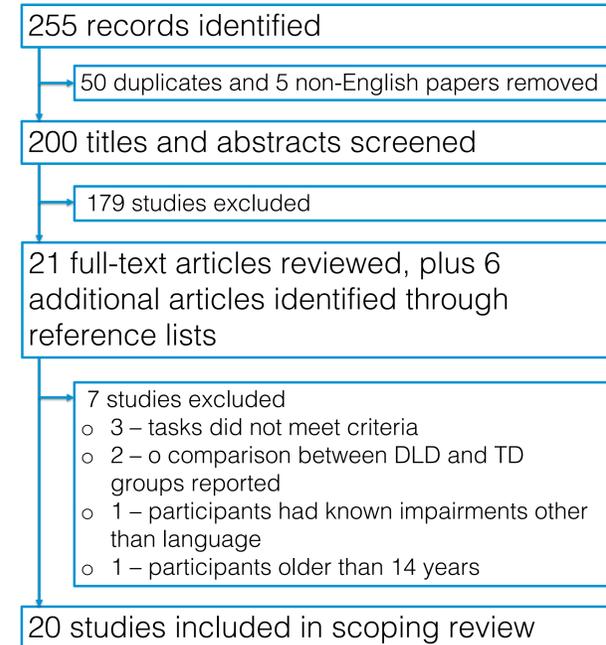
A scoping review was conducted using the PsycINFO and Web of Science databases and the following terms:

- *specific language impairment, primary language impairment, language disorder, or language disability,* and
 - *math*, numer*, count*, calculate*, arithmetic, or magnitude.*
- 255 studies were returned.

Inclusion Criteria

- Papers written in English
- Participants between 4 and 14 years old
- Group of participants identified with DLD by clinical professionals or standardized assessment
- Comparison of DLD to TD groups, or published population norms on at least one behavioural measure of mathematics

Scoping Review Procedures



Results

	n (TD age-matched)	n (TD language-matched)	n (DLD)	Age range of DLD group (years)	Tasks with high verbal demands				Tasks with low verbal demands				
					Number Transcoding	Counting	Arithmetic	Story Problem	Number Line	Digit Comparison	Non-Symbolic Comparison	Concepts	
Nelson et al., 2011 ²	116	n/a	220	4				X					
Fazio, 1994 ³	20	20	20	4-5		X							
Arvedson, 2002 ⁴	19	19	19	4-5		X							=
Willinger et al., 2017 ⁵	61	n/a	61	4-6			X						=
Jordan et al., 1995 ⁶	33	n/a	33	5-6			X	X					=
Kleemans et al., 2011 ⁷	111	n/a	61	5-7		X			=				
Donlan, 1993 ⁸	17	n/a	13	6-7	X	X				=			
Fazio, 1996 ⁹	15	16	14	6-7		X	X						
Donlan et al., 1998 ¹⁰	n/a	37	12	6-7						=	=		
Kleemans et al., 2012 ¹¹	107	n/a	53	6-8			X						
Kleemans et al., 2013 ¹²	100	n/a	50	6-8			X						
Alt et al., 2014 ¹³	21	n/a	20	6-9						X		=	
Donlan & Gourlay, 1999 ¹⁴	13	12	13	7-8						=		=	
Cowan et al., 2005 ¹⁵	57	55	55	7-9	X	X	X	X	X				
Nys et al., 2013 ¹⁶	n/a	n/a	28	7-14		X	X			X			
Donlan et al., 2007 ¹⁷	55	55	48	8		X	X						=
Alloway & Stein, 2014 ¹⁸	n/a	50	40	8-10			X						
Maniela-Arnold et al., 2011 ¹⁹	17	n/a	17	8-11			X						X
Fazio, 1999 ²⁰	11	11	10	9-11		X	X						
Koponen et al., 2006 ²¹	120	20	29	9-11			X			X			

Note: X indicates abilities significantly below same-age peers; = indicates abilities not significantly different from same-age peers

Conclusions

Key Findings

Deficits were consistently observed in children with DLD on tasks relying on verbal representation of number, including number transcoding, counting, arithmetic, and story problems.

- Performance on these tasks was associated with language comprehension, phonological awareness, and naming speed

Children with DLD performed more similarly to TD peers on tasks relying on non-verbal domains, including number line, magnitude comparison, and conceptual tasks.

- Performance on these tasks was associated with visuospatial working memory and nonverbal intelligence

Implications

Counting and arithmetic form the building blocks of later math learning.

- These skills rely on verbal representations
- This may place children with DLD at risk for poor long-term academic outcomes

Children with DLD may benefit from instruction that allows them compensate for verbal difficulties in math.

- Use multiple modalities
- Integrate manipulatives

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