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Understanding comorbidity between dyslexia and other developmental disorders

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Attention & motor skills in children at risk of dyslexia

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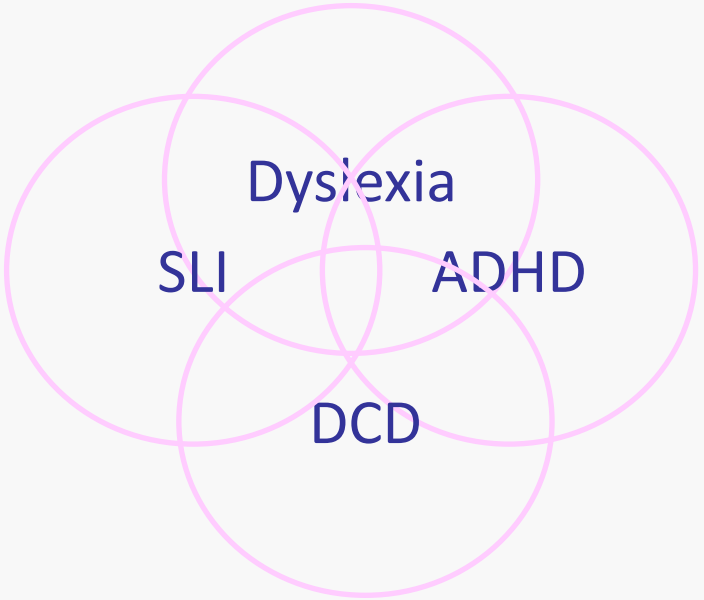
Dyslexia

- Reading and spelling deficit affecting 3-7% of school aged children
  - Core phonological deficit

- Co-occurring disorders:
  - SLI (McArthur et al., 2000)
    - Separable from dyslexia?
  - ADHD (Willcutt & Pennington, 2000)
  - DCD (Rochell & Talcott, 2006)



- Shared etiological risk factors?

- May affect the profile of difficulties in children with dyslexia and their response to intervention

Dyslexia & ADHD

- Symptoms of inattention, hyperactivity & impulsivity (DSM V; APA, 2010)
  - Core deficit in behavioural inhibition > executive functions (Barkley, 1997)
    - Sustained attention, Response variability, Working memory (visuo-spatial), Temporal processing (Castellanos & Tannock, 2002)
  - Prevalence rate 5-7% (Polanczyk, Silva de Lima, Horta, Biederman & Rohde, 2007)

- 15-35% with dyslexia also have ADHD (Shaywitz et al., 1992; Willcutt & Pennington, 2000)
  - Common causal mechanisms (Shared etiology)
    - Cognitive level (McGrath et al., 2010; Willcutt, Pennington, Olson, Chhabildas & Hulslander, 2005)
    - Biological level (Light, Pennington, Gilger, & DeFries, 1995; Stevenson et al., 2005)

Dyslexia & DCD

- Difficulties in motor performance that are unexpected given the child's age and opportunities for skill acquisition (DSM-V; APA 2010)
  - Prevalence rates vary widely (5-18%) (Geuze, Jongmans, Schoemaker & Smits-Englesman, 2001)

- Over 50% of children with dyslexia meet criteria for DCD (Kaplan et al., 1998) and DCD is frequently comorbid with other developmental disorders e.g. SLI and ADHD (Visser, 2003; Hill, 2001)
  - Common causal mechanism
    - Genetic (Regehr & Kaplan, 1988)
    - Neuropsychological e.g. Timing (Wolff et al., 1984; 1990)
  - Marker of atypical brain development (Kaplan et al., 1998)

Findings from at risk studies

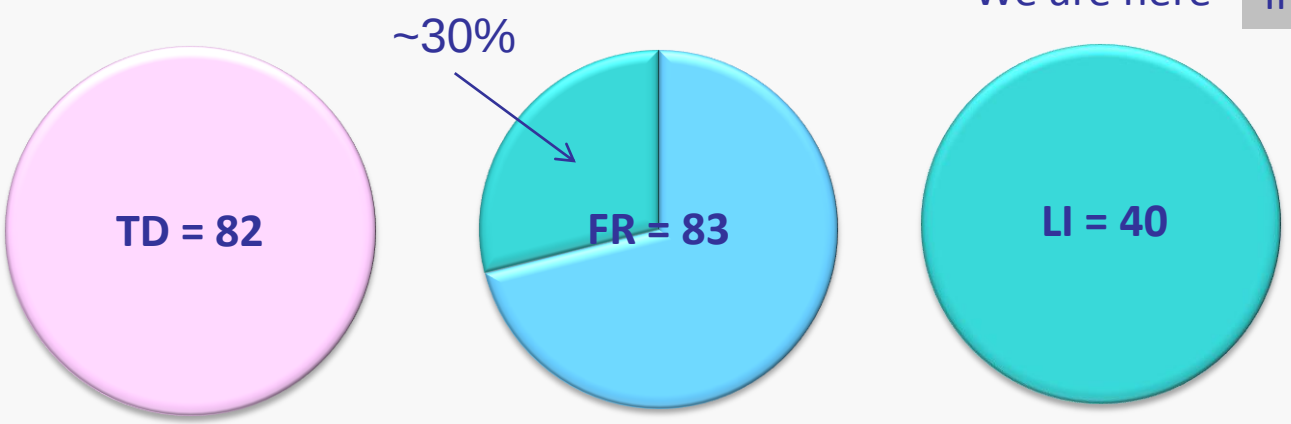
- Some at risk children are slower to reach early developmental motor milestones (Viholainen et al., 2006 - Jyvaskyla project)
  - 3 yrs - language difficulties (they had smaller vocabularies and poorer inflectional skills
  - 7 yrs - slower readers
- At risk children who received a diagnosis of dyslexia had more symptoms of inattention/hyperactivity than those who did not receive a diagnosis (Snowling, Carroll & Muter, 2007)
- Complex interplay between disorders
  - Multiple deficit models (e.g. Pennington, 2006) suggest that comorbidity between disorders is expected if they share risk factors

Research questions

- Do children at risk of dyslexia have weaknesses in their early attention/motor skills?
  - FR and LI compared to TD
- What are the relationships between children's attention/motor skills and their early language/literacy skills?
- Do children's attention/motor skills contribute to their literacy outcomes over and above known predictors of literacy?
  - Are children with additional comorbid difficulties most at risk?

The study

Oct 2007 Recruitment begins	March 2008 Phase 1 begins	Feb 2009 Phase 2 begins	Feb 2009 Phase 3 begins	Feb 2010 Phase 4 begins	Sept 2011 Phase 5 begins
	3;09	**4;08**		We are here	**7;00** Intervention



FR = 59 FRLI = 24

LI = below SS 85 or criterion on 2/4 language tests
(CELF BC, EV, SS + TEGI)

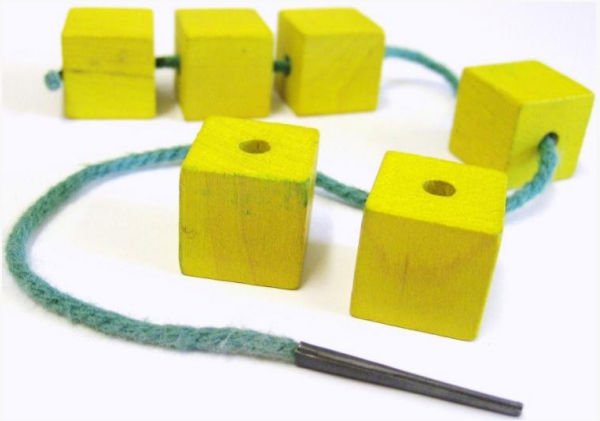
The groups

		TD (82)	FR (59)	LI (40)	FR+LI (24)	F	*p*	Post-hoc
3;09	**T1 Age (mths)**	45	46	44	45	2.40	ns	n/a
4;08	**T2 age (mths)**	56	57	55	57	1.49	ns	n/a
	NVIQ(ss)	114	109	98	100	13.63	sig	(TD=FR) > (FRLI=LI)
	SES Postcode rating (%)	68	65	55	51	3.44	.02	None
	% males	54	54	68	75	Chi Sq = 5.26, ns		

Motor tasks

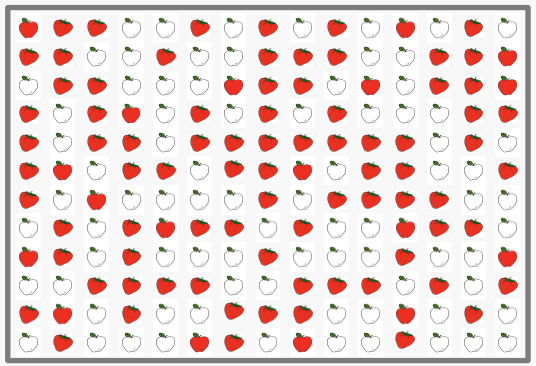
- Fine motor skills
  - Posting coins
  - Bead threading
  - Bike trail
- Balance

Movement ABC
(Henderson & Sugden, 1992)



Executive Function tasks

- Executive function
  - Complex inhibition/Behavioural regulation
    - Head Toes Knees and Shoulders task (Burrage et al., 2008)
  - Memory
    - Block recall (Pickering & Gathercole, 2001)
    - Word recall
  - Selective attention
    - Apples task (Breckenridge, 2010)
  - Sustained attention
    - Auditory Continuous Performance task

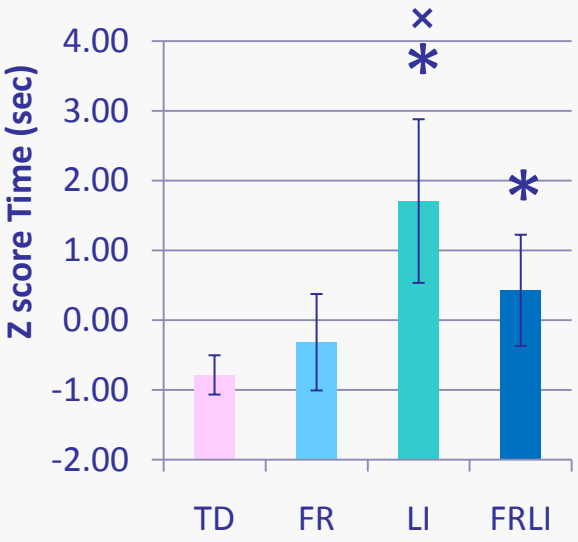


- Simple reaction time

T2 Motor skills

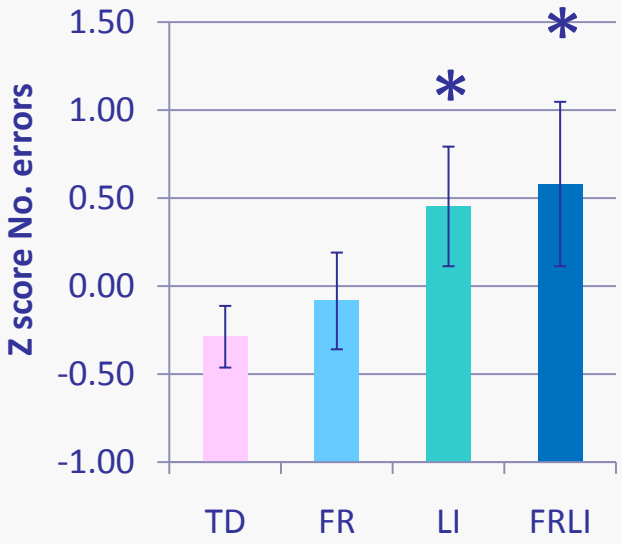
× = worse than FR
* = worse than TD

Fine Motor skills



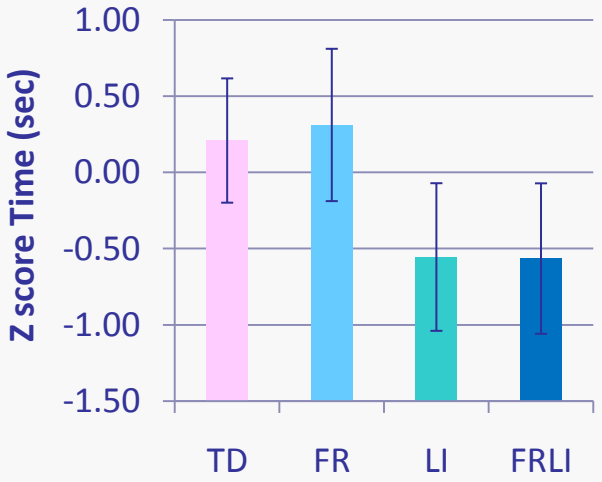
LI, FRLI > TD
LI > FR

Bike Trails



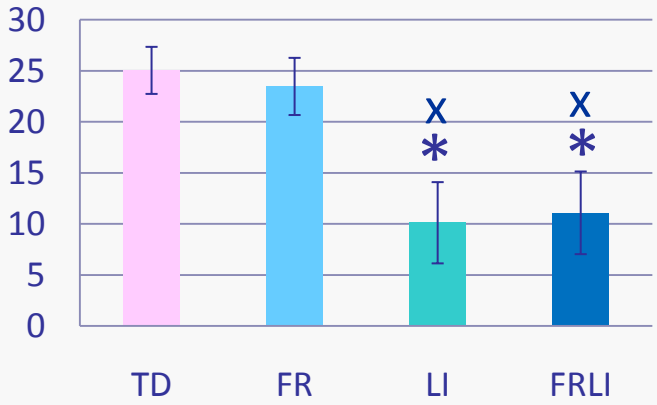
LI, FRLI > TD

Balance



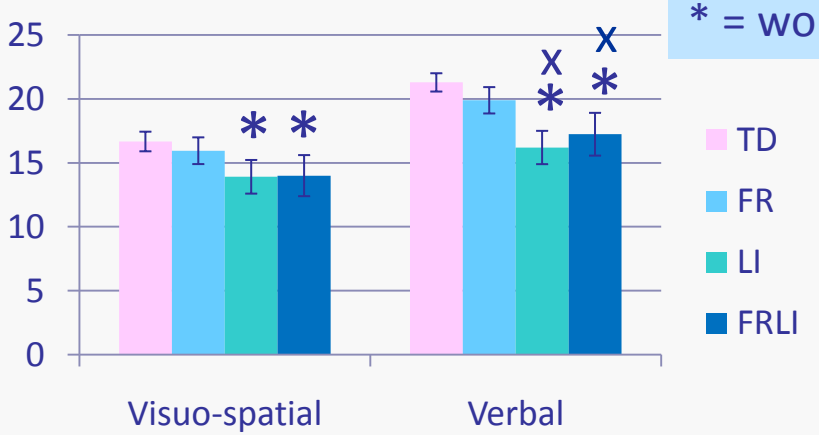
T2 Executive Function

HTKS - complex inhibition

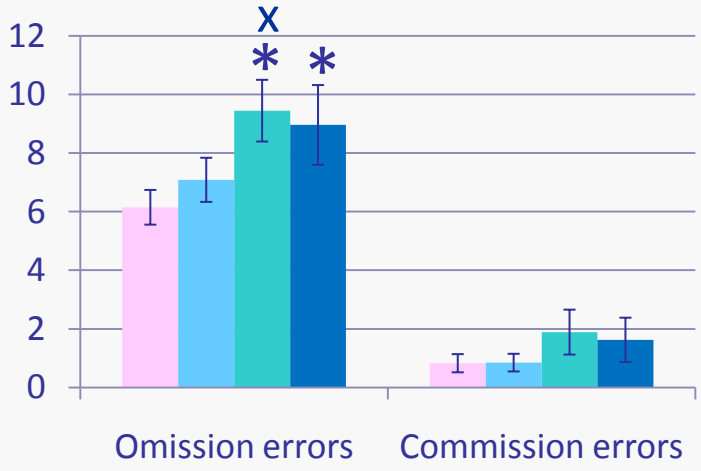


Memory

× = worse than FR
* = worse than TD



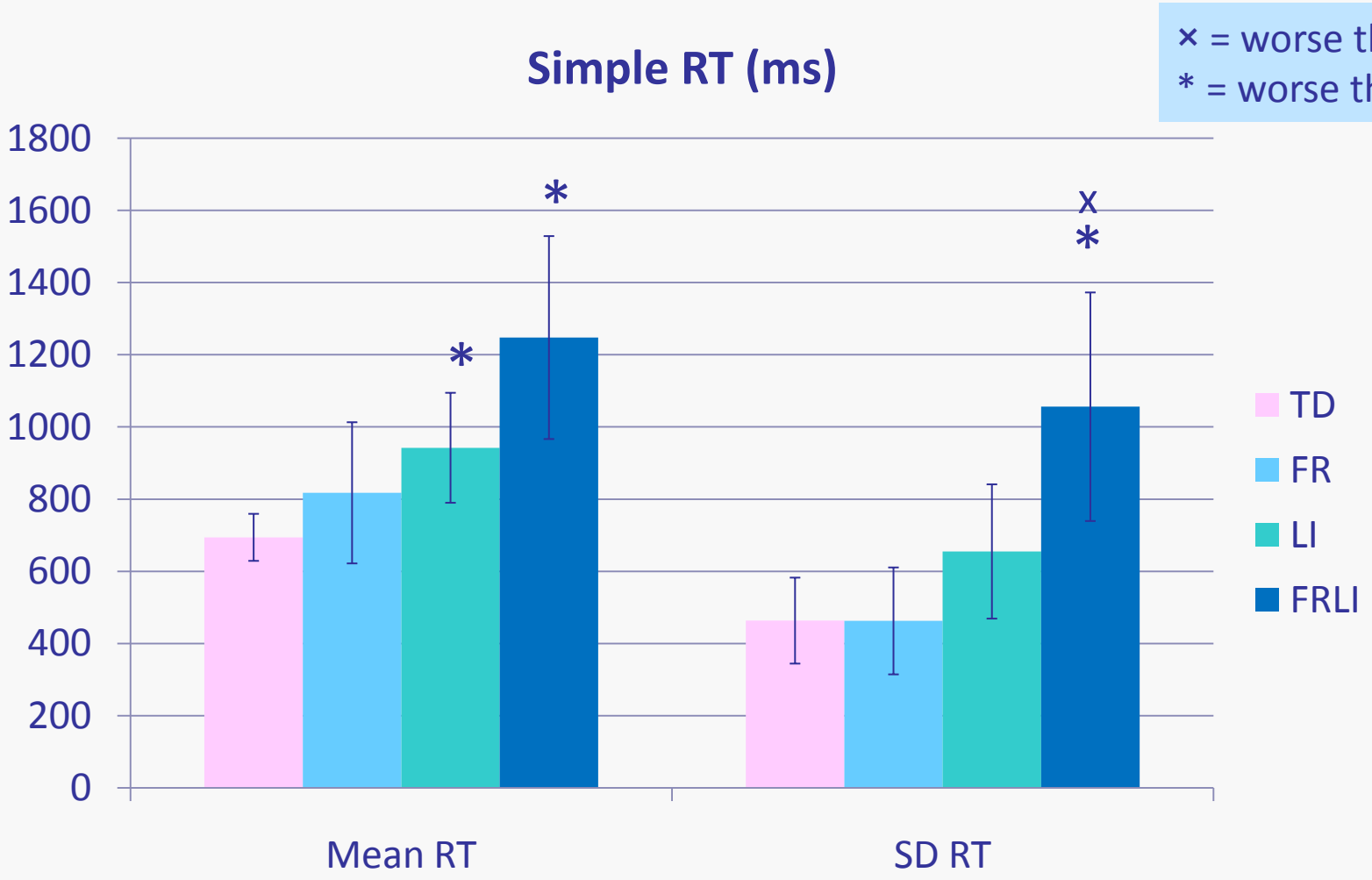
Visual search - selective attention



ACPT - sustained attention

T2 Reaction time

× = worse than FR
* = worse than TD



T2 Partial correlations (FR group)

	NVIQ	Language	LSK
Receptive Language	.31		
LSK	.37	.34	
Fine Motor	-.22	-.29	-.39
Balance	.14	.21	.21
Sustained attention	-.37	-.46	-.39
Selective attention	-.33	-.11	-.07
HTKS (Inhibition)	.42	.38	.39
Visual-Spatial Memory	.41	.38	.32
RTSD	-.24	-.23	-.36

Controlling for age; r > .24 sig at p<.05, N = 63

Who is most at risk in the FR group?

Step	Predictors of T2 LSK	Unique predictors	R^2
1	Age	*	
	T1 LSK	**	
	NVIQ	ns	
	T1 DEAP (Speech)	ns	.55
	T2 Non-Word Rep	ns	
	T2 Sentence structure	ns	
	T2 Alliteration Matching	**	
2	T2 HTKS (Behavioural inhibition)	ns	.55
2	T2 ACPT omissions (attention)	ns	.57
2	T2 RT variability (attention)	* (3%)	.58
2	T2 Fine Motor	* (3%)	.58

T2 Summary & conclusions

- Children with LI continue to show weaknesses in motor skills and executive functions when they are 4 yrs
  - Specific or non-specific difficulties?
  - Children with FRLI have weaknesses in attention compared to TD controls (ACPT and RT variability)
    - Evidence of multiple risk factors?
- RT variability (key endophenotype of ADHD) and fine motor skills predict LSK over and above language skills

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Thank you for listening

Thank you to
the families

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