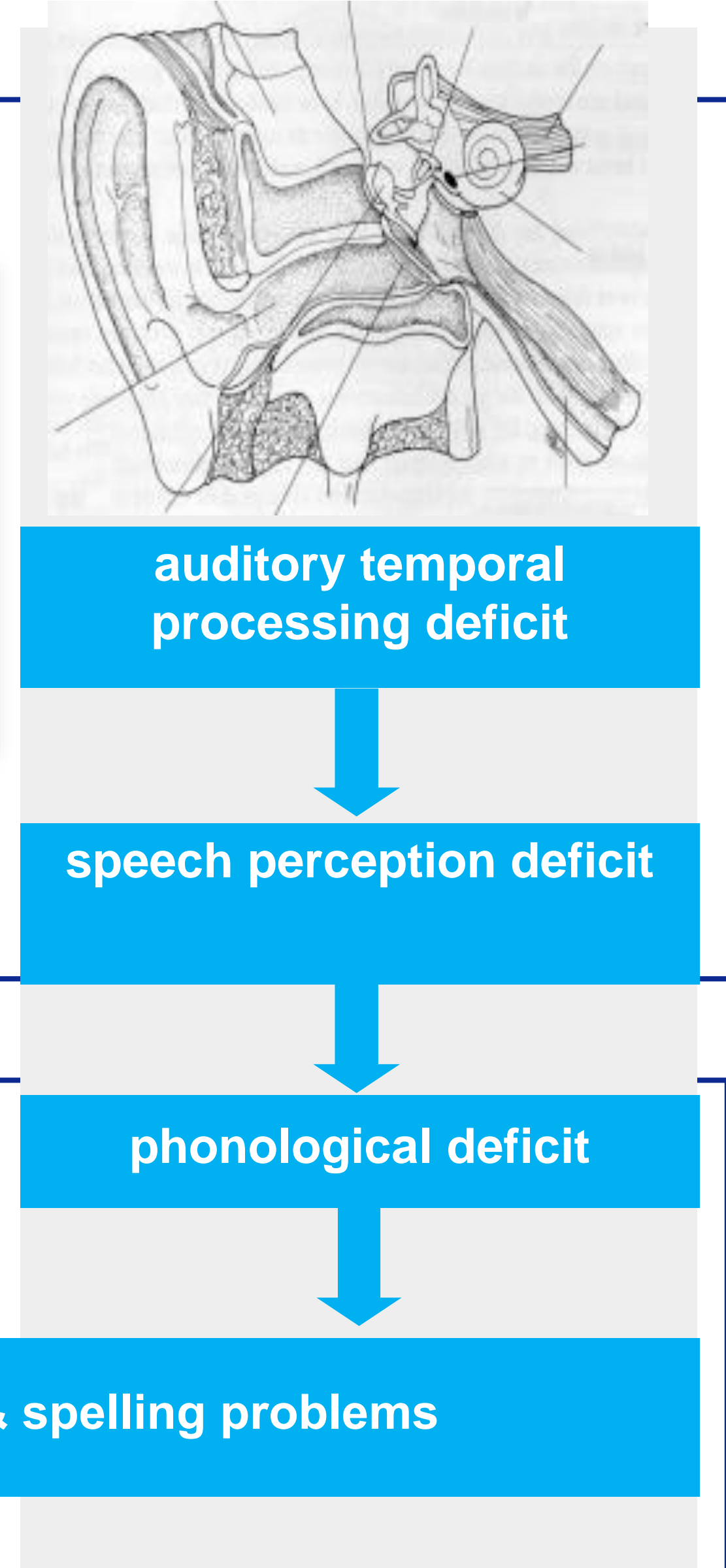


1. BACKGROUND

- Developmental dyslexia is characterized by persistent reading and spelling difficulties.
- It has been well established that one of the major causes of these literacy problems lays in a deficit involving the quality and accuracy of phonological representations.
- Frequently these phonological problems have been linked to more basic perceptual impairments, specifically deficits in auditory temporal processing and speech perception.
- It is thought that during the pre-literate phase of development, a deficit in the perception and processing of speech-specific acoustic cues could limit a person's ability to isolate and reflect upon basal phonological information, resulting in inaccurate phonological representations (Boets et al. 2007; Nittrouer, 2006).
- Studies have suggested the existence of an underlying deficit in low-level auditory temporal processing in the dyslexic population (Goswami et al., 2002, Farmer & Klein, 1995; Habib, 2000; Boets et al., 2006).
- Auditory cues specific to the speech envelope (RT discrimination) have been shown to be sensitive measures in discriminating between dyslexics and controls (see Hämäläinen, Salminen, & Leppänen 2013).

The auditory temporal processing deficit theory of dyslexia:

- This theory postulates that the primary deficit of dyslexia lays within poor auditory processing of speech specific auditory cues which cascades through speech perception disrupting the formation of quality phonological representations and ultimately impacting literacy achievement.



4. OBJECTIVES / FINDINGS

Objective 1. Do kindergarten measures of auditory processing and speech perception relate to cognitive and literacy outcomes in first and second grades.

- Significant relations between auditory processing and speech perception were not observed at any time point. Therefore, this study could not support the theorized directional pathway from auditory processing through speech perception to phonological skills.
- Yet, partial cross-lagged correlations, controlling for autoregressive effects, confirmed the directionality between measures of RT discrimination and PA. Where performance on RT tasks was found to have a larger impact on future PA development than PA's influence on auditory processing development. Thus supporting the bottom-up model proposed by Tallal (1980).

Objective 2. Does pre-reading RT discrimination, FM sensitivity and PA predict later literacy achievement.

- Regression analysis demonstrated that RT, FM and PA uniquely contributed to reading at both first and second grade. Yet PA's influence did not extend past the onset of formal reading instruction.
- These results were contrary to Boets et al. (2011), suggesting that basic auditory processing skill's impact on reading development may not be limited to the time point prior to reading instruction

Objective 3. Are pre and post reading deficits in auditory processing and speech perception present in children later found to be dyslexic?

- Group analyses demonstrated significant poorer performance of children later diagnosed with dyslexia on the measure of RT discrimination at the pre-reading phase indicating these problems are not consequential of the expressed literacy problems characteristic of dyslexia.
- The lack of group differences of FM task, may imply the existence of a specific deficit in the perception of dynamic auditory cues related to the speech envelope (as measured by the RT task).

2. PARTICIPANTS

- 44 English speaking children, recruited at ages 4-5 years old in Ontario, Canada.
- Testing occurred at 3 time points: kindergarten, first grade & second grade.
- Retrospective analyse allowed for the creation of a dyslexic group consisting of 17 high-risk children and 4 low-risk children; in addition to a literacy unimpaired (control) sample of 19
- Groups were matched by age, IQ, SES, and parental education level.

Table 1 Participant characteristics

	NR (n=23)	DYS (n=21)	p-value
Gender (F/M)	10/13	10/11	.783 ^a
Age in months (mean ± SD)	64.0 ± 4.2	62.1 ± 2.8	.078 ^c
Non-Verbal IQ ^a (mean ± SD)	109 ± 6.7	107 ± 6.3	.212 ^c
Hyperactivity (mean ± SD)	2.7 ± 1.7	3.2 ± 2.3	.461 ^c
SES (ISCED) (low/middle/high)	1/13/9	2/12/7	.900 ^d
Mother's education (SE/PSE/GS)	3/15/5	4/14/3	.823 ^d
Father's education (SE/PSE/GS)	5/13/5	5/13/3	.839 ^d

Notes: ^a Scores are standardized (M = 100, SD = 15). ^b Pearson Chi-Square. ^c Independent t-Test ^d Fisher's Exact Test. SE = secondary school education, PSE = post-secondary education, GS = graduate studies

3. MEASURES

Literacy:

- Letter knowledge (WRAT-III)
- Reading & Word attack (WJ-III)
- Spelling (WJ-III)

Phonological awareness:

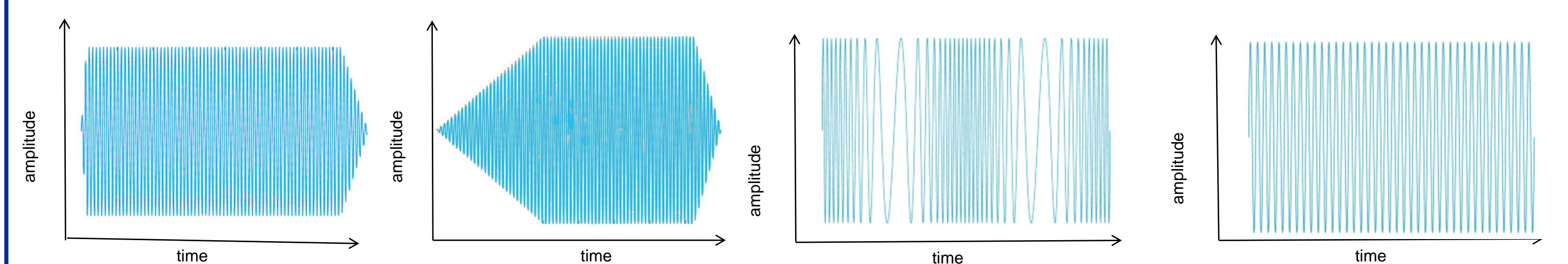
- Measures at 3 grain sizes
- Syllable awareness
- Rime awareness
- Phoneme awareness

Speech-in-noise:

- CASPA (word in noise)

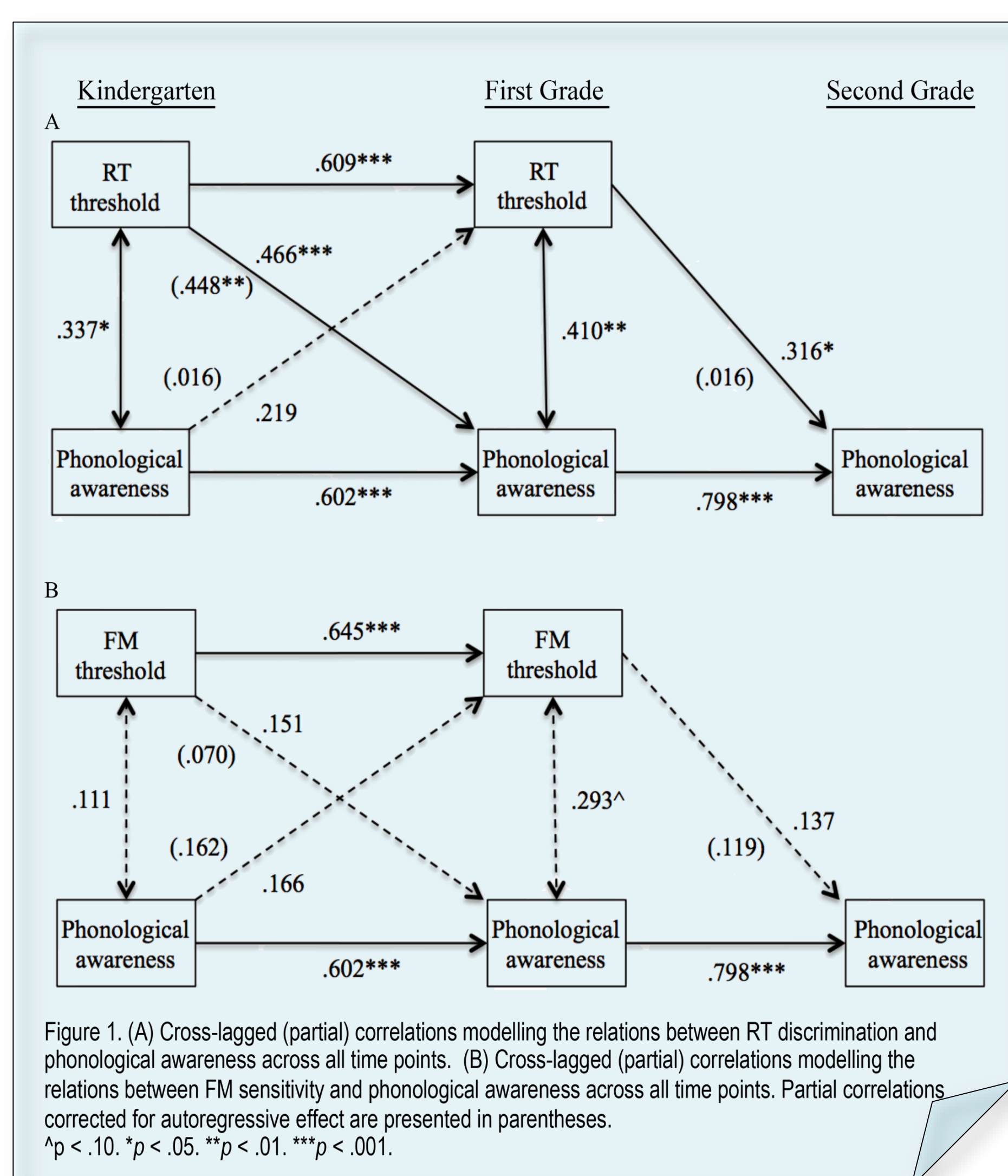
Auditory processing

- Rise time discrimination (RT)
- Frequency modulation (FM)



- Intensity discrimination (ID): control variable

5. RESULTS



Correlations

- Of the auditory processing measures only **RT correlated significantly with PA and the reading at all grade levels.**
- **RT in first grade significantly correlated with PA**, while it was found to be approaching significance with reading in first and second grades.
- **RT & FM were found to be significantly correlated** within and between each grade level.
- Speech-in-noise was not found to relate to any of the target measures across all time-points.
- **All significant correlations were maintained when controlling for group**, with the exception of the relationship of kindergarten and grade one RT with first grade PA.

Predicting later literacy achievement

Table 3 Unique variance in first and second grade reading, and spelling accounted for by Letter knowledge (LK), Phonological awareness (PA), Rise time (RT) and Frequency (FM) (R² change and standardized Beta)

	First Grade		Second Grade	
	Reading	Spelling	Reading	Spelling
	R ² change	β	R ² change	β
PA	.121	.439**	.170	.521**
LK	.009	.118	.015	.152
RT	.133	.439**	.029	.206
FM	.060	.287*	.022	.173
Total				
R ²	.529		.479	
			.549	
				.527

Note: *p < .05. **p < .01. ***p < .001.

Children with dyslexia vs. control group

- Groups were found to be **significantly different on all literacy, and PA measures** at each of the three grade levels with the dyslexic group performing poorer across all tasks compared to controls.
- Of the auditory and speech measures, **significant group differences were only found for RT** when standard alpha of 0.05 was applied. Only kindergarten RT remained significant after applying adjusted alphas to correct for multiple testing.

FOR MORE INFORMATION

Contact:

Jeremy M. Law
Faculty of Psychology and Educational Sciences
Parenting and Special Education
The University of Leuven (KU Leuven)
Leopold Vanderkelenstraat 32, bus 3765/ 3000 Leuven
Belgium: +32 (0) 477033818
E-mail: jeremy.law@ppw.kuleuven.be