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How oral language skills contribute to spelling development in children with and without reading difficulties?

Apostolos Kargiotidis, Ioannis Grigorakis, Angeliki Mouzaki, & George Manolitsis

University of Crete

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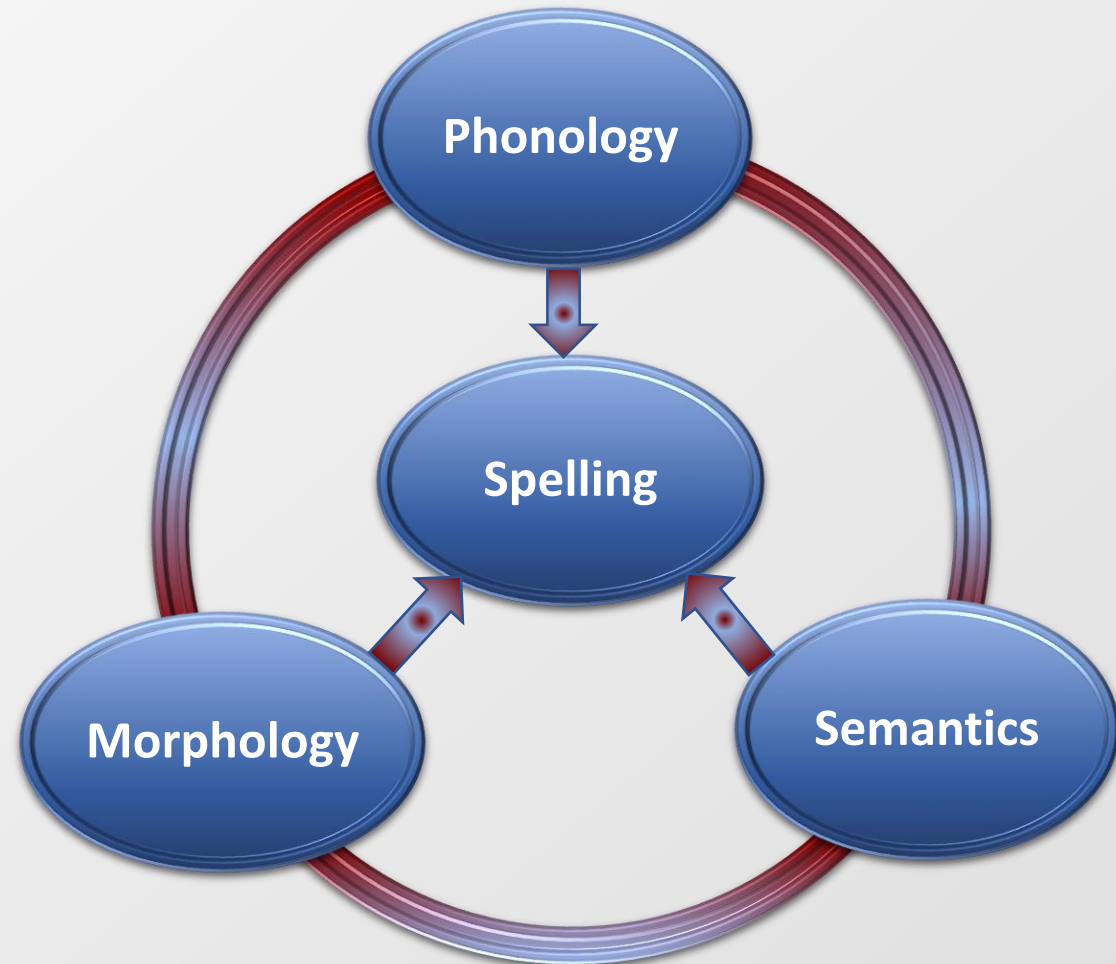
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“Spelling: A linguistically-based literacy skill”

- Spelling development depends on various oral language (OL) skills.

(Apel, Masterson, & Hart, 2004; Treiman & Kessler, 2014)



- Phonological awareness (PA) and RAN uniquely predict children’s spelling from early on (e.g., Chen et al., 2021; Lervåg & Hulme, 2010).
- Morphological awareness (MA) uniquely contributes to spelling (Deacon et al., 2009), especially in the morphologically rich Greek orthography (e.g., Desrochers et al., 2018; Grigorakis & Manolitsis, 2021).
- Semantics promote spelling by facilitating the formation of stable connections between the phonological and orthographic properties of words (e.g., Hilte & Reitsma, 2011; Ouellette, 2010).

Reading difficulties and oral language skills

- Reading difficulties (RD) are assumed as outcomes of earlier deficits in OL skills.
(e.g., Landi & Ryherd, 2017; Snowling et al., 2020; Velutino et al., 2004)
- Less is known about the developmental changes of children with RD across different domains of OL skills and how these might be related to spelling development.
(e.g., Caravolas et al., 2012; Lervåg et al., 2018; Manolitsis et al., 2019)

Developmental lag model

- Literacy-related cognitive skills present a slower growth rate for children with RD.
- Differences between children with RD and typically developing (TD) children reduce or even disappear across time.

(e.g., Stanovich et al., 1988)

Developmental deficit model

- Children with RD are characterized by underdeveloped literacy-related cognitive skills.
- The gap between them and TD children remains constant or even increases.

(e.g., Francis et al., 1996)

Importance of the study

Children rely on a variety of OL skills for spelling with a developmental shift from phonological to morphological strategies (Apel et al., 2004; Treiman, 2017).

Children with RD lag behind TD children in OL skills (e.g., Dandache et al., 2014; Law & Ghesquière, 2017), and may differ in the developmental patterns of phonological and morphological processing skills (Law & Ghesquière, 2017; Schmidt et al., 2020).

It is important to know whether the development of OL skills of children with RD contribute to their spelling development in the same way as for TD children or not.

Provide useful insights about the interplay between RD, OL skills, and spelling.

Guide intervention policy to promote spelling development for children with RD.

Study aims

- A) Whether the growth pattern of OL skills (PA, MA, Vocabulary, and RAN) from Grade 1 to Grade 2 differs between children with RD and TD children.

- B) Whether the early OL skills in Grades 1 & 2 and their growth rate across these two first grades predict differently the spelling skills of children with RD and TD children at the beginning of Grade 3.

Method



Participants (N = 125; 53 females)



- Letters of information to parents of first-grade children.



- Classroom teachers nominated those children who:
- were most likely to develop RD in the future
- were Greek native speakers
- no history of intellectual, neurodevelopmental, or sensory disorder.



- For each nominated child, we randomly selected from the same class at least one more of the same gender with written parental consent.



- From the initial sample of 167 children, 3 children were excluded, because of non-verbal IQ < 70, based on DSM-V (APA, 2013), and 39 children because they did not meet the classification criteria neither for the RD nor for the TD group.



Measuring Instruments

Grades 1 & 2

Non-verbal IQ (Raven's Colored) – only at Grade 1

Oral language skills

- 1) Phonological Awareness (Word & Pseudoword Elision, Blending, see Manolitsis et al., 2019; Manolitsis & Georgiou, 2015)
- 2) Morphological Awareness (Word Analogy, Manipulation of Derived Word Forms, Compound Word Production, see Manolitsis et al., 2017)
- 3) Rapid Automatized Naming (Digits, see Landerl et al., 2019)
- 4) Vocabulary (WISC-V^{GR}, see Stogiannidou et al., 2017)

Reading tasks

- 1) Word & Pseudoword Decoding (DADA test; Padeliadu et al., 2019)
- 2) Text-Reading Fluency (DADA test; Padeliadu et al., 2019)
- 3) Reading comprehension (see Porpodas, 2008 for Grade 1; Tafa, 1995 for Grade 2)

Grade 3

Spelling Dictation Test (Mouzaki et al., 2010)

- Children had to write 60 words which were presented inside a sentence.

Classification of children in RD and TD group

RD
Group
N = 64

Performance on **AT LEAST ONE** standardized reading test (word decoding, pseudoword decoding, text fluency, and reading comprehension) \leq the 16th percentile in **BOTH** Grade 1 and Grade 2.

TD
Group
N = 61

Performance on **ALL** standardized reading tests \geq the 25th percentile in Grade 2.

Statistical Analyses

Composite percentage scores for MA and PA in G1 and G2 by averaging the percentage correct scores of the respective component tasks

Difference scores of OL skills by subtracting the G1 from the G2 score

Repeated measures ANOVAs

Dependent variables
OL skills

Within-subjects factor
Grade (G1 vs G2)

Between-subjects factor
Literacy group (RD vs TD)

Correlation analyses for RD &TD group

- 1) OL skills G1 scores
- 2) OL skills G2 scores
- 3) OL skills difference scores
- 4) G3 spelling scores

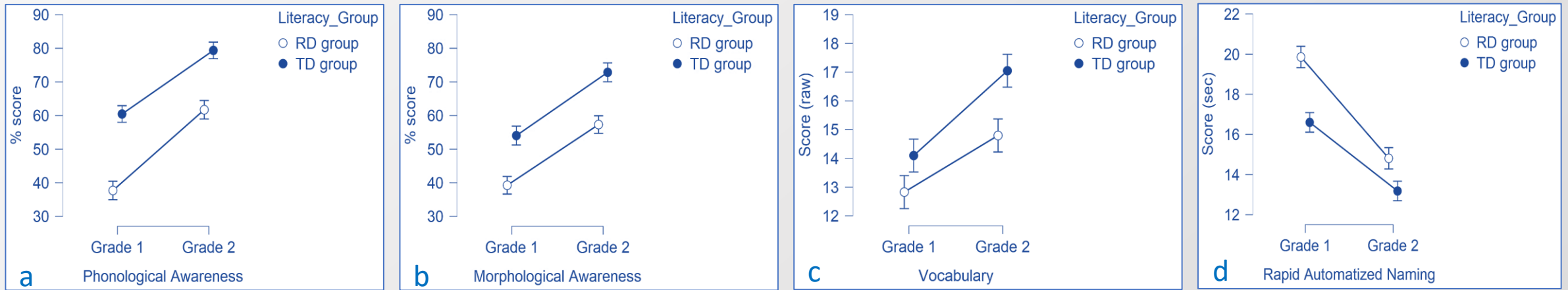
Moderated Regression Analyses

Dependent Variable
G3 Spelling

Predictors
1) OL skills G1 scores
2) OL skills G2 scores
3) OL skills difference scores

Moderator variable
Literacy group (RD vs TD)

Fig 1. Means and confidence intervals (95%) of scores on phonological awareness (a), morphological awareness (b), vocabulary (c), and RAN (d) in the first two grades between the RD and the TD group.



Main effects of Grade

$$F_{PA}(1,123) = 268.18, p < .001, \eta^2_{\rho} = .69$$

$$F_{MA}(1,123) = 185.26, p < .001, \eta^2_{\rho} = .60$$

$$F_{VOC}(1,123) = 73.63, p < .001, \eta^2_{\rho} = .37$$

$$F_{RAN}(1,123) = 273.72, p < .001, \eta^2_{\rho} = .69$$

Main effects of Literacy group

$$F_{PA}(1,123) = 44.61, p < .001, \eta^2_{\rho} = .27$$

$$F_{MA}(1,123) = 25.76, p < .001, \eta^2_{\rho} = .17$$

$$F_{VOC}(1,123) = 10.28, p < .01, \eta^2_{\rho} = .08$$

$$F_{RAN}(1,123) = 24.35, p < .001, \eta^2_{\rho} = .17$$

Significant Interaction effects of Grade x Literacy group

$$F_{RAN}(1,123) = 10.13, p < .01, \eta^2_{\rho} = .08$$

- Both children with RD and TD children performed better in all OL skills in G2.
- Children with RD lagged behind TD children in all OL skills in both grades.
- Only the growth pattern of RAN from G1 to G2 differed significantly between children with RD and TD children.

Table 1. Correlations between OL skills scores **in Grade 1** and spelling scores in Grade 3 for the RD & the TD group.

	PA	MA	Vocab	RAN	G3 Spell
TD		.66**	.11	-.40**	.52**
	.25		.34**	-.21	.48**
	.24	.42**		.12	-.002
	-.28*	-.08	-.08		-.21
RD	.44**	.17	.13	-.26*	

Note. Vocab = Vocabulary; Spell = Spelling. * $p < .05$, ** $p < .01$.

Table 2. Correlations between OL skills scores **in Grade 2** and spelling scores in Grade 3 for the RD & the TD group.

	PA	MA	Vocab	RAN	G3 Spell
PA		.58**	.27*	-.24	.50**
MA	.51**		.41*	-.02	.57**
Vocab	.31*	.55**		.17	.37**
RAN	-.46**	-.13	-.23		-.03
G3 Spell	.45**	.33**	.31*	-.42**	

Note. Vocab = Vocabulary; Spell = Spelling. * $p < .05$, ** $p < .01$.

Table 3. Correlations between OL skills **difference scores** and spelling scores in Grade 3 for the RD & the TD group.

	PA	MA	Vocab	RAN	G3 Spell
TD		.23	-.19	-.14	-.34**
	-.07		-.15	.03	.01
	.09	-.004		.18	.42**
	.11	-.11	-.05		.22
RD	.004	.18	.23	-.02	

Note. Vocab = Vocabulary; Spell = Spelling. ** $p < .01$.

- For TD children, G3 spelling was **positively** correlated with **PA and MA in both grades and with Vocabulary in G2**. In addition, it was **positively** correlated with **Vocabulary difference score and negatively with PA difference score**.
- For children with RD, G3 spelling was **positively** correlated with **PA and negatively with RAN in both grades**. Also, it was **positively** correlated with **MA and Vocabulary in G2**.

Tables 4-7. Moderated regression analyses results with G3 spelling as the dependent variable, **G1 OL skills** as predictors, and literacy group as the moderator.

Variables	β	SE	t
PA	.12**	.04	2.81
Literacy Group (LG)	2.34	2.64	.88
PA x LG	.06	.05	1.19
R ²	.49		

Note. ** $p < .01$.

Variables	β	SE	t
MA	.05	.05	1.00
Literacy Group (LG)	1.42	2.85	.50
MA x LG	.12*	.06	2.06
RD x MA	.05	.05	1.00
TD x MA	.17***	.03	5.00
R ²	.44		
R ² change	.02		

Note. * $p < .05$; *** $p < .001$.

Variables	β	SE	t
RAN	-.28	.19	-1.47
Literacy Group (LG)	12.06*	5.97	2.02
RAN x LG	-.26	.33	-.78
R ²	.35		

Note. * $p < .05$.

Variables	β	SE	t
Voc	.16	.23	.69
Literacy Group (LG)	10.80*	5.38	2.01
Voc x LG	-.16	.38	-.42
R ²	.32		

Note. * $p < .05$.

- In Grade 1, **Morphological Awareness** predicted G3 spelling for TD children, but not for children with RD.
- In Grade 1, **Phonological Awareness, Rapid Naming and Vocabulary** predicted G3 spelling equally among the two groups of children.

Tables 8-11. Moderated regression analyses results with G3 spelling as the dependent variable, **G2 OL skills** as predictors, and literacy group as the moderator.

Variables	β	SE	t
PA	.12**	.04	2.83
Literacy Group (LG)	-4.80	4.76	- 1.01
PA x LG	.14*	.06	2.24
RD x PA	.12**	.04	2.83
TD x PA	.26***	.05	5.43
R ²	.48		
R ² change	.02		

Note. * $p < .05$; ** $p < .01$; *** $p < .001$.

Variables	β	SE	t
MA	.09*	.04	2.11
Literacy Group (LG)	-3.29	3.88	-.85
MA x LG	.14*	.06	2.48
RD x MA	.09*	.04	2.11
TD x MA	.24***	.04	6.36
R ²	.50		
R ² change	.03		

Note. * $p < .05$; *** $p < .001$.

Variables	β	SE	t
RAN	-.69*	.29	-2.35
Literacy Group (LG)	-.16	6.89	-.02
RAN x LG	.59	.49	1.19
R ²	.35		

Note. * $p < .05$.

Variables	β	SE	t
Voc	.36	.20	1.83
Literacy Group (LG)	-.41	4.93	-.08
Voc x LG	.49	.30	1.63
R ²	.40		

- In Grade 2, **Phonological Awareness** and **Morphological Awareness** predicted G3 spelling skills for **both children with RD and TD children**.
- However, **the interaction in both cases was due to the larger effect for TD children**.

Tables 12-15. Moderated regression analyses results with G3 spelling as the dependent variable, **OL skills difference scores** as predictors, and literacy group as the moderator.

Variables	β	SE	t
PA	.001	.05	.03
Literacy Group (LG)	12.52***	1.99	6.29
PA x LG	-.20*	.08	-2.58
RD x PA	.001	.05	.03
TD x PA	-.20*	.06	-3.38
R ²	.37		
R ² change	.03		

Note. * $p < .05$; *** $p < .001$.

Variables	β	SE	t
RAN	-.03	.27	-.12
Literacy Group (LG)	11.07***	2.06	5.37
RAN x LG	.67	.41	1.65
R ²	.34		

Note. *** $p < .001$.

Variables	β	SE	t
MA	.05	.06	.97
Literacy Group (LG)	9.56***	1.84	5.20
MA x LG	-.05	.08	-.61
R ²	.32		

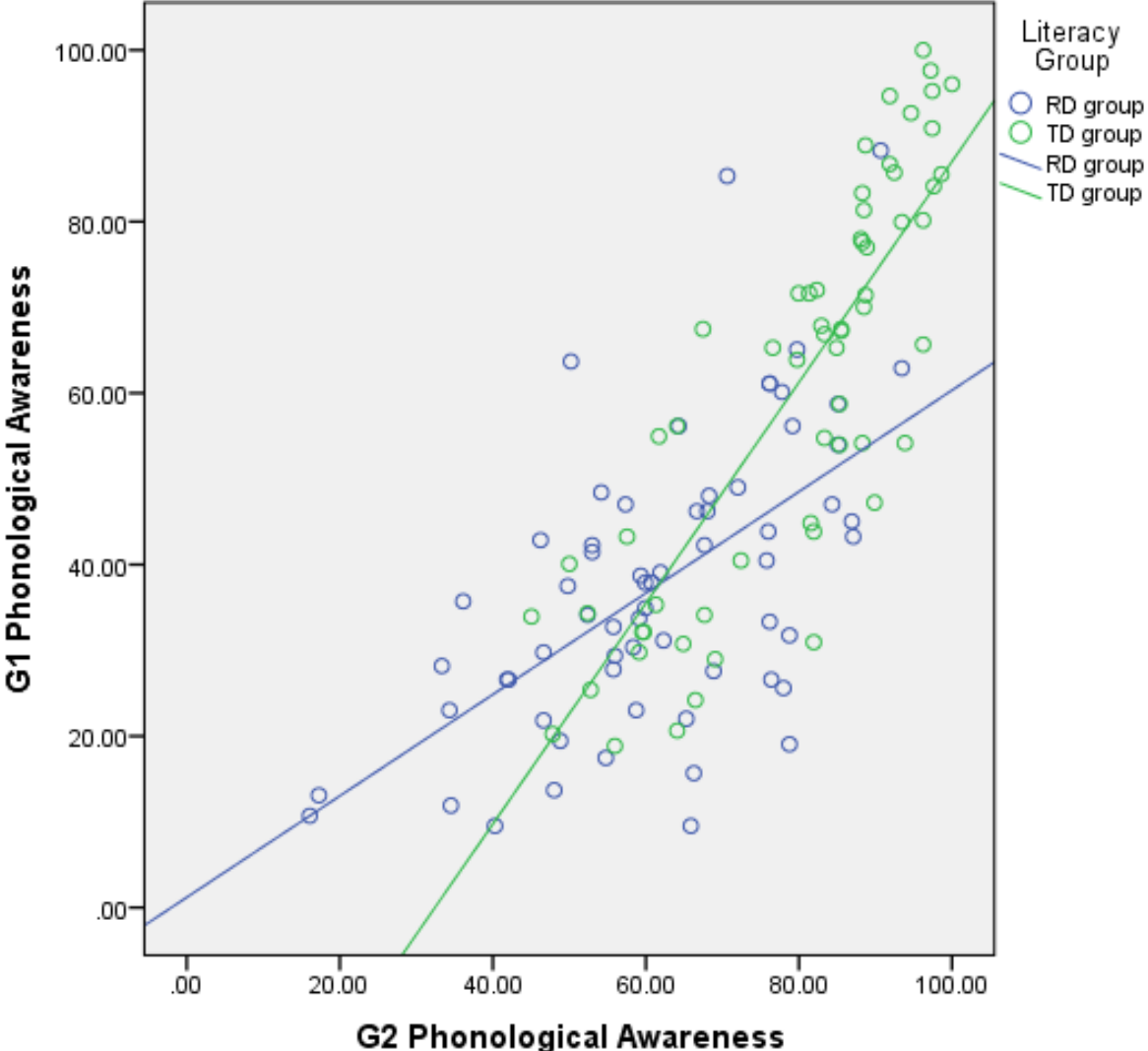
Note. *** $p < .001$.

Variables	β	SE	t
Voc	.32	.23	1.35
Literacy Group (LG)	6.20***	1.38	4.49
Voc x LG	.75*	.34	2.21
RD x Voc	.32	.23	1.35
TD x Voc	1.07***	.25	4.32
R ²	.41		
R ² change	.02		

Note. * $p < .05$; *** $p < .001$.

- The growth rate of **Phonological Awareness** and **Vocabulary** from G1 to G2 predicted TD children's G3 spelling skills **but not** those of children with RD.

Fig 2. Comparison of PA scores of TD children and children with RD in G1 and G2.



- The slower growth rate in PA for TD children who showed better spelling scores in G3 was due to the fact that these children had very high scores on PA already from G1.

Conclusions

Children with RD lagged behind TD children in all OL skills during G1 and G2 (see also, Dandache et al., 2014; Law & Ghesquière, 2017).

Children with RD seem to over-rely on phonological strategies in G1 for spelling, whereas TD children employ both phonological and morphological strategies.

In G2, morphological strategies for spelling seem to become apparent for children with RD and vocabulary emerges as a significant associate for spelling for both groups.

The growth rate of PA and vocabulary predicted G3 spelling of TD children but not of children with RD.

- Both groups of children seem to have the potential to use multiple linguistic strategies for spelling, **BUT** TD children seem to rely on a wider repertoire of linguistic strategies earlier on literacy development.
- The significant contribution of PA and Vocabulary growth rate on TD children's later spelling might provide support to the Lexical Quality Hypothesis (Perfetti, 1997).

Educational implications

- MA instruction, as early as in G1, is necessary for children with RD in order to promote their spelling development.
- Semantics, although neglected, so far, in the research area of spelling development, seem to be a promising contributory factor which needs to be reinforced through targeted interventions for children with RD.

Limitations

- Findings should be interpreted in the context of the diagnostic criteria and measures used in the present study for the classification of children in the RD and the TD group.

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