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Early oral language skills precursors of different types of literacy difficulties in a consistent orthography

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Theoretical background

Phonological Processing Skills

- Deficits in **Phonological Awareness (PA)** and **Rapid Naming (RAN)** have been repeatedly associated with reading and/or spelling difficulties.
(e.g., Moll & Landerl, 2009; Papadopoulos et al., 2020)
- However, the role of PA on the emergence of reading difficulties seems to be time limited in consistent orthographies (e.g., Furnes & Samuelsson, 2010; Papadopoulos et al., 2009).

Morphological Awareness

- Research evidence highlights the important role of **Morphological Awareness (MA)** on the manifestation of difficulties in *word reading*, *reading comprehension* and/or in *spelling*.
(e.g., Casalis et al., 2004; Diamanti et al., 2014; Rothou & Padeliadu, 2019; Tong et al., 2011)

Vocabulary

- Limited **vocabulary** knowledge has been found to predict difficulties in reading comprehension (e.g., Catts et al., 2016; Nation et al., 2010; Spencer et al., 2019).
- Weak vocabulary knowledge by itself does not suffice to account for reading comprehension difficulties (Spencer, Wagner, & Petscher, 2019).

Literacy Difficulties (LD)

Literacy Difficulties

- Literacy Difficulties (LD) are considered quite heterogeneous, as children might experience difficulties either in **both reading and spelling (RSD)** or **difficulties only in reading (RD)** or **spelling (SD)** (Moll et al., 2020; Torppa et al., 2017; Wimmer & Mayringer, 2002).
- Different types of LD involve differences in oral language (OL) skills.

RSD

- OL skills profile in children with RSD is better explained by the double-deficit hypothesis (Wolf & Bowers, 1999), as they manifest **low achievement in both RAN and PA** (Moll et al., 2020; Torppa et al., 2017; Papadopoulos et al., 2020).

RD

- Phonological problems of children with RD are mainly associated with **deficits in RAN** (Moll et al., 2020; Torppa et al., 2017; Wimmer & Mayringer, 2002) and **less to deficits in PA** (Manolitsis & Georgiou, 2015; Papadopoulos et al., 2020).

SD

- Children with SD present mainly **deficits in PA** (Moll et al., 2020; Torppa et al., 2017; Wimmer & Mayringer, 2002), although in Greek-speaking children with SD the deficits seem to concern mostly orthographic processing skills (Manolitsis & Georgiou, 2015; Papadopoulos et al., 2020).

Importance of the study

The multidimensionality of OL skills indicates the need to evaluate more than the phonological deficits of children with LD (Mouzaki et al., 2020).

The role of PA in predicting RD seems to be time restricted in consistent orthographies (Furnes et al., 2019; Papadopoulos et al., 2009).

Very few studies examining MA and vocabulary in children with different types of LD.

In this context, it is important to broaden our knowledge regarding the prediction of different types of LD by OL skills.


Understand the language underpinnings of LD in reading and/or spelling.

Guide effectively early identification and individualized interventions for different types of LD.

Aim of the Study

The **aim** of this study was to longitudinally examine:

(a) Whether early OL skills (PA, MA, RAN, and Vocabulary) assessed in Grades 1 & 2 would predict children's LD at the beginning of Grade 3.



(b) Whether OL skills in Grades 1 & 2 would predict the specific type of children's LD (mixed reading & spelling difficulties - RSD, reading difficulties - RD, or spelling difficulties - SD) in Grade 3.

Method



Participants (N = 159; 68 females)



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



- Classroom teachers nominated those children who:
 - were most likely to develop LD 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, in accordance to DSM-V guidelines for LD classification (APA, 2013), and 5 children because they did not meet the classification criteria neither for the LD nor for the TD group.



Measures

Grade 1

Non-verbal IQ (Raven's CPM; Sideridis et al., 2015)

Grades 1 & 2

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)

Grades 2 & 3

Literacy tasks - standardized

- 1) Word & Pseudoword Decoding (DADA test; Padeliadu et al., 2019)
- 2) Text-Reading Fluency (DADA test; Padeliadu et al., 2019)
- 3) Reading comprehension (Tafa, 1995)
- 4) Spelling Dictation Test (Mouzaki et al., 2010)

Classification of children in LD and Typically Developing (TD) group

LD group

(N = 88; 42 females)

Performed in **BOTH** G2 and G3 < 25th %ile

- on AT LEAST ONE literacy test

TD group

(N = 71; 26 females)

Performed in G3 ≥ 25th %ile

- on at least 3 (out of 5) literacy tests

Classification of children in LD subgroups

RSD group

(N = 46; 23 females)

Performed in **BOTH** G2 & G3 < 25th %ile

- on AT LEAST ONE literacy test.

RD group

(N = 21; 6 females)

Performed on AT LEAST ONE reading test
< 25th %ile in **BOTH** G2 & G3

AND

Performed on spelling test \geq 25th %ile in G3.

SD group

(N = 21; 13 females)

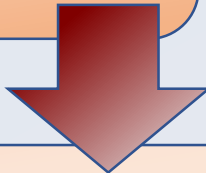
Performed on spelling test < 25th %ile in
BOTH G2 & G3.

AND

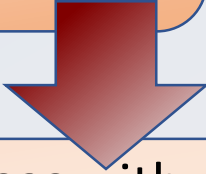
Performed on at least 2 (out of 4) reading
tests \geq 25th %ile in G3.

Statistical Analyses

We calculated **composite percentage scores** for MA and PA in G1 and G2 by averaging the percentage correct scores of the respective component tasks.



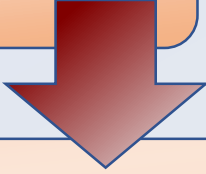
We performed a series of **binomial logistic regression analyses** with children's classification in the LD and the TD group as the dependent variable and OL skills (Voc, PA, MA, RAN) in G1 & G2 as the predictors.



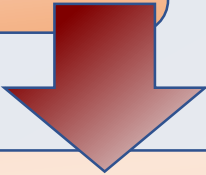
We performed a series of **multinomial logistic regression analyses** with children's classification in the LD subgroups and the TD group as the dependent variable and OL skills (Voc, PA, MA, RAN) in G1 & G2 as the predictors.

Critical indices for predictive accuracy in binary logistic regression

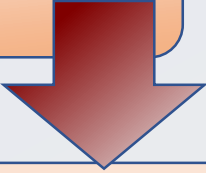
Sensitivity: Percentage of children who turned out to have LD and who had been also predicted as having LD.



Specificity: Percentage of children who turned out to be typical learners and had been also predicted as children not having LD.

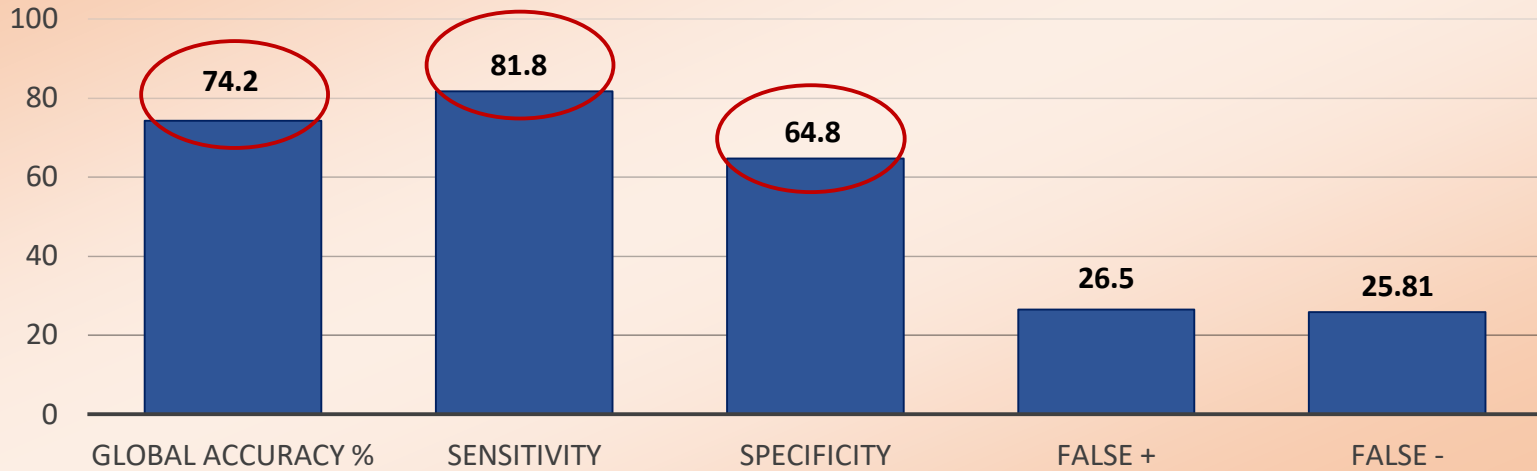


False Positive rate: Percentage of children who were predicted to have LD, but who turned out to be typical learners.



False Negative rate: Percentage of children who were predicted to be typical learners, but who turned out to have LD.

Fig 1. Predictive accuracy of OL skills in Grade 1 for children's LD in Grade 3



Sensitivity and Specificity findings:

- Grade 1 OL skills predicted slightly better those children who turned out to have LD in Grade 3
- Grade 2 OL skills were better at predicting Grade 3 typical learners.

Effect size of the predictive models

Grade 1: Nagelkerke $R^2 = .37$

Grade 2: Nagelkerke $R^2 = .42$

- The model with the Grade 2 predictors was slightly better than the respective model in Grade 1.

Fig 2. Predictive accuracy of OL skills in Grade 2 for children's LD in Grade 3

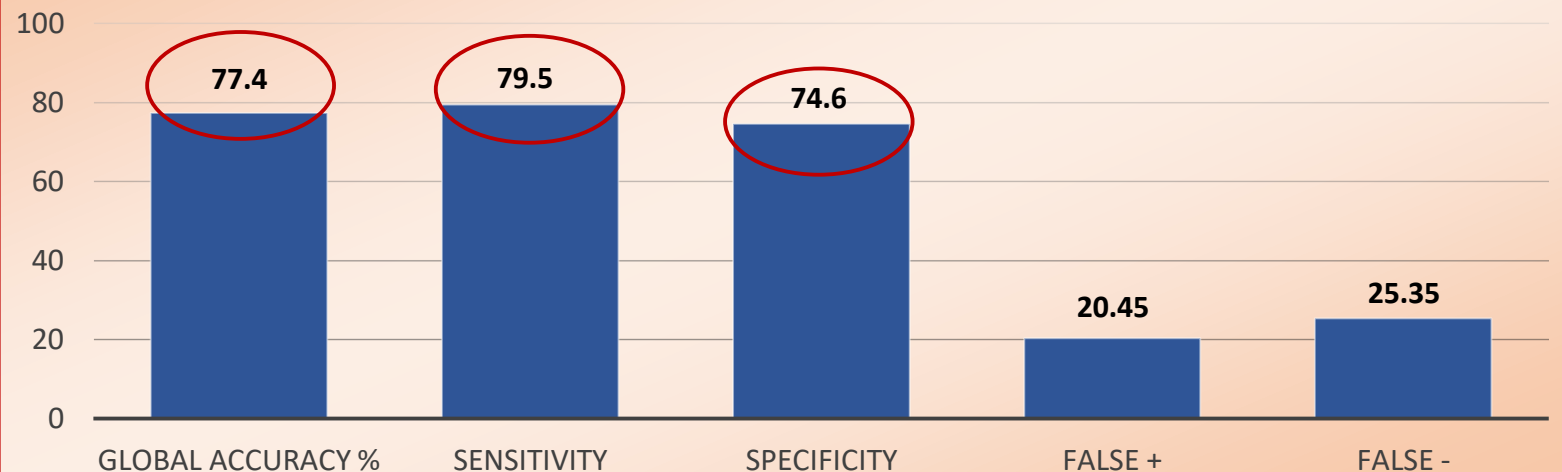


Table 1. Results of logistic regression predicting children's LD in Grade 3 from Grades 1 and 2 predictors

Measures	Grade 1 predictors					Grade 2 predictors				
	B	SE	Wald	OR	CI	B	SE	Wald	OR	CI
Vocabulary	.05	.03	2.25	1.05	.99-1.12	.04	.03	1.62	1.04	.97-1.12
Phonological Awareness	.05	.01	13.78***	1.05	1.02-1.07	.05	.02	9.00**	1.05	1.02-1.09
Morphological Awareness	.01	.01	.64	1.01	.99-1.03	.03	.02	4.13*	1.03	1.00-1.06
Rapid Automatized Naming	-.11	.06	3.27	.90	.80-1.01	-.22	.10	5.19*	.81	.67-.97

Note. SE = Standard Error; OR = Odds Ratio; CI = 95% Confidence Interval. Reference category = Typically developing children. * $p < .05$. ** $p < .01$. *** $p < .001$

- Grade 1 PA was the only significant predictor of LD classification in Grade 3.
- In Grade 2, a larger number of OL skills (PA, MA, RAN) emerged as significant predictors of children's LD than in Grade 1.

Fig 3. Predictive accuracy of OL skills in Grade 1 for children's type of LD in Grade 3

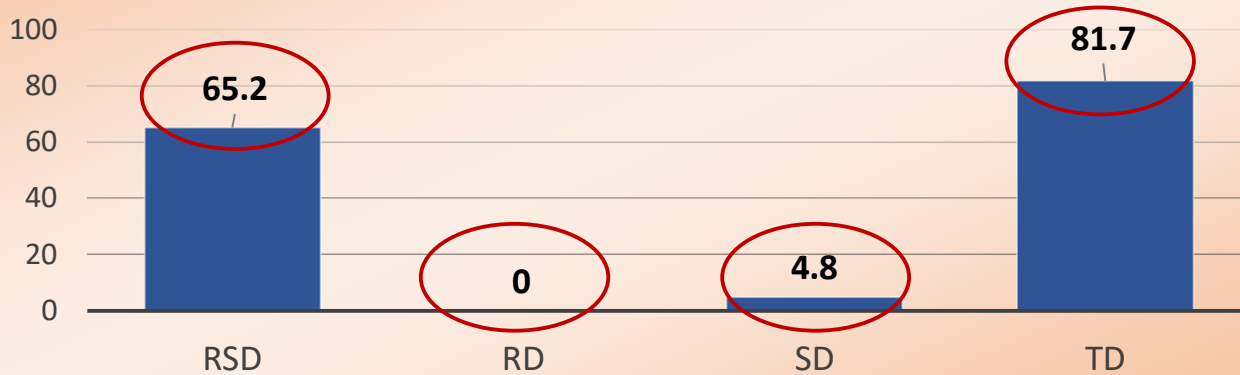
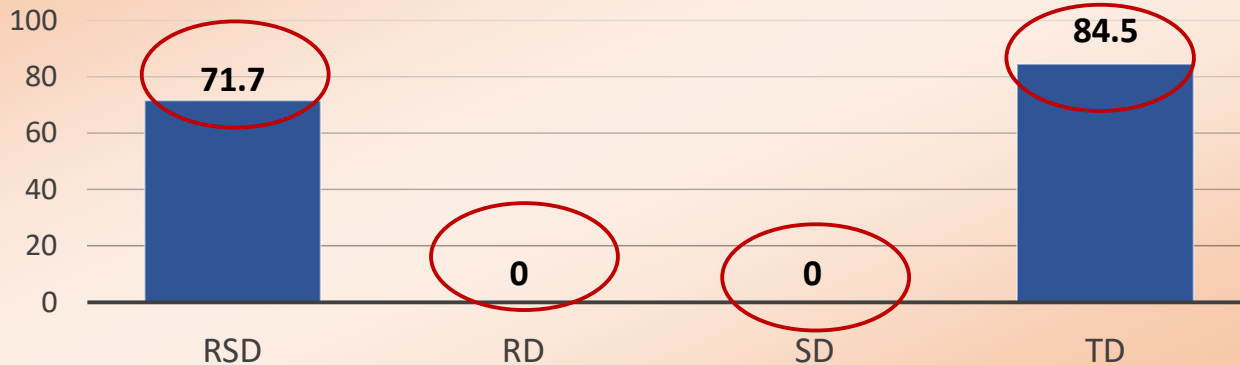


Fig 4. Predictive accuracy of OL skills in Grade 2 for children's type of LD in Grade 3



In Grade 2, OL skills better predicted typical learners and children with RSD, but in both Grades they failed to successfully predict children with single RD or SD.

Effect size of the predictive models

Grade 1 Nagelkerke $R^2 = .38$

Grade 2 Nagelkerke $R^2 = .40$

Overall percentage of correct classification in LD groups

Grade 1 = 56 %

Grade 2 = 58.5 %

Table 2. Grades 1 and 2 predictors for the classification of children in different types of LD

Measures	Grade 1 predictors			Grade 2 predictors		
	-2 Log Likelihood	χ^2	p	-2 Log Likelihood	χ^2	p
Vocabulary	334.9	3.93	.27	332.4	7.48	.06
PA	350.3	19.2	.00	337.5	12.63	.01
MA	340.1	9.08	.03	329.4	4.50	.21
RAN	337.1	6.96	.07	332.1	7.23	.07

Grades 1 and 2 predictors for the classification of children in each type of LD vs the group of TD children

Grade 1 predictors:

- 1) PA (B = -.05; $p < .01$; **RSD vs TD**)
(B = -.06; $p < .01$; **SD vs TD**)
- 2) RAN (B = .15; $p < .05$; **RSD vs TD**)

Grade 2 predictors:

- 1) PA (B = -.06; $p < .01$; **RSD vs TD**)
(B = -.05; $p < .05$; **SD vs TD**)
- 2) RAN (B = .25; $p < .05$; **RSD vs TD**)
(B = .28; $p < .05$; **RD vs TD**)
- 3) VOC (B = -.09; $p < .05$; **RSD vs TD**)

- In both Grades, **PA and RAN** predicted children's classification in the **RSD group** than in the TD group.
- In Grade 2, **Vocabulary** predicted children's classification in the **RSD group** than in the TD group.
- In both Grades, **PA**, predicted children's classification in the **SD group** than in the TD group.
- In Grade 2, **RAN** predicted children's classification in **the RD group** than in the TD group.

Summary of findings

- Evaluation of Oral Language skills in the beginning of the first two grades of primary school could predict with satisfactory accuracy children who would face literacy difficulties in Grade 3.
- Among the four OL skills examined, PA is the earliest and most consistent contributor for classifying children in general and specific types of LD across the first two years of schooling.
- RAN skills emerge as a better predictor of specific Reading Difficulties than the other OL skills.
- Vocabulary and MA appears to be an important predictor for classifying children facing general LD from typically developing children mainly after the initial phase of literacy learning (after Grade 1).

Discussion of results

In line with previous studies, results showed that **children with LD** are likely to experience early **deficits in phonological processing skills** (Moll & Landerl, 2009; Papadopoulos et al., 2009, 2020).

On a first level, these results corroborate previous findings suggesting that children with RSD present a double-deficit profile, with early deficits mainly in both PA and RAN (Moll et al., 2020; Torppa et al., 2017; Papadopoulos et al., 2020).

On a second level, they are in line with previous findings in consistent orthographies indicating that children's RD are mainly associated with deficits in RAN, whereas, SD with PA deficits (Moll et al., 2020; Torppa et al., 2017; Wimmer & Mayringer, 2002).

Another strand of our results, confirm previous evidence indicating that many dyslexic children experience OL problems not limited in the phonological domain (Nation & Snowling, 2004; Snowling et al., 2020), by showing that RSD are predicted by all of the OL skills assessed after Grade 1.

Finally, our results revealed **the important role of Vocabulary** in predicting children's LD (see also, Casalis et al., 2004; Diamanti et al., 2014; Rothou & Padeliadu, 2019; Tong et al., 2011), especially after grade 1.

Conclusions and implications

- Assessment of OL skills at the beginning of primary school (Grade 1) provides a powerful tool for identifying children who will face LD later (Grade 3), particularly children with the combined type of RSD.
- In good agreement with existing knowledge and educational practices only phonological skills were proven to be significant predictors of specific RD or SD.
- Implementation of a comprehensive preventive model aiming to enhance a broad array of oral language skills seems essential for children with mixed RSD.
- More longitudinal research that extends to later grades should be undertaken to further refine the predictors for early identification of children with specific difficulties in reading or spelling.

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