

How Cognitive Requirements of the Phonological Tests Affect their Ability to Discriminate Children with and without Developmental Dyslexia

Svetlana V. Dorofeeva* (1), Ekaterina Iskra (1,2), Daria Goranskaya (1), Andrey Zyryanov (1), Elizaveta Gordeyeva, (1) Tatiana V. Akhutina (3), Margarita Serebryakova (2), Olga Dragoy (1,4)

*sdorofeeva@gmail.com

1) HSE University

2) Center for Speech Pathology and Neurorehabilitation

3) Lomonosov Moscow State University

4) Institute of Linguistics, Russian Academy of Sciences

Background

- The cognitive requirements of the tests used to assess phonological processing (PP) skills differ between studies, and the degree of association between PP and the reading skills could depend on the requirements of the PP tests (Kilpatrick, 2012).
- The objective of this study was to investigate PP abilities in schoolchildren with and without developmental dyslexia (DD) using phonological tasks varying in linguistic complexity.

Method

Participants

- 49 children with developmental dyslexia and 124 typically developing children
- 7-to-11 years-of-age.

All participated children had normal vision, hearing and non-verbal intelligence.

Materials

- We assessed phonological skills with the Russian Test of Phonological Processing (RuToPP, Dorofeeva et al., 2020)
- The absence of primary auditory impairment was tested using a professional audiometric system (Audiogramm version 4.6.1.3; Sennheiser HDA 280 audiology headphones)
- We assessed reading fluency with a standardized reading test for Russian (Kornev & Ishimova, 2010), and a comparison with normative cut-off levels was performed using recent normative data for this test (Dorofeeva et al., 2019)

Linguistic processes involved in seven phonological tests						
	Linguistic processes					
Tests	Input (speech perception, phonological decoding)	Lexical access	Phono-logical working memory	Phono-logical analysis	Operations with phoneme sequences	Output (phonological retrieval and articulation)
Phoneme discrimination	+	-	-	-	-	-
Lexical decision	+	+	-	-	-	-
Phoneme detection	+	+	-	+	-	-
Pseudoword repetition	+	-	+	-	-	+
Phoneme isolation	+	+	-	+	-	+
Number of sounds	+	+	+	+	-	+
Changing sound in a pseudoword	+	-	+	+	+	+

Note. "+" reflects the linguistic process involved in the task.

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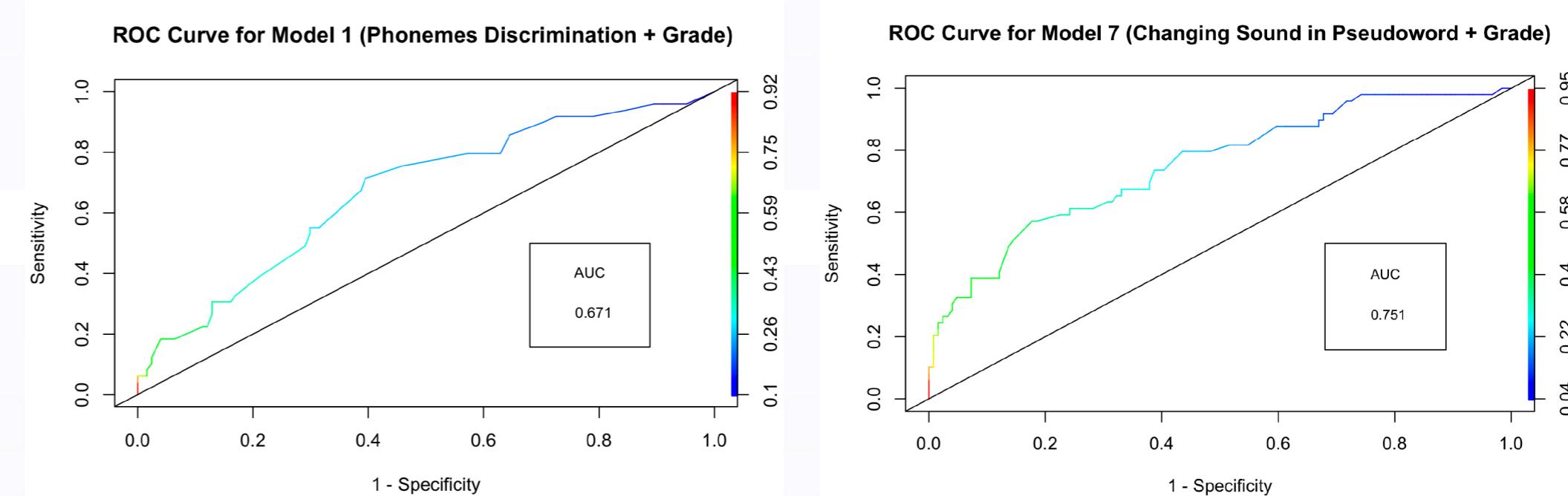
Results

Our analysis showed that two groups of children did not differ significantly in two simplest phonological tests of the RuToPP: Phoneme Discrimination ($W=3654$, $p=.034$, it did not retain significance following the Bonferroni correction) and Lexical Decision ($W =2907$, $p=.65$).

Two groups significantly differed in reading fluency ($W=672$, $p<.001$) and in all more complex phonological tests:

- Pseudowords Repetition ($W =1978$, $p<.001$),
- Phoneme Detection ($W =2070$, $p<.001$),
- Phoneme Isolation ($W =1538$, $p<.001$),
- Number of Sounds ($W =1994$, $p<.001$),
- Changing Sound ($W=1677$, $p<.001$).

Six out of seven RuToPP tests were significant predictors of dyslexia. However, while the RuToPP correctly identified 93–99% of typically developing children, for children with dyslexia it ranged from 4 to 47% depending on the test.



Model	True Positive	False Negative	True Negative	False Positive	Sensitivity	Specificity
1. Phonemes Discrimination + Grade	5	44	121	3	0.10	0.98
2. Lexical Decision + Grade	2	47	123	1	0.04	0.99
3. Pseudoword Repetition + Grade	11	38	118	6	0.22	0.95
4. Phoneme Detection + Grade	5	44	118	6	0.10	0.95
5. Phoneme Isolation + Grade	23	26	116	8	0.47	0.935
6. Number of Sounds + Grade	18	31	119	5	0.37	0.96
7. Changing Sound in Pseudoword + Grade	16	33	115	9	0.33	0.93

Discussion and Conclusions

Our findings are consistent with the literature on predictors of literacy skills and dyslexia, while uniquely demonstrating the impact of the complexity level of the phonological tests on the classification outcome. Phonological processing is a significant and necessary predictor of reading skills but it is not sufficient indicator for diagnostic purposes.

References

- Dorofeeva, S. V., Reshetnikova, V., Serebryakova, M., Goranskaya, D., Akhutina, T. V., & Dragoy, O. (2019). Assessing the validity of the standardized assessment of reading skills in Russian and verifying the relevance of available normative data. *The Russian Journal of Cognitive Science*, 6(1), 4–24.
- Dorofeeva, S. V., Laurinavichyte, A., Reshetnikova, V., Akhutina, T. V., Tops, W., & Dragoy, O. (2020). Complex phonological tasks predict reading in 7 to 11 years of age typically developing Russian children. *Journal of Research in Reading*, 43(4), 516–535. <https://doi.org/10.1111/1467-9817.12327>