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A Complex View of the Grapheme-to-Phoneme Conversion (GPC) Procedure: Evidence for Vowel Developmental Dyslexia from a Shallow Orthography Language

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A complex view of the Grapheme-to-Phoneme Conversion (GPC) procedure: Evidence for developmental vowel dyslexia from a shallow orthography language

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Introduction

Recent findings suggest that the sublexical route described in the Dual-Route Model of reading (Coltheart et al., 2001) cannot be considered a unitary process, generally devoted to the conversion from grapheme-to-phoneme, but it is likely to be a multi-layered and feature-based process. In particular, differences in the processing of consonants and vowels were observed in neurotypical readers of various languages (see Winskel, 2011 for a review) and, in Hebrew, Khentov-Kraus & Friedmann (2011,2018) described a new type of reading impairment, vowel dyslexia, which was observed in acquired and developmental cases. This reading disorder, leading to errors in reading vowel letters via the sublexical route, was later reported also in Arabic (Friedmann & Haddad-Hanna, 2014) and Turkish (Güven & Friedmann, 2021). The aim of this study is to confirm the presence of this type of dyslexia in a further shallow-orthography language like Italian, in which GPC rules are usually automatized early in reading acquisition. If vowel dyslexia is found in Italian as well, with properties similar to those reported in the deeper orthographies in which it was reported, it will indicate that the separate treatment of vowels and consonants is independent from script, and that a complex view of GPC procedure should be taken into consideration.

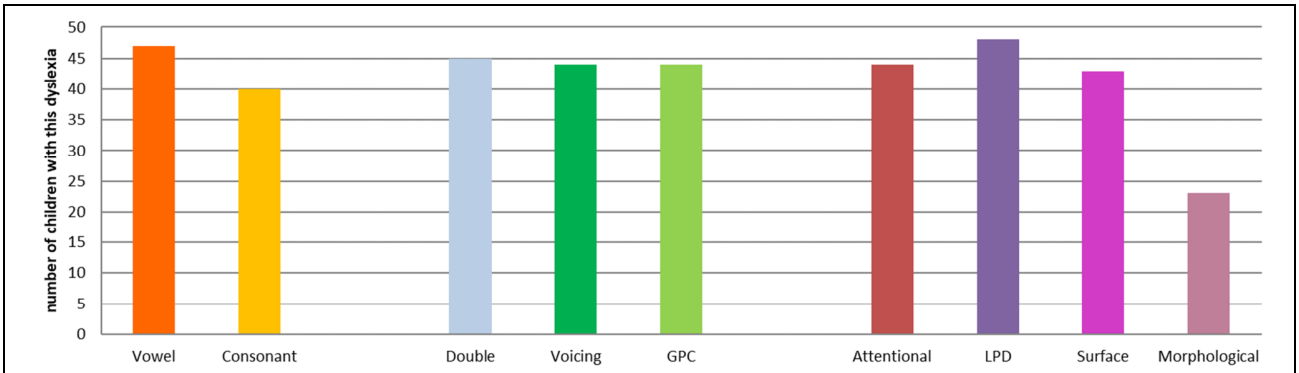
Methods

The new TILTAN-IT reading battery, aimed at assessing specific types of dyslexia, was administered to 609 Italian-speaking children (from 2nd-8th grade), recruited at their schools. This battery includes lists of Italian words, word-pairs, and non-words selected as sensitive stimuli for each type of dyslexia (Friedmann & Coltheart, 2018). Reading errors were coded through an automatic procedure, developed to identify different error categories. Errors of substitution, addition, omission, and migration of vowels were coded separately from the parallel errors in consonants.

Results

For each participant, the amount of error types classified according to the coding system was compared to a cutoff created using Crawford and Garthwaite's (2002) t-test. Figure 1 summarizes the distribution of dyslexia types detected with TILTAN-IT.
As for vowel dyslexia, after excluding children with Letter Position dyslexia and children with Attentional dyslexia, 28 children (4.6% of all children tested) produced significantly

more vowel errors (vowel letter omission/substitution/addition/migration) than the cut-off, but made none or only one consonant errors. Interestingly, we also found the opposite pattern, which has not been reported before: 21 children showed significantly more errors on consonants than their age-peers, but they made fewer than 2 vowel errors.



Vowel – vowel dyslexia (a selective deficit in the conversion of vowels - vowel substitution, omission, addition, migration); **Consonant**: a selective deficit in the conversion of consonants (substitution, omission, addition, migration of consonants only); **GPC** – errors in multiletter conversion (e.g., chi, gn); **Double**: a deficit in geminates and doubled letters; **Voicing**: dyzlegzia (voicing substitutions g-k, d-t, f-v,b-p etc.). These 5 dyslexias are deficits in the sublexical route and were determined according to the participants performance in the nonword reading subtest.
Attentional – attentional dyslexia (letter migrations between neighboring words); **LPD** - letter position dyslexia (letter migrations within words); **Surface:** surface dyslexia (reading via the sublexical route instead of the lexical route); **Morphological**: morphological errors in reading aloud (substitution of an affix with another affix, omission and addition of whole affixes). These 4 dyslexias were determined according to the participants' performance in the word reading subtest.

Figure 1. Types of developmental dyslexia in Italian detected by TILTAN-IT: number of children with each kind of developmental dyslexia

Conclusions

TILTAN-IT allows one to detect different types of dyslexia in Italian. In particular, the results suggest that despite the highly consistent conversion of vowels from orthography to phonology, it is still possible to identify a specific impairment in reading vowel letters in the sublexical route. We were also able to identify children who showed the mirror-image dyslexia, with errors only on consonants in reading nonwords. These results indicate that the sublexical route is more complex than previously thought, with separate conversion mechanisms for vowel letters and for consonant letters.

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