

# The Development of Reading Speed in Italians with Dyslexia: A Longitudinal Study

Patrizio E. Tressoldi, Giacomo Stella, and Marzia Faggella

## Abstract

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The development of reading speed in Italian children with dyslexia was estimated using individualized growth curves for a group of 38 children with dyslexia tested longitudinally from the second to the eighth grade and compared with typical readers. Their reading speed development followed a linear trend of .3 syllables per second per grade, approximately half the increment observed in typical children reading a passage and similar to typical children's reading of nonword lists. These findings give support to the deficit hypothesis versus the lag hypothesis and to reading speed as the core deficit in dyslexia with transparent orthographies.

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Until recently, very few data have been available about the long-term natural development of reading efficiency in Italian children with dyslexia. By *natural*, we mean the development derived from the scholastic reading experience that in most educational systems in Europe and North America includes some extra educational resources (special teachers, more or less specific treatments, etc.) but without prolonged and intensive specific training. We define as prolonged and intensive a scientifically based training lasting at least one academic year with a minimum of two sessions a week.

This information is important for several reasons: first, to know what level of reading efficiency these children may attain in order to forecast which educational and social resources to activate for helping them to mitigate their disability at school and in their cultural environment; and second, to have a measure to compare every treatment aimed at improving their reading efficiency. The comparison of the reading progress of children with dyslexia

with that of typical readers is a useful measure, but given that their disability is often severe, it may be sufficient to obtain gains superior to the natural estimated reading development of children with dyslexia.

Accuracy is the measure of reading efficiency most often used in English-speaking countries given the disparity between English orthography and phonology. However, for Italian and other so-called transparent orthographies like Spanish and German, accuracy is a minor problem whereas low reading speed remains a core symptom of reading impairment (Wimmer, 1993; Wimmer & Goswami, 1994; Zoccolotti et al., 1999). However, the problem of speed or automatization of reading has recently been intensely investigated and theoretically considered also in English, to differentiate subtypes of developmental reading disorders. In their review, Wolf and Bowers (1999) supported the necessity to differentiate at least three dyslexia subtypes:

a subtype with only phonological deficits, characterized by severe dif-

ficulties in reading nonwords and in several blending and assembling phonological tasks;

a second subtype with a specific difficulty in the speed of processing verbal and sometimes nonverbal information; and

a mixed subtype presenting characteristics of both the phonological and the speed subtypes.

In their longitudinal study, Francis, Shaywitz, Stuebing, Shaywitz, and Fletcher (1996) investigated the lag hypothesis versus the deficit hypothesis of reading disability following the achievement of a composite score on three reading tasks (word identification, word attack, and passage comprehension) by 34 children with below-average reading, 29 children with reading disabilities, and 301 typical English readers from Grade 3 to Grade 9. Using an individualized growth curve, they identified a nonlinear function that fitted with good approximation the reading scores of all three groups. The curves followed a simple quadratic trend until the age of 15,

when they reached a plateau, supporting the deficit hypothesis.

Klicpera and Schabmann (1993) longitudinally studied 356 German readers from the second to the eighth grade divided into different subgroups according to their initial percentage ranking on a test of reading and spelling skills. For reading, they found that all subgroups developed their reading speed in parallel following a linear trend. For spelling, the performance of the average and above-average groups revealed a very low number of errors since the first evaluation, whereas the below-average groups showed a linear trend with slopes reaching the average level at the 8th grade. These findings are interesting for languages with transparent orthographies like German and Italian, but children with below-average reading cannot be considered to have dyslexia.

We had the opportunity to follow longitudinally from the second to the eighth grade the reading efficiency of a group of children with dyslexia and to estimate their development of passage reading speed with respect to the standardized norms of passage reading and nonword reading obtained from their peers matched by chronological age and grade. The comparison with nonword norms gives us a measure of the efficiency of the phonological processes, whereas the comparison with passage norms gives a measure of the efficiency of the orthographic and lexical processes. Similar to Francis et al. (1996), we estimated the development of this population using individualized growth curves, but unlike them we studied reading speed.

## Method

### Participants

Children with dyslexia were tested in two centers specialized in the diagnosis and treatment of language and learning disabilities. The diagnosis followed the *DSM-IV* recommendations (American Psychiatric Association,

1994), namely, normal level of general intelligence, reading performance at a clinical level, and no neurological, sensory, or educational deficit that could justify their reading impairments. We included in the dyslexia group only participants whose reading speed level was at least 2 standard deviations below the mean in three successive grades. When these measures were not consecutive we estimated their reading level using linear interpolation.

The dyslexia group was composed of 38 children (4 girls and 34 boys; mean chronological age 7.2 years,  $SD = .4$ ). As usual in the Italian school system, all these children attended general education schools with some special help by specialized teachers. Most of the children in the dyslexia group followed some kind of remediation training during the period considered in this investigation, but no one followed intensive and very specific training based on well-documented efficacy. Thus we may consider their reading development as typical natural reading development for Italian children with dyslexia.

### Instrumentation

The speed and accuracy of reading a text passage was assessed using the MT battery (Cornoldi, Colpo, & Gruppo, 1981). The MT battery is the most psychometrically valid Italian instrument to measure passage reading speed and accuracy. It comprises different passages for each grade level with an increasing number of syllables per passage (from 250 in second grade to 570 in eighth grade). The sample used for the standardization comprised more than 200 children for each grade from the second to the eighth grade. Mean test-retest coefficient for all grades was .85. Construct and parallel validity evidence are satisfactory and are reported in the administration manual.

Each participant was tested individually by one of the authors. The participant was required to read the passage according to his or her grade level. In-

structions emphasized accuracy and speed ("Read as accurately and rapidly as you can.") while paying attention to the text content. Speed was calculated by dividing the number of syllables in the passage by the time in seconds necessary to read it. Accuracy corresponded to the number of words misread.

As a comparison measure, the normative data from another test were used. This test was developed by Job, Sartori, and Tressoldi (1995) and is a standardized battery for the diagnosis of dyslexia and dysorthographia. It is composed of 5 different subtests for the evaluation of different aspects of reading and 3 subtests for the evaluation of writing. The subtests for reading comprise single grapheme identification, a lexical decision task, 4 lists of isolated words of different frequency, 3 lists of nonwords of different orthographic complexity, and 3 subtests for the identification of homophones. The subtests for writing comprise word dictation, nonword dictation, and sentence-with-homophone dictation. Norms are drawn from different samples ( $n > 100$ ) from the second to the eighth grade. Parallel and construct validity evidence are psychometrically appropriate and are reported in the administration manual. Mean test-retest coefficient of speed measures was .77. Speed corresponds to the number of seconds used to complete the reading of each subtest. Accuracy corresponds to the number of correct stimuli identified. None of the students who participated in the current study were part of the standardization samples for either of the instruments.

## Results

As expected, accuracy levels reached a ceiling around the 3rd grade, so we will present only data related to reading speed. Given that for typical readers the speed of reading a passage follows a linear trend from the second to the eighth grade according to the formula  $\text{Passage} = 1.24 + (.51 \times \text{Grade})$ ,

$R^2 = .986$  (see Figure 1, Norm\_Pass data), for each child with dyslexia we calculated a linear equation and the corresponding  $R^2$ . To obtain a more confident estimate of the intercept, the slope, and  $R^2$ , we used a bootstrap procedure with 100 resamplings using the Simstat™ (1996) statistical software. The linear function obtained with these estimated values was  $\text{Passage} = .028 + (.3 \times \text{Grade})$  with  $SDs$  of .49 and .14 for intercept and slope, respectively, and the mean  $R^2 = .90$  ( $SD = .10$ ).

The developmental trend of the dyslexia group using the estimated values with the corresponding 95% confidence interval is presented in Figure 1 (Dysl\_Pass data). Typical Italian readers improve their passage reading speed with a constant trend of .5 syllables per second from the second to the eighth grade. Children with dyslexia, on the other hand, increase their passage reading speed by .3 syllables per second per grade. Interestingly, if we compare their reading develop-

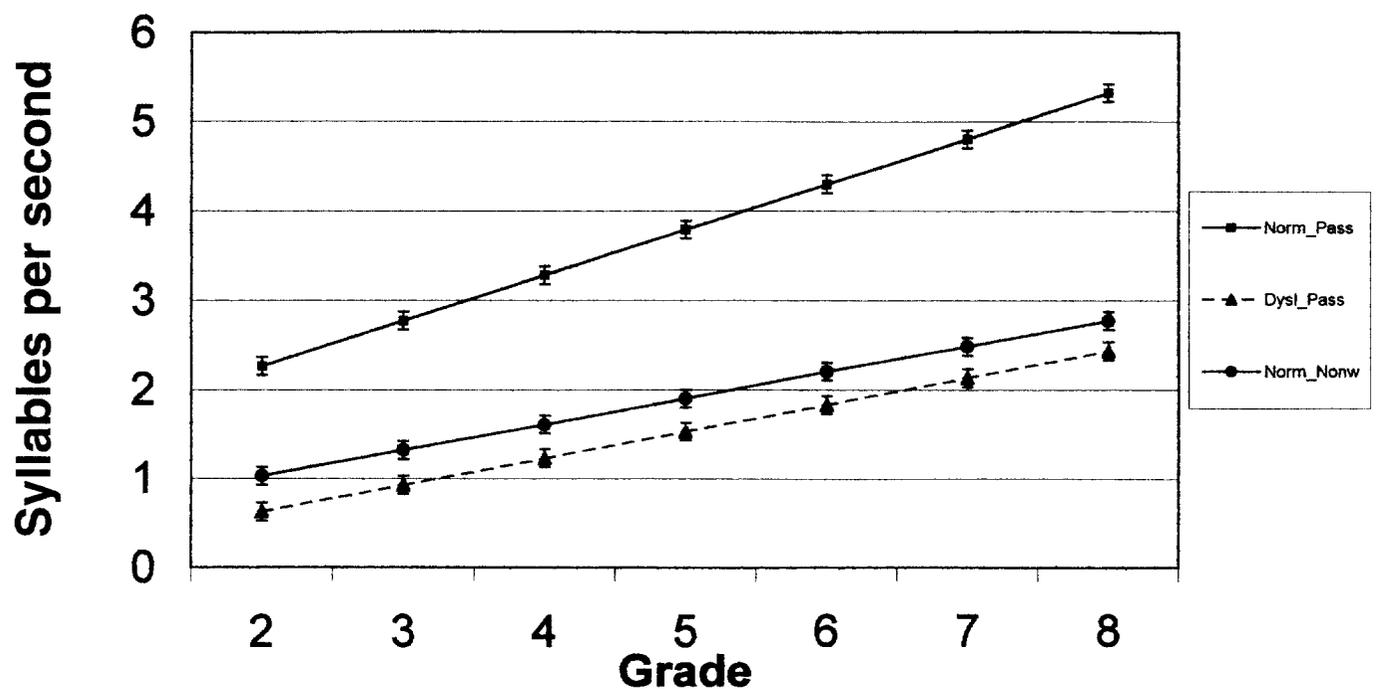
ment with that of typical children reading lists of regularly spelled nonwords, we observe an almost perfect parallel development with the following linear equation:  $\text{Nonwords} = .45 + (.29 \times \text{Grade})$ ,  $R^2 = .98$  (see Figure 1, Norm\_Nonw data). Norms for the speed of reading nonword lists were obtained from the standardized battery of Job et al. (1995). We do not have sufficient longitudinal data about the development of speed of reading nonword lists for children with dyslexia, but what emerges from our transversal data (Tressoldi, Stella, & Faggella, 2001) is the following equation:  $.27 + (.145 \times \text{Grade})$ ,  $R^2 = .96$ ; again, an increment approximately corresponding to half that observed in typical readers.

## Discussion

These data support the view that for Italian children with dyslexia the core problem is the speed or automatization

of reading processes. For the first time, we have a measure of their impairment with respect to typical readers. However, much work is still necessary to investigate at which level the impairment takes place. Wolf, Bowers, and Biddle (2000) discussed in depth different hypotheses to explain the reading speed deficit, but our data do not offer useful information to support one of them except for the information that the reading speed deficit affects the reading of both unfamiliar and connected regular nonwords, suggesting that this deficit involves not only the lexical retrieval level but also the encoding level.

Our data confirm the deficit hypothesis as suggested by Francis et al. (1996), although we agree with Francis et al. that a simple linear trend is not a correct estimate of reading development because it is very plausible that at a certain point reading efficiency will reach a plateau. Our data are valid only to describe reading speed develop-



**FIGURE 1.** Development of reading speed of Italian children with and without dyslexia from the second to the eighth grade: Estimated linear trend and 95% confidence interval. Norm\_Pass = estimated trend of typical readers reading a passage; Dysl\_Pass = estimated trend of children with dyslexia reading a passage; Norm\_Nonw = estimated trend of typical readers reading lists of regular nonwords.

ment from the second to the eighth grade.

Our findings differ from those of Klicpera and Schabmann (1993) in that we did not observe a parallel development between children with and without dyslexia, but a divergent one. However, as already pointed out, the poor readers in Klicpera and Schabmann's study ranked in the low percentiles of the whole group and could not be considered children with dyslexia. We included in the sample only children with a level of reading efficiency two standard deviations below the mean for at least three consecutive grades.

What emerges from our data looks like a hard-wired constraint, very probably of biological origin, on the capacity of these children with dyslexia to process orthographic and lexical information at a faster rate. Is this constraint a fixed resource, or may it be overcome with very intensive and specific training? This is a question we are currently investigating (see Tressoldi, Lonciari, & Vio, 2000).

#### ABOUT THE AUTHORS

**Patrizio E. Tressoldi**, PhD, is a full-time researcher at the Department of General Psychology of Padova University, Italy. His current interests in the field of learning disabilities are

related to treatment methods. **Giacomo Stella**, EdD, is associate professor of developmental psychopathology at the Institute of Psychology of Urbino University, Italy, and scientific member of the Italian Dyslexia Association. His current interests are related to dyslexia and specific language impairments. **Marzia Faggella**, MA, is a professional psychologist. Her current interests are related to diagnosis and treatment of developmental learning disabilities. Address: Patrizio E. Tressoldi, Dipartimento di Psicologia Generale, Università Padova, via Venezia, 8, 35131 Padova, Italy; e-mail: patrizio.tressoldi@unipd.it

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