

The effects of covid-19 pandemic and Distance Learning on reading skills in typical readers children

Effetti della pandemia da covid-19 e della Didattica a Distanza (DAD) sulle abilità di lettura in bambini normo-lettori

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ABSTRACT

Due to the covid-19 pandemic, in February 2020 the Italian government decided to take action in order to reduce physical contact and contain the spread of the virus; among the other measures, face-to-face teaching was suspended. All along 2020 and for the major part of 2021 online teaching replaced face-to-face teaching. Teachers and parents were unprepared for this kind of didactic activities and online modality varied during the lockdown months and among different schools. Different studies analysed the outcome of these online modalities, mostly on pathological samples (Baschenis et al., 2021). We conducted a research study in order to investigate whether online teaching had a negative effect on development of reading skills in Italian children typical readers. We recruited forty-nine children from a primary school in Alessandria (Piedmont, Italy) and assessed their reading skills before (T1) and after (T2) the pandemic. All children with learning disabilities, cognitive and sensory impairments were excluded from our group. Children attended third grade at T1 and fifth grade at T2. We evaluated reading speed, accuracy and comprehension; data from existing literature has been used to confront our participants with the population of children typical readers. We compared the results obtained at T1 and T2; our findings show that our group reached the expected improvement in reading fluency. The subjects obtained a significant improvement in reading comprehension as well, but existing data are insufficient to determine if the improvement reached by our group is the same as expected. Therefore, we can state that online teaching has not worsened the development of reading skills in our group of typical readers.

Keywords: covid-19, reading skills, reading development, reading comprehension, distance learning, online teaching

1. Introduction

During the first months of 2020, many countries were rapidly and dramatically affected by the outbreak of the SARS-CoV-2 pandemic (covid-19 disease) that changed our lives in many aspects, including education (Reimer et al., 2021). In Italy, the attempts of institutions to mitigate and contain the virus spread required a significant reduction of physical contact; among the other measures, the government decided to suspend all school activities from February 24th until the end of the academic year in June 2020. Distance learning was recommended, but its implementation was not immediate for many institutions and the teaching modalities varied during the lockdown months and among different schools. In the beginning, parents were resistant towards online learning, mainly because of their lack of time and expertise in managing their childrens' school activities; the need for the child to be assisted during school time in a domestic environment is another factor that had an impact on parents' perception about online teaching (Dong et al., 2020). In this instance, a reduction of learning outcomes might be expected as reported in previous studies on partial or temporary interruptions of school attendance (Bacher-Hicks et al., 2020; Kuhfeld et al., 2021). Negative consequences might be predicted both for children who already present special educational needs and learning disabilities, and for children who read fluently (Werner & Ludger, 2021; Scarpellini et al., 2021).

Previous studies (Baschenis et al., 2021) investigated learning skills in Italian children during the covid-19 pandemic, focusing on the improvement rate in reading fluency in dyslexic children; the authors found a lower increase than expected during the pandemic in the pathological sample. The aim of our paper, on the other hand, is to investigate whether changing the way of teaching had an impact on the improvement trend on typical readers in primary school.

Children learn how to read and write in Italian during the first two years of primary school, i.e. when they are 6 to 7 years old. First, through the development of phonological awareness, children automatize how to transform a sound (phoneme) in its respective grapheme and vice versa (Job et al., 2005; Orsolini et al., 2006). After the first period, when the correspondence phoneme-grapheme is stable, children tend to merge graphemes into wider units: the syllables (Springer et al., 1997; Burani et al., 2002). The next step of reading development is recognizing the whole word; this process is typical of lexical reading (Frith, 1985). The amount of time needed to learn and automate reading skills depends on the type of orthography of the language (Spencer & Hanley, 2010). This process happens relatively fast in Italian children, because Italian is a language with an almost transparent orthography (Carlson et al., 1985), which means that the majority of the sounds have only one correspondent grapheme.

According to the Dual Route Cascade (DRC) model (Coltheart et al., 2001), there are two different neuropsychological pathways that lead to reading a word aloud: a lexical path and sub-lexical path. The *lexical path* is used mostly for known words, and it overlaps with U. Frith lexical reading (Frith, 1985). The *sub-lexical path* is used for irregular or unknown words, in which the transduction grapheme-phoneme is necessary (Coltheart et al., 2021). The correspondence sound-symbol follows the rules of the orthography of the language.

The passage from the second to the first pathway happens usually at the beginning of third grade for children without learning disabilities (Tressoldi et al., 2001). It has been established by previous studies that typical Italian readers “improve their reading speed with a constant trend of .5 syllables per second [each year] from the second to the eighth grade. Children with dyslexia, on the other hand, increase their reading speed by .3 syllables per second per grade” (Tressoldi et al., 2001, p. 415). According to this data “for typical readers the speed of reading a passage follows a linear trend from the second to the eighth grade according to the formula = $1.24 + (.51 \times \text{Grade})$ ” (Tressoldi et al., 2001, p. 416).

In the present study, we compare the reading fluency of a group of typical reader children before (T1) and after the covid-19 pandemic (T2); during that time teachers used mostly online teaching within their

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classrooms. We used data from literature (Cornoldi et al., 2016) as a normative group for both T1 and T2. We looked for significant changes in reading fluency between T1 and T2 and we confronted our results with the improvement rate that was expected with a typical face-to-face teaching.

2. Materials and Methods

2.1 Participants and procedures

Forty-nine ($n = 27$ females) typical readers were enrolled from two different classes in a private primary school in Alessandria, Italy; like most of the Italian private institutes, the socio-economic background of the children of our group is considered middle-high. At the time of the first assessment (T1) children were attending third grade, while at T2 they were attending fifth grade. We did not evaluate children in fourth grade, because during that time teaching was still blended, half online and half in-class. Teachers of the two different classes did not follow specific didactic protocols, and did not receive any specific training to face online teaching. In each class there was one appointed main teacher. The main teachers of the two classes which participated in our study had the same Intended Learning Outcomes (ILO) for their students, despite no specific didactic program was put in action. In order to conduct an appropriate analysis, we tested the same group of students at T1 and T2. All the children who performed below 2 Standard Deviation (SD) in a task of reading fluency were not included in the present study, as well as all the children with cognitive or sensory impairment; six children were excluded for these reasons from the original sample of fifty-five children. The mean age at T1 was 8.48 years, $SD = .5$ (min = 8, max = 9). The mean age at T2 was 10.48, $SD = .5$ (min = 10, max = 11). Tab. 1 and Tab. 2 describe the anagraphic of the participants to our study.

	<i>N</i>
<i>Female</i>	27
<i>Male</i>	22
	49

Table 1. Number of participants

	Min	Max	M	SD
Age T1	8	9	8.48	.5
Age T2	10	11	10.48	.5

Table 2. Age at T1 and T2

The subjects were assessed with three reading tasks, as stated below, at T1 (February 2020) and at T2 (February 2022). Children were attending third grade at T1 and fifth grade at T2: at that age children typically read through a lexical path and reading impairments should already have emerged if present. During 2021 teaching and learning modalities were still affected by covid-19 pandemic; when more than one positive case per class was spotted, face-to-face teaching was suspended and the online modality was

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restored. For this reason we chose to set T2 at February 2022, when the online modality was not used anymore. All subjects were evaluated by a speech therapist and trained psychology students. The assessments were individual and took place inside the school. Parents/legal guardians of the involved children provided informed consent to participate in this study. All the data were stored according to the GDPR/2016.

2.2 Measures

In both the reading assessments at T1 and T2, the same three tests were presented to the subjects. The first task consisted in reading aloud a list of words; the items used are part of the Battery for the Assessment of Developmental Dyslexia and Dysorthography-2 (DDE-2, Sartori-Job-Tressoldi), which is used to assess reading speed (syllables per second) and accuracy (number of errors) in Italian children. The second task consisted in reading a text passage from the Assessment of Reading and Comprehension Skills for Elementary and Middle School (MT-3-Clinica, Cornoldi & Carretti). The children were asked to read aloud as fast as they could a text in order to assess reading fluency (syllables per second) and accuracy (number of errors). A third task has been submitted to the children, in which they had to silently read a text and answer some questions related to what they had read, choosing among four options. The text and questions proposed to the children have been chosen among the ones belonging to the Assessment of Reading and Comprehension Skills for Elementary and Middle School (MT-3-Clinica, Cornoldi & Carretti), in order to evaluate reading comprehension. The order of tests presentation to the subjects was randomized through the use of a latin square.

2.3 Analysis

Simple statistical analysis was used to analyze reading and comprehension skills at both T1 and T2, and descriptive data were generated for all variables. Then, *t*-Test were performed to confront our results at T1 with the data stated in literature for each variable analyzed, to be sure that our group would have been representative of the population of typical readers. After that, T1 and T2 performances of children for all the variables were compared through paired sample *t*-Test, in order to assess reading skills development through time during the covid-19 pandemic. Lastly, a sub-group of qualitative analysis has been used to evaluate what percentages of children reached the expected increase in reading speed of .51 syllables per second for each year, according to the linear trend suggested by Tressoldi et al. (2001). SPSS was used for the statistical analyses and *p-value* was set at .05.

3. Results

Time 1. The mean of reading speed in a text passage in our group is 2.83 (SD= 1.00) while the reading speed of a list of words is 2.57 (SD= .90).

The accuracy has also been measured (in terms of number of errors) and analyzed, reaching the following results: text reading: M= 5.03, SD= 3.86; word reading: M= 5.14, SD= 5.20. Lastly, the number of correct answers in the reading comprehension task has been assessed (M= 10.80, SD= 3.63).

We compared the mean of each variable analyzed with data from previous studies that set parameters to define typical readers (Cornoldi et al., 2016; Sartori et al., 2007; Tressoldi et al., 2001); the results show

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reading fluency text (syll/sec) $t(48) = .647, p > .05$; text accuracy (number of errors) $t(48) = .245, p > .05$; reading fluency words $t(48) = .408, p > .05$; words accuracy $t(48) = .432, p > .05$, reading comprehension (number of correct answers) $t(48) = .606, p > .05$. Fig. 1 represents the overlapping between our data and the results previously reported in the literature. Each graph shows one variable; in each chart it is possible to see the mean and standard deviation of the normative sample (blue) compared with the results of our group (red). These results suggest that our group of readers is representative of a population of typical Italian readers and comprehenders.

Mean and Standard Deviation in our group and in control at T1 and T2

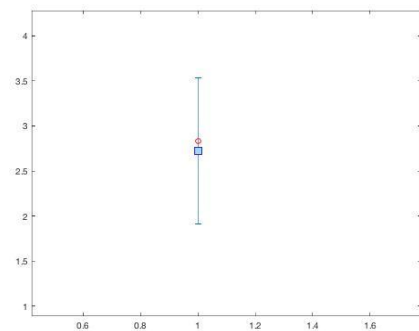


Figure 1.1

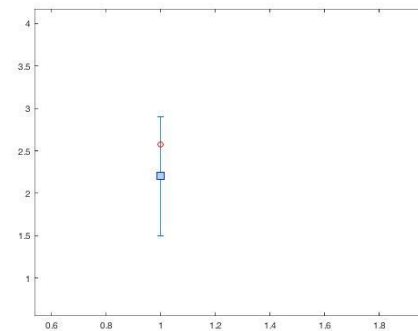


Figure 1.2

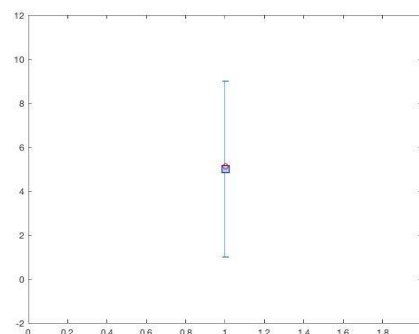


Figure 1.3

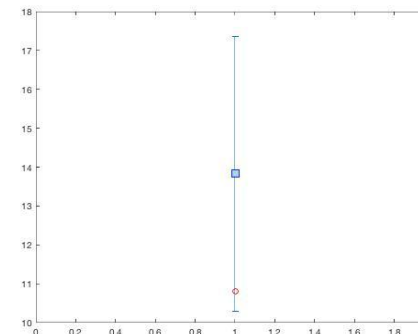


Figure 1.4

Fig 1. 1.1: M and SD expressed in syllables per second in typical readers in third grade according to Cornoldi et al. in text reading (*blue*) and M of syllables per second in our group (*red*); 1.2 M and SD deviation expressed in syllables per second in typical readers in third grade according to Sartori et al. in words reading (*blue*) and M of syllables per second in our group (*red*); 1.3 M and SD expressed in number of errors in typical readers in third grade according to Sartori et al. in words reading (*blue*) and M of number of errors in our group (*red*); 1.4 M and SD deviation expressed in number of correct answers in typical comprehenders in third grade according to Cornoldi et al. in words reading (*blue*) and M of number of correct answer in our group (*red*).

Tab. 3 sums up reading skills in our group at T1, in terms of reading fluency and accuracy, and reading comprehension.

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	Min	Max	M	SD
Text reading speed (syll/sec)	1.30	6.04	2.83	1.00
Text reading errors	.00	16.00	5.03	3.86
Words reading speed (syll/sec)	.90	5.17	2.57	.90
Words reading errors	.00	25.00	5.14	5.20
Reading Comprehension (number of correct answers)	5.00	19.00	10.80	3.63

Table 3. Reading skills at T1 - February 2020

Time 2. Reading speed and accuracy of words and text passage were assessed, along with reading comprehension, in the same group two years after the first evaluation.

In our subjects the mean of speed reading at T2 in the text passage is 3.96 (SD= .86) while the mean of speed reading of words is 3.81 (SD= .85). These data are consistent with the linear trend supposing that the mean of speed reading of a text passage in children of this age should be around 3.79 syllables per second (Tressoldi et al., 2001; Cornoldi et al., 2016).

The number of errors in reading has also been analyzed (text reading: M= 4.70, SD=2.96; word reading: M= 3.00, SD=3.65). Lastly, the number of correct answers in the reading comprehension task has been assessed (M=13.51, SD=3.24). Tab. 4 sums up reading skills at T2.

	Min	Max	M	SD
Text reading speed (syll/sec)	2.26	6.30	3.96	0.86
Text reading errors	.00	12.00	4.70	2.96
Words reading speed (syll/sec)	2.26	6.40	3.81	0.85
Words reading errors	.00	22.00	3.00	3.65
Reading Comprehension (number of correct answers)	7.00	21.00	13.51	3.24

Table 4. Reading skills at T2 - February 2022

Fig. 2 shows the mean score expressed in syllables per second obtained by the group in reading fluency of both text and words.

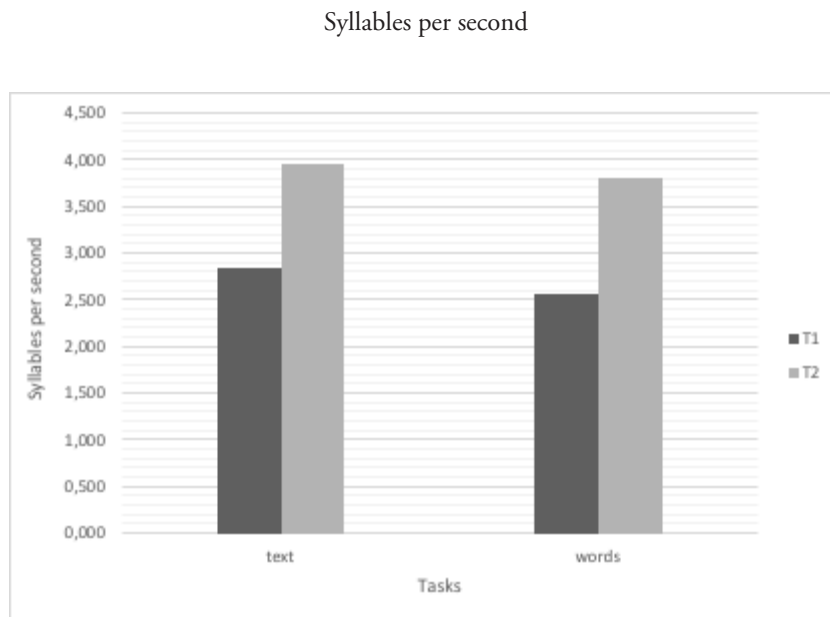


Figure 2. Syllables per second in Text reading and words reading at T1 and T2

The paired sample *t*-Test between T2 and T1 showed that there is a significant difference between children before and after covid-19 pandemic in the reading speed of text passage ($t(48)=15.23, p < .001$) and of words ($t(48)=22.165, p < .001$), showing that typical readers improved significantly their reading speed. Moreover, children within our group showed a reduction of errors in word reading ($t(48)=3.67, p = .001$).

Regarding reading comprehension, children showed an increase of correct answers in the task at T2 compared to T1 ($t(48)= 6.52, p < .001$). Tab. 5 sums up the *t*-Test results.

	M	SD	t	p-value
Text reading speed at T2 Text reading speed at T1	1.13	0.52	15.23	.000*
Text reading errors at T2 Text reading errors at T1	.32	2.87	.80	.430
Words reading speed at T2 Words reading speed at T1	1.24	.39	22.17	.000*
Words reading errors at T2 Words reading errors at T1	2.14	4.09	3.67	.000*
Reading comprehension at T2 Reading comprehension at T1	2.71	2.91	6.52	.001*

Table 5. Comparison of performances at T2-T1

Fig. 3 represents the improvement from T1 to T2 within our group and in literature in terms of syllables per second in both tasks. As it is shown in the image, the inclination of the line is almost identical if we compare our data and the ones from the literature, meaning that the increment of speed happened as ex-

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pected during the pandemic. The gap between the lines that represent our group and the literature lines is not significant; therefore, it is possible to assume that the two lines for each task belong to the same population of typical readers.

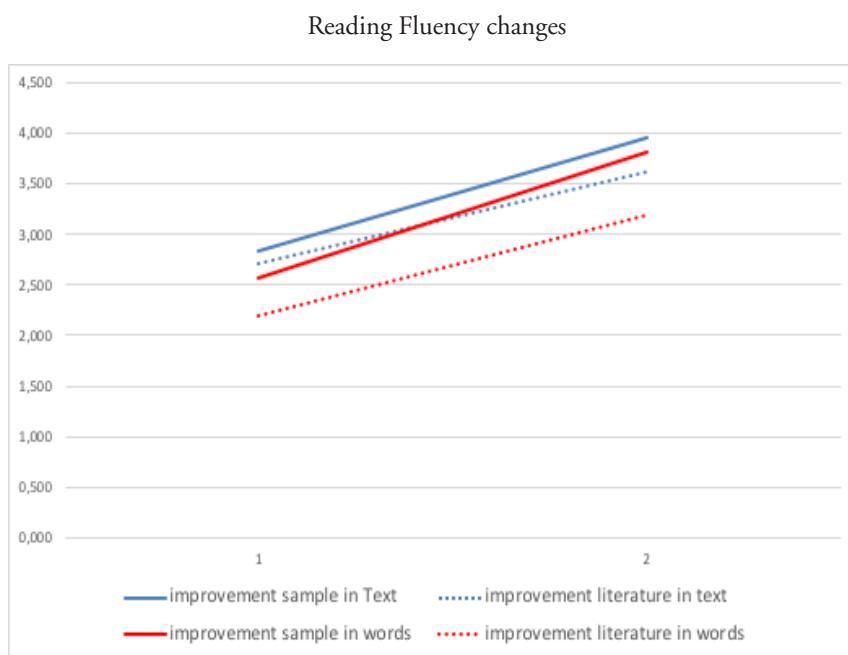


Figure 3. Improvement in reading fluency from T1 to T2 in our group and in literature

4. Discussion

Several papers (Bacher-Hicks et al., 2020; Kuhfeld et al., 2021; Scarpellini et al., 2021) investigated scholastic outcome with online teaching due to covid-19 pandemic. All the authors seem to agree on the fact that psychological and cognitive worsening should have affected children as a result of switching to distance learning.

The aim of this study was to investigate the evolution of reading speed and accuracy on typical readers, in order to determine whether online teaching was a limit for the development of reading skills. Baschenis et al. (2021) focused on the improvement rate in reading fluency in dyslexic children, finding a lower increase than expected during the pandemic.

The results of our study indicate that there has been an improvement in reading fluency that is consistent with the gain in two years of almost 1 syllable per second, coherent with what was expected. Only 34% of our participants did not achieve the improvement predicted. Among them, 30% of subjects already achieved a reading speed score over the average at T1 ($SD > 1.5$) and another 59% reached more than three-quarter of the expected improvement, which means a gain of .75 syllables per second in two years. Only the 11% of the participants gained a smaller improvement than what was expected. A possible explanation for this might be that the data at T2 were collected some months before the end of the school year.

Reading accuracy has improved as well, since the number of errors significantly decreases in the words reading task. The improvement is consistent and coherent with what is expected; 24.5% of our participants did not decrease its number of errors as much as predicted, but among this percentage the 75% already showed a low number of errors at T1 ($SD < -1.5$).

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Moreover, the children we tested performed a reading comprehension task at T1 and T2 revealing a significant increase of correct answers. It may be possible that these students benefited from a more automated reading fluency in order to move their attentional focus to reading comprehension.

Nevertheless, little is known about the evolution of reading comprehension's skills across school years. Further research is needed to investigate this topic in correlation with different teaching modalities. To the best of our knowledge, as for today there is no consistent data that allows us to make an esteem regarding the gain expected in reading comprehension, therefore we can only state that within our group there has been an improvement in terms of reading comprehension, but we do not have enough data to declare that the improvement that occurred with online teaching would have been the same with face-to-face teaching.

In conclusion, the results of this research seem to support the idea that despite online teaching, typical readers might have a naturally occurring improvement of their reading fluency (in terms of speed), according to what is expected from the general linear trend. We have enough data regarding reading fluency to assume that in our group the gain reached in two years of mostly online teaching is the same gain that is expected with face-to-face teaching. Despite our group resulted statistically representative of the population of typical readers, we must be cautious about generalizing our outcomes; the socio-economic background of Italian private schools consists of children coming from middle-high classes families. This factor might have had an impact on the availability of the parents and their support during the online teaching period. Future studies might consider socio-economic status as an intervening factor and therefore have a better picture of the hierarchies of events involved in reading processes under different teaching conditions.

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