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EVOLUTION OF READING SPEED OVER THE FIRST CYCLE OF ELEMENTARY SCHOOL

Cristina Rodrigues Leitão Prodanoff

Renata Mousinho

Abstract: Reading speed is an important competence to be evaluated, given its correlation with fluency and reading comprehension. The latter, the main objective of reading, is fundamental to learning and good school development. The objective of this work is to follow the evolution and development of oral reading speed throughout the first cycle of fundamental education, through a longitudinal study, through comparisons between the reading level of a given year with the subsequent year. The sample consisted of 40 children in typical development, evaluated from the 2º to the 6º year of elementary school, and the reading speed was calculated by the number of words read per minute. The results showed high statistical significance, confirming the hypothesis that this speed increases with the advancement of schooling. The greatest increase occurred between the 2º and 3º grades of elementary school, suggesting that students, despite still reading primarily through the phonological route, begin the reading process through the lexical route at this stage, which is improved throughout schooling. However, the increments in reading speed are smaller and smaller as the child advances to the following years, which may be related to vocabulary stabilization and the pattern of development of executive functions related to language processing. The high statistical significance revealed demonstrates that reading speed can be a good indicator of difficulties in this area, serving as a parameter for identifying children at risk for a specific reading disorder (dyslexia).
Keywords: Reading. Speed measurement. Learning. Child. Schooling.

INTRODUCTION

The readingit is an important means of transmitting culture and social integration of the individual (KOMENO et al., 2015; MESSIAS et al., 2008). Its learning and evolution are, therefore, some of the main objectives of fundamental education, since it is necessary for the learning of all disciplines, being an important way of acquiring knowledge and school content.

It is a consensus in the literature that reading is a human invention and, therefore, learned; unlike oral language, whose competence for acquisition is innate to the human being, it is enough that there is communicative intention and the child's exposure to linguistic stimuli for it to be acquired. Thus, oral language is natural to the individual and serves as the basis for learning written language (MATTOS, 2017).

The readingit is a complex activity that involves multiple interdependent processes, being fundamentally composed of components of decoding and word recognition and comprehension (LOPES; FILIPE; MONIZ, 2014; OLIVEIRA; GERMANO; CAPELLINI, 2016). One of the models that seeks to justify the processing of information during reading (and also writing) is the dual route model, widely cited in the literature to explain the word recognition process, in which this can occur through a process of phonological mediation (phonological route) or direct visual recognition (lexical route) (ARAÚJO; MINERVINO, 2008; COLTHEART et al., 2001; CUNHA; CAPELLINI, 2009; OLIVEIRA; CAPELLINI, 2010; SALLES; PARENTE, 2002).

When the child begins to learn to read, this is initially done through grapheme-phoneme conversion, characteristic of the phonological route, in which the student will visually recognize each letter of the word, associating it with the corresponding phoneme. Each of these sounds/phonemes is stored until it forms the phonemic construction of the read word, which will be

identified by the auditory word recognition system through access to the corresponding phonological representation, thus enabling the recovery of its meaning in the semantic system and its articulatory production. This process is known as phonological decoding, and plays an important role in the beginning of learning to read, since it provides access to the phonological representations of words acquired through oral language, recovering their meaning, as well as the formation of the corresponding orthographic representations. Such ability will allow the individual, later, to read through the lexical route (CUNHA; CAPELLINI, 2009; DOURADO; SCHMID; CHIAPPETTA, 2005; KOMENO et al., 2015; MORAIS, 1996; OLIVEIRA; CAPELLINI, 2010; OLIVEIRA, GERMANO; CAPELLINI, 2016; SALLES; PARENTE, 2002).

The decoding process using the phonological route is, therefore, generative, as it enables the incorporation of the orthographic representation of words into the visual lexicon: either words already acquired through oral language, but not yet represented in the visual lexicon; or new words found for the first time (SALLES; PARENTE, 2002). Thus, as the individual maintains contact with reading, he acquires the orthographic representations of words, which are recorded in memory, starting to compose the visual lexicon, as well as reinforcing those that already exist. Reading through the lexical route, therefore, will depend on the existence of such orthographic representations in the lexicon, since it occurs through direct visual recognition of the written word, that is, it is necessary for the reader to know the word to be read. The individual, when looking at the word, immediately recognizes it through access to its orthographic representation, recovering its meaning, through the semantic system, and its pronunciation (CUNHA; CAPELLINI, 2009; OLIVEIRA; CAPELLINI, 2010; OLIVEIRA; GERMANO; CAPELLINI, 2016). The greater the occurrence of a given word in the reading, the better, therefore, its orthographic representation will be, making it more accurate and its rescue from the lexicon is quick (ARAÚJO; MINERVINO, 2008).

Therefore, reading will be faster, the greater the direct visual recognition of words, characterizing the predominance of the lexical route in the word recognition process during reading. This way, with the advancement of schooling and the increase in reading frequency, students become increasingly familiar with a greater number of words, whose orthographic representations compose the lexicon, which becomes increasingly robust, thus providing an increasing reading speed, with the increasingly active participation of the lexical route (ÁVILA; CARVALHO; KIDA, 2009; CAVALHEIRO; SANTOS; MARTINEZ, 2010; DE JONG et al., 2009; KOMENO et al., 2015; MACEDO et al., 2005; SALLES; PARENTE, 2002).

This way, it is expected that, as students progress in elementary school, they will acquire fluency in reading, automatically recognizing words in the text and recovering their meaning quickly and accurately. Such competence, once developed, will provide the learner with the release of cognitive resources, such as attention and memory, for other activities related to understanding and learning. However, any difficulties that arise during this process, if not detected and treated in time, can generate cumulative deficits, causing damage to the child's school development, a feeling of incapacity and low self-esteem (AQUINI et al., 2007; KOMENO et al, 2015; MARTINS; CAPELLINI, 2019; MILLER; KEENAN, 2009; MOUSINHO; CORREA, 2013; PIKULSKI; CHARD, 2005; SALLES; PARENTE, 2002).

The present study aims to verify the evolution of oral reading speed from the 2nd

to the 6th year of elementary school, as well as to compare this speed in a given year with that of the following year.

From the results found, we want to confirm the hypothesis that there is an increase in reading speed throughout the first cycle of fundamental education as the school years progress. In addition, it is intended to identify the stage in which the greatest increase in this speed occurs, reflecting on the possible reason that justifies this increase. It is also intended to assess whether there is a pattern of variation in this growth with the advancement of schooling, that is, to verify whether this occurs in a constant, decreasing or increasing manner.

METHOD

This is a longitudinal study supported by research approved by the Research Ethics Committee of the Instituto de Neurologia Deolindo Couto under nº 003/07. The study included all children enrolled in the year 2007 in the first year of elementary school at a reference federal institution, whose admission was through a draw (varied social class). All guardians signed the Free and Informed Consent Form.

The sample consisted of 40 students in the second year of elementary school, of both genders and in typical development, literate in this institution.

The children were monitored and reassessed annually, until the 6th year of elementary school, when the sample was reduced to 38 students, due to changes in school and/or failure. The assessment was carried out individually, at the beginning of each school year. To verify the oral reading speed, the oral reading of narrative texts was timed, with a complexity compatible with each school level, but without or with few dialogues, since the type of structures contained in the texts can influence the final speed (MOUSINHO, 2015; STITES; LUKE; CHRISTIANSON, 2013; YAO; SCHEEPERS, 2011). Once the reading time in seconds was obtained, from the beginning to the end, the number of words correctly read per minute (PPM) was calculated, a measure defended as of great validity by researchers in the area (MOUSINHO, 2015; SKINNER et al, 2009).

The readings were carried out individually, in a single session, at the time provided by the school. The participants remained seated at a school desk during the reading.

RESULTS

Statistical analysis of data was performed using descriptive statistics measures (mean and standard deviation) and Student's t test for paired samples, with a significance level of 5% ($p<0.05$), for comparison of results.

Table 1 demonstrates the descriptive analysis of oral reading speeds, with the averages of these speeds, measured in words read per minute (WPM), and standard deviations, as well as the t values calculated in the pairing between the samples and the level of significance (p-value):

From the analysis of the data, it appears that the calculated t values point to the validity of the scientific hypothesis that the oral reading speed of a given school year is greater than that corresponding to the previous school year, with a very high level of significance ($p <0.001$ in the pairings between the 2nd and 5th year and $p<0.005$ between the 5th and 6th year). This data points to the evidence that there is an increase in the speed of oral reading as the child advances in schooling. The high values of standard deviations demonstrate the variability of scores found among the sample members.

Table 2 shows the evolution in the growth of reading speed, through the differences obtained with the pairing between the samples of a given school year and the subsequent year.

2nd year		3rd year			
Average	Detour pattern	Average	Detour pattern	t	P
57.8	32,869	84.5	27,468	-6,539	0.000
3ºyear		**4ºyear**			
Average	Detour pattern	Average	Detour pattern	t	P
84.5	27,468	107.5	28,828	-6,475	0.000
4ºyear		**5ºyear**			
Average	Detour pattern	Average	Detour pattern	t	P
107.5	28,828	127	30.631	-5,298	0.000
5º year*		**6º year**			
Average	Detour pattern	Average	Detour pattern	t	P
126.1	31.072	139	24,787	-3.201	0.003

Note: The mean and standard deviation values for the 5th year differ slightly from those reported in the previous line, as 38 samples (students) were used here. Comparing the 4th with the 5th year, 40 samples were considered.

Table 1: Mean reading speed (PPM), standard deviation, t values and significance level.

Source: Survey data.

	Difference between means (ppm)*	**Standard deviation**
3º year – 2º year	26.76	25,882
4º year – 3º year	22.96	22,424
5º year – 4º year	19.48	23,251
6º year – 5º year	12.91	24,857

Note: Difference between means = Mean of differences in pairing.

Table 2: Difference between reading speed averages for a given school year and the previous year, accompanied by the respective standard deviation.

Source: Survey data.

Data analysis, especially with regard to the difference between reading averages between one school year and the previous one, demonstrates that the positive variation rate (increase/growth) in reading speed is greater between the 2nd and 3rd years, decreasing in subsequent years.

DISCUSSION

It is observed that the reading speed always grows throughout the first cycle of fundamental education, since the differences found are always positive, that is, the reading speed in a given school year, in number of words read orally per minute, is always higher than the previous year; however, this increase occurs at decreasing rates, at a decelerating pace, so that, as the child advances in schooling, the increments in this speed are smaller and smaller.

The results show that there is a gradual increase in the students' oral reading speed as they progress through the first cycle of elementary school. Such findings are consistent with findings from previous studies (ÁVILA; CARVALHO;KIDA, 2009; CELESTE et al., 2018; DELLISA; NAVAS, 2013; MOUSINHO; 2015; MOUSINE; CORREA, 2013; WANG et al., 2011). It is observed that the speed of oral reading is lower in the early years, as students tend to read more slowly at the beginning of schooling, since reading processing occurs primarily through the phonological route at this stage, through conversion grapheme-phoneme (CUNHA; CAPELLINI, 2009; DELLISA; NAVAS, 2013; KOMENO et al., 2015; MACEDO et al., 2005; SALLES; PARENTE, 2002).

The phonological route, therefore, seems to have a fundamental role in the development of reading and in the gradual increase of its speed, favoring the increasingly efficient performance of the lexical route, contributing to the acquisition of fluency and to the automaticity of this process (MARTINS; CAPELLINI, 2019; SALLES; PARENTE, 2002).

As the children advance in schooling, moving on to the following years, it is observed that the reading speed improves. This is justified by the repeated contact with reading over the years, which facilitates the memorization of words found in texts, so that their orthographic representations are gradually incorporated into the visual lexicon. This allows the child, with advancing schooling, to start reading with increasing participation in the lexical route, identifying words and recovering their meaning through direct visual recognition and not just through graphophonemic decoding; faster, therefore (CAVALHEIRO; SANTOS; MARTINEZ, 2010; CUNHA; CAPELLINI, 2009; DE JONG et al., 2009; KOMENO et al., 2015; MACEDO et al., 2005; SALLES; PARENTE, 2002).

Analyzing the evolution of reading speed between school years, it appears that its greatest increase occurs between the 2nd and 3rd years, which may suggest that children start

reading through the lexical route at this stage, although still incipient, with a predominance of the phonological route. Possibly, in the 3rd year, children already have a considerable number of regular high-frequency words with their orthographic representations recorded in their memory, due to the stimuli and repeated contact with reading in the previous year (2nd year), which allows them to start reading process by the lexical route in this phase.

However, in the 3rd year, the child still does not have a large vocabulary of words to be immediately identified in the lexicon, without phonological mediation, in order to allow the preponderant use of the lexical route; therefore, preferentially use the phonological route in this phase (CUNHA;

CAPELLINI, 2009; SALLES; PARENTE, 2002). At this stage, children still have less knowledge of irregular words, especially those of low frequency, compared to regular words (SALLES; PARENTE, 2007). However, from the 4th year onwards, they are better able to identify any type of stimulus, starting to read primarily through the lexical route, which justifies the large increase in reading speed observed between the 3rd and 4th years (CUNHA; CAPELLINI, 2009 ; MOUSINHO, 2009; MOUSINHO; CORREA, 2013; SALLES; PARENTE, 2002).

It can also be observed, in relation to the evolution in reading speed, that the increases occurred in a decreasing way, that is, the biggest increase occurred from the 2nd to the 3rd year, being also expressive from the 3rd to the 4th year, albeit a little smaller. It appears that the increases were smaller and smaller as the children progressed in schooling for the following years. That is, with advancing schooling, the increase in reading speed between a given year and the subsequent year was smaller than the increase seen between that given year and the previous year.

With a view to justifying such behavior, it must be emphasized that, although we are dealing here with reading speed, there are studies that relate verbal fluency with vocabulary, and a correlation was found only in younger children. This would happen because vocabulary is a more elementary skill, which becomes more stable over time, so that fluency performance, with advancing age, would become more influenced by more complex skills, such as executive functions (DIAS; SEABRA, 2014).

It is suggested that this vocabulary stability over time is related to the fact that the most frequent words in the language are already incorporated into the lexicon of older children, and can be accessed quickly through the lexical route. For this reason, the increase in the reading speed of these children would be lower and would not be justified by the vocabulary, since, with the advancement of schooling, this variable would no longer significantly influence that speed. However, we cannot forget the important role occupied by executive functions in language processing, which continue to develop into adolescence.

Thus, although vocabulary does not significantly influence reading speed in older children and adolescence, it is suggested that this speed still grows throughout schooling during this period, although with increasingly smaller increases, mainly due to the development of different executive functions that provide this increase to the limit of cognition for language processing with understanding.

In fact, research points to the reality that the skilled reader reads around 250-300 words per minute, which is a cognitive and physiological/visual limit for this reader to perfectly understand what he reads (NATION, 2009; RAYNER et al., 2016).

Reading speed would be much more related to language processing skills than the ability to control the eyes. It must be noted that some studies related to the increase in reading speed in fast reading courses clarify that these are based on the rapid capture of visual information and that such a practice, despite leading individuals to higher rates of speed, also leads to a loss of understanding. Such loss would be justified by the fact that if the visual stimulus arrives faster than the cognitive system can process it, this increase in speed is wasted in loss of understanding (NATION, 2009; RAYNER et al., 2016).

Thus, as the purpose of reading is comprehension, there comes a time in an individual's life when the reading speed becomes practically constant (it can obviously improve with greater reading stimuli, but not so much), with an exchange between speed

and understanding, due to the limitation of cognitive resources related to language processing (RAYNER et al., 2016), which include executive functions.

Executive functions are related to cognitive and metacognitive development and include several components that develop throughout childhood and adolescence, among which we can mention working memory skills, inhibitory control, flexibility, selective attention, verbal fluency and planning, with evidence that such skills develop throughout childhood and adolescence, until early adulthood. However, in a variable way (DIAS; MENEZES; SEABRA, 2013; ELIOTT, 2003).

Many studies have already been carried out with a view to studying different executive functions as a function of age, pointing out that the development of these skills occurs more quickly during childhood, becoming slower and less progressive during adolescence, with a tendency towards stability in around the age of 14/15, although changes may occur in some skills, differently and at different rates, depending on the skill analyzed (ANDRADE; DE SANTANA, 2017; BEST; MILLER; NAGLIERI, 2011; COWAN, 2016; DIAS; MENEZES; SEABRA, 2013; GATHERCOLE et al, 2004; HUIZINGA; DOLAN; VAN DER MOLEN, 2006; KLENBERG; KORKMAN; LAHTI-NUUTTILA, 2001; KORKMAN; KEMP; KIRK, 2001).

This development has been related to the maturation of the prefrontal cortex and changes in its functional pattern, especially during adolescence (DIAS; MENEZES; SEABRA, 2013; DURSTON; CASEY, 2006;ESTÉVEZ-GONZÁLEZ; GARCÍA-SÁNCHEZ; BARRAQUER-BORDAS, 2000; LAMM; ZELAZO; LEWIS, 2006; PAPAZIAN; ALFONSO; LUZONDO, 2006).

Thus, as reading speed requires the active participation of working memory, retaining and manipulating information, as well as other executive functions (COWAN, 2016), it is suggested that this speed has a pattern of growth and development similar to that observed to the executive functions that support it. Thus, its growth becomes slower and less expressive during adolescence, tending to stability at the end of the second cycle of fundamental education.

This suggestion is in line with the data from the present study, which demonstrate that the decrease in increases in reading speed seems to converge to a constant speed in more advanced years. There is a study that demonstrates a tendency of stabilization in reading speed at the end of the second cycle of elementary school (MOUSINHO, 2015).

CONCLUSION

This study points to evidence that oral reading speed grows throughout schooling, which can be explained by the fact that children, as they have more contact with reading, become increasingly familiar with a growing number of of words, starting to use the lexical route more frequently; reading, thus, with increasing speed.

The pattern of evolution in reading speed identified in the study can contribute by helping education and health professionals to identify students who are not following the typical development curve of this skill, so important and necessary, but not unique or sufficient, for the acquisition of fluency and full comprehension.

Further studies and discussions are necessary regarding the reason(s) that justify(m) the decreasing increase in the reading rate (deceleration in the growth of reading speed) with advancing schooling.

Reading speed can be a good indicator of difficulties in this area, serving as a parameter for identifying children at risk for a specific reading disorder (dyslexia).

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