

Speed and pressure of handwriting as critical issues of the contemporary age: A research in Italian students in early literacy

Simone Aparecida Capellini*, Gabriela Franco dos Santos Liporaci**, Isabela Pires Metzner**, Noemi Del Bianco***, Ilaria D'Angelo****, Arianna Taddei*****, Catia Giaconi*****

Abstract

Among the present critical issues that pedagogy and special teaching have to deal with it is possible to notice the contrast between writing and technology, up to the pertinent field of prevention and observation of dysgraphies. The authors present in the following article a study conducted in Italy aimed at evaluating writing, specifically in the speed and pressure parameters in early literacy using *NeuroScript Movalyzer Software*. The aim is to implement suitable research paths to support the dissemination of observation procedures and inclusive teaching practices, capable of enhancing the fluidity of writing by all students.

Keywords: Writing, Dysgraphia, Observation, Inclusive Didactics

Introduction

Writing is a cultural invention and its first forms date back to six thousand years ago. It has the function of communication, that is, it plays the role of spreading the culture and concepts of humanity. The act of writing is the

* Full Professor of Speech and Hearing Sciences Department, São Paulo State University “Júlio de Mesquita Filho” UNESP, Marília, São Paulo, Brazil. E-mail: sacap@uol.com.br.

** Investigation Learning Disabilities Laboratory (LIDA) at the Speech and Hearing Sciences Department, São Paulo State University “Júlio de Mesquita Filho”, UNESP, Marília, São Paulo, Brazil. E-mail: cdi@fapesp.br.

*** PhD student in Human Sciences, Department of Education, Cultural Heritage and Tourism, University of Macerata, Italy. E-mail: noemi.delbianco@gmail.com.

**** PhD student in Education, Cultural Heritage and Tourism, University of Macerata, Italy. E-mail: ilariadng3@gmail.com.

***** RTDB, Department of Education, Cultural Heritage and Tourism, University of Macerata, Macerata, Italy. E-mail: arianna.taddei@unimc.it.

***** Full Professor of Didactic and Special Pedagogy, Department of Education, Cultural Heritage and Tourism, University of Macerata, Italy. E-mail: catia.giaconi@unimc.it.

subject's ability to express his thoughts and ideas, being fundamental for success in school, in the job market and for participation in modern society (Kim, Al Otaiba, Wanzek, 2015).

The quality of handwriting has a fundamental role in school performance, as the academic skills of students, regardless of their country, from elementary school through high school, are measured by tests involving proficient written in international competitions and tests thus, poor calligraphic writing can mask a student's academic ability since the highest grades are always assigned to works written in legible letters than to works with illegible letters (McCarney *et al.*, 2013).

When school is competent in other areas, such as reading and/or mathematics, questions of difficulty with handwriting can be attributed to laziness or lack of motivation, however, this is a mistake, since difficulties with calligraphic writing are considered as a specific learning difficulty, which compromises written production Language (Berninger *et al.*, 2009; Federe *et al.*, 2007).

In order for the student to be precise when registering letter shapes, it is necessary to use fine motor skills, visual perception, visual-motor integration, maturity and cognitive integration (Brown *et al.*, 2008, 2009; Tsai *et al.*, 2008; Shams *et al.*, 2010), which makes the development of writing a long, demanding and complex process (Tsai *et al.*, 2008), requiring the involvement of different skills and many neurological circuits interacting dynamically with each other to produce the desired result (Qiu *et al.*, 2007; Wardak *et al.*, 2011).

It is notable that during the process of learning handwriting, students acquire their own handwriting style (Simonnet, Anquetil, Bouillon, 2017), since their individual characteristics such as gender, level of skill and practice with writing, coordination visual-motor, motivation, among others, can interfere with the quality and speed of writing (Shen *et al.*, 2012).

However, when the legibility of the writing interferes with the understanding of the material read, such as, for example, changes in the quality of the letter formation, the alignment and spacing of letters and words, the dimensioning of the letters, among others, it can be raised evidence that the writer may also be presenting changes in writing speed because the student needs to be able to transfer his ideas to a paper fluently, while trying to keep up with his thoughts, on a certain subject (Rosenblum, Parush, Weiss, 2003; Shen *et al.*, 2012).

The type of text required of students also influences the speed, due to the task demand (Graham, Weintraub, 1996), that is, writing a self-generated text is more demanding than the copied text. This is because when writing a self-generated text, such as a diary, for example, it involves complex cognitive

processing; ideas need to be generated and long-term memory is used to form the sequence of letters, words, and, ultimately, to build a sentence (Graham *et al.*, 2006).

The parameters of speed and pressure are related, because at the moment of writing, the pressure information exerted on the pencil and on the paper, as well as the positioning of the fingers and hand, the direction of the pencil movements and mistakes made, are stored in long-term memory, to be remembered when writing is repeated (Almeida, 2013). With practice, writing becomes automatic and the control of coordinated movements of writing improves with age and education, favoring an increase in writing speed (Meulenbroek, Van Galen, 1986; Shen *et al.*, 2012; Giaconi, Capellini, 2015; Cardoso, Capellini, 2016).

The aim of this study was to characterize the speed and pressure of handwriting in Italian students in the early stages of literacy.

1. Material and Method

Twenty-five students of both genders participated in this study, 16 males and 9 females, enrolled in the second year of elementary school I at a school in the city of Macerata, Italy.

The writing analysis procedure was performed by the *NeuroScript Moyalzer Software*, which analyzes the movement performed through a digitizing table, used to interpret the movements generated by a pen, providing data of inclination, speed, acceleration, and pressure of the pen. In addition, it is used to process handwritten images, being able to record and segment the writing, descent, elevation, and pauses of the pen.

To carry out the data collection, a notebook provided by the Learning Deviations Research Laboratory - LIDA was used coupled to a digitizing tablet of the Wacon brand, in which the student was asked to write the word “Educazione”, as this word contains all the vowels of the alphabet.

This assessment was applied in 20 minutes, asking each student to write the same word twice in a row. For this study, the measures of writing speed and pressure were considered.

The data obtained were analyzed statistically in order to compare the results of the first and second attempts of students in writing the word “Educazione”. The program *IBM SPSS Statistics (Statistical Package for the Social Sciences)*, version 25.0, was used to obtain and analyze the results. Statistically significant results will be marked with an asterisk “*”.

2. Results

Table 1 shows the performance of students when compared to the skills of writing speed and pressure in the first and second attempts. The results analyzed statistically, showed a significant difference in the performance of the students regarding the ability of pressure during writing, showing better performance.

Tab. 1 - Distribution of means, standard deviations, and p-value regarding the performance of students in the skills of pressure and speed in the first and second attempts

Ability	n	Average	Standard deviation	Percentile 25	Percentile 50	Percentile 75	p value
[VEL] T_1 [average]	25	0,128	0,226	-0,005	-0,005	0,171	0,989
[VEL] T_2 [average]	25	0,086	0,106	0,047	0,066	0,135	
[PRE] T_1 [average]	25	286,012	130,465	179,406	392,723	397,633	< 0,001*
[PRE] T_2 [average]	25	80,550	42,571	55,894	72,424	105,704	

Legend: Vel - speed; T1- first attempt; PRE - pressure; T2 - second attempt

The results presented in Table 1 showed that students in the 2nd year of literacy showed similar performance in writing speed when compared to the first and second attempts, while when compared to the writing pressure skill, a higher average was observed in the first attempt in relation to the second demonstrating that when there is less attention to the task of writing the word, the pressure to write is less.

The 25th and 75th percentiles shown in Table 1 indicated that in this population of students, there is variability in performance for both writing speed and pressure, thus indicating the shortest and longest duration for the writing of the word used in this study.

3. Discussion

The fact that the students in this study did not present a discrepancy in the writing speed parameter can be explained by the fact that all students submitted to the method of this study are within the same age group and grade year, therefore, exposed to the same amount of exposure to handwriting material.

This finding corroborates a study by Lin *et al.* (2015) who described that when the writing pattern is not automated there may be no variation in the speed of writing, however, with the increase in the grade year, there is a decrease in speed. The greater the student's writing experience, the lower the writing speed.

Unlike what happened in this study, there was a difference between attempts at the writing pressure skill, indicating that younger children may take more time in copying tasks, this can be justified by the fact that younger children do not yet have internalized motor programs, as described by Barrientos (2016). This means that the pressure can change when the student is subjected to a successive copy of the same word because knowledge of the word on the first attempt and recognition on the second attempt can favor the motor learning of calligraphic writing.

There are still few studies in the literature that use technology to measure speed and pressure skills in students in the initial phase of literacy. However, these studies are necessary for normality measures to be established so that these parameters can be used later to assist in the diagnosis of specific calligraphic writing disorder, where speed and legibility characteristics are important to be considered for the diagnosis of dysgraphia.

Future studies that investigate and monitor the development of these parameters in students in the initial phase of literacy need to be conducted with expanding the sample so that the profile of these students' handwriting is known so that prevention and early intervention strategies are used in an educational context to minimize the impacts of quality of dysgraphic writing on the academic life of students.

4. Conclusion

The findings of this study allowed us to conclude that Italian necklaces in the initial phase of literacy have the same speed regardless of the number of writing attempts, while the pressure shows variability demonstrating that the number of writing attempts can influence this ability.

The present study, in addition to the results, presents an interesting research within the testing of procedures for identifying early signals which, on the whole, can lead to the hypothesis of cases at risk of dysgraphia. Specifically, the experimentation was conducted in Italian classes of the first cycle, because is an important period for prevention. In fact, a general agreement is registered on the timing of the diagnosis. To avoid extending the assessment to situations of delay or to evolutionary variations that can potentially occur over time, the timing of the diagnosis is identified «with the

completion of the second year of primary school» (Consensus Conference, 2009, p. 43) for Specific Disorders to reading and writing and with the completion of the third year of primary school for the specific Calculus Disorder. The importance of training in the observation of any signs at risk and therefore starting early not only adequate identification procedures, but also of strengthening. Identification, early detection and timely intervention, as we will see, are recognized as indicators of effectiveness for the future profile of the subject with Specific Learning Disorder. This, however, postulates the need for specific training, on the one hand, to avoid underestimating these situations of “alert” of a potential Disorders framework, on the other, not to exceed in a widespread association between simple school difficulties and Specific Learning Disorders.

With a view to the dissemination of investigations that systematize early identification procedures that can be used in the classroom (Giaconi, Capellini, 2015), other delicate issues are positioned at the center of the debate, national and international, such as: the detection of early signals, the evaluation and interventions in favor of subjects with Specific Learning Disorders. The matter has reached several points of high consensus, but leaves some knots open which still need to be studied in depth by careful scientific investigations. In conclusion, this article deserves to be re-evaluated an element, shared and proven by various data from the scientific literature, which concerns the value of the earliness of both diagnosis and intervention. Earliness seems to be a highly significant prognostic indicator in the history and evolution of DSA conditions (Gersons-Wolferbensberger, Ruijsenaars, 1997) and is closely related to the effectiveness of the intervention itself.

The scientific investigation continues to consolidate the path of research of “risk factors” which, pre-existing to the appearance of the disorder, could increase the appearance of Specific Learning Disorders. It should be noted that timely taking charge reduces the extent of the disorder and the risk of the onset of secondary comorbidities, for example, in terms of «psychopathological profile» (Penge, 2010, p. 39). For this reason, we believe that it is fundamental to start, from the first training courses for future teachers, educators and pedagogists, a reflection on the conceptual and operational lines and to enter into the logic of building pertinent skills to be integrated together with those of others. Specialists, who for example deal with the diagnostic process, to achieve a real management of subjects with Specific Learning Disorders. In addition, the longitudinal research that allows to appreciate over time the incidence of an early identification of risk factors and a timely intervention on the evolution of the disorder and to conduct significant observations regarding school and professional orientation need to be expanded (Giaconi, Taddei, Del Bianco, Capellini, 2018).

References

- Almeida I. (2013). Evaluation of the handwriting process in children with poor handwriting quality and good handwriting quality. Master's Thesis.
- American Psychiatric Association *et al.* (2013). Diagnostic and statistical manual of mental health disorders. 5th edn Washington. DC: American Psychiatric Association.
- Barrientos P. (2016). Handwriting development in Spanish children with and without learning disabilities: A graphonomic approach. *Journal of learning disabilities*, 5(50): 552-563.
- Berninger V. W. *et al.* (2009). Comparison of pen and keyboard transcription modes in children with and without learning disabilities. *Learning Disability Quarterly*, 32(3): 123-141.
- Brown T., Rodger S. (2008). Validity of the developmental test of visual-motor integration supplemental developmental test of visual perception. *Perceptual and motor skills*, 103(3): 659-678.
- Brown T., Unsworth C., Lyons C. (2009). Factor structure of four visual-motor instruments commonly used to evaluate school-age children. *American Journal of Occupational Therapy*, 63(6): 710-723.
- Cardoso M. H., Capellini S. A. (2016). Identification and characterization of dysgraphia in students with learning difficulties and disorders. *Distúrbios da Comunicação*, 28(1): 27-37.
- Consensus Conference (2009). *Disturbi Evolutivi Specifici di Apprendimento. Raccomandazioni per la pratica clinica della dislessia, disortografia, disgrafia e discalculia*. Trento: Erickson.
- Federe K. P., Majnemer A. (2007). Handwriting development, competency, and intervention. *Developmental Medicine & Child Neurology*, 49(4): 312-317.
- Giaconi C., Capellini S. A. (2015). *Conoscere per includere*. Milano: FrancoAngeli.
- Giaconi C., Taddei A., Del Bianco N., Capellini S. A. (2018). Inclusive University didactics and technological devices: a case study. *Education Sciences and Society*, 1, testo disponibile al sito http://ojs.francoangeli.it/_ojs/index.php/ess/article/view/6248/300 28.03.2020.
- Graham S. *et al.* (2006). Dimensions of good and poor handwriting legibility in first and second graders: Motor programs, visual-spatial arrangements, and letter formation parameter setting. *Developmental Neuropsychology*, 29: 43-60.
- Graham S., Weintraub N. (1996). A review of handwriting research: Progress and prospects from 1980 to 1994. *Educational psychology review*, 8(1): 7-87.
- Kim Y. S., Al Otaiba S., Wanzek J. (2015). Kindergarten predictors of third grade writing. *Learning and Individual Differences*, 37: 27-37.
- Lin Q. *et al.* (2015). Characterization of fine motor development: Dynamic analysis of children's drawing movements. *Human movement Science*, 40:163-175.
- McCarney D. *et al.* (2013). Does poor handwriting conceal literacy potential in primary school children?. *International Journal of Disability, Development and Education*, 2(60): 105-118.

- Meulenbroek R. G. J., Van Galen G. P. (1986). Movement analysis of repetitive writing behaviour of first, second and third grade primary school children. *Advances in Psychology*, 37: 71-92.
- Penge R. (2010). Screening, indicatori precoci e fattori di rischio per i DSA. In Simoneschi G. a cura di, *Annali della pubblica istruzione. La dislessia e i disturbi specifici di apprendimento*, Firenze: Periodici Le Monnier, pp. 37-50.
- Qiu J., et al. (2007). Brain mechanisms underlying visual perception and visual mental imagery of Chinese pseudo-characters: an event-related potential study. *Brain research*, 202-209.
- Rapporto della Commissione sulla dislessia del Consiglio Superiore di Sanità dell'Olanda (1997) riportato da D. C .M., Gersons-Wolferbensberger e W. A. J. J. M. Ruijsenaars. *Journal of Learning Disabilities*, 30(2) (testo adattato da G. Stella)
- Rosenblum S., Parush P., Weiss P. L. (2003). Computerized Temporal Handwriting Characteristics of Proficient and Non-Proficient Handwriters. *American Journal of Occupational Therapy*, 57:129-138.
- Shams L., Kim R. (2010). Crossmodal influences on visual perception. *Physics of life reviews*, 7(3): 269-284.
- Shen I. H., Lee T. Y., Chen C. L. (2012). Handwriting performance and underlying factors in children with Attention Deficit Hyperactivity Disorder. *Research in developmental disabilities*, 33(4):1301-1309.
- Simonnet D., Anquetil E., Bouillon M. (2017). Multi-criteria handwriting quality analysis with online fuzzy models. *Pattern Recognition*, 69: 310-324.
- Tsai C. L., Wilson P. H., Wu Sheng K. (2008). Role of visual-perceptual skills (non-motor) in children with developmental coordination disorder. *Human movement science*, 27(4): 649-664.
- Wardak C., Denève S., Hamed Suliann Ben (2011). Focused visual attention distorts distance perception away from the attentional locus. *Neuropsychologia*, 49(3): 535-545.