Article

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Relationships between verbal fluency and literacy: exploring the influence of oral language on subsequent reading and writing performance

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Abstract

This study analyzed Verbal Fluency as a predictor of reading and writing performance during the first two years of literacy among 51 participants. Verbal Fluency, measured at the beginning of the process, was correlated with reading and writing performance at five points. The results showed significant correlations ($p < 0.05$) between Verbal Fluency and reading and writing skills, ranging from R 0.70 to R 0.56, indicating its relevance in developing these skills. The coefficient of determination (R^2) revealed that Verbal Fluency explained 31% to 49% of performance. However, the correlations decreased over time (from R 0.68 to R 0.56), suggesting that its predictive power diminishes as literacy progresses. These findings highlight the importance of pedagogical practices aimed at developing Verbal Fluency in Early Childhood Education to address literacy delays.

Keywords: Verbal fluency. Predictors of learning. Literacy. Reading. Writing.

Relações entre fluência verbal e alfabetização: explorando a influência da linguagem oral no desempenho ulterior em leitura e escrita

Resumo

Este estudo analisou a Fluência Verbal como preditora do desempenho em leitura e escrita durante os dois primeiros anos de alfabetização de 51 participantes. A Fluência Verbal, medida no início do processo, foi correlacionada ao desempenho em leitura e escrita em cinco momentos. Os resultados mostraram

correlações significativas (p < 0,05) entre Fluência Verbal e habilidades de leitura e escrita, variando de R 0,70 a R 0,56, indicando sua relevância no desenvolvimento dessas habilidades. O coeficiente de determinação (R^2) revelou que a Fluência Verbal explicou entre 31% e 49% do desempenho. No entanto, as correlações diminuíram ao longo do tempo (de R 0,68 para R 0,56), sugerindo que sua capacidade preditiva se reduz à medida que a alfabetização avança. Esses achados destacam a importância de práticas pedagógicas voltadas ao desenvolvimento da Fluência Verbal na Educação Infantil para combater atrasos na alfabetização.

Palavras-chave: Fluência verbal. Preditores de aprendizagem. Alfabetização. Leitura e escrita.

Relaciones entre fluidez verbal y alfabetización: exploración de la influencia del lenguaje oral en el desempeño posterior en lectura y escritura

Resumen

Este estudio analizó la Fluidez Verbal como un predictor del desempeño en lectura y escritura durante los primeros dos años de alfabetización de 51 participantes. La Fluidez Verbal, medida al inicio del proceso, se correlacionó con el desempeño en lectura y escritura en cinco momentos. Los resultados mostraron correlaciones significativas (p < 0.05) entre Fluidez Verbal y habilidades de lectura y escritura, que van de R 0,70 a R 0,56, lo que indica su relevancia en el desarrollo de estas habilidades. El coeficiente de determinación (R^2) reveló que la Fluidez Verbal explicó entre el 31% y el 49% del desempeño. Sin embargo, las correlaciones disminuyeron con el tiempo (de R 0,68 a R 0,56), lo que sugiere que su capacidad predictiva se reduce a medida que avanza la alfabetización. Estos hallazgos destacan la importancia de las prácticas pedagógicas dirigidas a desarrollar la Fluidez Verbal en la Educación Infantil para combatir los retrasos en la alfabetización.

Palabras clave: Fluidez verbal. Predictores del aprendizaje. Alfabetización. Lectura. Escritura.

Initial considerations

In this study, the objective was to analyze whether there is a significant correlation between Verbal Fluency, which is an aspect of oral language, and an indicator of the initial development of reading and writing skills. According to Viana (2002), oral language is fundamental for the development of these skills, since communication is mediated by language. However, according to the author, the importance of orality is often not properly recognized, both in the educational context and in research. In the initial literacy process, certain linguistic skills are essential for adequate learning of the writing system. Among these skills are lexical knowledge, speed of lexical recall, semantic understanding, mastery of grammatical relations, and awareness of linguistic structure (Viana, 2002; Soares, 2021).

These skills develop when language is actively used, either through interaction with the child or by stimulating their reflection on the language, both at home and in formal education. In other words, as suggested by the literature, it is possible to affirm that there is a reciprocal relationship between literacy and oral language, as the development of literacy is associated with the development of oral language.

However, there are still limitations in the scientific documentation on the specific relationship between components of orality and their possible relationships with literacy success. Among these relationships that are poorly documented in the literature, it is possible to mention the deficiency of studies that evaluate Verbal Fluency and its potential to predict subsequent performance in reading and writing, a task that this study proposes to undertake.

The specific objective was to analyze phonological and semantic verbal fluency as a predictor of initial reading and writing learning. Based on this goal, we hypothesize that there is a significant relationship between Verbal Fluency and the initial stages of literacy. According to the findings of Petraça, Crippa, and Dassie-Leite (2023), we expect to find evidence that Verbal Fluency has significant predictive potential for the acquisition and subsequent development of reading and writing skills.

Oral language and its relationship with literacy

Language plays a crucial role in human communication, allowing us to express needs, desires, and feelings from childhood. As Bakhtin (2006) notes, language is essentially dialogic and shaped by social interaction, reflecting the collective nature of communication. Therefore, both genetic-cognitive and social factors are fundamental to language acquisition.

Vocabulary knowledge, as documented by Soares (2021), is related to the contextual understanding of words, which contributes to successful literacy. Accordingly, Viana (2002) argues that the experiences lived by the child contribute to the development of oral language, which influences the initial development of reading and writing.

The interaction between oral language and literacy is complex and multifaceted, involving skills such as phonological and morphological awareness, as argued by Monteiro, Fernandes, and Leopoldina (2021). Capovilla (2020) suggests that these skills are crucial for decoding written words and understanding the structure of the language. Furthermore, aspects such as receptive and expressive vocabulary, as well as verbal fluency and rapid naming, have been identified as important predictors for learning to read and write. Studies show an important relationship between oral language and reading performance, demonstrating the importance of a solid foundation in oral language to identify sounds, recognize word patterns, and understand the grammatical structure of the written language (Petraça, Crippa, Dassie-Leite, 2023; Monteiro, Fernandes, and Leopoldina, 2021; Cruvinel and Alves, 2013; Bräkling, 2012).

In general, the literature shows that both the family and school environments play complementary roles in preparing children for literacy. While the family environment provides opportunities for verbal interaction and the development of social skills (Cruvinel and Alves, 2013), the school environment offers structured learning and practices that promote verbal expression (Bräkling, 2012).

It is essential to recognize that oral language teaching should not be dissociated from real communicative situations. Verbal language, in both modalities, is shaped by social contexts and requires an approach that is sensitive to the individual needs of students (Bräkling, 2012). Literacy involves

a variety of factors, including cognitive, phonological, visual, and socioeconomic skills. These subsystems interact dynamically, resulting in complex modifications in the process of learning to read and write (Guaresi, 2024). Contemporary theories, including the Theory of Complex Adaptive Systems, suggest that each child develops skills in unique and non-linear ways, requiring adaptive and personalized educational interventions to ensure academic success (Souza, Teixeira, Silva, Satler, and Cera, 2020). Given this complexity, the study sought to examine the relationship between a specific component of oral language and the initial learning process of reading and writing.

Verbal fluency

Verbal Fluency activities, as defined by Henry, Messer, and Nash (2015), assess the strategic processes of searching and retrieving lexical and semantic memory, representing the ability to express words clearly, coherently, and fluidly. These tasks encompass both language production and comprehension. Understanding the cognitive processes underlying Verbal Fluency can provide insights into how oral language can influence early reading and writing learning. In this study, the Verbal Fluency variable was analyzed using the Verbal Fluency Test (hereinafter VFT), an instrument designed to also measure other cognitive aspects involved in language processing, including memory, attention, and vocabulary.

The VFT, as defined by Souza, Teixeira, Silva, Satler, and Cera (2020) and applied in this research, is an assessment that aims to measure a person's ability to generate words within a specific category in a period of sixty seconds. This test is commonly used in clinical, neuropsychological, and educational contexts to assess cognitive functioning, especially in areas such as language, memory, and verbal processing. For the authors, the application of the test involves the assessment of two skills: phonemic Verbal Fluency and semantic Verbal Fluency. Phonemic Verbal Fluency requires the generation of words that begin with a specific letter, such as "A," "F," "S," etc., within a short period of time. The choice of the letter "F" in the phonemic fluency category was based on its greater occurrence in Brazilian Portuguese (Santos, Chioss, Soares, Oliveira, and Chiari, 2014).

On the other hand, semantic verbal fluency involves naming words belonging to a specific category, such as animals, people's names, fruits, among others (Santos, Chioss, Soares, Oliveira, and Chiari, 2014; Becker, Müller, Rodrigues, Villavicencio, and Salles, 2014). In the specific case of this study, the semantic category chosen was animals. This test modality allows the analysis of vocabulary knowledge, organization, and retrieval in semantic memory, which is the system responsible for storing and retrieving knowledge related to the meanings of words (Becker, Müller, Rodrigues, Villavicencio, and Salles, 2014).

In addition to its application in clinical assessment contexts, Verbal Fluency has been extensively studied in neuroscience, especially in cases of degenerative diseases such as Parkinson's and Alzheimer's. Studies show that performance in Verbal Fluency can provide information about the storage capacity of long-term memory, the ability to retrieve information stored in memory, and the processing of executive functions, including the organization of thought and word search strategies (Rodrigues, Yamashita, and Chiappetta, 2008).

Furthermore, deficits in Verbal Fluency may indicate damage to cognitive functions related to the acquisition, processing, and storage of information, suggesting a possible association with learning difficulties (Rodrigues, Yamashita, and Chiappetta, 2008). Studies have documented alterations in Verbal Fluency in several pathological conditions, including degenerative dementias, frontal brain lesions, and psychiatric illnesses (Rodrigues, Yamashita, and Chiappetta, 2008).

In the field of education, the correlation between Verbal Fluency and cognitive skills associated with learning to read and write plays a prominent role in human development and long-term educational success. According to Dehaene (2012), learning difficulty reflects the amount of neuronal recycling required. Therefore, understanding and assessing Verbal Fluency is essential to identify possible learning difficulties and develop effective educational intervention strategies.

Methodology

The data collection for this research was carried out after approval by the Research Ethics Committee, under the Certificate of Presentation of Ethical Appreciation (CAAE): 50713115.7.0000.0055, under opinion number 1.530.352. The participant selection process was conducted after defining the inclusion and exclusion criteria, which were strictly followed. The inclusion criteria consisted of the 1st grade student being enrolled in the first year of elementary school, having the consent of their parents or guardians, and presenting normal visual and hearing acuity and cognitive performance.

To meet the inclusion criteria mentioned above, the list of students was obtained from the school secretariats. All students whose parents signed the Free and Informed Consent Form (TCLE) were included in the evaluation, the terms of which were filed at the Laboratorio de Aquisição da Linguagem e Aspectos Linguísticos (LALALIN). Regarding visual acuity, the students underwent the Visual Acuity Screening Test, according to the guidelines of the Ministério da Saúde e da Educação, Brazil (2009). Regarding auditory acuity, an audiometric assessment was performed to screen for hearing deficits. After applying the criteria, 51 participants were selected from 5 elementary school classes of three public schools in Vitória da Conquista.

In Table 1 it is possible to see the instruments used to evaluate the dependent and independent variables.

Frame 1: List of variables and instruments used

Variables	Instruments
1- Verbal Fluency	Verbal Fluency Test (Benton, 1962)
2- Reading and writing	Learning Monitoring Test (Guaresi, Silva e Abreu, 2020)

Source: Authors

Verbal Fluency Test

To assess the independent variable Verbal Fluency, we chose to use the Verbal Fluency Test, an instrument developed by Arthur Lester Benton in

1962 under the name Controlled Verbal Fluency Task, better known as FAS, widely used to assess the Verbal Fluency variable in this study. In this version, the individual is asked to name the largest number of words within a period of sixty seconds for each letter (F, A, S) and to name the largest number of words in the semantic category (animals) in the same time.

The instructions given to the participant were: In one minute, you must say all the words you remember that begin with the letter F or the sound /f/. You can start. After 60 seconds, they were asked to stop and the question was asked about the next letter and/or semantic category. The timer used was the one on the researcher's cell phone.

The test is designed to assess the efficiency and quality of an individual's lexical access and expressive verbal skills. The words spoken by the students were written down on an answer sheet, so that it was possible to count the words spoken and tabulate them in the Verbal Fluency column of the Excel spreadsheet.

Monitoring Test for the Acquisition and Initial Learning of Reading and Writing

To assess the dependent variable Reading and Writing Performance, the Learning Monitoring Instrument, developed by Guaresi, Silva, and Abreu (2020), was used. This test allows for the monitoring of initial reading and writing learning. The test was applied on 5 occasions with a spacing of two to three months between applications.

The test consists of eight levels, each containing five items for assessment, totaling 40 items. According to Guaresi, Silva, and Abreu (2020), the levels are organized as follows: a) First level: Vowels; b) Second level: Consonant/vowel (CV) and/or vowel/consonant (VC) syllabic structures; c) Third level: Simple words with consonant/vowel (CV) and/or vowel/consonant (VC) syllabic structures; d) Fourth level: Syllables with consonant/vowel/consonant (CVC) structure; e) Fifth level: Syllables with consonant/consonant/vowel (CCV) structure; f) Sixth level: Syllables with other structures (e.g., CCVC) and digraph + vowel/consonant (VC) clusters; g) Seventh level: Words with complex syllabic structures; h) Eighth level: Assessment of the ability to encode/decode simple sentences. The test is recommended to be applied every two

months, with the structure being repeated in each edition (8 levels with 5 items per level).

In the reading test, the student encounters the same structure, but with the spaces filled in by the corresponding segments: in the first level, the vowels; in the second level, syllables with a CV structure; in the third level, words with a simple syllabic structure, and so on. The student's performance is evaluated on a scale of zero to eighty points, reflecting the eight levels, each with five questions.

Presentation and discussion of results

For the study, 51 participants were evaluated and, on average, these participants, as can be seen in Table 1, presented, in the 5th edition of monitoring of learning in reading and writing, 21.1 points in reading (out of 40 possible), 18.8 in writing (out of 40 possible) and 39.9 in total average of reading and writing (out of 80 possible). The average in phonemic Verbal Fluency (VF) letter F was: 0.902; phonemic VF letter A: 1.84; phonemic VF letter S: 0.76; semantic VF - animals category: 7.73, and total VF: 11.2. The reading and writing data refer to the 5th edition of monitoring, which took place in June 2023. Regarding the administration of the Verbal Fluency test, the application took place in April 2022.

Table 1 – Descriptive statistics of the components of the Verbal Fluency variable and reading and writing performance (5th edition)

	Reading 5th edition	Writing 5th edition	Total L.W 5th edition	PVFF	PVFA	PVFS	SVF Animals	Total
N	VF	51	51	51	51	51	51	51
Mean	21.1	18.8	39.9	0.902	1.84	0.765	7.73	11.2
Standard error of the mean	2.01	1.86	3.81	0.195	0.246	0.167	0.416	0.777
Median	15	15	30	0	1	0	7	10
Mode	40.0	5.00	13.0	0.00	1.00	0.00	9.00	8.00
Standard deviation	14.4	13.3	27.2	1.39	1.76	1.19	2.97	5.55
Minimum	4	5	9	0	0	0	3	4
Maximum	40	40	80	6	6	4	17	29
W de Shapiro-Wilk	0.799	0.827	0.817	0.678	0.862	0.672	0.944	0.890
p Shapiro-Wilk	<.001	<.001	<.001	<.001	<.001	<.001	0.018	<.001

Source: The authors

Legend:

L.W – Reading and writing

PVFF – Phonological Verbal Fluency letter F

PVFA – Phonological Verbal Fluency letter A

PVFS – Phonological Verbal Fluency letter S

SVF – Semantic Verbal Fluency – animals category

Total VF – Total Verbal Fluency

The standard error of the mean indicates the accuracy of the data presented, taking into account the mean and the number of individuals in the study (Paes, 2008). In our study, the standard error of the mean in reading was 2.01; in writing it was 1.86, and total reading and writing was 3.81. The standard error of the phonemic VF of the letter F was 0.19; phonemic VF of the letter A was 0.24; phonemic VF of the letter S was 0.16; semantic VF of the animals category was 0.41, and total VF was 0.77. It is possible to deduce from these data that the results attest to the reliability of the calculated sample

mean, that is, if we expand the sample, for example, the means would most likely not be very different.

The median results of 15 in reading, 15 in writing and 30 in total reading and writing, and 0 in phonemic VF letter F, 1 in phonemic VF letter A, 0 in phonemic VF letter S, 7 in semantic VF category animals and 10 in total VF respectively show that half of the individuals scored less than 15 points in reading and writing and the other half scored more than fifteen points.

The mode, a component of central tendency that shows the most frequent number, was 40 in reading, and 5 in writing, 13 in total reading and writing, 0 in phonemic VF letter F and phonemic VF letter S, 1 phonemic VF letter A, 9 in semantic VF category animals, and 8 in total VF, showing that in some variables, such as semantic verbal fluency animals, the students knew how to answer everything, and others, such as phonemic verbal fluency letters F, some did not score. The 0 in phonemic VF showed that some students have greater difficulty naming words beginning with the letter F or the sound /f/, compared to the other students.

In the variation of the reading data, the minimum was 4 and the maximum was 40; in writing the minimum was 5 and the maximum was 40; in the total reading and writing the minimum value was 9 and the maximum value was 80, therefore, it is possible to observe that between the minimum and maximum there is a significant variation in the reading and writing results among the individuals evaluated, showing that some individuals have already mastered reading (at least in terms of decoding) and others have not yet, that is, they only know the vowels. The minimum and maximum values in phonemic VF letter F were 0 and 6; Phonemic VF letter A minimum 0 and maximum 6, phonemic VF letter S minimum 0 and maximum 4, in semantic VF category animals minimum 3 and maximum 17, and total VF minimum 4 and maximum 29. Therefore, some individuals knew how to respond to the test categories and others did not know how to respond to any of the categories, with the exception of the semantic VF category animals, in which both the minimum and maximum indicate that everyone knew how to respond to this category. The values of the Shapiro-Wilk indicator show whether there is a normal distribution of the data. In this regard, in the table above the values of 0.799 in reading, 0.827 in writing, 0.817 total reading and writing and 0.890 in total VF show, therefore, as we expected, values above 0.05 indicating that there is no abnormal distribution of the data. In other words,

this tool ratifies the trend of significant discrepancy in the results of the variables evaluated of our participants. Table 2 below shows the averages of the total results of the independent variables of the study, namely, Verbal Fluency (Total VF) and the totals of the dependent variables Reading and Writing (Total L.W). Individuals who did not participate in any of the tests were automatically eliminated in the statistical treatment.

Table 2 – Comparative statistical description between the 5 editions of monitoring reading and writing learning

	1st edition		2nd edition		3rd edition		4th edition		5th edition	
	Total	**Total FV**	**Total L.E**	**Total FV**	**Total LE**	**Total FV**	**Total LE**	**Total FV**	**Total LE**	**Total FV**
N	R.W	Total VF	Total	52	48	48	53	52	51	51
Mean	RW	Total	23.4	11.4	30.9	10.4	36.6	11.4	39.9	11.2
Standard error of the mean	VF	Total RW	Total	0.752	3.22	0.569	3.34	0.723	3.81	0.777
Median	VF	Total RW	Total	10.0	22.0	10.0	30	10.0	30	10
Mode	VF	Total RW	Total	8.00	12.0	8.00	11.0	5.00	13.0	8.00
Standard deviation	FV	5.76	20.3	5.42	22.3	3.95	24.3	5.21	27.2	5.55
Minimum	4	4	4	4	5	5	0	4	9	4
Maximum	75	25	80	29	80	22	80	25	80	29
Shapiro-Wilk's W	0.614	0.907	0.728	0.901	0.838	0.942	0.881	0.931	0.817	0.890
p Shapiro-Wilk	<.001	0.011	<.001	<.001	<.001	0.019	<.001	0.005	<.001	<.001

Source: The authors

Legend:

Total RW - Total Reading and Writing

Total VF - Total Verbal Fluency

The total values of the first edition were 14.9 in reading and writing, and 11.5 in total VF; in the second edition, it was 23.4 in reading and writing

and 11.4 in total VF; in the third edition, it was 30.9 in reading and writing and 10.4 in total VF; in the fourth edition, it was 36.6 in reading and writing and 11.4 in total VF; and in the fifth edition, it was 39.9 in reading and writing and 11.2 in total VF. Therefore, we can observe an improvement in the average reading and writing scores (from 14.9 in the 1st edition to 39.9 in the 5th edition), considering that for a student to decode autonomously, a score close to 80 is required (Guaresi, Silva, & Abreu, 2020). As we can see, the results from the second year of literacy are mostly below 40, meaning that most of our participants were unable to reach half of the possible score on the test and therefore still cannot decode, although a slow but gradual improvement in reading and writing is evident.

Table 3 shows the correlation coefficient values between the VF variables and reading and writing. As shown, the correlation between the phonemic VF letter F and reading was 0.43 with a p-value < 0.001, indicating a moderate correlation according to Dencey and Ready (2019); the correlation between the phonemic VF letter F and writing was 0.45 with a p-value < 0.001, also indicating a moderate correlation; and the correlation between the phonemic VF letter F and total reading and writing was 0.45 with a p-value < 0.001, again indicating a moderate correlation.

Table 3 - Correlational values (Simple Linear Regression) between components of the variables Verbal Fluency (letters F, A, S and animals) and performance in Reading and Writing (Reading, Writing and total Reading and Writing)

	Reading 5th edition	**Writing 5th edition**	**Total RW**
PVFF	R 0.437 R^2 0.191 p <0.001	R 0.454 R^2 0.206 p <0,001	R 0.454 R^2 0.206 p< 0.001
PVFA	R 0.555 R^2 0.308 p < 0.001	R 0.618 R^2 0.382 p < 0.001	R 0.591 R^2 0.350 p < 0.001
PVFS	R 0.546 R^2 0.298 p < 0.001	R 0.550 R^2 0.303 p < 0.001	R 0.552 R^2 0.305 p < 0.001
PVSA	R 0.267 R^2 0.071 p 0.049	R 0.249 R^2 0.062 p 0.078	R 0.266 R^2 0.070 p 0.059
Total VF	R 0.546 R^2 0.298 p < 0.001	R 0.561 R^2 0.315 p <0.001	R 0.562 R^2 0.316 p < 0.001

Source: The authors

Legend:

PVFF- Phonological Verbal Fluency letter F

PVFA- Phonological Verbal Fluency letter A

PVFS- Phonological Verbal Fluency letter S

FVSA- Verbal Fluency Semantic Category (Animals)

Total RW - Total Reading and Writing

Total VF - Total Verbal Fluency

The correlation between the variables phonemic VF letter A and reading was 0.55 with a p-value < 0.001, indicating a moderate correlation; phonemic VF letter A and writing was 0.61 with a p-value < 0.001, indicating a high correlation; phonemic VF letter A and total in reading and writing was 0.59 with a p-value < 0. 001, indicating a moderate-high, almost high correlation.

The correlation between the variables phonemic VF letter S and reading was 0.54 with a p-value < 0.001, indicating a moderately high correlation; phonemic VF letter S and writing was 0.55 with a p-value < 0.001, indicating a moderately high correlation; phonemic VF letter S and total reading and writing was 0.55 with a p-value < 0.001, indicating a moderately high correlation.

The correlation between the variables animal semantic FV and reading was 0.26 with a p-value of 0.049, indicating a weak correlation; animal semantic FV and writing was 0.24 with a p-value of 0.078, indicating a weak correlation; animal semantic FV and total reading and writing was 0.26 with a p-value of 0.059, indicating a weak correlation.

The correlation between the variables total FV and Reading was 0.54 with a p-value < 0.001, which indicates that the correlation between these variables is moderate; total FV and Writing was 0.56 with a p-value < 0.001, so what we can conclude is that there is a moderate correlation between these variables; between total FV and total Reading and Writing, the correlation observed was 0.56 with a p-value < 0.001, which indicates a moderate correlation.

Therefore, the data obtained from the Simple Linear Regression between the components of the Verbal Fluency variable (letter F, letter A, letter S, and animal category) and reading and writing performance (5th edition) showed that the dependent variable reading and writing is moderately influenced by the independent variables Verbal Fluency (letter F, letter A, letter S).

Table 4 - Correlational values between reading and writing performance in the 5 editions of the reading and writing assessment and total FV (total RW and VF)

1st edition Apr./2022	2nd edition jul./2022	3rd edition nov./2022	4th edition Mar./2023	5th edition jun./2023
R 0.684 R^2 0.468 p < 0.001	R 0.706 R^2 0.498 p < 0.001	R 0.613 R^2 0.376 p < 0.001	R 0.599 R^2 0.359 p < 0.001	R 0.562 R^2 0.316 p < 0.001

Source: The authors

The correlations between the variables of the reading and writing assessment tests (RW totals of the 5 tests) and Verbal Fluency (Total VF, test administered in April 2022) regarding its correlation with the five reading and writing tests were: R 0.68 in the first test, R 0.70 in the second test, R 0.61 in the third test, R 0.59 in the fourth test, and R 0.46 in the fifth test. These results show a moderately high correlation between Verbal Fluency and the sum of reading and writing, so in general we can consider Verbal Fluency as a moderate predictor of reading and writing performance.

The percentages of the relationship coefficient - R^2 show how much we can predict the response variable from the predictor variables, in other words, in this study how much of the performance in Reading and Writing (dependent variable) can be explained by the variable Verbal Fluency (predictor variable).

The R^2 values in percentage figures show that, in the first edition, 46 per cent (R2 0.46) of performance in Reading and Writing is due to performance in Verbal Fluency; in the second edition 49 per cent (R^2 0.49) of performance in Reading and Writing is due to performance in Verbal Fluency; in the third edition 37 per cent (R^2 0. 39) of performance in Reading and Writing is due to performance in Verbal Fluency; and in the fifth edition 35 per cent (R^2 0.35) of performance in Reading and Writing is due to performance in Verbal Fluency.39) of performance in Reading and Writing is due to performance in Verbal Fluency; in the fourth edition 35% (R^2 0.35) of performance in Reading and Writing is due to performance in Verbal Fluency; and in the fifth edition 31% (R^2 0.31) of performance in Reading and Writing is due to performance in Verbal Fluency. These percentages indicate that Verbal Fluency is therefore a moderately high predictor of later performance in reading and writing. With regard to these results, it is worth highlighting the fact that the percentage values decrease over time, which leads us to conclude that the predictive potential of verbal fluency decreases with the teaching-learning process, as other variables come into play, such as the teaching variable, or more specifically, the choice of teaching practices adopted.

The statistical analysis of the data carried out so far reveals a significant relationship between verbal fluency and subsequent performance in reading and writing. This relationship was demonstrated through the statistical treatment applied. In general, this collective analysis shows a gradual pattern in the initial and continuous acquisition of reading and writing skills.

This pattern suggests a gradual progression from the non-reader stage to the subsequent reader stage, as well as from the non-writer stage to the writer stage.

Another indication of this gradual progression lies in the fact that the majority of individuals show superior performance in reading compared to writing, based on the premise that the ability to write presupposes the ability to read or decode. There is a notable trend in the recall of words belonging to the animal category compared to other categories. In addition, in relation to phonological verbal fluency, the letter 'A' tends to have a lower naming frequency than animal names, but is higher than the naming incidences of the letters 'F' and 'S'. This can possibly be attributed to the vast presence of words in the Portuguese language beginning with the letter 'A', as well as the frequent use of these words. According to Souza and Guaresi (2023), the incidence of words can be categorised into high, medium and low frequency in each student's daily life, and can vary according to schooling, age, language, cultural aspects and environment.

The tendency for students to perform better in semantic verbal fluency in the animals category is in line with the studies carried out by Moura, Simões and Pereira (2013); and Heleno, (2006). In these studies, the averages for the animals category were also higher than the others. The higher performance in semantic verbal fluency suggests that pre-school children predominantly use semantic strategies to access words, to the detriment of orthographic or phonological approaches, as discussed by Moura, Simões and Pereira (2013). This finding suggests that orthographic and phonological skills may not be innate, but probably develop based both on children's experiences in the family environment and in the context of formal education. In this sense, this study showed that even students who were unable to answer all the categories of the Phonological Verbal Fluency Test were able to name animals, most of which are common in their social context.

When analysing verbal fluency as a predictor of reading and writing performance, there was a general trend showing a moderate correlation with reading and writing performance (R 0.56 - $p < 0.001$). On average, the verbal fluency of each child assessed was around 60, with an average of 11.2 words evoked. On the other hand, the average performance in reading and writing was 39.9. In other words, individuals who evoked around 11 words were expected to have an average reading and writing performance of 40.

However, it was observed that some individuals who had a verbal fluency of less than 11 achieved a reading and writing performance above 40. For example, individual 14EAH evoked only 5 words, but showed a reading and writing performance of 69, much higher than the average of 40 and considerably above what would be expected for someone evoking only 5 words. This shows that there are several individuals whose performance differs from what is expected, a fact that can be considered a strong indication of the non-linearity of Complex Adaptive Systems Theory. For these individuals, the path to learning to read and write follows unexpected paths, thus deviating from the general trend.

On the other hand, individual 49AAH showed a verbal fluency performance of 13, above the expected average of 11.2. Following the general trend, his performance in reading and writing was also expected to be higher than the average of 39. However, in the fifth edition, 49AAH only achieved 20 points in total in reading and writing, 12 in reading and 8 in writing. Therefore, in relation to verbal fluency, 49AAH is an example of an individual who demonstrated a non-linear pattern of learning, even though he was part of the class. 49AAH was affected by different variables, resulting in an unexpected performance.

In the context of the first edition, 53 per cent of the 26 students assessed, corresponding to 14 individuals, scored between 8 and 12 on the total reading and writing test. This range indicates a knowledge fundamentally centred on vowels.

In the second edition, held between August and September 2022, 40.3% of the participants scored between 8 and 12 points in reading and writing. It is worth mentioning that 12 of the 14 students who scored in this range in the first edition maintained the same score in the second, indicating relative stability in knowledge, particularly in identifying the names or sounds of letters, between the first and second editions. This is a strong indicator both of the presence of attractors in the process of consolidating complex systems and that one of the attractors in this process is knowledge of the names or sounds of vowels. In the attractor phase of learning there is a moment of stability in the knowledge acquired, resulting in greater organisation than the previous state.

The second period of stability, as predicted by Guaresi (2024), is related to knowledge of simple syllables. It was observed that 13.4 per cent of

schoolchildren in the second edition scored between 23-33 points and 12.1 per cent in the third edition, suggesting the presence of another period of stability, although not as clear as the first related to knowledge of the names and sounds of letters.

In the study carried out by Moura, Simões and Pereira (2013), the authors showed that as the timer on the VF test advances and the most common words are used, there is a transition to more extensive lexical storage, requiring more effort to search for less frequent words. This suggests, according to the authors, that subsequent performance in these tasks is more associated with controlled information recall processes and becomes more dependent on executive functions. Therefore, the ability to access both the most common words available and the less frequent ones, with more effort, significantly influences performance in verbal fluency.

It is important to emphasise that it was difficult to find studies in the Portuguese-language literature on verbal fluency that were directly related to learning to read and write. Therefore, these findings offer an incentive to carry out future more comprehensive and detailed investigations, with the aim of providing a deeper understanding of these relationships.

Final considerations

This study advances scientific understanding of the correlation between Verbal Fluency (VF) and early performance in reading and writing, underscoring the importance of oral language in the literacy process. The analysis confirms the hypothesis that VF is a significant predictor of the development of these skills. The moderately high correlation observed, with coefficients ranging from R = 0.46 to R = 0.70, and VF's ability to account for between 31% and 49% of reading and writing performance, emphasize VF's importance in the early stages of literacy.

Another key finding is that, although VF initially shows a statistically significant correlation with reading and writing performance, its predictive power diminishes as the literacy process advances. This decline may be due to the increasing complexity of the skills required and the influence of other educational and contextual factors, including the methods employed by literacy teachers. In other words, while VF remains an important predictor, its role

becomes less decisive over time, suggesting that other competencies and teaching practices increasingly impact reading and writing performance.

These findings highlight the need for educational interventions focused on supporting children with difficulties in VF to enhance their fluency and, consequently, their reading and writing development. Implementing specific pedagogical strategies, such as reinforcing phonological awareness and reading fluency during kindergarten, may help address initial literacy challenges, particularly among the subset of students who are lagging behind.

Furthermore, the study identifies a gap in the literature regarding VF in literacy contexts, especially in Portuguese. This gap offers opportunities for future research to explore the relationship between VF and reading and writing skills more thoroughly. A deeper understanding of this relationship could lead to the development of more effective pedagogical approaches tailored to individual students' needs.

In summary, this study not only confirms the relevance of VF in the early stages of literacy but also suggests that incorporating VF into educational strategies can be crucial for optimizing the development of reading and writing skills. Continued research in this area is vital for enhancing pedagogical strategies and promoting more effective teaching.

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