DOI: HTTPS://DOI.ORG/10.15446/RCP.V35N1.111118

Predictive Effects of Reasoning and Metalinguistic Skills for Reading Comprehension

ADRIANA SATICO FERRAZ
Centro Universitário Belas Artes de São Paulo, Brazil
Centro Universitário de Brasília, Brazil

MIRELLE CHRISTINA PINHEIRO
Universidade de São Paulo, Brazil
Instituto Lisandra Borges, Brazil

AMANDA LAYS MONTEIRO INÁCIO
Universidade Estadual Paulista, Brazil

THATIANA HELENA DE LIMA
Universidade Federal da Bahia, Brazil

ACÁCIA APARECIDA ANGELI DOS SANTOS
Universidade de Brasília, Brazil

How to cite this article: Ferraz, A. S., Pinheiro, M. C., Inácio, A. L. M., Lima, T. H. & Santos, A. A. A. (2026). Predictive Effects of Reasoning and Metalinguistic Skills for Reading Comprehension. Revista Colombiana de Psicología, 35(1). https://doi.org/10.15446/rcp.v35n1.111118

Correspondence: Adriana Satico Ferraz (https://orcid.org/0000-0002-9856-0094). Email: adrianasatico.as@gmail.com

SCIENTIFIC RESEARCH ARTICLE

RECEIVED: SEPTEMBER 13TH, 2023 - ACCEPTED: MAY 8TH, 2024

Abstract

Background: The aim of this study was to investigate the direct and indirect predictive effects of metalinguistic skills (metatextual, morphological, and phonological awareness) for reading comprehension, adding intelligence to prediction models (verbal/numerical reasoning), school year and age. **Method**: Participants were 222 Brazilian students from public schools (Elementary School). The instruments were applied in person in pencil and paper format. **Results**: The results indicated that reading comprehension was predicted directly by the three metalinguistic skills and indirectly by the metatextual (mediated by verbal reasoning) and phonological (mediated by numerical reasoning) awareness. Findings also showed the direct predictive contribution of most metalinguistic skills and school year to only one of the reading comprehension measures (Cloze 1). **Conclusions**: Further studies are suggested to deepen the investigation of the predictive relationships existing between metalinguistic skills, reading comprehension, intelligence, and aspects inherent to formal instruction and maturation in basic education.

Keywords: metatextual awareness, morphological awareness, phonological awareness, reading comprehension, formal instruction.

Efectos Predictivos del Razonamiento y las Habilidadades Metalingüisticas en la Comprensión Lectora

Resumen

Antecedentes: El objetivo de este estudio fue investigar los efectos predictivos directos e indirectos de las habilidades metalingüísticas (conciencia metatextual, morfológica y fonológica) en la comprensión lectora, añadiendo inteligencia a los modelos de predicción (razonamiento verbal/numérico), el año escolar y la edad. **Método**: Los participantes fueron 222 estudiantes brasileños de escuelas públicas (escuela primaria). Los instrumentos se aplicaron en persona en formato papel y lápiz. **Resultados**: Los resultados indicaron que la comprensión lectora se predecía directamente por las tres habilidades metalingüísticas e indirectamente por la conciencia metatextual (mediada por el razonamiento verbal) y fonológica (mediada por el razonamiento numérico). Los resultados también mostraron la contribución predictiva directa de la mayoría de las habilidades metalingüísticas y el año escolar a solo una de las medidas de comprensión lectora (Cloze 1). **Conclusiones**: Se sugieren más estudios para profundizar en la investigación de las relaciones predictivas existentes entre las habilidades metalingüísticas, la comprensión lectora, la inteligencia y los aspectos inherentes a la instrucción formal y la maduración en la educación básica.

Palabras clave: conciencia metatextual, conciencia morfológica, conciencia fonológica, comprensión lectora, instrucción formal.

Metalinguistic skills have been shown to be relevant in the school context due to their contribution to the literacy process and to the development of reading comprehension (Santos et al., 2018). They can be defined as the students' intentional reflection on their own language (Oliveira et al., 2020; Spinillo & Simões, 2003), and, are developed in daily life and in formal education (Santos et al., 2018). Metalinguistic skills are divided according to the focus used in language, so that the reflection and analysis of morphemes, phonemes, syntax, text and context are named, respectively, as morphological, phonological, syntactic, metatextual, and pragmatic awareness (Gombert, 1992). In the present study, the role of phonological, morphological and metatextual awareness in reading comprehension performance was emphasized.

Intentional reflection on the sounds that make up speech is beneficial for the development of reading comprehension in Portuguese (Korad & Lorandi, 2019). This intentional reflection is called phonological awareness (Freitas Junior & Mota, 2015). When reflecting on the sounds of speech, students would find it easier to make associations between sounds and letters and, with that, acquire alphabetic principles, which is an important skill in literacy (Mota & Santos, 2009). Empirical findings in elementary school show that students with reading comprehension proficiency are also those who score the most in phonological awareness, revealing that the two skills share characteristics in common (Mota & Santos, 2009; Suehiro & Santos, 2015).

Awareness of morphemes is also a relevant skill for reading comprehension (Coelho et al., 2024). Morphemes are the smallest meaningful linguistic units that make up words, and morphological awareness is the student's ability to consciously reflect on these units (Gombert, 1992). Developing morphological awareness in early literacy enables readers to understand complex words and improve reading comprehension (Liu et al., 2024). However, the contribution of morphological awareness to reading comprehension sometimes appears in research with different results when morphemes are assuming an inflectional function (adapt words to the requirements of gender, number and degree) or derivational (word formation) (Freitas Junior & Mota, 2015; Guimarães & Mota, 2016). At other times, similar results are obtained in the two functions (Ferraz & Santos, 2019; Santos et al., 2018).

Another aspect to be highlighted is that the text can also be more easily understood if the student is aware of the textual genre (Cunha & Santos, 2019). The intentional reflection about the text and the elements that compose it is conceptualized as metatextual consciousness (Gombert, 1992). Among the ways to assess and develop this metalinguistic skill is the identification of textual genres (Cunha & Santos, 2014). Awareness of the textual genre, in which the text is inserted, helps in the reading comprehension process, considering that depending on the textual genre, the reader will deal with different classes of inferences (Spinillo & Simões, 2003). In research carried out by Cunha and Santos (2014; 2019) and Santos and Cunha (2012), evidence was identified that reading comprehension performance is associated with metatextual awareness.

Despite the contribution of metalinguistic skills to reading comprehension, it is important that other variables are considered in this relationship, as intelligence, age, and school year. In studies carried out by Lima and Santos (2017) and Trassi et al. (2019) the correlations between the constructs were evaluated, as well as the effects of verbal reasoning on reading comprehension. In the results of the studies by Lima and Santos (2017) and Trassi et al. (2019), a positive correlation of moderate magnitude was obtained between verbal reasoning and reading comprehension. The results obtained in the cited studies show that the higher the verbal coefficient, the greater the reading comprehension.

Investigations carried out by Freitas Júnior and Mota (2015), Guimarães and Mota (2016)

and Oliveira et al. (2020) the results were similar. Morphological awareness (derivational and inflectional) and phonological awareness in correlation analysis showed positive and significant correlations with reading comprehension. However, when performing regression analyzes and placing new variables in the models, morphological awareness failed to independently explain reading comprehension in the three studies. In the research of Freitas Junior and Mota (2015), the control variables were non-verbal intelligence and phonological awareness. However, in the studies by Guimarães and Mota (2016) and Oliveira et al. (2020) the age variable was added, along with phonological awareness and non-verbal intelligence.

Regarding the school year variable, in the study carried out by Oliveira and Justi (2017), the contribution of morphological and phonological awareness to reading comprehension was different in the school years. In regression analyses, having intelligence and age as control variables, morphological awareness independently contributed to reading comprehension only for 4th and 5th grade students. Regarding the contribution of phonological awareness, it was significantly associated with reading comprehension for students from 2nd to 5th grade. A similar result was found in the study by Coelho et al. (2024) with 2nd to 4th grade students with morphological awareness and significant differences in morphological awareness throughout schooling. In Liu et al. (2024) study, morphological awareness contributed to reading comprehension across a wide age range, from 6 years old to 16 years old.

These results reinforce the importance of stimulating metalinguistic skills in the literacy process, highlighting their strong association with formal instruction and the need to consider them when investigating these skills. This study brings relevant scientific and educational contributions since the inclusion of intelligence (verbal/numerical reasoning), school year, and age in the models allows for a more precise understanding of the factors that influence reading. In addition, it provides evidence on which metalinguistic skills are most decisive for reading comprehension, helping to develop more effective teaching methods. By expanding knowledge about the mechanisms involved in learning to read, the research also contributes to theories on cognitive and linguistic development. By investigating the contribution of metalinguistic skills to reading comprehension, more effective pedagogical interventions can be developed, positively affecting the literacy process.

In view of the research findings presented, the present study aimed to investigate the associations between metalinguistic skills (phonological awareness, derivational and inflectional morphological awareness, and metatextual awareness) for performance in reading comprehension when controlling intelligence through verbal and numerical reasoning skills, as well as school year and age. The specific objectives are: (a) to analyze the direct and indirect predictive effects of the metalinguistic skills for reading comprehension, considering verbal and numerical reasoning; and (b) to investigate the interference of school year and age on the predictive effects of metalinguistic skills for reading comprehension. It is expected that the results will contribute to the understanding of metalinguistic and cognitive processes present in reading comprehension.

Method

Participants

The sample consisted of 222 Brazilian elementary school students from public schools in the countryside of Sao Paulo, with $n = 79$ for 3rd grade, $n = 57$ for 4th grade, and $n = 86$ for 5th grade. The minimum age was eight, and the maximum age was 11 ($M_{idade} = 9.53$; $DP = 1.06$ years). In the distribution of students by sex, 113 girls and 109 boys participated in the survey.

Instruments

Cloze test (Santos, 2005).

The Cloze Tests "The Princess and the Ghost" and "An Unhappy Revenge" have a total of 204 words, being of equivalent size and difficulty, elaborated by Cloze standards by fixed ratio, and chosen specially to assess reading comprehension in students from 2nd to 5th grade of elementary school. In each text, the fifth words are omitted, replaced by a dash the size of the omitted word. During the application, the student is asked to initially read the text in a low voice and then fill in the gaps with the appropriate word to make sense of the text. The correction is literal, so that only words identical to those omitted are considered correct. The possible score on each text is 15 points. About their psychometric properties, it was found in the study by Mota and Santos (2014), evidence of criterion validity for the two texts in elementary school. Also, Cunha and Santos (2009) identified evidence of validity by response process.

Phonological Awareness Assessment Guide – RACF (Santos, 1996)

The purpose of the RACF is to assess the identification of the initial, final and middle phonemes of words. The instrument consists of three sets of items, each with five items and two examples. E.g., of item with initial sound: *Copo* (glass): *cobra* (snake) – *sapo* (frog) – *lata* (tin). For each correct answer, the student receives one point and can reach up to 15 points. This test has evidence of criterion validity (Mota et al., 2014; Suehiro & Santos, 2011).

Morphological Awareness Assessment Task – TCM (Guimarães & Mota, 2016).

TCM has two sets of tasks, namely the derivational analogy (TCMd) and the inflectional analogy (TCMf). The TCMd has 17 items, and in each of them, the student is instructed to form a morphologically complex word from a target word (e.g.: *banana-bananada* [banana – banana candy]; *goiaba* - _____? [*guava jam*]). The TCMf has 19 items referring to verb agreement, number inflection, and gender inflection (e.g. *anda* (walk) – *andou* (walked); *olha* (look) -____? [*olhou*; looked]). The total score is the sum of correct answers for each of the tasks: TCMd, maximum of 17 points; and TCMf, maximum 19 points. Both tasks presented reliability estimates in the study by Ferraz and Santos (2019), TCMd, α = .77; TCMf, α = .86.

Metatextual Awareness Assessment Questionnaire – QACM (Santos & Cunha, 2012).

The instrument was built to assess the levels of metatextual awareness of elementary school students. It is composed of fifteen excerpts of different textual genres in which the student must mark one of the four available options indicating the corresponding genre. For each correct answer the student receives a point. The instrument has a maximum score of 15 points. About its psychometric properties, the QACM obtained an estimate of reliability, with an alpha value of .80, considered satisfactory. The QACM also presents evidence of validity based on the relationship with other variables, verified by Cunha and Santos (2014).

Battery for evaluating high abilities/giftedness: Verbal and numerical reasoning tests (Nakano & Primi, 2012).

Verbal Reasoning Test (PRV): Having in its composition 12 questions, the test presents sentences with four related words, one of which is omitted. The student must fill in the gap with the missing word, considering the relationship between the first two words. The specific ability assessed in this test is vocabulary extension and the ability to establish abstract relationships between verbal concepts. For each correct answer, the student receives 1 point, and the maximum score in the test is 12 points.

Numerical Reasoning Test (PRN): Composed of 12 questions, presented in different numerical sequences. The student must fill in the missing numbers taking into account the order presented above. The specific ability evaluated in this test is to reason inductively and deductively about mathematical symbols in quantitative problems, as well as knowledge of basic arithmetic operations. For each correct answer, the student receives 1 point. The maximum score in the test is 12 points. Verbal

reasoning and numerical reasoning tests present precision estimates (α = .78).

Initially, the psychometric properties of the measuring instruments were investigated using the sample from the current study. All presented evidence of validity based on internal structure and reliability estimates. This statement is supported by the results of the confirmatory factor analysis and the composite reliability shown in Table 1.

Table 1

Internal Structure Indexes and Composite Reliability of Instruments

Instrument	χ^2/gl	RMSEA (IC 90%)	CFI	TLI	*cc*
Cloze 1	3.24	.10 (.09 – .11)	.77	.73	.90
Cloze 2	1.22	.03 (.01 – .05)	.95	.95	.84
RACF	1.34	.04 (.02 – .06)	.70	.65	.64
TCMd	1.27	.03 (.01 – .05)	.97	.96	.87
TCMf	1.44	.04 (.03 – .06)	.87	.87	.87
QACM	1.27	.03 (.01 – .05)	.94	.92	.86
PRV	1.26	.03 (.01 – .06)	.84	.81	.59
PRN	1.92	.06 (.05 – .08)	.97	.97	.96

Tests were applied collectively with an average duration of 40 minutes. RACF and TCM were applied individually, with an average duration of 15 minutes. The data collection was conducted in 2017 and lasted for one month. It was carried out by two graduate students and two students from the Scientific Initiation program.

Data Analysis Procedure

Analyzes were performed using the *Statistical Package for Social Sciences software* (SPSS; V. 22.0), MPlus (version 8.8; Muthén & Muthén, 2017) and the composite reliability calculator (*cc*) *online* (available at http://www.thestatisticalmind.com/calculators/comprel/composite_reliability.htm).

Firstly, we analyzed the psychometric quality of the assessment measures used in the research. To verify the evidence of validity based on the internal structure, we applied the confirmatory factor analysis (CFA). These were the fit indices of the models generated by the CFA: Ratio of χ^2 divided by degrees of freedom (*gl*) < .05; Root Mean Square Error of Approximation (RMSEA) < .10, Confirmatory Fit Index (CFI) e Tucker-Lewis Index (TLI) ≥ .90 (Marôco, 2014). The reliability estimates of the instruments were analyzed using composite reliability (*cc*), with a value equal to or greater than .70 being considered adequate (Dunn et al., 2014).

Next, descriptive statistics were used to characterize the sample and determine the minimum, maximum, mean, and standard deviation scores of the instruments. The average score variation was obtained by percentage values, considering the total number of items in each test.

Relationships between reasoning, metalinguistic, and reading comprehension skills were examined using Pearson's bivariate product-moment correlation analysis. Partial correlations were applied to control the variables verbal and numerical reasoning, school year and age. The interpretation of the magnitudes of the correlation

Data Collection Procedure

First, the research was submitted and approved by the Ethics Committee of São Francisco University (Brazil) (Approval nº 1.245.116). At the beginning of the collection, the schools that accepted the invitation to participate received the Free and Informed Commitment Term for signing. After students were authorized to participate, data collection began. The assessment measures were administered in printed format. The Cloze Test, QACM, and the Verbal and Numerical Reasoning

coefficients was based on these cut-off points: *r* between .1 to .39, weak magnitude; *r* between .40 to .69, moderate magnitude; *r* between .70 to .99, strong magnitude (Dancey & Reidy, 2013).

To investigated objective "a" of this study, we applied test the regression models with direct and indirect effects through the *path analyzes* technique, with *Robust* Maximum Likelihood estimator (MLR; Hu & Bentler, 1999). The following presents the structure of the tested models (restricted and saturated), and the parameters for interpreting their fit. Composition of the saturated model containing verbal and numerical reasoning: direct regression effects - Cloze 1 and Cloze 2 (dependent variables [VDs]), RACF, TCMd, TCMf, QACM, PRN, and PRV (independent variables [VIs]); PRN and PRV (VDs), RACF, TCMd, TCMf, and QACM (VIs); indirect regression effects - Cloze 1 and Cloze 2 (VDs), RACF, TCMd, TCMf, and QACM (VIs To compose the restricted model, the VIs of the saturated model were excluded, whose standardized regression coefficients (β) showed $p > .05$ for the respective VDs. The plausibility of both models was assessed by the value of $p > .05$ of χ^2 and the same fit index values referenced in the AFC (Marôco, 2014).

To investigated objective "a" of this study, we used multiple linear regression analysis (enter method) to assess the regression effects of VIs metalinguistic skills, school year, and age on reading comprehension. Structuring of the two models, one with VD Cloze 1 and the other with VD Cloze 2: VIs block 1, RACF, TCMd, TCMf, QACM; VI block 2, school year; VI block 3, age. The value of R^2 was considered for the explained variance of the final model and the ΔR^2 for the variables of each block of the model. The Durbin-Watson residual statistics were applied to evaluate the autocorrelation of the residues of each tested model, with acceptable values between 1.5 e 2.5 (Field, 2013).

Results

To assess the students' performance in each of the linguistic and metalinguistic skills evaluated in the research, Table 2 presents the results. The sample of students demonstrated lower reading comprehension skills in the Cloze 2 text. The text "An Unhappy Revenge" emphasizes action and consequence, requiring verbs and terms that structure the progression of events. In contrast, the text "The Princess and the Ghost" (Cloze 1) focuses on referential cohesion, requiring the retrieval of pronouns and connectors that provide fluidity to the narrative.

The students had mean scores above the midpoint of the instruments that assessed phonological awareness (RACF), morphological awareness (inflectional - TCMf and derivational - TCMd), and metatextual awareness (QACM). The opposite was observed for verbal and numerical reasoning skills, whose mean scores were below the midpoint of the instruments (PRV and PRN). Students' performance in numerical reasoning was lower compared to verbal reasoning.

Table 2

Instrument Descriptive Statistics

	Min.	**Max.**	*M*	*DP*
Cloze 1	0	14	8.84	2.94
Cloze 2	0	13	6.34	2.06
RACF	5	5	9.59	2.16
TCMd	3	25	10.46	3.60
TCMf	2	18	11.60	3.46
QACM	0	15	9.78	2.93
PRV	0	10	4.50	1.81
PRN	0	11	3.70	2.53

Legend. Min. = Minimum; Max. = Maximum; *M* = average; *DP* = standard deviation; Cloze 1 and Cloze 2 = reading comprehension measures; RACF = phonological awareness measure; TCMd = derivational morphological awareness measure; TCMf = inflectional morphological awareness measures; QACM = metatextual awareness measure; PRV = verbal reasoning measure; PRN = numerical reasoning measure.

In line with the objectives of this study, Table 3 shows the incidence of statistically significant, positive, and weak bivariate correlations between reading comprehension (Cloze texts 1 and 2) and phonological awareness, as well as moderate correlations between reading comprehension and derivational, inflectional, and metatextual awareness. The results of the bivariate correlations indicate that even when controlling for verbal and numerical reasoning, as well as school grade and age, the correlations between reading comprehension and linguistic skills remain statistically significant, with a reduction in coefficient values but maintaining their magnitude. The lowest correlation values were observed between reading comprehension and phonological awareness, while the highest were found between reading comprehension and metatextual awareness.

Table 3

Bivariate and Partial Correlations between Reading Comprehension and Language Skills and Verbal and Numerical Reasoning (N = 222)

	Bivariate correlation			
	RACF	TCMd	TCMf	QACM
Cloze 1	.40***	.54***	.58***	.63***
Cloze 2	.39***	.53***	.50***	.65***
Partial correlation – verbal and numerical reasoning control				
	RACF	TCMd	TCMf	QACM
Cloze 1	.20**	.41***	.42***	.50***
Cloze 2	.21**	.41***	.31***	.51***
Partial correlation – school year and age control				
	RACF	TCMd	TCMf	QACM
Cloze 1	.23***	.42***	.50***	.50***
Cloze 2	.26***	.43***	.42***	.55***

Legend. Cloze 1 and Cloze 2 = reading comprehension measures; RACF = phonological awareness measure; TCMd = derivational morphological awareness measure; TCMf = inflectional morphological awareness measure; QACM = metatextual awareness measure.

Note. Statistically significant correlations *p < .05; **p < .01; ***p < .001.

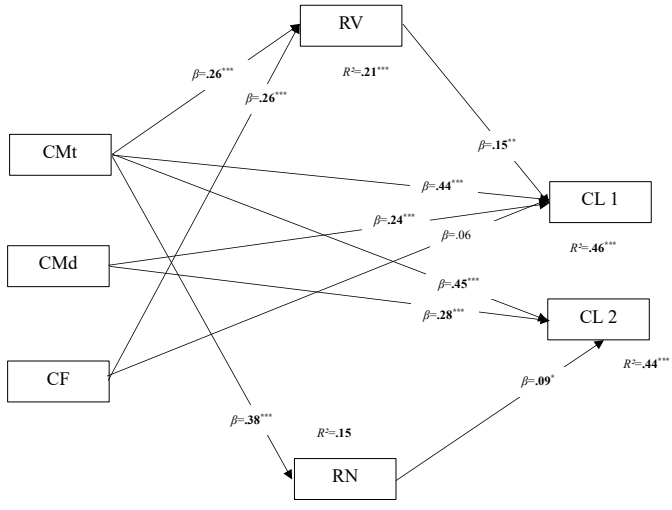
Continuing the investigation of the first objective of this study, the predictive effect of metalinguistic skills and verbal and numerical reasoning on reading comprehension was analyzed. The saturated model 1 proved to be plausible, with values of $\chi^2 = 1.870$, $gl = 1$, $p < .17$ and adjustment indices RMSEA = .06 (IC .01 – .20), CFI = 1, TLI = .94. To compose the restricted model, the independent variables were excluded (VIs) with $p > .05$, namely, phonological awareness, inflectional morphological awareness and numerical reasoning, with the dependent variable (VD) the Cloze test 1; the VIs inflectional morphological awareness and verbal reasoning were excluded from the VD Cloze test 2; derivational and inflectional morphological awareness of VD verbal reasoning; phonological awareness, derivational and inflectional morphological awareness of VD numerical reasoning.

The restricted model presented a χ^2 value and adequate adjustment indices, which guarantees the plausibility of the tested structure: $\chi^2 = 11.024$,

gl = 7, $p < .14$ and RMSEA adjustment indices = .05 (IC .01 – .11), CFI = .99, TLI = .97. As shown in Figure 1.46% of the reading comprehension variance in the Cloze test 1 (CL1) is explained by metatextual awareness, derivational morphological awareness and verbal reasoning. A one-point increase in metatextual awareness predicts a .42-point increase in reading comprehension. Good performance in derivational morphological awareness represented a .24-point increase in reading comprehension and a .15-point increase in verbal reasoning ability. Phonological awareness did not directly predict reading comprehension but had an indirect predictive effect considering verbal reasoning for the CL1: β =.04, p=.02 (standard error=.02). Metatextual awareness indirectly predicted reading comprehension with verbal reasoning: β =.04, p =.01 (standard error = .02). Phonological awareness and metatextual awareness explained 21% of verbal reasoning variance. A one-point increase in metatextual awareness increased verbal reasoning by .29 points, and phonological awareness predicted an increase in this skill by .26 points.

Still in Figure 1, reading comprehension assessed by the Cloze test 2 (CL2) had 44% of its variance explained by derivational morphological awareness, metatextual awareness, and numerical reasoning. These skills directly predicted reading comprehension. The domain of metatextual awareness assumed an increase in reading comprehension by .45 points, in derivational morphological awareness by .28 points and in numerical reasoning by .09 points. The indirect prediction path of metatextual awareness and numerical reasoning was not statistically significant (β = .03, p = .08, standard error = .02). Metatextual awareness accounted for 15% of the explained variance of numerical reasoning, and the development of this metalinguistic ability presupposed an increase of .38 points in this measure of intelligence.

Figure 1. Direct and Indirect Predictive Effects of Metalinguistic Skills for Reading Comprehension with Verbal and Numerical Reasoning Control Variables.



β=.06

Legend. CL1 and CL2 = reading comprehension; CF = phonological awareness; CMd = derivational morphological awareness; CMt = metatextual awareness; β = standardized regression coefficient.

Note. Statistically significant indices in bold $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

To meet the second objective of this research, the predictive effects of the three metalinguistic skills (phonological awareness, morphological awareness, and metatextual awareness) and the variables of school year and age for reading comprehension were investigated. Table 4 reports the indices derived from this analysis.

Table 4

Metalinguistic Skills, School Year and Age as Predictors of Reading Comprehension

VD: Reading Comprehension (Cloze test 1)		
VIs Predictors	β	t
(Constant)	-	.275
Metatextual Awareness	.34***	5.294
Phonological Awareness	.06	1.021
Inflectional Morphological Awareness	.24***	3.777
Derivational Morphological Awareness	.15*	2.359
School Year	.20*	2.089
Age	-.07	-.847
VD: Reading Comprehension (Cloze test 2)		
VIs Predictors	β	t
(Constant)	-	-1.786
Metatextual Awareness	.43***	6.551
Phonological Awareness	.08	1.463
Inflectional Morphological Awareness	.09	1.371
Derivational Morphological Awareness	.22***	3.359
School Year	.06	.637
Age	.01	.095

Legend. VD = Dependent Variable; VIs = Independent Variables; β = Standardized regression coefficient.

Note. Values in bold indicate β statistically significant $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

Metatextual awareness, derivational and inflectional morphological awareness, and school year represented approximately 51% of the explained variance of reading comprehension assessed by the Cloze test 1 (F [6, 208] = 38.169; p < .001), Durbin-Watson test = 1.98. Among the metalinguistic skills, the increase in metatextual awareness contributes .34 points in reading comprehension. In inflectional morphological awareness, this contribution was .24 points and in derivational morphological awareness .15 points. The contribution of metalinguistic skills to the explained variance of reading comprehension was 50%, according to ΔpR^2. The advance of the school years in elementary school (3rd to 5th grade) reflected in an improvement in reading comprehension of .20 points, however, it represented only 1% of the explained variance of the performance of this linguistic cognitive skill. Phonological awareness and age did not show an explanatory contribution to Cloze test 1, also considering their β with $p > .05$.

Reading comprehension assessed by the Cloze 2 test had 48% of its explained variance by metatextual awareness and derivational morphological awareness (F [6, 209] = 34.009; p < .001), Durbin-Watson test = 1.82. In the model tested, the development of metatextual awareness impacted reading comprehension skills by .43 points and derivational morphological awareness by .22 points. The metalinguistic skills phonological awareness and inflectional morphological awareness and the variables school year and age did not add explained variance to reading comprehension in the Cloze 2 test, as well as their β were not statistically significant.

Discussion

Initially, about the scores obtained by the students in the researched sample, it was verified that they showed greater difficulty in the tests of verbal and numerical reasoning and in reading comprehension, so that they did not reach 50% in the average score in the instruments that evaluated these skills. It would be expected that there would be an appropriation of reading comprehension beyond the initial process of decoding, as this allows for greater depth and criticality in the content read, greatly contributing to the development of school subjects, given that reading with effective understanding of the content precedes all of them (Santos et al., 2018).

The results of the correlations between the investigated skills converge with the literature (Cunha & Santos, 2019; Mota et al., 2014; Santos et al., 2018) and fulfill the prerequisite for the application of regression analyses provided for care of the objectives of this research (Dancey & Reidy, 2013). Studies indicate the contribution of metalinguistic skills throughout the literacy process and for the development of reading comprehension (Santos et al., 2018). Controlling intelligence measures as verbal and numerical reasoning and learning context variables as school year and age, showed changes in partial correlation coefficients involving metalinguistic skills and reading comprehension. To some extent, this result is in line with the findings of Freitas Junior and Mota (2015), Guimarães and Mota (2016), and Oliveira et al., (2020). In these, the inclusion of new variables, as intelligence, age and school year, meant that morphological awareness no longer independently explained reading comprehension. In the research in question, the correlations of moderate magnitude between reading comprehension with phonological awareness and inflectional morphological awareness became weak magnitude after controlling for verbal and numerical reasoning measures. The same occurred after controlling for school year and age in the partial correlations, so that the correlation of moderate magnitude between reading comprehension and phonological awareness became of weak magnitude, which did not occur in the other partial correlations. This result is an indication of the need to consider age and school year when proposing to investigate the relationships between reading comprehension and metalinguistic skills, since they can also be configured as strange or even confounding variables (Dancey & Reidy, 2013).

In the investigation of the direct and indirect predictive effects of metalinguistic skills for reading comprehension, also considering measures of verbal and numerical reasoning, which is the main objective of this research, the contribution of metatextual awareness, derivational morphological awareness, and verbal reasoning was initially verified for reading comprehension with the Cloze test 1, explaining 46% of the variance. When performing the Cloze Test 2 analyses, the explained variance of metatextual awareness, derivational morphological awareness, and verbal reasoning was 44%. The result in question brings important reinforcements to scientific literature, given that the contribution of these variables is more often presented individually (see Coelho et al., 2024; Cunha & Santos, 2019; Ferraz & Santos, 2019; Liu et al., 2024).

Furthermore, it was possible to observe the indirect predictive effect of phonological awareness considering verbal reasoning in reading comprehension. Something similar occurred with metatextual awareness, having an indirect predictive effect on reading comprehension, considering verbal reasoning. Phonological awareness and metatextual awareness explained 21% of verbal reasoning variance. The findings demonstrate the interference of vocabulary extension, and the ability to establish abstract relationships between verbal concepts in the mediation of phonological and metatextual awareness variables for reading comprehension. Verbal reasoning is an important resource at the time of reading, as it facilitates access to previously stored content, which will help in understanding the text, as well as in solving

problems related to the processing of verbal information with the use of prior knowledge (Lima & Santos, 2017; Trassi et al., 2019). In this way, it is hypothesized that verbal reasoning mediates between phonological and metatextual awareness for reading comprehension, by facilitating not only access to knowledge derived from these skills, but also, in the acquisition of proficiency in manipulating them appropriately, contributing to the understanding of the text.

Regarding the interference of age and school year in the predictive effects of metalinguistic skills on reading comprehension, only the school year variable significantly contributed to the explained variance of metalinguistic skills for reading comprehension. In the Cloze test 1, metalinguistic skills (metatextual awareness, inflectional and derivational morphological awareness) explained 50% of the variance in reading comprehension, and with the addition of the school year, the explained variance increased to 51%. This result points to the importance of developing metalinguistic skills during schooling, through formal instruction (Oliveira & Justi, 2017; Santos et al., 2018; Mota et al., 2013). Considering the absence of a statistically significant interference of the age variable, and the results obtained with the school year and with metalinguistic skills, the inclusion of activities that stimulate them in school curriculum may have important implications in the development of reading comprehension in students from elementary school.

Metalinguistic skills have been widely recognized as essential factors for reading comprehension, as they involve the ability to reflect on language, manipulate it consciously and understand its underlying structures. Recent research indicates that skills as phonological, morphological, and syntactic awareness play a fundamental role in decoding and textual interpretation, especially in transparent and opaque languages. Furthermore, reasoning has been identified as a predictive factor of reading comprehension, contributing to the inference and integration of information at the discourse level. Contemporary studies indicate that the relationship between reasoning, metalinguistic skills and reading is not linear, but mediated by factors as vocabulary, working memory, and reading experience. However, gaps in literature still persist, especially regarding the interaction between these components in different age groups and linguistic contexts. Therefore, understanding how these variables relate can contribute to the development of more effective educational interventions, aimed at improving reading comprehension in populations with learning difficulties and strengthening the teaching of reading in different educational contexts (Coelho et al, 2024; Liu et al., 2024).

Still on this topic, another point that should be considered is the presence of out-of-age students in the classes of the school years investigated here. This is a limitation of the research, as this data was not collected. For future research, it is pointed out the need to consider this aspect, reiterating the deepening of investigations on the role of age and school year as variables that alone contribute to the development of linguistic and metalinguistic skills or if they are characterized as strange variables (Dancey & Reidy, 2013).

In view of the conjectures presented in this study, it is necessary to mention some limitations that result in recommendations for proposing future research involving this theme. The use of only one measure to assess each of the metalinguistic skills stands out. Therefore, it is suggested to add other measures that have stimuli different from those presented in the instruments applied in this research to expand the evaluation of these skills. About the sample, it is important to consider the inclusion of students from private schools and from other Brazilian states, allowing comparisons to be made between students from different educational institutions and Brazilian regions. This indication aims to expand the investigation of aspects related to formal education, inherent to the knowledge acquired with the progression of the school years, in particular the level of mastery

of metalinguistic skills and verbal and numerical reasoning, considering their consequences in reading comprehension. In this perspective, it will also be possible to verify if the results obtained with the models tested here are sustained in contexts in which students will present better performance in the skills identified as falling short of expectations in this study (e.g. verbal and numerical reasoning and reading comprehension [Cloze 2]). Moreover, it is expected that there will be progression of essential learning throughout Basic Education and that the student, over the school years, will acquire proficiency in the ability to understand the content read. However, the result shown in the descriptive statistics involving intelligence measures should be viewed with caution, as elementary school students are in the process of developing through literacy and are still learning disciplines that require, among other skills, verbal reasoning and numerical.

References

Cunha, N. B., & Santos, A. A. A. (2009) Validade por processo de resposta no teste de cloze. [Validity by Response Process in the Cloze Test.] *Fractal: Revista de Psicologia, 21*(3), 549-562. http://dx.doi.org/10.1590/S1984-02922009000300010

Cunha, N. B., & Santos, A. A. A. (2014). Estudo de validade do questionário de avaliação de consciência metatextual. [Validity Study of the Metatextual Awareness Assessment Questionnaire.] *Revista Psicologia: Teoria e Prática, 16*(1), 141-154. http://dx.doi.org/10.15348/1980-6906/psicologia.v16n1p141-154.

Cunha, N. B., & Santos, A. A. A. (2019). Avaliação da consciência metatextual e sua predição da compreensão de leitura. [Assessment of Metatextual Awareness and its Prediction of Reading Comprehension.] *Psicologia: Teoria e Prática, 21*(1), 37-52. http://dx.doi.org/10.5935/1980-6906/psicologia.v21n1p53-68

Coelho, C., Capelas, S., Couto, P. S., Vinagre, R., & Lousada, M. (2024). The Impact of Morphological Awareness on Reading and Spelling. *Research Report, 30*, e0017, 1-16. https://doi.org/10.1590/1980-54702024v30e0017

Dancey, C. P., & Reidy, J. (2013). *Estatística sem matemática para psicólogos. [Statistics Without Mathematics for Psychologists.]* Penso Editora.

Dunn, T. J., Baguley, T., & Brunsden, V. (2014). From Alpha to Omega: A Practical Solution to the Pervasive Problem of Internal Consistency Estimation. *British Journal of Psychology*, *105*(3), 399-412. https://doi.org/10.1111/bjop.12046

Ferraz, A. S., & Santos, A. A. A. (2019). Compreensão de leitura e consciência morfológica no ensino fundamental I. [Reading Comprehension and Morphological Awareness in Elementary School.] *Estudos interdisciplinares em Psicologia, 10*(2), 03-19. https://doi.org/10.5433/2236-6407.2019v10n2p03

Field, A. (2013). *Discovering statistics using IBM SPSS statistics*. Sage.

Freitas Junior, P. V., & Mota, M. M. P. E. (2015). So, Morphological Awareness Contributes to Reading in Brazilian Portuguese?. *Psico-USF, 20*(3), 471-479. https://doi.org/10.1590/1413-82712015200309

Gombert, J. E. (1992). *Metalinguistic Development*. University of Chicago Press. [e-book].

Guimarães, S. B., & Mota, M. M. P. E. (2016). Qual a contribuição da consciência morfológica das crianças na precisão de leitura de palavras e compreensão de texto no português? [What is the Contribution of Children's Morphological Awareness to Word Reading Accuracy and Text Comprehension in Portuguese?] *Estudos de Psicologia, 21*(3), 239-248. https://doi.org/10.5935/1678-4669.20160023

Hu, L., & Bentler, P. M. (1999). Cutoff Criteria for Fit Indexes in Covariance Structure Analysis: Conventional Criteria Versus New Alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Konrad, J. T., & Lorandi, A. (2019). Relação entre Consciência Fonológica e Compreensão Leitora em Crianças: Revisão Sistemática de Pesquisas Brasileiras [The Relationship between Phonological Awareness and Reading Comprehension in Children: Systematic Review of Brazilian Researches]. *Letras de Hoje*, *54*(2), 274-283. https://doi.org/10.15448/1984-7726.2019.2.32525

Lima, T. H., & Santos, A. A. A. (2017). Compreensão de leitura e sua relação com raciocínio verbal. [Reading Comprehension and its Relationship With Verbal Reasoning.; In. S. G. Caliatto; S. M. S. S. Oliveira; N. B. Cunha & M. C. R. A. Joly (Orgs.), *Avaliação: diferentes processos no contexto educacional. [Assessment: different processes in the educational context.]* (101-117). 1ªed. Navegando Publicações.

Liu, Y., Groen, M. A. & Cain, K. (2024). The Association Between Morphological Awareness and Reading Comprehension in Children: A Systematic Review and Meta-Analysis. Educational Research Review, 42, 100571. https://doi.org/10.1016/j.edurev.2023.100571

Marôco, J. (2014). *Análise de equações estruturais: Fundamentos teóricos, software & aplicações*. *[Analysis of Structural Equations: Theoretical Foundations, Software & Applications.]* ReportNumber.

Mota, M. M. P. E., & Santos, A. A. A. (2009). O papel da consciência fonológica na leitura contextual medida pelo teste de Cloze. [The Role of Phonological Awareness in Contextual Reading as Measured by the Cloze Test.] *Estudos de Psicologia, 14*(3), 207-212. https://doi.org/10.1590/S1413-294X2009000300004

Mota, M. M. P. E., & Santos, A. A. A. (2014). O cloze como instrumento de avaliação de leitura nas séries iniciais. [The Cloze as a Reading Assessment Instrument in the Early Grades.] *Revista Quadrimestral da Associação Brasileira de Psicologia Escolar e Educacional, 18*(1), 135-142. http://dx.doi.org/10.1590/S1413-85572014000100014.

Mota, M. M. P. E., Santos, A. A. A., Guimarães, S. B., & Conti, C. (2014). Evidências de validade do Roteiro de Avaliação da Consciência Fonológica (RACF). [Validity Evidence of the Phonological Awareness Assessment Guide (RACF).] *Estudos e Pesquisas em Psicologia, 14*(3), 933-948. https://www.e-publicacoes.uerj.br/index.php/revispsi/article/view/13892/10579

Muthén, L. K., & Muthén, B. O. (1998-2017). *Mplus User's Guide*. (8th ed.). Muthén & Muthén.

Nakano, T. C., & Primi, R. (2012). A estrutura fatorial do teste de criatividade figural infantil. [The Factorial Structure of the Children's Figural Creativity Test.] *Psicologia: Teoria e Pesquisa, 28*(3), 91-100. https://doi.org/10.1590/S0102-37722012000300003

Oliveira, B. S. F., & Justi, F. R. R. (2017). A contribuição da consciência morfológica para a leitura no português brasileiro. [The Contribution of Morphological Awareness to Reading in Brazilian Portuguese.] *Revista Psicologia: Teoria e Prática, 19*(3), 270-286. http://dx.doi.org/10.5935/1980-6906/psicologia.v19n3p270-286.

Oliveira, M., Levesque, K. C., Deacon, S. H., & Mota, M. M. P. E. (2020). Evaluating Models of How Morphological Awareness Connects to Reading Comprehension: A Study in Portuguese. *Journal of Research in Reading, 43*(2), 161-179. https://doi.org/10.1111/1467-9817.12296

Santos, A. A. A. (1996). A influência da consciência fonológica na aquisição da leitura e da escrita. [The Influence of Phonological Awareness on the Acquisition of Reading and Writing] In. F. F. Sisto, G. C. Oliveira, L. D. T. Fini, M. T. C. C. Souza, & R. P. Brenelli (Orgs.), *Atuação psicopedagógica e aprendizagem escolar [Psychopedagogical Performance and School Learning]* (213-247). Vozes.

Santos, A. A. A. (2005). *O Teste de Cloze como instrumento de avaliação da compreensão em leitura.* [The Cloze Test as an Instrument for Assessing Reading Comprehension.] Technical report.

Santos, A. A. A., & Cunha, N. B. (2012). Consciência metatextual: Evidências de validade para instrumento de medida. [Metatextual Awareness: Validity Evidence for a Measurement Instrument.] *Psico-USF, 17*(2), 233-241. https://doi.org/10.1590/S1413-82712012000200007

Santos, A. A. A., Ferraz, A. S., & Rueda, F. J. M. (2018). Relações entre a compreensão de leitura e as habilidades metalinguísticas. [Relationships Between Reading Comprehension and Metalinguistic Skills.] *Psicologia Escolar e Educacional, 22*(2), 301-309. http://dx.doi.org/10.1590/2175-35392018026239

Spinillo, A. G., & Simões, P. U. (2003). O desenvolvimento da consciência metatextual em crianças: Questões conceituais, metodológicas, e resultados de pesquisa. [The Development of Metatextual Awareness in Children: Conceptual, Methodological Issues, and Research Findings.] *Psicologia: Reflexão e Crítica, 16*(3), 537-546. https://www.scielo.br/j/prc/a/fkpfDt9s6LyCJ8GgRHNXJNf/?format=pdf&lang=pt

Suehiro, A. C. B., & Santos, A. A. A. (2011). Roteiro de avaliação da consciência fonológica (RACF). [Phonological Awareness Assessment Script (RACF).] *ACTA Colombiana de Psicología, 14*(1), 147-154. http://www.scielo.org.co/pdf/acp/v14n1/v14n1a13.pdf

Suehiro, A. C. B., & Santos, A. A. A. (2015). Compreensão de leitura e consciência fonológica: Evidências de validade de suas medidas. [Reading Comprehension and Phonological Awareness: Validity Evidence of Their Measures.] *Estudos de Psicologia, 32*(2), 201-211. https://doi.org/10.1590/0103-166X2015000200005

Trassi, A. P., Oliveira, K. L., & Inácio, A. L. M. (2019). Reading Comprehension, Learning Strategies and Verbal Reasoning: Possible Relationships. *Psico - USF, 24*(4), 615-624. https://doi.org/10.1590/1413-82712019240401