Calidoscópio
20(1): 167-189 janeiro-abril 2022
ISSN 2177-6202
Unisinos - doi: 10.4013/cld.2022.201.09

Reading comprehension is modulated by lexical-semantic knowledge in skilled and less-skilled comprehenders

A compreensão leitora é modulada pelo conhecimento léxico-semântico em bons leitores e leitores com dificuldades de compreensão

Lucilene Bender de Sousa[1]
Instituto Federal do Rio Grande do Sul (IFRS)
lenebender10@gmail.com
https://orcid.org/0000-0002-3833-5987

Lilian Cristine Hübner[2]
Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS)
lilian.c.hubner@gmail.com
http://orcid.org/0000-0002-7876-2211

Bárbara Luzia Covatti Malcorra[3]
Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS)
barbaraluz.malcorra@gmail.com
https://orcid.org/0000-0001-5710-7130

Abstract: This study aimed at examining the depth of vocabulary knowledge, lexical-semantic processing and implicit semantic memory in SCs and L-SCs. The participants were 86 eighth-graders from public schools in the south of Brazil, tested with tasks of word definition, semantic judgment, and lexical decision. Results showed that SCs and L-SCs differed significantly in the depth of vocabulary

[1] Doutora em Linguística pela Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS) com doutorado sanduíche na Universidade de Pittsburgh, no Learning Research and Development Center (LRDC). Possui mestrado em Letras, área de concentração em Leitura e Cognição, e graduação em Letras Português/Inglês pela Universidade de Santa Cruz do Sul. Atua 40 horas com dedicação exclusiva no Instituto Federal do Rio Grande do Sul (IFRS) campus Farroupilha nas áreas de língua portuguesa e língua inglesa. Tem como área de pesquisa a Psicolinguística, com foco na aquisição da linguagem, leitura, cognição e léxico.

[2] Professora adjunta do Curso de Letras e do Programa de Pós-Graduação em Letras da Escola de Humanidades da Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS). É Mestre em Estudos da Linguagem – Aquisição - Universidade Federal do Rio Grande do Sul (UFRGS) e Doutora em Letras – Linguística e Língua Inglesa - Universidade Federal de Santa Catarina (UFSC). Bolsista de Produtividade em Pesquisa do CNPq.

[3] Doutoranda em Linguística pelo Programa de Pós-Graduação em Letras da Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS). Mestre em Linguística pela mesma instituição. Licenciada em Letras com habilitação Português e Inglês pela Universidade do Vale do Rio dos Sinos (UNISINOS). Integrante do Grupo de Estudos em Neurolinguística e Psicolinguística (GENP), coordenado pela Profa. Dra. Lilian Cristine Hübner.

knowledge and lexical-semantic processing but not in the implicit semantic memory. Although it is not clear if L-SCs present lexical-semantic knowledge delay or deficit, the results are more consistent with the hypothesis of a delay. They also suggest that lexical-semantic knowledge and processing may be an important path for intervention with L-SCs.

Keywords: reading; comprehension; vocabulary; semantic; priming.

Resumo: Este estudo objetiva examinar a profundidade do conhecimento de vocabulário, o processamento léxico-semântico e a memória semântica implícita em bons leitores e leitores com dificuldades de compreensão. Os participantes foram 86 estudantes de 8ª série de escolas públicas do sul do Brasil que foram testados com tarefas de definição de palavras, julgamento semântico e decisão lexical. Os resultados mostraram que bons leitores e leitores com dificuldades se diferenciaram significativamente na profundidade do conhecimento de vocabulário e no processamento léxico-semântico, mas não na memória semântica implícita. Embora não fique claro se os leitores com dificuldades de compreensão apresentam atraso ou déficit de vocabulário, os resultados são mais consistentes com a hipótese de atraso. Eles também mostram que o conhecimento e processamento léxico-semântico podem indicar importantes caminhos para intervenções junto a leitores com dificuldades de compreensão.

Palavras-chave: leitura; compreensão; vocabulário; semântico; *priming*.

Introduction

Specific reading comprehension difficulties (SRCD) may originate from cognitive or linguistic aspects (Cain & Oakhill, 2006). Studies have found that poor comprehenders, also called less-skilled comprehenders (L-SC), present regular word reading skill but deficit in reading comprehension which emerge from linguistic deficits even before initiating formal literacy in school, and that these deficits persist throughout school years (Catts et al., 2006; Elwér et al., 2015; Nation et al., 2010). Likewise, Hulme & Snowling (Hulme & Snowling, 2011) argue that poor comprehenders exhibit subclinical impairments in a range of subskills related to reading comprehension, such as vocabulary knowledge, grammatical processing and general oral language comprehension, which are usually unnoticed at schools.

Regarding the linguistic factors, vocabulary is among those that present the strongest relationship with reading comprehension. There is evidence of an intrinsic relationship between word knowledge and discourse comprehension (Catts et al., 2006; Davis, 1944; Harmon & Wood, 2018; Spencer et al., 2014; Stanovich, 1986). Nagy (2005) proposes the existence of a direct reciprocal relationship between vocabulary and comprehension. He also claims that vocabulary has an indirect influence on other abilities crucial to reading comprehension such as word reading and metalinguistic awareness. Olson et al. (2011) found genetic and environmental correlations between vocabulary and reading

comprehension in a longitudinal study from preschool through Grades 2 and 4. Landi & Ryherd (2017) reviewed studies about specific reading comprehension deficits and claim that "Vocabulary and lexical-semantic knowledge have been consistently identified as areas of weakness, making these hallmarks of S-RCD". Therefore, poor vocabulary knowledge is among the main possible causes of reading comprehension difficulties. Not only quantity but also quality of word knowledge is related to reading. According to the study conducted by Ouellette (2006), receptive vocabulary is more associated with decoding, while productive vocabulary is more associated with comprehension. The Reading Systems Framework (Perfetti & Stafura, 2014) sets word knowledge in the center of the reading comprehension process, being the output of word identification and the input to comprehension processes.

Two important and complementary hypotheses may contribute to explain the origin of reading comprehension difficulties. According to the lexical quality hypothesis (Perfetti & Hart, 2002), efficiency in the word identification process depends on the quality of the lexical representation, which encompasses orthographic, phonological, and semantic information. In the same vein, but more focused on semantic representation, Nation & Snowling (1998, 1999) postulated a more generic verbal-semantic deficit related to SRCD.

The quality of the lexical representation is defined by the extension in which each constituent is detailed (orthographically and phonologically) and differentiated (semantically and syntactically) as well as by the concatenation of the connection among them. Perfetti et al. (1992) posits that the phonological information is always activated in the lexical access and that the other aspects may activate each other reciprocally. Therefore, according to the author, automatic and efficient reading is achieved only by consolidated and interconnected lexical knowledge. The quality varies according to the precision, redundancy and flexibility of word form and meaning representation. The higher the quality of lexical representation is, the higher is the quality of reading comprehension.

Some studies bring evidence that supports this hypothesis. Nation and Snowling (1998) have observed that poor comprehenders exhibit problems in the recognition of irregular and low frequency words. Based on Plaut and colleagues' (Plaut et al., 1996) model of word recognition, the authors attributed these problems to the semantic deficit shown by poor comprehenders in receptive and productive vocabulary tasks. Ricketts and colleagues (Ricketts et al., 2014) verified that vocabulary predicted exception word reading when other component reading skills were controlled for, corroborating the important role of semantic knowledge to word recognition and discourse comprehension. In another study, Nation and Snowling (1999) investigated the impact of the sensitivity to semantic categorical and functional relations in 10-year-old good and poor comprehenders. They verified that both groups demonstrated significant priming effect to functionally related pairs; however, poor comprehenders showed categorical priming only to words of the same category with high associability. This result corroborates the idea of a semantic deficit in poor comprehenders.

Studies conducted with readers with specific reading comprehension deficits show that they present more difficulty in learning vocabulary than do SCs (James et al., 2020; Nation et al., 2010; Ryherd & Landi, 2019), lower ability in inferring the meaning of new words from context as well as in learning

new words through direct instruction (Cain et al., 2003, 2004). In the research developed by Landi & Perfetti (2007), SCs showed more sensitivity to categorical and associative relations and differences in P200[4] and N400[5] activation during semantic judgment tasks. More specifically, the P200 is sensitive to early orthographic components in word reading, while the N400 is of special interest due to its sensitivity to differences in both phonological and semantic processing. For example, in semantic judgement tasks using a priming paradigm, the N400 effect is larger (more negative) when the target stimulus and the probe are semantically unrelated. This same effect is seen, for example, when a person reads a semantically inconsistent/unexpected word in a sentence. Thus, differences between groups provide neurophysiological evidence of the semantic deficit hypothesis.

Taken together, the studies above demonstrate the crucial role of vocabulary knowledge in reading comprehension and a consistent weakness in lexical semantic knowledge and processing among L-SCs. However, the nature of this weakness is still not fully known. Furthermore, it is also unclear what aspects of vocabulary are deficient (Nation, 2001). More specifically, are the deficits associated with vocabulary breadth or depth, in implicit or explicit vocabulary, in productive or receptive semantic knowledge? Does it relate to vocabulary knowledge only or also to lexical-semantic processing? Is it restricted to some specific kind of semantic relation (category, synonym), frequency of words or part of speech? Most of the vocabulary tasks used in the studies are standard and encompass general measures that do not allow a deeper understanding about lexical semantic knowledge and processing. This understanding could help to identify the causes of reading difficulty and ways of intervention with L-SCs. Although research about depth of vocabulary knowledge is gradually increasing, they vary a lot in their conceptualization and measures (Yanagisawa & Webb, 2020). These studies are more common in second language processing because of the smaller number of words acquired by learners, especially in the initial stages of acquisition. In the mother language, the challenge to investigate depth is higher. In this study, we tried to develop a semantic judgement task which analyzed some of the mentioned aspects related to word knowledge.

Considering that studies on semantic knowledge are much scarcer and incipient as compared to those on phonological and orthographic knowledge in reading research (Landi, 2012), and also considering a lack of research focusing on specific features regarding the nature of vocabulary knowledge, this study aimed at investigating lexical-semantic knowledge in eighth-grade SCs and L-SCs, addressing the following questions: Are there differences between L-SCs and SCs in depth of vocabulary knowledge, in lexical-semantic processing and in implicit semantic memory? Do L-SCs present a semantic deficit when compared to SCs? Do their semantic knowledge differ? We hypothesized that L-SCs would show lower vocabulary knowledge in all tasks measuring these aspects (accuracy of word definition and ability in semantic judgment tasks), slower lexical-semantic processing (response time (RT) in the semantic judgement task), as well as lower facilitation in implicit

[4] The P200 wave is an event-related potential (ERP) component which indicates a positive spike in EEG signals observed in general within 150 to 250 ms after the exhibition of a target auditory or visual stimulus.
[5] The N400 wave is an event-related potential (ERP) which indicates a negativity peaking in EEG at about 400 ms after the target (auditory or visual) stimulus onset.

semantic memory (semantic priming task). This way, this study intends to bring contribution to the field of reading processing, by exploring different aspects of lexical-semantic knowledge and semantic priming effect in readers which differ in reading comprehension levels.

Method

Participants

Forty-nine SCs and 37 L-SCs were selected from a group of 336 eighth-grade students from public schools in the south of Brazil. Children's assent and their parents' informed consent were obtained to implement the study. This study was approved by the Ethics Committee of the institution where it was conducted under protocol number 24304113.0.0000.5336.

All participants were native speakers of Brazilian Portuguese with no diagnosed neurological disorders or dyslexia as reported by their teachers and parents. In both groups, age varied from 13 to 17 years (mean 14). There were more girls than boys in each group. There were 16 (32.7%) boys and 33 (67.3%) girls among SCs, and 15 (40.5%) boys and 22 (59.5%) girls among L-SCs. All participants were studying English at school, but at a very basic level; thus, proficiency in another language would not be an interference factor in reading ability in Brazilian Portuguese. In both groups, participants belonged to the middle-class socioeconomic status.

In order to form the groups described above according to their reading comprehension ability, the participants were assessed by multiple tasks: 1) two reading comprehension tasks with written open-ended and multiple-choice questions; 2) a listening comprehension task with multiple-choice questions; 3) a word/pseudoword reading task (Salles & Parente, 2002). The comprehension tasks included literal and inferential questions and required written responses. As there is a lack of standardized reading assessment tests available in Brazilian Portuguese for these age groups, we carefully developed tasks 1 and 2 in the selection process, with the use of pilot studies, and assessment and rating of tasks construction and participants' answers by specialist judges, as described in Sousa and Hübner (2020). The selection process was divided in two stages. In the first one, preselection, only the reading and listening tasks with multiple-choice questions were conducted to select the participants from a group of 336 students. After this, in the second stage, reading comprehension tasks with open-ended questions and a word/pseudoword reading task were administered to the participants who showed equal or above one standard deviation (SD) of the mean in the reading comprehension task (48 students equivalent to 14,28% of the total sample) and equal or below one standard deviation (SD) in reading comprehension (51 student equivalent to 15,17% of the total sample). The multiple-choice question task was chosen to be used as the main measure of reading comprehension because its structure was designed to be similar to the listening comprehension task.

The groups were divided according to the following criteria: a) SC - equal or above one standard deviation (SD) of the mean in the reading comprehension task with multiple-choice questions and age-appropriate word/pseudoword reading score; b) L-SC - equal or below one SD of the mean in

the reading comprehension task with multiple-choice questions and age-appropriate word/pseudoword reading accuracy according to the standards of performance in the task (Salles et al., 2013). The listening comprehension task was used as a complementary comprehension measure in order to verify whether L-SC and SC differed in discourse comprehension, independently of their decoding skill. Table 1 summarizes the groups' performance on the selection tasks.

Table 1 - Skilled comprehenders' and less-skilled comprehenders' performance on participants' selection and grouping tasks

	Maximum	**SCs** (N = 49, F = 32)	**L-SCs** (N = 37, F = 22)		
	Score	mean (SD)	mean (SD)	**t (84)**	**p**
Age	-	14.2 (0.76)	14.51 (1.01)	-1.55	p = 0.12
Reading comprehension (MC)	15	12.86 (0.89)	4.92 (1.16)	34.56	p= 0.01*
Listening comprehension	15	10.9 (1.43)	7.05 (2.10)	9.55	p= 0.01*
Reading comprehension (OE)	15	11.02 (2.41)	5.86 (2.04)	10.71	p= 0.01*
Word/pseudoword reading	60	58.82 (1.14)	57.38 (1.57)	4.89	p = 0.01*

Notes: SC = skilled comprehenders; L-SC = less-skilled comprehenders; N = number of participants; F = number of female participants; SD = standard deviation; MC = multiple choice; OE = open ended; *Represents significant differences between groups after Bonferroni correction for multiple comparisons.

SCs and L-SCs differed in all comprehension measures of performance in the reading, multiple choice and open-ended tasks, as well as in the listening comprehension task. Both groups presented adequate word/pseudoword reading for their age, but SCs were slightly better on this task. Ceiling effect can be explained because the word/pseudoword reading task was initially developed for children from the 1st to the 7th year of Elementary School and our sample were children from the 8th year. Despite this limitation, this task was used because it was the only validated for children near this age in Brazilian Portuguese available for free. To further examine the difference, between-groups comparisons were conducted. The task was composed of regular, irregular and pseudowords. The groups differed significantly in pseudoword reading $t(81) = 3{,}349$, $p = 0{,}001$ and in irregular word reading $t(81) = 2{,}900$, $p = 0{,}006$. When analyzing more transparent orthographies like Portuguese, it is important to consider differences in these two categories of words because they reveal different aspects of word reading. On one hand, pseudoword reading assesses orthographic-phonological mapping skill independently of vocabulary knowledge. On the other hand, irregular word reading assesses the recognition of words with more complex orthography which rely more on vocabulary knowledge and print exposure.

Procedures and materials

Children were assessed individually in a quiet room indicated by the school supervisor. In the present research, which is part of a larger study, we report data of three linguistic tasks that are briefly described below: a word definition task that lasted approximately 15 minutes, administered by trained research assistants; a semantic judgment task and a lexical decision task administered by the first author, lasting approximately 10 minutes.

Word definition task: The Wechsler Intelligence Scale for Children WISC III (Wechsler, 2002), adapted to Brazilian Portuguese (Figueiredo et al., 1998), was used to assess the depth of vocabulary knowledge. The task consists of requiring the participant to orally define 30 words with increasing difficulty levels. All participants were trained with three words before the beginning of the test. An experienced psychologist conducted the test analysis and scoring. Definitions were scored from 0 to 2 according to the test guidance.

Semantic judgment task: This task examined the semantic knowledge of words controlled by frequency and relation-synonym (similar meaning, e.g.: moderno/atual; modern/current), category subordinate (category and member, e.g.: animal/elefante; animal/elephant). The task followed the design adopted by Oakhill et al. (2012). The stimuli were presented in one separate block for each kind of relation.

As the objective of this study was to investigate the relationship between the quality of the lexical-semantic representation and reading comprehension, the participants' vocabulary knowledge was assessed through an additional task involving relations between synonyms and category (subordinate) words in order to verify whether there was a group difference in the depth of the lexical-semantic knowledge and also to compare the two types of relationships (synonym and category subordinate). Synonym's processing was hypothesized to be easier than categorical association processing. In addition to accuracy, participants' response time (RT) was recorded, aiming at verifying whether the participants would differ in the time of word peer analysis and of decision on their semantic relationship. This way, the measure of time would serve to verify whether there would be a difference in the lexical-semantic processing between groups, assuming that longer RTs would indicate greater difficulty in semantic judgment, while shorter RTs would indicate greater ease in the process. Between- and within-group analyses were performed in both accuracy and RT. It is important to clarify that this task was initially intended to examine not the effect of semantic priming, but rather the depth of lexical-semantic knowledge and its processing in the two groups of participants.

The first block was composed of 32 related pairs of synonyms and 32 unrelated pairs of words that varied in four frequency ranges: a) above 100,000; b) from 50,000 to 99,999; c) from 10,000 to 49,999; d) from 1,000 to 9,999; ranges are based on the Brazilian Portuguese Corpus of Word Frequency (http://corpusbrasileiro.pucsp.br/cb/Inicial.html). As it was not possible to keep the same frequency range for both words in each pair, the classification was based on the first word of the pair. Whenever possible, we selected the second word of the pair from a higher frequency range (for example: demonstrar (demonstrate) - frequency of 201,743; mostrar (show) - frequency of 459,633). Each frequency range was composed of four nouns, three verbs, and one adjective, in order to verify the semantic knowledge of words from different parts-of-speech categories. The number of syllables of the first ($t(6) = 0.15$; $p = 0.88$) and the second word of the pairs ($t(6) = -1.87$; $p = 0.11$) in both conditions (related - unrelated) was controlled in all frequency ranges.

The second block of stimuli was composed of 30 pairs of category subordinate related words and 30 pairs of unrelated words. The stimuli were selected following the normative studies of categorical representation (Carneiro et al., 2008; van Overschelde et al., 2004). The categories were general

and diverse, not demanding knowledge about any specific area, and classified into three groups: natural, artificial, and cultural, each composed of 10 pairs of stimuli. It was not possible to control the frequency of the words in each group. However, the number of syllables for the first ($t(4) = 0.40$; $p = 0.70$) and second word of the pairs ($t(4) = 0.09$; $p = 0.93$) was controlled in both conditions (related - unrelated) in each category group.

The stimuli were presented in black letters, 25-point Courier New font, in the center of a white screen of a 12-inch laptop using the software E-prime (Professional 2.0.10.242) to display stimuli and collect responses. A Stimulus Onset Asynchrony (SOA) of 950 ms was used, the prime was presented for 750 ms, in capital letters, followed by a blank screen for 200 ms; then the target, in lowercase letters, was presented until the response was given. Each experimental trial was preceded by a fixation cross (+), which appeared for 500 ms in the center of the screen. Following a training section, participants were asked to read silently and respond, as quickly and accurately as possible, whether the words were synonyms, in the first section, or category-members, in the second section, by pressing the green button for "yes" or the red button for "no." Two keys of the keyboard, "p" and "q," were randomly alternated for the answers "yes" or "no" and labeled with a small green (for "yes") and red (for "no") sticker. Students were asked to keep their index fingers on these keys throughout the experiment. The pairs were randomized in each section. Prior to the experiment, the participants were given a practice trial with 10 pairs of stimuli that did not comprise the experimental conditions.

Lexical decision task: This task assessed implicit semantic memory. The stimuli were provided by Holderbaum & Salles (2011) and Salles et al. (2011) and Holderbaum et al. (2015). There were 78 pairs, and half of these trials were composed by word (prime)-word (target) and the other half by word (prime)-pseudoword (target). The 39 target words (35 nouns, 10 adjectives, and four adverbs) were three to six letters long, comprising 19 low, 12 high, and six average-frequency words according to norms for third graders in Brazilian Portuguese (Pinheiro, 1996). Primes that preceded the word targets were semantically related or unrelated to the target based on the norms published in Salles et al. (2009). Unrelated primes were selected to have similar length to semantically related primes and no structural or semantic relation with the target words.

Two versions of the task were used, one with 20 semantically related pairs and 19 unrelated pairs (total of 39 target words) and one with 20 unrelated primes and 19 related pairs. The words used as targets in semantically related pairs in one version were used in unrelated pairs in the other version. Trials with pseudowords as targets remained the same in both versions. Target words used for related and unrelated primes were different so that the same stimulus was seen only once by any participant. All trials were randomly presented for each participant to control for possible order or pairs effect. Five practice trials (three word-word and two word-pseudoword) preceded the experiment.

The stimuli were presented in black letters, 24-point Arial font, in the center of a white screen on a 12-inch laptop using the E-prime (Professional 2.0.10.242) software to display stimuli and collect response time and accuracy. The SOA was 250 ms, each trial started with the prime, in capital letters, displayed for 150 ms, followed by a fixation cross (+) exhibited for 100 ms, and then the target, in lowercase letters, which remained on the screen until the response was given. A white screen appeared

for 2,000 ms between each trial. Two keys of the keyboard, "m" and "z," were randomly alternated for the answers "yes" or "no" and marked with a small green (for "yes") and red (for "no") label.

Procedures for data analyses

All the statistical analyses were performed in RStudio (Team, 2020). First, we used the Shapiro-Wilk test to verify data distribution, and the Levene's test to verify the homogeneity of variances. Next, we performed pairwise comparisons between different sets of stimuli. Scores from the word definition task had homogeneous variances and were normally distributed, so parametric tests were adopted (Student's t-test). Scores from the semantic judgment task and the lexical decision task had homogeneous variances, but were normally distributed, so non-parametric tests were adopted (Mann-Whitney U-test). The significance level was considered based on Bonferroni correction.

Results

Word definition task

Forty-eight SCs and 37 L-SCs performed the word definition task. Raw scores (maximum 60 points) and standard scaled scores (maximum 19 points) were obtained. The L-SCs demonstrated less word knowledge than the SCs group, with lower raw scores ($p < 0.001$) and scores per age ($p < 0.001$).

SCs had minimum raw scores of 27 and maximum scores of 52, averaging 40.69 (SD = 5.77). The WISC's standard score, from 1 to 19, takes into account the standard means for the age of the participant. This analysis showed that only one SC scored below his age standard, 18 (37.6%) scored from 10 to 13 points, and 29 (60.6%) SCs scored 14 or more points. L-SCs had a minimum raw score of 23 and a maximum score of 45, averaging 33.65 (SD = 5.63). The standard score analysis showed that 10 (27%) L-SCs scored below the expected for their age (9, 8, and 7), but nobody scored below 5, which would indicate cognitive difficulty. Among the other L-SCs, 22 (59.4%) presented a mean between 10 and 13 points, and five (13.5%) had a mean over 14 points. The groups' performance was significantly different ($t(83) = 5.63$; $p = 0.001$) in this task, showing that SCs demonstrated higher word knowledge than did L-SCs.

Semantic judgment task

The L-SCs showed lower accuracy than did the SCs group in synonyms ($p = 0.0017$), non-synonyms ($p < 0.0001$) and category related ($p = 0.0005$), with a trend for non-category related ($p = 0.024$) (did not survived the Bonferroni correction). There was no significant difference between the groups in reaction time.

Concerning accuracy, the comparison between the two conditions indicated that both groups demonstrated better performance in the semantic judgment of category subordinate (mean accuracy of 93.33%) than in judging synonyms (mean accuracy of 81.25%) pairs. However, among the unrelated pairs, non-synonyms were more easily identified (mean accuracy of 87.50%) than the non-category (mean accuracy of 70%) ones. In the accuracy comparison of related and unrelated pairs, SCs exhibited facilitation for synonyms ($Z = -3.07$; $p = 0.002$) and category ($Z = -5.81$; $p = 0.001$) relations while L-SCs exhibited facilitation only for category ($Z = -4.64$; $p = 0.001$), not showing significant difference in the judgment of synonyms and non-synonyms ($Z = -0.92$; $p = 0.353$). Table 2 shows that SCs performed significantly better than L-SCs for related and unrelated pairs in both conditions.

Table 2 - Groups' accuracy (AC) and response time (RT) in the semantic judgment task

	SCs (N = 49)	L-SCs (N = 37)**	Mann-Whitney Test		
	Median (IQR)	Median (IQR)	U	Z	P
Synonym pairs (T = 32) AC.	26 (23–28)	23 (20.5–25.5)	547	3.14	0.002*
RT.	1,376 (1,116–1,749)	1,456.37 (1,213–1,622)	737	-0.37	0.707
Unrelated pairs (T = 32) AC	28 (27–31)	23 (18–25.5)	330.5	5.04	0.001*
RT.	1,521 (1,204–2,030)	1,590.30 (1,434–2,010)	620	-1.52	0.129
Category pairs (T = 30) AC.	28 (27–29)	26 (25–28)	513.5	3.46	0.001*
RT.	1,107 (930–1,375)	1,227.16 (1,049–1,365)	668	-1.44	0.147
Unrelated pairs (T = 30) AC	21 (16.50–24.5)	18 (16–21)	647.5	2.26	0.024
RT	1,437.93 (1,101–1,723)	1,491.06 (1,165–2,049)	722	-0.94	0.346

Notes: IQR = interquartile range; N = number of participants; T = total of pairs; AC = accuracy; RT = response time in milliseconds. *Represents significant differences between groups after Bonferroni correction for multiple comparisons. **Total of 35 participants considered in the analysis of RT in the category judgment task and 33 participants in the analysis of RT in the synonym judgment task.

A more detailed analysis was performed on the semantic judgment of synonyms, whose pairs were classified in four frequency ranges: 1) over 100,000; 2) from 50,000 to 99,999; 3) from 10,000 to 49,999; 4) from 1,000 to 9,999. SCs and L-SCs exhibited similar knowledge of high frequency words (ranges 1 and 2) but differed significantly in the accuracy of low frequency pairs (range 3 ($p < 0.0001$) and a trend in range 4 ($p = 0.0210$), which did not survive the Bonferroni correction), as described in Table 3. The performance analysis in the four frequency ranges for the whole sample showed significant differences ($x^2(3) = 87.49$; $p = 0.001$). The frequency ranges that showed significant differences ($p < 0.05$) for both SCs and L-SCs were: 1 and 4, 2 and 3, 2 and 4. L-SCs also differed significantly in the performance of ranges 1 and 3. As expected, participants had better performance in high frequency words than in low frequency ones, and this difference was observed mainly in the L-SC group.

Table 3 - Groups' performance in synonym pairs distributed in four different frequency ranges

	SCs (N = 49)	L-SCs (N = 37)	Mann-Whitney Test		
	Median (IQR)	Median (IQR)	U	z	p
Frequency 1 (T = 8)	7 (6 – 8)	7 (6 – 7.5)	862.5	-0.3	0.692
Frequency 2 (T = 8)	7 (6.5 – 8)	7 (6 – 8)	734	-1.5	0.114
Frequency 3 (T = 8)	6 (5.5 – 7)	5 (4 – 6)	463.5	-3.9	0.001*

Frequency 4 (T = 8)	6 (4.5 – 7)	5 (4 – 6)	648	-2.3	0.021

Notes: IQR = interquartile range; N = number of participants; T = total of pairs.
*Represents significant differences between groups after Bonferroni correction for multiple comparisons.

Synonym pairs were also classified according to word classes - each frequency range was composed of three verbs, four nouns, and one adjective. Word class was analyzed independently of frequency range due to the reduced number of stimuli in each range. SCs performed significantly better than L-SCs in the judgment of synonyms of the three word classes. Although the median in the verb judgment was equal for the groups, they statistically differed in this word class too, as shown in Table 4.

Table 4 - Groups' performance in the judgment of synonyms of three word classes

	SCs (N = 49)	L-SCs (N = 37)	Mann-Whitney Test		
	Median (IQR)	Median (IQR)	U	Z	p
Nouns (T = 16)	13 (11 – 14)	11 (10 – 13)	663.5	-2.13	<0.001*
Verbs (T = 12)	10 (9 – 11)	10 (8.5 – 11)	690.5	-1.92	<0.001*
Adjectives (T = 4)	3 (3 – 4)	2 (2 – 3)	507.5	-3.65	<0.001*

Notes: IQR = interquartile range; N = number of participants; T = total of pairs.
*Represents significant differences between groups after Bonferroni correction for multiple comparisons.

Due to the difference in the number of stimuli in each word class, the percentage of accuracy was analyzed to investigate the performance in the three word classes. Both groups presented 83% accuracy in the judgment of verb synonym pairs. However, SCs had higher performance in nouns (81%) and adjectives (75%) than did L-SCs (68%, 50% respectively). The comparison between word classes in the entire sample indicated significant differences (X^2 (2) = 23.56; p = 0.001). All word classes differed statistically ($p < 0.05$) in both groups. Despite the difference in the number of stimuli in each word class, which restricts the comparison, this task demonstrated that the judgment of noun and adjective synonym pairs was more difficult for L-SCs than was the judgment of verb synonym pairs.

Category (subordinate) pairs were classified into three groups: natural, artificial, and cultural. Both groups showed near-ceiling performance in the task (Table 5). However, SCs showed significantly better performance than L-SCs in the judgement of artificial category. No significant differences were found in the comparison of accuracy between the three category groups when analyzed in the whole sample ($X^2(2) = 4.50$; p = 0.105) or in each group: SC ($X^2(2) = 5.15$; p = 0.076) and L-SC ($X^2(2) = 0.97$; p = 0.615).

Table 5 - Groups' performance in the judgment of category (subordinate) related pairs

	SCs (N = 49)	L-SCs (N = 37)	Teste Mann-Whitney		
	Median (IQR)	Median (IQR)	U	Z	p
Natural category (T = 10)	9 (8.5 – 10)	9 (8 – 9.5)	673.5	-2.12	0.033
Artificial category (T = 10)	10 (9 – 10)	9 (7 – 10)	557.5	-3.27	0.001*
Cultural category (T = 10)	10 (9 – 10)	9 (8 – 10)	683	-2.10	0.035

Notes: IQR = interquartile range; N= number of participants; T = total of pairs.
*Represents significant differences between groups after Bonferroni correction for multiple comparisons.

In addition to accuracy, the semantic judgment task measured the response time (RT) for each pair of stimuli. Unlike in the lexical decision task, there were no comparable criteria from previous studies to support that the analyses of RT originated from errors produced in this task. Some pairs, especially the low frequency ones, for example, pormenor/DETALHE (particular point/DETAIL), required a longer time for judgment. Thus, the two longer and two shorter RTs of each participant were excluded and 93.75% of the answers remained. Subsequently, the mean RT for related and unrelated pairs was calculated through E-prime (Professional 2.0.10.242), considering only the correct responses. For this reason, the RT of participants with excessive errors (97 percentile) were not considered in the analysis: a) Synonyms: 15 or more errors for related and 18 or more errors for unrelated pairs; total of two SC and four L-SC RTs were excluded; b) Category (subordinate): 23 or more errors for category and 19 or more errors for unrelated pairs; total of two SC and two L-SC RTs were not considered in the analysis.

Response time analysis for synonym and category pairs showed similar results, as demonstrated in Table 2. Both groups had longer RT to synonym pairs as compared to category pairs, confirming that the synonym judgment was more difficult than the category judgment, as demonstrated in the analysis of accuracy. Although SCs had shorter RT than L-SCs, the difference did not reach significance. Other RT possible analyses were explored, such as non-exclusion of RT with excess errors and other filters (for example, exclusion of RTs less than 200 ms and more than 5,000 ms). However, none of these analyses showed significant difference in the mean RT between SCs and L-SCs. Similarly, no differences were found in the RT analysis of different ranges of frequency and different word classes of synonyms.

The analysis of groups' RTs in three different categories separately (Table 6) showed that SCs were significantly faster than L-SCs in the judgment of pairs from artificial category but not in the natural and cultural category relation. There was no significant difference in the RT comparison between the three categories for the total sample ($X^2(2) = 4.46$; $p = 0.107$).

Table 6 - Comparison of groups' RT (ms) in three categories

	SCs (N = 47)	L-SCs (N = 35)	Mann-Whitney Test		
	Median (IQR)	Median (IQR)	U	Z	P
Natural	1,138 (978 – 1,588)	1,247 (1,041 – 1,480)	783	-0.37	0.711
Artificial	1,080 (929 – 1,310)	1,194 (1,007 – 1,509)	591	-2.17	0.030*
Cultural	1,062 (920 – 1,366)	1,156.75 (1,045 – 1,435)	598	-2.10	0.035

Notes: IQR = interquartile range; N = number of participants; RT = response time in milliseconds. *Represents significant differences between groups after Bonferroni correction for multiple comparisons.

We also compared the RTs in the different conditions for the whole sample. The synonym pairs had significantly lower RTs ($Z = -5.66$; $p = 0.001$) when compared to non-synonym pairs. In the same way, category pairs showed significantly shorter RTs ($Z = -7.55$; $p = 0.001$) than did non-category pairs. Thus, there was a facilitation effect as shown in the RTs of semantic related pairs in both conditions. The analysis of each group separately confirmed contextual facilitation for both SCs and L-SCs, which characterizes the priming effect (Meyer & Schvaneveldt, 1971). Nevertheless, there was no significant difference in the amount of RT facilitation between groups in both conditions. Despite the fact that this task has not been constructed to investigate semantic priming, the RT facilitation indicates that both groups demonstrated indirect semantic priming effect in the judgment of synonyms and category (subordinate) pairs.

Lexical decision task

The lexical decision task in the semantic priming paradigm aimed to verify whether there was a difference in the groups' implicit semantic memory. Participants with more than 15 errors in related and unrelated pairs, one SC and three L-SCs, were excluded from all the analyses because only RTs for correct responses were considered. Outliers, defined as data points beyond 3 SD from each participant's mean RT and responses below 200 ms, were excluded. This criterion was adopted in accordance with a criterion used in previous papers (Holderbaum & Salles, 2011; Nobre & Salles, 2016; Salles et al., 2011) that analyzed the same task. Altogether, 128 RTs were removed, 79 (2.11%) from SCs and 49 (1.84%) from L-SCs. Table 7 shows the RT and accuracy comparison between groups.

Table 7 - Median (IQR) of RT (ms) and error percentage (EP) of groups in the lexical decision task

	SCs (N = 48)	L-SCs (N = 34)	Mann-Whitney Test U	Z	p
Related pairs RT	786 (700–884)	792 (659–886)	800	0.15	0.880
EP	0 (0–0)	0 (0–5)	691	1.56	0.118
Unrelated pairs RT	871 (775–958)	894 (772–1,034)	736	0.75	0.451
EP	0 (0–5)	0 (0–6.44)	570	2.55	0.010*
UR – R (RT)	89 (33–156)	82 (43–151)	790	0.25	0.807
UR – R (EP)	0 (0–5)	0 (-0.06–5.32)	742	0.73	0.464

Notes: IQR = interquartile range; N = number of participants; RT = response time in milliseconds; EP = error percentage; UR-R = difference between unrelated and related pairs.
*Represents significant differences between groups after Bonferroni correction for multiple comparisons.

Groups did not differ in accuracy of related pairs; but L-SCs showed significantly higher error percentage than did SCs in unrelated pairs. However, they did not differ in the subtraction of error percentage in both conditions. While SCs had similar performance in both conditions, L-SCs exhibited a significantly lower percentage of error in related pairs than in unrelated pairs, which demonstrated that they benefited from context in the performance of the task.

SCs ($Z = -4.53$; $p = 0.001$) and L-SCs ($Z = -4.65$; $p = 0.001$) showed faster RTs in related pairs than in unrelated pairs, confirming the priming effect for both groups. Although L-SCs were slower in both conditions, there was no significant difference in RTs between the groups. The subtraction of RT to unrelated and related pairs aimed to verify the proportion of facilitation. SCs showed higher facilitation than L-SCs; however, the difference was not significant ($U = 790$; $z = 0.245$; $p = 0.80$).

ANCOVA analysis

Ancova[6] tests were conducted to examine whether the results of semantic judgment and lexical decision tasks were influenced by the differences between the groups in word reading skill (Table 1). This analysis confirmed the results obtained in the accuracy of the semantic judgment task of synonym pairs (F (2,79) = 9,217, p = 0.003), non-synonyms (F (2,79) = 19,714, p = 0.001), and category pairs (F (2,79) = 5,299, p = 0.024); however, groups did not differ in non-category pairs (F (2,79) = 1,367, p = 0.246). In the lexical decision task, results remained marginally significant for the percentage of errors in related pairs (F (2,79) = 2,026, p = 0.159) and significant in unrelated pairs (F (2,79) = 8,394, p = 0.005). Therefore, word reading ability did not interfere with the performance of groups in the investigated tasks.

Discussion

The aim of the present study was to determine if there are differences between L-SCs and SCs in three aspects related to word knowledge and processing: in depth of vocabulary knowledge, in lexical-semantic processing and in implicit semantic memory. We will discuss each one separately.

Depth of vocabulary knowledge

In the word definition task, a productive task that assesses depth of lexical-semantic knowledge, L-SCs showed significantly lower knowledge of words when compared to SCs, similar to the study of Colenbrander et al. (2016). Thus, the result suggests that SCs have more robust vocabulary knowledge than do L-SCs. This difference in semantic knowledge is consistent with previous research (Braze et al., 2007; Catts et al., 2006; Nation et al., 2004; Perfetti et al., 2013; Ricketts et al., 2014; Spencer et al., 2019; Stothard & Hulme, 1995) and may be one of the key causes of differences in reading comprehension performance.

The semantic judgment task aimed at taking a closer look at the groups' lexical-semantic knowledge. The results confirmed the findings of the previous task, since L-SCs' performance was significantly lower than SCs' for both synonym and category (subordinate) pairs, corroborating the findings of previous studies (Nation & Snowling, 1998, 1999). In the synonym task, the difference between the groups occurred in low frequency words. Therefore, differences in the lexical-semantic knowledge seem to be more visible in tasks testing low frequency words. Hart & Perfetti (2007) also observed that word frequency is an important factor to learning and development of word knowledge. They found that less-skilled readers exhibited differences in the representation of high and low

[6] ANCOVA (Analysis of Covariance) is a general linear model which combines ANOVA and regression. It is used to test the main interaction effects of categorical variables on continuous selected dependent variable(s). In other words, it includes a continuous variable in addition to the variables of interest as means for control. These control variables are called "covariates".

frequency words, similar to a neuroimaging study by Cutting et al. (2013), which provided neurobiological evidence of disrupted lexical-semantic processing in L-SCs.

According to Oakhill et al. (2012), the word definition and semantic judgment tasks are measures of the depth of vocabulary knowledge. Considering that the groups showed significant differences in the performance of both tasks, it is possible to assume that SCs and L-SCs differ in the depth of their lexical-semantic knowledge. Most of the research in the area does not distinguish between breadth and depth of vocabulary knowledge in the groups. This is the case because, although many studies have confirmed their vocabulary differences, it has remained unclear whether they were restricted to the quantity of known words or whether they also encompassed the quality of their semantic representation. Some studies (Ouellette, 2006; Ouellette & Beers, 2010) have shown the importance of the distinction between these measures in the research of the relationship between vocabulary and reading comprehension, since the depth of vocabulary knowledge is capable of predicting the performance in reading comprehension even when the breadth is controlled. One of the difficulties in the research on the depth of vocabulary knowledge is the scarcity of tasks (Read, 2000). In this study, as in Ouellette's (2006), the word definition task was complemented by the semantic judgment task, similarly to Oakhill et al. (2012), as a measure of the depth of vocabulary knowledge. The use of these tasks combined aimed at compensating their possible limitations as measures of depth of word knowledge.

Lexical-semantic processing

In the semantic judgement task, accuracy measures the knowledge, while RT measures processing speed. The analysis of RT in the semantic judgment task showed that L-SCs were slower than SCs; however, the difference in the mean RT reached significance only in the judgment of artificial categories. In the study of Nation and Snowling (1998), the difference in RTs between the groups was more consistent in the semantic judgment of synonyms. L-SCs were slower than SCs in pairs of synonyms with low imageability as well as in unrelated pairs. In the investigation of Landi & Perfetti (2007), adult L-SCs' RT in the judgment of pairs with categorical and associated relations was also significantly slower than SCs' RT. In our study, other psycholinguistic variables were controlled, but not imageability and association between stimuli. Moreover, methodological differences in the way of stimuli presentation and SOA make it difficult to establish a direct comparison between the results of these experiments. Despite the limitations, this study confirms the result of the mentioned research that L-SCs need more time to make semantic judgments under certain conditions, which corroborates the hypothesis that they present differences not only in their lexical-semantic knowledge, obtained in the comparison of the tasks' accuracy, but also in their lexical-semantic processing.

Implicit semantic memory

As previously described, the present study used the same instrument and SOA as Holderbaum & Salles (2011) and Holderbaum (2015), which analyzed the priming effect in third grade and undergraduate students. It also followed the same criteria for analysis to enable the comparison between the experiments. There was a difference in the error percentage when contrasting the studies. SCs showed a lower mean than the undergraduate students in both conditions while L-SCs exhibited a mean error percentage close to that of the third-grade students in related pairs and more than double in unrelated pairs. This result suggests that L-SCs present more difficulty in the processing of unrelated words, this difference being more visible in accuracy than in the RT, which may indicate that L-SCs are more dependent on the context while reading words.

The mean RTs for related pairs of both SCs and L-SCs were similar to the ones presented by the undergraduate students in (Holderbaum & Salles, 2011). Considering that they observed priming effect in SOA of 250 ms in third-graders, it is not surprising that even L-SCs show contextual facilitation in the task. In the same way, observing that children did not exhibit significant difference in the magnitude of the facilitation when compared to undergraduate students, it is expected that L-SCs also did not differ from SCs, since the difference in reading comprehension between the groups is possibly less important than the difference in the reading comprehension between children and undergraduate students.

There are few investigations of semantic priming comparing groups with different reading comprehension levels. Unlike the research of Nation & Snowling (1999) and Henderson et al. (2013), the results of this study do not show significant differences in the implicit semantic memory of SCs and L-SCs. Such dissimilarity in the results may be due to methodological differences such as the type of semantic relationships of the pair of stimuli, the modality of the stimuli presentation (auditory vs. written), SOA, and type of response (nomination vs. lexical decision). In this study, we chose a shorter SOA (250 ms) to capture more automatic and less strategic processes. The other factor of variance is the age of participants. In this study, the readers were eighth-grade teenagers while the participants of the other two studies were children in an earlier stage of schooling, which may indicate the existence of developmental differences in priming effect of SCs and L-SCs.

The other known study that compared SCs and L-SCs on semantic priming was conducted by Bonnotte & Casalis (2010) with fourth-graders, using long SOA (800 ms). SCs showed priming effect only to category-related words, while L-SCs showed priming effect to category-related words, with strong and weak association, and to strongly associated function-related words. Our results suggested, similarly to Bonnotte & Casalis (2010), that both SCs and L-SCs show semantic priming but with differences in the processing of some words with specific semantic relation, since in our study SCs were significantly faster than L-SCs in the judgment of pairs with artificial categorical relations but not significantly in the judgment of synonyms and categories related to nature and culture.

General discussion

In this study, L-SCs showed lower vocabulary knowledge, while they did not present lower facilitation effects in semantic priming and semantic judgment. Therefore, we partially confirmed our hypothesis. Furthermore, SCs and L-SCs differed significantly in word definition and in the semantic judgment of synonyms and category (subordinate) related words, confirming that L-SCs present lower quality in their lexical representations, especially in the semantic aspect, confirming our hypothesis that SCs and L-SCs differ not only in breadth but also in depth of vocabulary knowledge.

Moreover, the significant difference in RT between the groups in the judgment of related semantic pairs with categorical relations (artificial) suggests that SCs and L-SCs may also differ in their lexical-semantic processing, which is implicated in the lexical quality hypothesis (Perfetti & Hart, 2002). Regarding implicit semantic memory, this study could not find differences between the groups. It is difficult to evaluate whether the experiment was not statistically robust enough to prove the differences in RT, perhaps due to the large data variability, especially in L-SC responses, or if there are specific deficits that entail only some semantic groups as non-associated words with categorical relation (Nation & Snowling, 1999), homonyms (Henderson et al., 2013), and category (artificial and cultural) related words. Therefore, future studies could develop complementary experiments to further investigate the existence of differences in implicit semantic memory of SCs and L-SCs, since there are only a few known experiments prior to this one on this topic. Considering that priming experiments require a very refined design, future research should explore factors such as age, schooling, SOA, modality of stimuli presentation, kind of semantic relation, and word frequency.

The analyses of accuracy of synonyms from different frequency ranges bring important contributions to the discussion. L-SCs differed from SCs in the accuracy of low frequency words, suggesting that L-SCs may have not a deficit, as proposed by the semantic deficit hypothesis (Nation & Snowling, 1998, 1999), but a semantic knowledge delay (Spencer et al., 2019). In the study that originated this paper, the group of L-SCs significantly differed from SCs in their access to reading material (Sousa & Hübner, 2017) and in their reading habits, especially the average number of books read during the year (Sousa & Hübner, 2020). Therefore, taken together, these results indicate that L-SCs may present a lexical-semantic knowledge delay due to lower print exposure. As predicted by the Matthew Effect (Stanovich, 1986) and some recent studies such as that of (Logan et al., 2019), the gap in the acquisition and development of word meanings can increase exponentially from kindergarten throughout the school years, strongly affecting reading comprehension. However, considering the variety of profiles among L-SCs, there is still no agreement regarding the causes of specific reading comprehension difficulties (Landi & Ryherd, 2017) and whether the linguistic weakness is a deficit, delay, or both, depending on the sample investigated.

Conclusion

This study confirmed that L-SCs and SCs differed significantly in depth of vocabulary knowledge and in lexical semantic processing; however, it could not confirm differences in implicit semantic knowledge. The evidence of these two critical differences between SCs and L-SCs indicates that lexical-semantic knowledge and processing are key factors to understand the relationship between vocabulary and reading comprehension and may be among the causes of reading comprehension difficulties. Moreover, our results also point to possible methods of intervention with L-SCs, emphasizing lexical-semantic knowledge and integration through thinking-aloud, reading aloud and direct instruction techniques.

Some obstacles found during the execution of this study resulted in limitations, especially the lack of standardized reading assessment tasks (decoding, fluency and comprehension) for students at the end of Elementary School in Brazilian Portuguese, as well as semantic association norms for words in Brazilian Portuguese, necessary for the production of lexical decision tasks to investigate the semantic priming effect. Further studies could explore tasks using variable word frequencies and other psycholinguistic criteria for word choices that explore more in depth the effect of word classes, or explore specific semantic relations, such as those explored in this study, which may reach sensibility to capture the differences in depth of vocabulary knowledge and in the ability of lexical-semantic processing of SCs and L-SCs.

The experimental evidence and theoretical debate developed in this study show the importance of the development of tasks to measure the depth of vocabulary knowledge and the use of online measures as essential to the progress of studies aiming at investigating lexical-semantic representation knowledge and its relationship to reading comprehension in mother and additional language research in both typical and atypical language development. The results may bring the enlargement of theoretical foundations, as well as useful research, clinical, and pedagogical implications.

References

BONNOTTE, I.; & CASALIS, S. 2010. Semantic priming in French children with varying comprehension skills. *European Journal of Developmental Psychology*, **7**(3):309–328. https://doi.org/10.1080/17405620802114546

BRAZE, D. *et al*. 2007. Speaking up for vocabulary: Reading skill differences in young adults. *Journal of Learning Disabilities*, **40**(3):226–243. https://doi.org/10.1177/00222194070400030401

CAIN, K.; & OAKHILL, J. 2006. Profiles of children with specific reading comprehension difficulties. *British Journal of Educational Psychology*, **76**(4):683–696. https://doi.org/10.1348/000709905X67610

CAIN, K.; OAKHILL, J.; & LEMMON, K. 2004. Individual Differences in the Inference of Word Meanings From Context: The Influence of Reading Comprehension, Vocabulary Knowledge, and

Memory Capacity. *Journal of Educational Psychology*, **96**(4):671–681. https://doi.org/10.1037/0022-0663.96.4.671

CAIN, K.; OAKHILL, J.; & ELBRO, C. 2003. The ability to learn new word meanings from context by school-age children with and without language comprehension difficulties. *Journal of Child Language*, **30**(3):681–694. https://doi.org/10.1017/S0305000903005713

CARNEIRO, P.; ALBUQUERQUE, P.; & FERNANDEZ, A. 2008. Portuguese category norms for children. *Behavior Research Methods*, **40**(1):177–182. https://doi.org/10.3758/BRM.40.1.177

CATTS, H. W.; ADLOF, S. M.; & WEISMER, S. E. 2006. Language Deficits in Poor Comprehenders: A Case for the Simple View of Reading. *Journal of Speech, Language, and Hearing Research*, **49**(2):278–293. https://doi.org/10.1044/1092-4388(2006/023)

COLENBRANDER, D.; *et al.* 2016. Individual differences in the vocabulary skills of children with poor reading comprehension. *Learning and Individual Differences*, **50**:210–220. https://doi.org/10.1016/j.lindif.2016.07.021

CUTTING, L. E.; *et al.* 2013. Not All Reading Disabilities Are Dyslexia: Distinct Neurobiology of Specific Comprehension Deficits. *Brain Connectivity*, **3**(2):199–211. https://doi.org/10.1089/brain.2012.0116

DAVIS, F. B. 1944. Fundamental factors of comprehension in reading. *Psychometrika*, **9**(3):185–197. https://doi.org/10.1007/BF02288722

LWÉR, Å.; *et al*. 2015. A retrospective longitudinal study of cognitive and language skills in poor reading comprehension. *Scandinavian Journal of Psychology*, **56**(2):157–166. https://doi.org/10.1111/sjop.12188

FIGUEIREDO, V. L. M.; PINHEIRO, S.; & NASCIMENTO, E. do. 1998. Teste de inteligência WISC-III adaptando para a população brasileira. *Psicologia Escolar e Educacional*, **2**(2):101–107. https://doi.org/10.1590/S1413-85571998000200004

HARMON, J.; & WOOD, K. 2018. The Vocabulary-Comprehension Relationship across the Disciplines: Implications for Instruction. *Education Sciences*, **8**(3):101. https://doi.org/10.3390/educsci8030101

HART, L.; & PERFETTI, C. 2007. Single-Word Reading. *In* : E. L. GRIGORENKO & A. J. NAPLES (Eds.), *Single word reading: behavioral and biological perspectives*. Psychology Press. https://doi.org/10.4324/9780203810064

HENDERSON, L.; SNOWLING, M.; & CLARKE, P. 2013. Accessing, Integrating, and Inhibiting Word Meaning in Poor Comprehenders. *Scientific Studies of Reading*, **17**(3):177–198. https://doi.org/10.1080/10888438.2011.652721

HOLDERBAUM, C. S.; & SALLES, J. F. de. 2011. Semantic Priming Effects in a Lexical Decision Task: Comparing third Graders and College Students in two Different Stimulus Onset Asynchronies. *The Spanish Journal of Psychology*, **14**(2):589–599. https://doi.org/10.5209/rev_SJOP.2011.v14.n2.7

HOLDERBAUM, C. S.; *et al*. 2015. Núcleo de Estudos em Neuropsicologia Cognitiva (Neurocog): panorama de pesquisas e estudos de priming semântico. *In:* A. BUCHWEITZ.; & M. MOTA (Eds.), *Linguagem e cognição: processamento, aquisição e cérebro.* EDIPUCRS, p. 293–300.

HULME, C.; & SNOWLING, M. J. 2011. Children's Reading Comprehension Difficulties. *Current Directions in Psychological Science*, **20**(3):139–142. https://doi.org/10.1177/0963721411408673

JAMES, E.; GASKELL, M. G.; & HENDERSON, L. M. 2020. Sleep-dependent consolidation in children with comprehension and vocabulary weaknesses: it'll be alright on the night? *Journal of Child Psychology and Psychiatry*, **61**(10):1104–1115. https://doi.org/10.1111/jcpp.13253

LANDI, N. 2012. Learning to read words: Understanding the relationship between reading ability, lexical quality and reading context. *In*: A. BRITT; S. GOLDMAN; & J.-F. ROUET (Eds.), *Reading from words to multiple texts.* Routledge, p. 17–33.

LANDI, N.; & PERFETTI, C. 2007. An electrophysiological investigation of semantic and phonological processing in skilled and less-skilled comprehenders. *Brain and Language*, **102**(1):30–45. https://doi.org/10.1016/j.bandl.2006.11.001

LANDI, N.; & RYHERD, K. 2017. Understanding specific reading comprehension deficit: A review. *Language and Linguistics Compass*, **11**(2):e12234. https://doi.org/10.1111/lnc3.12234

LOGAN, J. A. R. et al. 2019. When Children Are Not Read to at Home: The Million Word Gap. *Journal of Developmental & Behavioral Pediatrics*, **40**(5):383–386. https://doi.org/10.1097/DBP.0000000000000657

MEYER, D.; & SCHVANEVELDT, R. 1971. Facilitation in recognizing pairs of words: Evidence of a dependence between retrieval operations. *Journal of Experimental Psychology*, **90**(2):227–234. https://doi.org/10.1037/h0031564

NAGY, W. 2005. Teaching and Learning Vocabulary. *In:* E. H. HIEBERT.; & M. L. KAMIL. (Eds.), *Teaching and learning vocabulary: bringing research to practice*. Routledge. https://doi.org/10.4324/9781410612922

NATION, I. S. P. 2001. *Learning vocabulary in another language*. Ernst Klett Sprachen, 640 p. https://doi.org/10.1017/CBO9781139524759

NATION, K.; *et al.* 2004. Hidden language impairments in children: parallels between poor reading comprehension and specific language impairment? *Journal of Speech, Language, and Hearing Research*, **47**(1):199–211. https://doi.org/10.1044/1092-4388(2004/017)

NATION, K.; *et al.* 2010. A longitudinal investigation of early reading and language skills in children with poor reading comprehension. *Journal of Child Psychology and Psychiatry*, **51**(9):1031–1039. https://doi.org/10.1111/j.1469-7610.2010.02254.x

NATION, K.; & SNOWLING, M. 1998. Semantic Processing and the Development of Word-Recognition Skills: Evidence from Children with Reading Comprehension Difficulties. *Journal of Memory and Language*, **39**(1):85–101. https://doi.org/10.1006/jmla.1998.2564

NATION, K.; & SNOWLING, M. 1999. Developmental differences in sensitivity to semantic relations among good and poor comprehenders: evidence from semantic priming. *Cognition*, **70**(1):B1–B13. https://doi.org/10.1016/S0010-0277(99)00004-9

NOBRE, A. de P.; & SALLES, J. F. de. 2016. Lexical-semantic processing and reading: relations between semantic priming, visual word recognition and reading comprehension. *Educational Psychology*, **36**(4):753–770. https://doi.org/10.1080/01443410.2014.950948

OAKHILL, J.; *et al*. 2012. Making the link between vocabulary knowledge and comprehension skill. *In:* A. BRITT; S, GOLDMAN, & J.-F. ROUET. (Eds.), *From words to reading for understanding.* Routledge, p. 101–114. https://doi.org/10.4324/9780203131268

OLSON, R. K.; *et al.* 2011. Genetic and Environmental Influences on Vocabulary and Reading Development. *Scientific Studies of Reading*, **15**(1):26–46. https://doi.org/10.1080/10888438.2011.536128

OUELLETTE, G. 2006. What's meaning got to do with it: The role of vocabulary in word reading and reading comprehension. *Journal of Educational Psychology*, **98**(3):554–566. https://doi.org/10.1037/0022-0663.98.3.554

UELLETTE, G.; & BEERS, A. 2010. A not-so-simple view of reading: how oral vocabulary and visual-word recognition complicate the story. *Reading and Writing*, **23**(2):189–208. https://doi.org/10.1007/s11145-008-9159-1

PERFETTI, C. A.; & HART, L. 2002. The lexical quality hypothesis. *In:* L. VERHOEVEN; C. ELBRO; & P. REITSMA. (Eds.). *Precursors of functional literacy.* John Benjamins Publishing, p. 189–213. https://doi.org/10.1075/swll.11.14per

PERFETTI, C. A.; MARRON, M. A.; & FOLTZ, P. W. 2013. Sources of Comprehension Failure: Theoretical Perspectives and Case Studies. *In:* C. CORNOLDI; & J. OAKHILL. (Eds.), *Reading Comprehension Difficulties.* Routledge, p. 161–190. https://doi.org/10.4324/9780203053324-12

PERFETTI, C. A.; ZHANG, S.; & BERENT, I. 1992. *Chapter 13 Reading in English and Chinese: Evidence for a "Universal" Phonological Principle,* **4115**(08):62798-3. p. 227–248. https://doi.org/10.1016/S0166-

PERFETTI, C.; & STAFURA, J. 2014. Word Knowledge in a Theory of Reading Comprehension. *Scientific Studies of Reading*, **18**(1):22–37. https://doi.org/10.1080/10888438.2013.827687

PINHEIRO, Â. M. V. 1996. *Contagem de frequência de ocorrência de palavras expostas a crianças na faixa pré-escolar e séries iniciais do 1o grau*. Associação Brasileira de Dislexia. https://doi.org/10.13140/RG.2.1.3977.5123

PLAUT, D. C.; *et al.* 1996. Understanding normal and impaired word reading: Computational principles in quasi-regular domains. *Psychological Review*, **103**(1):56–115. https://doi.org/10.1037/0033-295X.103.1.56

READ, J. 2000. *Assessing Vocabulary*. Cambridge University Press, 293 p. https://doi.org/10.1017/CBO9780511732942

RICKETTS, J.; SPERRING, R.; & NATION, K. 2014. Educational attainment in poor comprehenders. *Frontiers in Psychology*, **5**. https://doi.org/10.3389/fpsyg.2014.00445

RYHERD, K.; & LANDI, N. 2019. Category Learning in Poor Comprehenders. *Scientific Studies of Reading*, **23**(4):305–316. https://doi.org/10.1080/10888438.2019.1566908

SALLES, J. F. de.; MACHADO, L. L.; & JANCZURA, G. A. 2011. Efeitos de priming semântico em tarefa de decisão lexical em crianças de 3ª série. *Psicologia: Reflexão e Crítica*, 24(3):597–608. https://doi.org/10.1590/S0102-79722011000300021

SALLES, J. F. de.; *et al.* 2013. Normas de desempenho em tarefa de leitura de palavras/pseudopalavras isoladas (LPI) para crianças de 1º ano a 7º ano. *Estudos e Pesquisas Em Psicologia*, **13**(2):397–419. https://doi.org/10.12957/epp.2013.8416

SALLES, J. F.; HOLDERBAUM, C. S.; & MACHADO, L. L. 2009. Normas de associação semântica de 50 palavras do português brasileiro para crianças: Tipo, força de associação e set size. *Interamerican Journal of Psychology*, **43**(1):57–67.

SALLES, J. F. de.; PARENTE, M. A. de M. P. 2002. Relação entre os processos cognitivos envolvidos na leitura de palavras e as habilidades de consciência fonológica em escolares. *Pró-Fono Revista de Atualização Científica*, **14**(2):175–186.

SOUSA, L. B.; HÜBNER, L. C. 2020. Avaliação da compreensão discursiva oral e escrita para estudantes concluintes do ensino fundamental. *In:* V. W. PEREIRA; & R. GUARESI. (Org.*). Leitura e escrita em avaliação: A ciência em busca de maior esclarecimento da linguagem verbal.* Vitória da Conquista: Fonema e Grafema, p. 381-414.

SOUSA, L. B. D.; HUBNER, L. C.; & SILVA, R. B. F. D. 2020. Lexical-semantic integration by good and poor reading comprehenders. *Ilha do Desterro,* **73**(1):63-78. https://doi.org/10.5007/2175-8026.2020v73n1p63

SOUSA, L. B.; & HÜBNER, L. C. 2017. A relação entre desempenho em compreensão leitora e fatores socioeconômicos. *Fórum Linguístico,* **14**(2):2044-2060. https://doi.org/10.5007/1984-8412.2017v14n2p2044

SPENCERS, M.; QUINN, J. M.; & WAGNER, R. K. 2014. Specific Reading Comprehension Disability: Major Problem, Myth, or Misnomer? *Learning Disabilities Research & Practice*, **29**(1):3–9. https://doi.org/10.1111/ldrp.12024

SPENCERS, M.; WAGNER, R. K.; & PETSCHER, Y. 2019. The reading comprehension and vocabulary knowledge of children with poor reading comprehension despite adequate decoding: Evidence from a regression-based matching approach. *Journal of Educational Psychology*, **111**(1):1–14. https://doi.org/10.1037/edu0000274

STANOVICH, K. E. 1986. Matthew Effects in Reading: Some Consequences of Individual Differences in the Acquisition of Literacy. *Reading Research Quarterly*, **21**(4):360–407. https://doi.org/10.1598/RRQ.21.4.1

STOHARD, S. E.; & HULME, C. 1995. A Comparison of Phonological Skills in Children with Reading Comprehension Difficulties and Children with Decoding Difficulties. *Journal of Child Psychology and Psychiatry*, **36**(3):399–408. https://doi.org/10.1111/j.1469-7610.1995.tb01298.x

TEAM, R. 2020. *RStudio: integrated development for R*. RStudio.

VAN OVERSCHELDE, J. P.; RAWSON, K. A.; & DUNLOSKY, J. 2004. Category norms: An updated and expanded version of the Battig and Montague (1969) norms. *Journal of Memory and Language*, **50**(3):289–335. https://doi.org/10.1016/j.jml.2003.10.003

WECHSLER, D. 2002. *WISC III - Escala de inteligência Wechsler para crianças - Manual* (3.). Casa do Psicólogo.

YANAGISAWA, A.; & WEBB, S. 2020. *Measuring depth of vocabulary knowledge*. Routledge, 618 p. https://doi.org/9780429291586

Submetido: 25/11/2021

Aceito: 24/03/2022