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Vocabulary Breadth and Depth in Early School-Aged Children with Developmental Language Disorder – Evidence from Serbian Speaking Children

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ABSTRACT

Objectives: Taking into account the positive association observed between lexical abilities and academic performance in children, this research aims to compare the expressive vocabulary skills and the organization of the lexical-semantic network in early school-aged children diagnosed with developmental language disorder (DLD) and their typically developing (TD) peers.

Method: The sample included 57 participants (aged 7 and 8 years), 27 children diagnosed with DLD and 30 TD children. The Boston Naming Test and Word Association Task were employed to assess lexical abilities.

Results: The findings revealed that children with DLD produced significantly fewer correct answers and a higher number of errors during the naming task when compared to their typically developing peers. Moreover, children with DLD provided significantly fewer developmentally mature types of associations and significantly more developmentally immature ones.

Conclusion: The study results indicate that children with DLD continue to display significant lexical deficits during school-age, encompassing both vocabulary breadth and depth. These findings highlight the importance of implementing additional intervention approaches that focus on semantic aspects to prevent further language deterioration and mitigate the potential negative impact of lexical impairments on the academic achievements of these children.

KEYWORDS

developmental language disorder, lexical abilities, early school-age

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INTRODUCTION

The term «developmental language disorder» (DLD), or previously classified as «specific language impairment», refers to a disorder in the language development associated with no known sensory, neurological, intellectual or emotional deficits (Bishop, CATALISE Consortium et al., 2017).

In the literature, there is still commonly accepted view that children with DLD demonstrate an unequal linguistic profile, with poor and inefficient syntactic abilities as a hallmark deficit. Despite reports of reduced receptive and expressive vocabularies in children with DLD compared to age-level expectations (Gray et al., 1999), as well as word-finding difficulties (German, 2000), lexical processing abilities are considered to be relatively preserved (Pizzioli & Schelstraete, 2011). Thus, there is a need for more research in the area of lexical abilities in these children in order to evaluate this theory further. In addition, most studies included only preschool or preschool and school-aged children together (McGregor et al., 2002; Sheng & McGregor, 2010a, Sheng & McGregor, 2010b), while studies with only school-age children are rare in the literature.

Researches in the area of lexical-semantic development in children with DLD are important for several reasons. Difficulties of vocabulary development can severely

restrict a child to express communicative message. Moreover, delayed development of lexical-semantic abilities can have a negative impact on development of other language skills, given that early lexical knowledge stimulates the development of syntactic and pragmatic abilities (Matthews et al., 2018; Tomasello, 2000). Also, lexical deficits are related to academic difficulties in these children (e.g., Isoaho et al., 2016). On the other hand, the lexicon is a very dynamic and complex construct which includes, apart from the storage, ability to access and integrate linguistic data (lexical processing). Therefore, the study of lexical-semantic abilities in children with DLD significantly contributes understanding of lexical-semantic network, both in terms of content and in terms of functioning.

Vocabulary Organization

Vocabulary represents a number of lexical-semantic representations organized into multiple hierarchical levels. Lexical-semantic representations consist of a large number of semantic features, which includes visual and functional characteristics of a lexical concept (Peters & Borovsky, 2019). Based on Bock and Levelt (1994) theoretical concept, semantic features of the lexical concept *sheep* are that it is *animal* which gives *milk* and growth *wool*, among others. On the other hand, the lexical concept *goat*, among other things, contains semantic features: *animal* which *gives milk*. Lexical concepts that belong to the same semantic category share a number of semantic features. Accordingly, lexical concepts *sheep* and *goat* share common semantic features *animal* and *gives milk*. During development, a child enriches lexical concepts with growing number of semantic features, while firming denotative (narrow) meaning of terms (Dwyer & Harbaugh, 2020). With linguistic experience, the meaning of lexical concepts extends to the connotative (wider) meanings (Sloutsky & Deng, 2019). Activation of a particular lexical concept activates all semantic features one has. Thereby, activation of the lexical-semantic network is broader and more stable with a larger number of semantic features in one's lexicon for any given concept (Patterson et al., 2007). Thus, activation of the lexical concept *goat*, for example, triggers semantic features shared with other lexical concepts in same semantic category. If a child has sparse lexical concepts, activation of a semantic network will be weaker and child may name a wrong concept from semantic category, usually one which is more frequent than required concept. Consequently, semantic errors are most frequent during the development of lexical-semantic abilities. For example, instead of *goat,* child can name a superordinate (e.g., *animal*) or other term from semantic category acquired earlier and used more frequently, such as *sheep*.

Vocabulary is often described in the context of two dimensions, «breadth» and «depth». Vocabulary «breadth» is usually measured by number of words that one has in his lexicon, through the receptive or expressive vocabulary assessment (McGregor et al., 2002). Assessing vocabulary breadth provides an estimation of the total number of concepts in one's lexicon, without focusing on the depth of knowledge for each concept (Hadley & Dickinson, 2020). This suggests a more superficial and less comprehensive aspect of word knowledge (Hoffman et al., 2014). Vocabulary «depth» includes all lexical concept features deposited in semantic memory (phonological, syntactic, semantic and colloquial), as well as their organisation. Measuring vocabulary depth indicates more «deeper» knowledge of words and the quality of lexical representations. (Hadley & Dickinson, 2020). Measuring this aspect of the lexicon can be challenging, and it is typically assessed through tasks such as word definitions, lexical ambiguity resolution, synonym tasks, word associations, and analysis of naming errors (Lahey & Edwards, 1999; McGregor et al., 2012; Boucher et al., 2008; Norbury, 2005).

Developmental Language Disorder

According to the ICD-11 criteria, DLD is characterized as a language impairment that persists during the developmental period, typically in early childhood. It involves deficits in the acquisition, comprehension, production, and/or use of language, whether spoken or written, leading to significant limitations in communication abilities (WHO, 2020). The affected individual's language skills are notably below the expected level for their age. It is essential to note that these language deficits cannot be attributed to any other neurodevelopmental disorder, sensory impairment, or neurological condition, including brain injury or infection (WHO, 2020).

Although data in the literature show that DLD represents a very heterogeneous group of disorders (Bishop, 2014a; Leonard, 2014), difficulties occur within all language levels. These children differ from typically developing (TD) peers at microlevel and macrolevel of language structure (Leonard, 2014). Regarding microlevel, these children can have phonological, morphosyntactic and semantic deficits. Most commonly, these difficulties are manifested as delayed occurrence of the first word, difficulties in learning and discriminating sounds, as well as in learning words, the use of simplified and incomplete sentences, omission and substitution of grammatical morphemes and difficulties in understanding complex sentences and grammatical rules of a native language (Bishop, 2008; Bishop, 2014a; Leonard, 2014). Regarding macrolevel, children with DLD can have deficits in the area of pragmatic abilities, conversational and narrative skills (Leonard, 2014). Deficits at macrolevel are usually manifested as difficulties in formulating pragmatic acts, initiating communication, resolving conflicts in verbal and non-verbal way, lacking coherent discourse, while some children with DLD may also have difficulties in the area of social relationships, social cognition and competence (Bishop, 2008; Bishop, 2014a; Leonard, 2014). However, difficulties in pragmatic and social skills in children with DLD are typically attributed to phonological, lexical-semantic, and syntactic

deficits that they experience, rather than being characteristic of the social communication impairments commonly observed in children with autism spectrum disorder (Bishop, 2014b; Leonard, 2014).

Lexical-Semantic Abilities in Children with Developmental Language Disorder

Information from prior research suggests the existence of diverse types of lexical-semantic deficits in children with DLD. These children exhibit substantial delays in early word acquisition (La Paro et al., 2004; Rice et al., 2008) and necessitate more attempts to learn new words in comparison to typically developing (TD) children (Gray, 2004; Kapa & Erikson, 2020). Additionally, they demonstrate less flexibility in employing strategies within cross-situational word-learning contexts (McGregor et al., 2022). Semantic knowledge deficits primarily account for the difficulties observed in the learning of new words in children with DLD (Gray, 2004).

Preschool-aged children with DLD have significant word-finding and naming difficulties. These difficulties include smaller number of lexical concepts in the vocabulary, extended latency during word retrieval and more frequent errors on naming tasks, compared to TD children (Haebig et al., 2019; Jackson et al., 2016; Leonard et al., 2019; Sheng & McGregor, 2010a; Sheng & McGregor, 2010b; Storkel et al., 2017). Previously it was thought that these children have adequate knowledge of words but they use ineffective and inadequate recall strategy (e.g., Rubin & Lieberman, 1983; Wolf, 1982), while recent studies support the view that children with DLD have sparse semantic representations in the lexicon, significantly less developed lexical-semantic network and difficulties in semantic processing (e.g. Drljan & Vuković, 2019; Sheng & McGregor, 2010a). Studies have revealed that children with DLD tend to make semantic errors more frequently during naming tasks compared to TD children (Sheng & McGregor, 2010b). These errors involve naming a word that is semantically related to the target word (superordinate, coordinate or other word semantically related to a prompt) (Drljan, 2022; Drljan & Vuković, 2019; Drljan et al., 2019). Lahey and Edwards (1999) speculate that semantic errors in children with DLD indicate diffuse semantic-lexical representations and that semantic-lexical representations are poorly differentiated, as well as poorly organized. Additionally, using the word association paradigm Sheng and McGregor (2010a) hypothesized that the spread of semantic activation in children with DLD is significantly weaker compared to TD children, and it is operating in an environment with a high level of errors (which they called *noise*) and with higher expression of primitive organizational principles (reflected in developmentally immature associations). However, the data so far indicate that children with DLD do not make atypical or random naming errors, suggesting that the structure of the lexical network, although underdeveloped, is similar to one seen in TD children (Sheng & McGregor, 2010b).

Studies investigating vocabulary breadth and depth in school-aged children with DLD are limited. While typically developing (TD) children show improvements in naming speed, accuracy, and similarity to adult speakers as they progress through school (Dockrell & Messer, 2004; Nippold, 2007), existing literature suggests that school-aged children and college students with DLD may continue to experience lexical difficulties during this period (Bishop & Hsu, 2015; McGregor et al., 2017a; McGregor et al., 2017b; McGregor et al., 2020).

Some evidence indicate that these children have difficulties with learning new words even at a school-age, but also that learning new words at a school-age is greatly influenced by reading skills (Kan & Windsor, 2010). Considering that a large percentage of children with DLD have difficulties in reading at a school-age (Catts et al., 2002), a double cause-effect relationship can lead to more severe lexical deficits in some children with DLD during this period. One of the few studies that included only school-aged children with DLD showed that these children can have significant deficits in semantic processing even in that period. Also, children with DLD exhibited more difficulties with the semantic aspects of definitions compared to the syntactic aspects (Marinellie & Johnson, 2002). Also, in two studies utilizing the definition task, data indicated that children with DLD provided lower content scores in their definitions compared to the control group (Dosi, 2021; Dosi & Gavriilidou, 2020). Data from another study using a same task indicate that school-aged children with DLD have difficulties in semantic processing unrelated to phonological and syntactic abilities (Mainela-Arnold et al., 2010). This indicates that sparse lexical representations are the cause of difficulties in semantic processing in school-aged children with DLD (Mainela-Arnold et al., 2010). On the other hand, in Pizzioli and Schelstraete study (Pizzioli & Schelstraete, 2011), school-aged children with DLD also performed significantly worse on a lexical-decision task (also a measure of lexical processing), compared to their TD peers. However, the authors explained the differences by the occurrence of the lexical-semantic network «overactivation» in children with DLD. According to their hypothesis, children with DLD do not necessarily have weaker associative links between words compared to TD children. Instead, difficulties in lexical processing may result from excessive activation of the semantic network. This compensatory mechanism is induced by the grammatical and syntactic deficit observed in children with DLD (Pizzioli & Schelstraete, 2011).

Present Study

In the existing literature, only a limited amount of research has been conducted on vocabulary breadth and depth in school-aged children with DLD. Most of the previous studies included mixed, school and preschool-aged children (McGregor et al., 2002; Sheng & McGregor, 2010a; 2010b) or small sample of children with DLD (Marinellie & John-

son, 2002). Also, previous studies of semantic processing in school-aged children with DLD used a word definition tasks (Mainela-Arnold et al., 2010; Marinellie & Johnson, 2002). However, definition of words relies heavily on syntactic abilities (Marinellie & Johnson, 2002) and syntactic difficulties are one of the dominant symptoms of DLD (Leonard, 2014). DLD children almost always have shortened and sparse sentences and pronounced morphological difficulties, which can persist even at school age (Leonard, 2014; Zwitserlood et al., 2015). Given that the definition task requires the sentences formulation with a purpose of describing a given concept, difficulties on this area may be caused by syntactic deficits that DLD children have. In addition, research on school-aged children with DLD is important because there is strong evidence of a link between lexical-semantic abilities and academic skills. Data from the literature suggest a significant association of lexical-semantic abilities with arithmetic (Amalric & Dehaene, 2018; Swanson & Beebe-Frankenberger, 2004) and writing skills (Singer & Bashir, 2004). Also, expressive vocabulary and lexical processing abilities are important predictors of reading skills and reading comprehension (Karami & Salahshoor, 2014; Roth et al., 2002; Verhoeven & Van Leeuwe, 2008). Furthermore, there are indications that the comorbidity of dyslexia and dyscalculia could be attributed to a shared deficit in storing and/or retrieving factual knowledge from semantic memory (Willburger et al., 2008). These data indicate that the lexical impairment in children with DLD can significantly aggravate the acquisition of reading, writing, and arithmetic skills during early school-age period. Investigating lexical-semantic abilities of school-aged children with DLD provides useful guidelines not only in the rehabilitation, but also in the pedagogical approach with these children in mastering academic skills.

Accordingly, the *main objective* of this research is comparison of expressive vocabulary and lexical processing skills between early school-aged children with DLD and their TD peers. Research questions derived from main objective were:

1. Do Serbian-speaking school-aged children with DLD differ from their peers on two dimensions of vocabulary knowledge (breadth and depth)?

2. What is the error pattern on tasks assessing vocabulary breadth and depth, as well as the organization of the lexical-semantic network in children with DLD?

METHOD

Participants and Settings

The study included a total of 57 participants, all aged between seven and eight years. The participants were divided into two distinct groups: a group of children diagnosed with the expressive type of DLD, consisting of 27 children, and a group of typically developing (TD) children. Participants with DLD were selected from the Institute for Psychophysiological Disorders and Speech Pathology «Prof. Dr Cvetko Brajovic» located in Belgrade, Serbia. In Serbia, children are commonly screened for language abilities at the ages of three and six. At the age of six, the screening is performed by a speech therapist at health centres and it is obligatory. If speech and language disorder is suspected, the child is sent further for evaluation in specialized institutions, such as the aforementioned institute. Children with DLD were included in the study based on the criterion of having an IQ score above 85. Data on the type of developmental language disorder and level of intelligence were obtained from the documentation of speech therapists and psychologists from the Institute. All children underwent assessment using the Wechsler Intelligence Scale for Children Revised, which has been normed on the Serbian population (Biro, 1997). The diagnosis of the type of speech and language disorders was conducted by qualified speech and language therapists from the Institute. The assessment included a battery of tests, such as the Phoneme Discrimination Test (Kostić, Vladisavljević & Popović, 1983) (scoring below 75% of age-expected performance), Understanding and Comprehension of Speech Test (scoring below 75% of age-expected performance) (Vladisavljević, 1997), Children's Grammar Test (scoring below 50% of age-expected performance) (Vladisavljević, 1983), Global Articulation Test (scoring below 75% of age-expected performance) (Kostić & Vladisavljevic, 1983), and Semantic Test (scoring below 50% of age-expected performance) (Vladisavljević, 1983). The above-mentioned instruments are not standardized, and language deficits are determined based on deviations from what is considered typical development (as given in parentheses with each individual test). This is commonly used tests in institutions in Serbia for language assessment of children, as well as in researches including Serbian speaking children with language impairments (e.g. Drljan & Vuković, 2017; Vuković & Stojanović, 2011). Due to the heterogeneity of the DLD population we wanted to recruit children from the DLD population broadly defined regarding the level of specific structural language abilities and level of severity.

The TD group comprised 30 first and second-grade children who were recruited from local schools in Belgrade as well. Data on language status and level of intelligence were obtained from the documentation of speech therapists and psychologists from schools. Written consent was obtained from the parents prior to the assessment.

All children are native Serbian speakers and monolinguals with both Serbian speaking parents, and all participants live in Belgrade.

Each child was individually tested in a quiet room either at the Institute or at their respective school. Lexical-semantic assessment was done by first author of this paper within the

time frame covering the second school semester during the late winter and the entire spring.

The research received approval from the Ethical Board of the Institute for Psychophysiological Disorders and Speech Pathology «Prof. Dr Cvetko Brajovic» in Belgrade, Serbia (1575/19-09-2016), as a part of larger project investigating lexical and cognitive abilities in children with DLD.

Data about age, gender, maternal education and general IQ measures for both groups are given in Table 1. There were no participants in the sample whose mothers had only an elementary level of education, therefore we compared middle and high school maternal education.

Assessments and Measures

The Boston Naming Test (BNT – Kaplan et al., 1983) is a standardized instrument used to assess expressive vocabulary skills, specifically measuring vocabulary breadth. It includes 60 black-and-white drawing objects and is designed to evaluate confrontational naming (visual naming) in children and adults, both with and without speech and language deficits. Confrontational naming is a common way for assessing vocabulary breadth in children (McGregor et al., 2012). BNT answers were coded as correct and errors. Furthermore, the errors made during the assessment were classified into several categories. *Semantic errors* involved providing answers that were semantically related to the target word, which included superordinate, coordinate, and associative errors. *Unrelated errors* consisted of real words that were not semantically related to the target word, such as «bed» being named as «scissors.» *Phonological errors* occurred when words were phonologically similar but not semantically related to the target word, for example, «globe» being named as «robe.» *Circumlocutions* referred to providing a semantic description of the target word without giving its correct name. *Pseudowords* were made-up words that did not exist in the Serbian language. Lastly, *omissions* were instances where the participant did not provide any response for a given item.

Word Association Task (WAT) is a non-standardized task that measures lexical-semantic organization and it was used in previous studies for assessment of vocabulary depth in DLD children (McGregor et al., 2012; Sandgren et al., 2021; Sheng & McGregor, 2010a), typically developing bilingual children (Peña et al., 2003), as well as in children with other developmental disorders which include language impairment (Küçük & Acarlar, 2022; McGregor et al., 2012). Free association task was used because it shows directly the strength of connections within the lexicon itself (Nelson et al., 2005), thus reducing the possibility of the influence on syntactic abilities which may be the case with the word definition task. Also, considering that the children from our sample had poor achievements on the morphosyntactic test (below 50% of age expected performance on Children's grammar), association task was more appropriate choice for vocabulary depth assessment. 80 words (nouns and adjectives) were used from Kent-Rosanof list (Kent & Rosanoff, 1910), and 10 lexical verbs were added. Lexical verbs were added in order to complete the three main classes of content words. The same word classes, as well as a similar percentage ratio of individual content word classes, were used in database norming study in the field of semantic network research (Nelson et al., 2004). The association test based on the Kent-Rosanof list is one of the most extensively studied linguistic tests available in the literature, particularly within the context of the Birkbeck Vocabulary Project (Meara, 1984). Based on the Serbian Children's frequency dictionary (Lukić, 1983), all the chosen words were acquired early in development with either high or medium frequency of use, and the children in the sample were familiar with all the words from the list. Words were medium to high imageability, and mostly concrete words were included with a small number of abstract words within all three classes of content words. The task is performed in a way that the examiner tells the child a word from the list and he or she has to say the first word that comes to mind. Before the assessment, the child was

Table 1

Participant Characteristics

	Age of participants (months)		General IQ	Maternal education		Gender	
Group	***n***	***Mean(SD)***	***Mean(SD)***	***n(%)***		***n(%)***	
DLD	27	83.963(7.085)	99.78(11.13)	Midle	17(63)	Male	20(74.1)
				High	10(37)	Female	7(25.9)
TD	30	83.567(6.632)	102.10(10.27)	Midle	11(36.7)	Male	15(50)
				High	19(63.3)	Female	15(50)
		F = .048, df = 1; p = .828	F = .671, df = 1; p = .416		$\chi2$ = 2.950; df = 1; p = .086		$\chi2$ = 2.534; df = 1; p = .060

Note: DLD – developmental language disorder; TD – typically developing

given two examples of words that were not from the list, and when the examiner was sure that the child understood, he began with the task. After each response to a given stimulus word, the examiner asked the child if he or she knew the word.

Associations were classified into six categories: *paradigmatic* associations included those with a clear semantic relation to a stimulus word, such as superordinate, coordinate, or other words that are semantically related to the prompt 2. associations were categorized as *syntagmatic* if they bear a clear sequential or colloquial relationship with the prompt. The three types of association were classified into this category: a) words that can form syntactic relationships with the stimulus word (e.g. *music – listen*) b) words that are in a colloquial relationship with stimulus word and often used in everyday speech as idioms (e.g. *butterfly – stomach* meaning «falling in love») c) compound words (e.g. derivation, compounding etc.) 3. *phonological* were those that rhyme with the prompt word but without any semantic relation (blue – glue) 4. *unrelated* were those that bore no perceivable relation to the prompt 5. *echolalic* responses consisted of the repetition of the target word and 6. *omissions*.

Code reliability. To ensure the reliability of coding, a second coder, who was unaware of the children's identities, independently coded 15% of samples from each group. The point-to-point agreement between the two coders averaged 95%. Any discrepancies in coding were resolved through discussions and agreement between the coders.

Data Analysis

Percentages of all types of BNT answers and WAT associations were used as scores for statistical analysis. Data analysis included method of descriptive (minimum, maximum and mean values, standard deviation) and inferential statistics (Chi-square test and analysis of variance – ANOVA). Chi-square test and analysis of variance (ANOVA) were employed to compare the two groups of children based on age, gender, general IQ, and maternal education.

Correct answers and omissions on the BNT test were used for comparing expressive vocabulary, and differences were investigated by using an ANOVA.

Analysis of semantic, unrelated, circumlocutions and pseudoword errors on the BNT test, as well as all types of associations on the WAT task were used for comparing lexical processing skills, and differences were investigated using ANOVA.

RESULTS

Children with DLD gave significantly less correct answers, as well as more omissions on the BNT compared to TD children ($p \leq .000$). Regarding errors, children with DLD made a significantly higher number of semantic and unrelated errors compared to their peers. However, there were no significant differences between children with DLD and their TD peers in terms of the number of phonological errors, circumlocutions, and pseudowords ($p > .05$) (Table 2).

Table 2

Groups Comparison of Answers Percentages on BNT

		Mean	SD	F	p
Correct answers	DLD	48.148	11.842	92.770	**.000**
	TD	73.599	7.810		
Semantic errors	DLD	14.752	5.675	20.136	**.000**
	TD	9.277	3.354		
Unrelated errors	DLD	3.581	4.708	16.180	**.000**
	TD	.111	.424		
Circumlocutions	DLD	3.272	4.945	.727	.398
	TD	2.282	2.650		
Phonological errors	DLD	.803	1.926	1.141	.290
	TD	.389	.840		
Pseudowords	DLD	.062	.321	1.113	.298
	TD	.000	.000		
Omissions	DLD	28.209	14.609	35.538	**.000**
	TD	9.944	6.940		

Note: BNT – Boston Naming Test; DLD – developmental language disorder; TD – typically developing. Statistically significant differences are bolded.

Analysis of answers distribution on BNT reveals a somewhat comparable pattern in both groups of children. Namely, children with DLD made a greater proportion of correct answers, followed by omissions, semantic, unrelated, circumlocutive and phonological errors, with lowest proportion of pseudoword type errors (Table 2). On the other hand, TD children made also a greater proportion of correct answers, followed in descending order by omissions and semantic errors, circumlocutive, phonological and unrelated errors, with lowest proportion of pseudoword type of errors (Table 2)

Regarding WAT, there are significant differences between children with DLD and their TD peers in the number of paradigmatic ($p \leq .000$), syntagmatic ($p < .05$), unrelated ($p < .01$), and echolalic associations ($p < .05$), as well as in the number of omissions ($p < .05$). In particular, the results revealed that children with DLD performed significantly worse than their TD peers, demonstrating a higher occurrence of immature associations (unrelated and echolalic) and a lower frequency of mature associations (paradigmatic and syntagmatic) (Table 3).

Regarding the number of phonological association children with DLD and TD children did not differ significantly.

DISCUSSION

The comparison of correct answers and errors between children with DLD and their TD peers revealed significant differences in the results. Namely, children with DLD gave significantly fewer correct answers and had significantly higher number of omissions. Significantly smaller number of correctly retrieved words and more omissions indicate deficits in vocabulary size or vocabulary breadth in school-aged children with DLD. It is difficult to reliably compare our results with the results of previous studies because most of them included both preschool and school-aged children in the sample, or just preschoolers. Since we lack naming studies specifically focused on school-aged children with DLD, our ability to fully compare our results with previous research is limited. However, our findings do align with previous studies, indicating that children with DLD may exhibit deficient vocabulary skills even during school-age. Our results partially confirm one obtained in research of Sheng and McGregor (Sheng & McGregor, 2010b), who have examined confrontational object naming in children with DLD with an average age of 7 years and 2 months. The findings of this study revealed that children with DLD provided significantly fewer correct answers compared to their TD peers. However, omissions were not significantly considered, yet they were classified as «other errors». Also, due to small sample in this study (n = 14), no reliable conclusions can be drawn about vocabulary breadth deficits of school-aged children with DLD. Löfkvist and colleagues (Löfkvist et al., 2014) also included children of both age categories and used the same methodology as in our study. The outcomes of their study indicated that children with DLD, aged 5.6 to 9, had fewer correct answers on the BNT when compared to their TD peers. Additionally, children with DLD demonstrated a significantly higher frequency of omitted answers compared to children with autism spectrum disorder. Although the authors of that paper hypothesize that the higher number of omissions on the naming test is due to difficulties in word retrieval, however, the respond latency is a better indicator of word retrieval difficulties (Messer & Dockrell, 2006).

Table 3

Groups Comparison of Associations Percentages on WAT

		Mean	SD	F	p
Paradigmatic	DLD	31.276	26.752	92.770	**.000**
	TD	58.111	19.023		
Syntagmatic	DLD	20.042	14.548	20.136	**.020**
	TD	30.075	16.840		
Unrelated	DLD	22.427	19.744	16.180	**.009**
	TD	11.295	10.214		
Phonological	DLD	3.814	14.643	.727	.089
	TD	.545	.824		
Echolalic	DLD	16.337	33.772	1.141	**.011**
	TD	.074	.281		
Omission	DLD	2.880	6.064	1.113	**.013**
	TD	.037	.203		

Note: WAT – Word Association Task; DLD – developmental language disorder; TD – typically developing Statistically significant differences are bolded.

During the school years, reading plays an increasingly crucial role in enriching vocabulary (Kan & Windsor, 2010). However, children with DLD are also at a higher risk of experiencing reading difficulties (Catts, 2002). Our study's results highlight the necessity for implementing school-based direct teaching techniques of new words for children with DLD. These children may find it more challenging to understand the meanings of new words through reading and understanding context in written material (Justice et al., 2005).

Distribution analysis of BNT answers showed similar pattern in both groups, children with DLD and their TD peers, which confirms the results of some previous research. (Brusewitz & Tallberg, 2010; Storms et al., 2004). Also, our results are in a line with results of Sheng and McGregor (Sheng & McGregor, 2010b) regarding the distribution of errors in a mixed age group of children with DLD. In this study, semantic type of errors were the most frequent and phonological errors were the least frequent ones in children with DLD. These data indicate possibility that phonological difficulties are not the cause of lexical-semantic deficits in school-aged children with DLD. Namely, phonological forms of words shape children's semantic representations during the early vocabulary development, and it is hypothesized that the challenges in processing and retaining novel phonological sequences might be the underlying cause of lexical-semantic difficulties in DLD (Gathercole, 2006; Quam et al., 2021). If the same mechanism is assumed to underlie lexical-semantic deficits in school-aged DLD children, we would expect a difference between children with DLD and their TD peers in the number of phonological errors during the naming test, or at least higher proportion of this type of errors. In support of this view, the results of the research conducted by Mainela-Arnold and colleagues (Mainela-Arnold et al., 2010) showed that phonological difficulties cannot explain the lexical-semantic deficits in children with DLD at school-age. Moreover, phonological errors suggest that the accurate semantic representation has been accessed, but the phonological representation appears to be inadequately defined or difficult to access. Therefore, the infrequency and the lack of a notable distinction between TD children and children with DLD regarding this type of error indicate that the naming difficulties in school-aged children with DLD are primarily due to deficits in lexical-semantic organization.

Nonetheless, the comparable pattern of error distribution suggests that children with DLD still follow a similar developmental trajectory as typically developing (TD) children, which aligns with the findings of Sheng and McGregor (2010b).

Furthermore, the notable disparity in the number of semantic and unrelated answers implies that school-aged children with DLD may exhibit limited semantic fields and weakened associative links between these semantic fields even during their school-age years, which is consistent with some of the previous studies with preschool and mixed age groups (preschool and school-aged) (McGregor & Appel, 2002; Sheng & McGregor, 2010b). Namely, semantic errors in children with DLD are the result of insufficient number of semantic characteristics for given concepts, as well as the consequence of weak associative links between concepts within a semantic category (McGregor & Appel, 2002; Sheng & McGregor, 2010b). The significantly higher number of unrelated answers on BNT may indicate a more severe deficit at the level of the lexical semantic network in school-aged children with DLD. The unrelated type of errors has not been significantly studied in children with DLD because they rarely occur during confrontational naming tasks and/or they were classified into groups of errors that were not significantly analysed according to the aim of specific studies, such as «other errors» (Sheng & McGregor, 2010b) or answers with «no semantic or phonological relation to target word» (Lahey & Edwards, 1999). However, this type of errors has been well studied in adults with acquired language disorders. Unrelated answers are most frequent in Wernicke's aphasia indicating severe deficits of vocabulary organization (Kohn & Goodglass, 1985; Laine et al., 1992). Also, answers that bare no semantic relationship with the presented item may be the result of distinct deficits in the activation of the lexical-semantic network, as well as weakened connections within the system of lexical semantics (Dell et al., 1997). Accordingly, it can be inferred that certain children with DLD at an early school-age might exhibit pronounced deficits in lexical-semantic organization.

In TD children, reorganization of the lexicon usually begins at the age of six and develops very dynamically up to the age of nine, when children begin to use more paradigmatic associations and reduce the number of syntagmatic associations (DiPisa, T., 2016). When comparing the lexical processing of children with DLD and their TD peers, significant differences were noted in the number of paradigmatic and syntagmatic associations. Specifically, children with DLD had significantly fewer paradigmatic and syntagmatic associations, pointing to a deficit in lexical processing (Sheng & McGregor, 2010a). Conversely, children with DLD in our sample gave more echolalic answers and unrelated associations than TD children, as well as more omissions. This is an indication that even at school-age, children with DLD can have a poorly developed lexical-semantic network. According to the theory of Collins and Loftus (Collins & Loftus, 1975), the strength of activation determines which word will be activated in a semantic network. Sheng and McGregor (2010a) proposed an additional hypothesis that suggests weaker activation in the semantic network, leading to limited access to semantic connections and, consequently, an increase in non-semantic associations, such as unrelated and echolalic responses. Echolalic responses may indicate a child's inability to access a specific concept or process a word effectively (Cronin, 2002).

The findings of our study align with previous research, which also reported significant deficits in lexical-semantic process-

ing in preschool or mixed-age groups of children with DLD (Broedelet et al., 2023; Dockrell et al., 2003; Drljan & Ječmenica, 2023; McGregor & Appel, 2002; McGregor et al., 2002; Sandgren et al., 2021; Simmonds et al., 2005). Moreover, the results support a growing body of evidence indicating that children with DLD may experience substantial lexical processing deficits even during school-age (Mainela-Arnold et al., 2010; Marinellie & Johnson, 2002). The results also suggest that certain children with DLD might experience a more pronounced impairment within the semantic network, which is not in a line with some of the previous studies in which this deficit were considered as a consequence of poor syntactic abilities (Pizzioli & Schelstraete, 2011).

Summarizing the results, we can say that some children with DLD can have significant difficulties of vocabulary breadth and depth, even at school-age, and there is an indication of severe semantic deficits. Indeed, child development is a dynamic process, and challenges in one learning system can exert a substantial and enduring negative influence on the advancement of another learning system, particularly when these systems are interconnected and closely linked (Guo et al., 2023). Results of some previous studies indicate that underdeveloped lexical-semantic processing abilities can impair reading and comprehension of written material in school-age children (Roth et al., 2002; Verhoeven & Van Leeuwe, 2008). Also, «deep word knowledge» is a key factor and direct predictor of reading comprehension, an ability that affects overall academic achievement (Dickinson et al., 2010; Hadley et al., 2016). This implies the need for implementing special intervention techniques which will improve expressive vocabulary and lexical-semantic processing skills in school-aged children with DLD. There are several studies which examined intervention approaches targeting lexical abilities in children with DLD at school-age. Some of them compared semantically and phonologically-based techniques (Bragard et al., 2012; Parsons et al., 2005), other focused primarily on morphological awareness (Good et al., 2015) or semantically-based approaches (Ebbels et al., 2012). Due to initial mastering of reading skills, phonologically-based approaches (e.g. phonological awareness training) prevail during the first years of elementary school for all children, including children with DLD who attend regular schools. However, the results of our study indicate the need for additional semantically-based interventions. Namely, phonologically-based intervention can improve naming of target words, but generalization to other words usually does not occur (Best, 2005). Semantic intervention endeavours to enrich the comprehension of specific word features, reinforcing the corresponding semantic representation (Bragard et al., 2012), while concurrently fostering self-cuing skills in school-aged children with DLD (Wittman, 1996). Additionally, considering that DLD children often rely on gestures when they have comprehension difficulties (Botting et al., 2010; Mainela-Arnold et al., 2014), it would be useful to consider the gesture-based methods that have been shown to improve the depth of word knowledge in TD children (for review see Lawson-Adams, 2020), which can also be the implication for future studies.

Shortcoming of our study is that we did not control some of the socio-demographic variables and children's cognitive abilities. Namely, the sample of participants did not include children residing in rural areas, which would give a better insight into children's lexical-semantic abilities because there are indications of the potential influence of this socio-demographic variable on language development. (e.g. Bornstein & Cote, 2005; Vázquez, 2018). Also, we did not control differences in nonverbal IQ, which proved to be a better control variable than general IQ.

CONCLUSION

To summarize the results of our research, it can be concluded that children with DLD display significant deficits in lexical abilities during early school-age. Moreover, the analysis of errors reveals that the observed deficit in children with DLD extends beyond a limited vocabulary breadth or a reduced number of terms in their expressive lexicon. The examination of naming errors and lexical processing performance indicates that school-aged children with DLD may face profound challenges in organizing and developing their lexical-semantic network. These difficulties manifest as deficits in the activation of the lexical-semantic network, indicating sparse semantic fields and weak connections between concepts within semantic categories and across different semantic categories.

In Serbia, when children reach the age to enrol in school, they are evaluated with standard assessment that does not include a more specific assessment of lexical-semantic abilities. Therefore, schooling is postponed only if the child has developmentally low achievements regarding morpho-syntactic and phonological abilities. Our study's findings reveal that school-aged children with DLD, who are attending regular school, can encounter notable challenges in their lexical-semantic abilities, which implies the more comprehensive assessment and use of additional interventional approach for these children. Also, results showed that even those lexical concepts that these children have in their vocabulary are characterized with poor semantic representations and with small number of semantic characteristics. Accordingly, for improving the expressive vocabulary skills and the organization of the semantic network, it is necessary to apply additional semantically-based intervention approaches with these children, in addition to the standard phonological ones that are regularly applied during the initial mastery of reading skills. Additional semantically-based strategies that facilitate access to and organisation of the lexicon can significantly improve the efficiency of naming and lexical processing, and thus improve the process of acquiring and applying academic knowledge and skills.

DECLARATION OF COMPETITING INTEREST

None declared.

AUTHORS' CONTRIBUTION

Bojana J. Drljan: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Software; Supervision; Validation; Visualization; Writing – original draft.

Nevena R. Ječmenica: Conceptualization; Data curation; Investigation; Project administration; Resources; Supervision; Validation; Visualization; Writing: original draft.

Ivana P. Arsenić: Conceptualization; Data curation; Investigation; Project administration; Resources; Supervision; Validation; Visualization; Writing – original draft.

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