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RECEIVED 04 June 2025

ACCEPTED 18 August 2025

PUBLISHED 03 September 2025

CITATION

Andreou G, Lympieropoulou V, and
Aslanoglou V (2025) Structural language in
neurodevelopmental disorders: comparison
between autism spectrum disorder (ASD) and
developmental language disorder (DLD).
Front. Educ. 10:1641303.
doi: 10.3389/feduc.2025.1641303

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Structural language in neurodevelopmental disorders: comparison between autism spectrum disorder (ASD) and developmental language disorder (DLD)

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Introduction: The aim of the present study is to investigate structural language of children with Autism Spectrum Disorder (ASD) and Developmental Language Disorder (DLD) in a Greek-speaking population.

Methods: Three groups participated in the study, matched for age and sex: 25 children with ASD aged 6–8 years (mean age 84.19 months; $SD = 6.55$), 25 children with DLD aged 6–8 years (mean age 84.09 months; $SD = 6.72$), and 25 typically developing children, who served as controls (mean age 84.09 months; $SD = 6.72$). Structural language was examined in all three groups by using standardized tests assessing their skills in phonological awareness, morphosyntax and vocabulary. Phonological skills were evaluated using subscales from the Test for the Detection and Investigation of Reading Difficulties, while scales from the Diagnostic Test of Linguistic Intelligence for school-age children were used for the assessment of morphosyntax. Finally, the lexical scale from WISC-V was used to assess expressive vocabulary.

Results: The findings of the study showed that both children with ASD and children with DLD performed worse on tests examining structural language than their typically developing peers. More specifically, statistically significant differences were observed across all measurements ($p < 0.001$). However, the comparison between the two clinical groups revealed that the performance of children with DLD was worse than that of children with ASD on all tests examining structural language. More specifically, the difference between the two groups in terms of phonology and morphosyntax was $p < 0.001$, while the difference in terms of expressive vocabulary was $p = 0.03$.

Discussion: The findings shed light on important aspects of structural language in both ASD and DLD by providing insights into the common and differential language challenges faced by individuals with these neurodevelopmental disorders. This analysis enhances the understanding of language development in the Greek-speaking population and offers a cross-disorder approach. These findings may contribute to the development of targeted educational strategies to support children with ASD and DLD.

KEYWORDS

structural language, autism spectrum disorder, developmental language disorder, neurodevelopmental disorders, Greek language

1 Introduction

Language is crucial for communication, the components of which are language form, content and language use. Structural language consists of the language form and content, while language use is part of the pragmatic language level (Reindal et al., 2021). More specifically, for a more complete understanding of the language mechanism, language is divided into five interrelated levels: phonology, morphology, syntax, semantics and pragmatics (Reetzke et al., 2015). The term structural language is used to describe phonology, morphosyntax and semantics (Reetzke et al., 2015; Vassiliu et al., 2022). Although, this distinction of language linguistic levels is artificial, it seems useful in order to evaluate these skills, especially when examining atypical populations (Matthews et al., 2018).

Language development is a complex process that progresses through different levels and follows a dynamic trajectory (Hoff, 2009), which is impacted by both biological and environmental factors (Rinaldi et al., 2023). Nevertheless, sometimes this trajectory does not follow the typical development, leading to deviations that may affect different aspects of language competence. Such deviations are often found in the context of neurodevelopmental disorders, mainly in Autism Spectrum Disorder (ASD) and Developmental Language Disorder (DLD) where language development appears with atypical features and may be accompanied by broader difficulties in communication and learning (Conti-Ramsden et al., 2012; Luyster et al., 2011; Whyte and Nelson, 2015).

ASD is a neurodevelopmental disorder which mainly concerns social difficulties, as reported in DSM-5 [American Psychiatric Association (APA), 2013]. The diagnostic criteria for ASD include deficits in social communication and social interaction occurring in multiple social contexts and limited repetitive (stereotypical) patterns of behaviors, interests and activities [American Psychiatric Association (APA), 2013]. Similarly, according to ICD-11, ASD is characterized by persistent deficits in initiating and maintaining reciprocal social interaction and social communication, accompanied by atypical or excessive limited, repetitive and rigid patterns of behavior, interests or activities relative to age and sociocultural context.

Research has shown that ASD presents high heterogeneity, as language and cognitive skills and deficits vary (Girolamo et al., 2024; Henderson et al., 2014; Silleresi, 2023). One aspect of this heterogeneity concerns structural language abilities. Difficulties in structural language as part of communication deficits are not a criterion for the diagnosis of ASD, according to the DSM-5 [American Psychiatric Association (APA), 2013]. However, approximately 65% of children who receive a diagnosis of ASD also have language deficits and receive a concurrent diagnosis of a language disorder (Levy et al., 2010; Schaeffer et al., 2023; Tager-Flusberg et al., 2005). Numerous studies highlight the strong heterogeneity of ASD population regarding language abilities, reporting different types of language difficulties in children with ASD (Rapin and Dunn, 2003). Tager-Flusberg and Joseph (2003) distinguished two language subtypes among verbal children with ASD: those with typical language skills and those with language impairments. Tager-Flusberg (2006)

further confirmed this variability by examining phonological processing and grammatical morphology, distinguishing a group with structural language impairments from one with typical structural language abilities. Later studies, also revealed a subgroup with structural language impairments (ASD-LI) and another exhibiting typical structural language development (Georgiou and Spanoudis, 2021; Whitehouse et al., 2008). The group with typical structural language development often demonstrates high level of verbal fluency, performing similarly to typically developing peers on tests of structural language (Tek et al., 2014) and exhibits advanced vocabulary and syntax (Boucher, 2012; Tager-Flusberg and Caronna, 2007).

While early studies describe two main subgroups in ASD, more recent research suggests a greater diversity of language profiles. Vogindroukas et al. (2022) proposed four language profiles: ASD and pragmatic difficulties, without the presence of any other language difficulties; ASD and comorbidity with DLD, or another developmental disorder; ASD and intellectual disability; and ASD and social communication and interaction difficulties. Similarly, Silleresi (2023) proposes three profiles that have been strongly established. The first profile consists of autism with language and intellectual abilities in accordance with the norms (ASD-LN), the second concerns autism with language and intellectual impairments, while the third profile includes autism with language impairments (ASD-LI) without intellectual impairments.

Significant language deficits and atypical language development are also observed in the population with DLD. Although the term DLD is not included in the DSM-5 [American Psychiatric Association (APA), 2013], it is accepted by both the scientific community and clinical practitioners. DSM-5 uses the term “Language Disorder”, which includes it among neurodevelopmental disorders, in order to identify persistent difficulties in the acquisition and use of language, both in terms of comprehension and production. In addition, ICD-11 uses the term DLD, which is defined as a neurodevelopmental disorder characterized by persistent deficits in the acquisition, comprehension, production or use of language (World Health Organization, 2019). These deficits arise during the developmental period, usually in early childhood, and cause significant limitations in the individual’s ability to communicate (Bishop et al., 2016, 2017).

Children with DLD exhibit delayed language development, as the acquisition of language skills is slower than that of typically developing children. Nonetheless, they exhibit great heterogeneity in their language abilities and weaknesses (Ryder and Leinonen, 2014). The difficulties of children with DLD, which may involve language expression, comprehension, or both (Bishop, 1997), negatively affect all cognitive functions. These difficulties impact all levels of language development, both in oral and written language, in children with DLD (Andreou and Aslanoglou, 2022; Girbau and Schwartz, 2007).

Previous research has shown that individuals with DLD exhibit difficulties in the use of structural language, namely phonology, morphology, syntax and semantics, while those difficulties have also been found present in ASD.

Phonology regards the linguistic sounds transmitted from the speaker to listener during the communication. It examines

the phonemes of the language system and focuses on phonetic categories, phonemes, and intonation (Shakila et al., 2024). Phonemes are the smallest sound units that differentiate words (Barokova and Tager-Flusberg, 2020; Stemberger and Bernhardt, 2023). By the age of 1 year, the child can produce phonetically stable forms for communication varying the tone and volume of the voice, and from this age onwards, the child begins to produce his or her first words (Dore et al., 1976; Shakila et al., 2024). Phonological development leads to phonological awareness, a very important skill for oral and written language. Phonological awareness is divided into phonemic awareness, which concerns the perception of the smallest units of speech (phonemes and speech sounds), and syllabic awareness (larger units of speech, such as syllables). Phonological awareness supports word and sentence production by enabling the perception of phonological units as distinct parts of language and their functional use in speech (Berninger et al., 2010; Sun and Poeppel, 2023). Children with ASD exhibit a delay in the development of phonological skills compared to that of typically developing children (Papoudi and Vakalopoulou, 2022; Schaeffer et al., 2023). However, Wetherby et al. (2004) observed that the order of occurrence of phonemes in children with ASD did not differ from that of typically developing children, and no differences were found in the pattern of expected phonological errors. On the other hand, the phonological processing of children with DLD is similar to that of typically developing younger children (Leonard, 1998). Nevertheless, they often omit or substitute phonemes and have difficulty managing even simple syllabic structures (of the consonant-vowel form) (Aguilar-Mediavilla et al., 2002). Furthermore, they have difficulty in the accurate articulation of laterals, nasals, and stops (Aguilar-Mediavilla et al., 2002), and in producing sibilant (/s/, /z/) and liquid (/l/, /r/) phonemes. In addition, children with DLD make errors in consonant clusters and experience articulation difficulties in the flow of speech, while errors in the articulation of polysyllabic words are also evident. In general, the speech intelligibility of children with DLD is negatively affected by the phonological errors they produce. Finally, there is difficulty in repeating pseudowords (Lalioti et al., 2016), especially when the repetition involves pseudowords with more than two syllables (Mengisidou et al., 2020).

Morphology refers to the individual components of words and the relationships between them. It studies the structure of words and the rules for their analysis and creation (Apel et al., 2013; Barokova and Tager-Flusberg, 2020; James et al., 2021). In particular, it examines the morphemes, which are the minimal units of language that have a meaning, and the way the morphemes are identified, analyzed and described through the structure of words. The ability of an individual to distinguish speech into morphemes is called morphological awareness and is important for language development (Berninger et al., 2010; Carlisle, 1995; James et al., 2021). From the age of 2 or 3 years, children begin to focus on word form through the use of morphemes to assign different functions to the words they produce and are able to identify individual words in the flow of speech (Peters, 2017). Gradually, around the age of three, the child is able to perform a sub-generalization of the rule for forming a word, which is considered an indication of the application of symbolic rules. From the age of 3 years, children gradually master the ability to distinguish the semantic

and phonological texture of words and word themes, as well as to follow the rules of language articulation in the words they produce (Hoff, 2009; Peters, 2017). Regarding morphological development in ASD, it has been observed that the use of functional words such as articles and pronouns is limited, while Kelley et al. (2006) found that children with ASD have difficulty in the correct use of tenses in a sentence, as they do not fully understand the temporal order of “now” and “then”. In addition, Vogindroukas (2020) noted difficulties in understanding and generalizing grammatical rules. The research of Crandall et al. (2019) confirms the above finding as the researchers also observed difficulties in using grammatical rules. In addition, Terzi et al. (2014) found that inflectional morphology in Greek language constitutes an area of difficulty for children with ASD. The development of morphology is also deficient in children with DLD. Research in the English language reveals difficulties in the use of verbs and specifically in the formation of regular past tense marker *-ed* and regular plural number marker *-s* (Joye et al., 2019), while the use of the passive voice and the formation of questions are also deficient (Andreou et al., 2023; Stavrakaki, 2020). In Greek, difficulties have been reported in the use of the definite article and in the production and understanding of personal pronouns (Tsimpli and Stavrakaki, 1999), as well as difficulties in specific grammatical functions (Stavrakaki, 2006). Furthermore, deficits have been observed in the use of tenses, in the acquisition of the definite article and weak forms of the definite pronoun (Tsimpli and Stavrakaki, 1999), as well as in the perception and use of morphological information in terms of number and case (Stavrakaki et al., 2015). Interestingly, studies investigating the production of clitics in children with DLD in Greek produced controversial results. Tsimpli and Stavrakaki (1999) reported that children with DLD omit direct object clitics while Theodorou and Grohmann (2015) failed to find differences between children with DLD and TD peers on similar tests. Conflicting findings suggest that difficulties at the morphological level may not be homogeneous, but may be related to individual linguistic and cognitive factors. More specifically, it has been suggested that such morphological difficulties may be associated with deficits in grammatical awareness and the ability to process and use grammatical information, as well as with limitations in perceptual ability (Aslanoglou et al., 2023; Lancaster and Camarata, 2019).

Syntax refers to the structure of a sentence, which concerns the order of terms in a sentence. In every language, there is a system of rules that determine the order of terms in a sentence, through which speakers understand the meaning of the sentence (Fromkin et al., 2017). In other words, syntax refers to the hierarchical relationships and rules that regulate how words are connected to form sentences (Shakila et al., 2024). According to Hoff (2009), the way words are combined conveys the speaker's thought, and often the meaning of a sentence is understood through its syntax. In particular, in languages with strict word order, two sentences may have the same formulas or words, but when they are in different order, the meaning changes (Lyons, 1995). Greek, by contrast, exhibits a relatively free word order due to its rich inflectional morphology (Alexiadou and Anagnostopoulou, 2000). By the age of six, the child is in the stage of full syntactic and morphological development. The child is able to systematically use functional words, as well as grammatical forms. Gradually,

the acquisition of basic syntactic and morphological structures is completed, and at this age the child's language comes close to the language of adults to a considerable extent (Hoff, 2009). Syntactic development in ASD is also deficient, as their sentences are short and simple, and they exhibit difficulties in both producing and understanding long complex sentences. In addition, the use of stereotypical expressions is still frequently observed, as they reproduce stereotypical expressions mechanically (Papoudi and Vakalopoulou, 2022). Zarokanellou et al. (2025) investigating the narrative skills of Greek-speaking children with ASD indicated that children with ASD exhibit a delay in syntactic development as compared to their TD peers. Nevertheless, Talli and Stavrakaki (2020) reported that syntactic deficits are key clinical features of the DLD population. Specifically, children with DLD produce simpler sentences than their TD peers, and they encounter difficulties in understanding long and complex syntactic sentences as well as in reading comprehension (Talli et al., 2016; Aslanoglou et al., 2023). Difficulties are also observed in sentence repetition and in their ability to understand the grammatical relationship between subject and object (Mengisidou et al., 2020).

Semantics is the level that examines the meaning of forms, words, phrases and sentences. These meanings are conventional or encoded in each language (Hoff, 2009). The morpheme, as mentioned above, is the smallest linguistic unit with a fixed form and meaning, while the word is the basic unit of the semantic level (Lyons, 1995). In a language, words may have a concrete or an abstract meaning, may be used with a literal or figurative meaning or even express more than one meaning (Andreou, 2012). Each person has a “mental lexicon”, a repository of information, containing the morphemes and words of their language (Fromkin et al., 2017; Papafragou et al., 2022; Sun and Poeppel, 2023). As early as the 7th month, the child is able to distinguish words produced in his/her native language from words in a foreign language (Höhle and Weissenborn, 2003). By the age of 9 years, children are able to categorize objects and know verbs that mainly denote movement (Andreou, 2012). Children with ASD exhibit difficulties at the semantic level of language. Rapin and Dunn (2003) found deficits on the part of individuals with ASD in understanding deep word meanings, resulting in weaknesses in non-literal language comprehension and vocabulary acquisition. Horvath et al. (2018) confirm the above findings, as they observed difficulties in understanding and generalizing abstract words, as well as in understanding and recalling multiple meanings of a word. The research of Eigsti et al. (2007) showed that the vocabulary of children with ASD includes neologisms, idiomatic words or even meaningless words, which children use for communicative purposes. Naigles and Tek (2017) observed that most children with ASD are able to acquire the rules of speech form more easily than meaning. Furthermore, Kambanaros et al. (2019) investigated children with ASD with low language skills and evaluated the comprehension and production of compound words with two constituents. The results showed that children with ASD were able to identify the two constituents that compose a compound word. However, they presented difficulty in understanding the meaning of this word, and even in their attempts to explain the meaning of compound words, they produced semantically incomprehensible responses. Moreover, Auza-Benavides et al. (2024) found that

children with ASD exhibit difficulties in expressive vocabulary, with the greatest difficulties presented in verbs and functional words. Similar findings regarding weaker expressive vocabulary in children with ASD in comparison to their TD peers were also reported by Seol et al. (2014). Furthermore, Liu et al. (2025) found an absence of the use of numerals and a low use of pronouns, while interjections seem to be the most frequent word category in the expressive vocabulary of children with ASD. On the other hand, children with DLD have limited lexical knowledge and poorer vocabulary as compared to their TD peers (Adams, 2002; Mengisidou et al., 2020), while learning nouns is considered easier for them than learning verbs (Alt et al., 2004). Dockrell et al. (2007) attribute deficits in semantics to limited knowledge of word morphology and to difficulty to producing compound words. Greater difficulties are found in words expressing abstract meanings and in multisyllabic words, and they also have difficulty in quickly and accurately recalling words that have an abstract meaning or are of low frequency. Furthermore, poorer expressive vocabulary and low word production have been observed in children with DLD in comparison to their TD peers (Auza-Benavides et al., 2024; Seol et al., 2014) while Jackson et al. (2021) found that children with DLD showed difficulties in expressive vocabulary tasks, such as naming and describing newly learnt words. In addition, difficulties have been reported in understanding proverbs and figurative and ironic expressions (Aslanoglou et al., 2023).

Language difficulties are the main feature of DLD and, as has already mentioned above, language deficits are also frequently found in individuals with ASD (Roberts et al., 2004; Tager-Flusberg and Joseph, 2003). Therefore, many studies have focused on the similarities between children with DLD and children with ASD at all levels of language development (Andreou et al., 2022; Leyfer et al., 2008; Ramírez-Santana et al., 2019). As a result of these similarities, the hypothesis of a common phenotype was set. This hypothesis argues that DLD and ASD are related and are probably different expressions of the same core cause or different parts of a continuum of the same disorder (Bishop, 2010; Kjelgaard and Tager-Flusberg, 2001; Tager-Flusberg and Joseph, 2003).

Research investigating language development through language tests, as well as studies that use neuroimaging and genetic methods, have been conducted in order to clarify the relationship between the two disorders. More specifically, the study of Herbert et al. (2005) regarding ASD and DLD showed similar patterns of asymmetry in the cerebral cortex, while both groups were more similar to each other than to the control group. Furthermore, it was observed that the right-asymmetrical region of the brain was more strongly developed in ASD compared to DLD, but both groups had significantly more right-handed asymmetry compared to the control group. Hodge et al. (2010) studying ASD and DLD found deficits in both populations regarding working memory, attention, language processing and motor control. Regarding language phenotype, Taylor and Whitehouse (2016) observed that children with language disorders met criteria for ASD, supporting the hypothesis that there is phenotypic overlap between ASD and DLD. They therefore concluded that the two disorders may be aspects of a single continuum, manifesting deficits in different domains. Voulgaraki (2023) found, also a high probability of autistic symptomatology in DLD, while, Leyfer et al. (2008) showed

that a significant proportion of children with DLD met the criteria to receive a diagnosis of ASD. In addition, Félix et al. (2024) in a review on the similarities between the two disorders, suggested that the differences in the language development of children with DLD and children with ASD were more evident during preschool age, but these differences decreased during school age.

On the contrary, several studies have identified significant differences between the two disorders in terms of language development (Creemers and Schaeffer, 2022; Schaeffer, 2018; Williams et al., 2008). Tager-Flusberg (2006) claimed that language impairments cannot serve as the sole criterion to differentiate the two disorders, as these commonalities in language impairments of DLD and ASD reflect only apparent distinctions. Therefore, it is not possible to draw definitive conclusions regarding the potential for a shared etiology derived from these similarities (Whitehouse et al., 2007).

However, the relationship between ASD and DLD has not yet been clarified, while various hypotheses have been put forward in recent years as an attempt to develop a well-defined diagnostic criterion that would separate the two disorders (Bishop and Norbury, 2002; Kjelgaard and Tager-Flusberg, 2001; Roberts et al., 2004).

Therefore, based on the above, the aim of the present study is to investigate structural language of children with ASD and DLD in a Greek-speaking population, and compare their abilities and weaknesses in this domain.

The specific objectives set for the present investigation are the following: (a) to assess and compare the performance of Greek-speaking children with ASD, DLD and typically developing children in structural language, namely phonology, morphosyntax and expressive vocabulary; (b) to identify specific areas of structural language strength and weakness in ASD and DLD; (c) to determine whether children with ASD and DLD exhibit overlapping or distinct structural language profiles.

The following research hypotheses were set:

Research hypothesis 1: Children with DLD are expected to perform lower on all tests that examine structural language than typically developing children.

Research Hypothesis 2: Children with ASD are expected to perform lower on all tests examining structural language than typically developing children.

Research Hypothesis 3: Children with ASD are expected to perform higher on tests examining phonology and morphosyntax than children with DLD.

Research Hypothesis 4: Children with ASD are expected to perform similarly to children with DLD on the test examining expressive vocabulary.

2 Materials and methods

2.1 Study design

The approach used for this research was quantitative, non-intrusive and cross-over. More specifically, the research followed a comparative approach to examine structural language skills in different clinical groups (ASD and DLD) and typically developing (TD) children. Language performance was assessed through

standardized tests and results were compared using statistical analyses of group means. In addition, a sampling research design was followed (Creswell, 2011). The sample was collected using the non-probability sampling technique, and more specifically using convenience sampling (Etikan et al., 2016).

2.2 Participants

The research was carried out in two phases. In the first phase, the sample simulation was conducted, and in the second phase the main research was carried out, in which participants of typical development (*mean age* = 84.09 months; *SD* = 6.72), participants with ASD (*mean age* = 84.19 months; *SD* = 6.55) and participants with DLD aged 6–8 years (*mean age* = 84.09 months; *SD* = 6.72) were evaluated.

The main research involved 75 students who were divided into two clinical groups and a control group. The first clinical group consisted of 25 children with ASD (17 boys and 8 girls), while the second group consisted of 25 children (17 boys and 8 girls) with official diagnoses including characteristics that consist the linguistic profile of DLD. The control group consisted of 25 typically developing (TD) children (17 boys and 8 girls). Inclusion criteria for all participants concerned age, non-verbal intelligence and language. To confirm comparability and internal validity of the sample, both non-verbal intelligence and Mean Length of Utterance(w) (MLUw) were measured to ensure that the participants belonged to the developmental category declared. In addition, the Greek version of the Children's Communication Checklist (CCC-2, Georgiou and Spanoudis, 2021; Bishop, 2003) was completed by the parents of all participants in order to further confirm DLD and ASD diagnoses.

The selection of participants of clinical groups was based on the current diagnostic framework in Greece, as implemented by the competent public institutions (e.g., Center for interdisciplinary assessment—counseling and support, Medical and Pedagogical Centers), which assign diagnoses according to official taxonomic systems (e.g., ICD-10, DSM-5) using relevant psychometric tools. However, for research validity, we ensured that only children with a clear and distinct diagnostic profile, without comorbidities, according to health professionals' reports and relevant assessments, were included in this study. To ensure relative homogeneity in language profiles, we included only children without intellectual disability, with no history of minimally verbal development and verbal language was the primary mode of communication.

Thus, the inclusion criteria for all participants in all groups were as follows: (a) monolingual Greek speakers; (b) aged 6–8 years; (c) non-verbal intelligence 85 and above. Participants in all groups were matched for age and sex.

Regarding the TD group, participants came from primary schools. Also, (a) their MLU(w) was greater than or equal to 6.0 (Rice et al., 2010); (b) General Communication Composite and Social-Interaction Deviance Composite based on the CCC-2 were above 55 and above 8 respectively (Norbury et al., 2004); (c) they did not have any special educational needs; (d) they performed well in the subjects of the school curriculum overall, according to their teachers.

TABLE 1 Socio-demographic profile of mothers in the sample (%)

Parental educational level	Percentage %	Parental occupation	Percentage %
Primary Education	10.7	Public sector employees	28
Secondary Education	50.7	Private sector employees	24
University degree (Bachelor)	36	Self-employed/ Farmers/ Business owners	16
Postgraduate degree (Master/PhD)	2.7	Unemployed/ Homemakers/ Other	32

Regarding the ASD group, participants came from special kindergartens, primary schools and special education centers and had an official diagnosis for ASD, High Functioning Autism, Non-typical Autism. They also followed a needs-based intervention program. High-functioning autism and non-typical autism were subsumed under the ASD label provided that participants met the language criteria set in the study. Specifically, (a) Mean Length of Utterance (MLUw) (Rice et al., 2010) was greater than or equal to 4.0; (b) General Communication Composite and Social-Interaction Deviance Composite based on the CCC-2 were below 55 and below 8 respectively (Norbury et al., 2004).

Regarding the DLD group, participants came from primary schools and special education centers and had an official diagnosis for language disorders with characteristics that compose the DLD profile. They also followed a needs-based intervention program. Inclusion followed ICD-11 criteria and required a diagnosis based on persistent language difficulties not explained by other neurodevelopmental conditions. To reduce internal heterogeneity, only children with combined expressive and receptive disorders were included. Additionally, the following were also taken into account: (a) Mean Length of Utterance (MLUw) (Rice et al., 2010) was greater than or equal to 4.0; (b) General Communicative Composite and Social-Interaction Deviance Composite based on the CCC-2, were below 55 and above 8 respectively (Norbury et al., 2004).

The exclusion criteria were as follows:

Participants were excluded from the study if (a) they did not meet the age, language or cognitive inclusion criteria; (b) they had comorbidity with other developmental or mental disorders; (c) they had a history of neurological impairment or severe sensory impairment; (d) they had articulation or voice disorders that could affect the results. In addition, for both clinical groups, participants were excluded if they did not have a diagnosis of the disorder (ASD, DLD) from an official public agency.

In terms of socio-demographic characteristics, all participants lived in small towns and villages in Greece. The families had similar socioeconomic and educational levels, as shown in the questionnaires completed by the participants' parents. Therefore, we consider the sample to be relatively homogeneous in terms of socioeconomic background, which limits the influence of possible confounding factors (Table 1).

2.2 Measures

For the purposes of this study, measures were initially administered for the selection and matching of the sample, followed by the measures used for the main research.

2.2.1 Measures for selection and matching of the sample

MLU(w) and non-verbal intelligence were measured, while the CCC-2 was completed by the parents of participants in order to simulate the sample. The number of morphemes or words that children use in each spontaneous expression is one of the most reliable indicators of language acquisition and is called Mean length of Utterance (MLU) (Ezeizabarrena and Garcia Fernandez, 2018). The MLU measurement demonstrates the language level at which the individual is at and is used to diagnose language disorders in children either as a measure to evaluate the effects of an intervention aimed at addressing language difficulties (Eisenberg et al., 2001; Tager-Flusberg et al., 2009) or as a factor for matching clinical groups in research studies (Rice et al., 2010). The MLU value is obtained by calculating the total number of produced morphemes (MLUm) or words (MLUw) divided by the total number of words in the utterance (Rice et al., 2010). For the present study conducted in Greek, the measurement of Mean Length of Utterance- Word (MLUw) was chosen, as in languages with high morphosyntactic complexity, such as the Greek language, it is considered more appropriate than the measurement of Mean Length of Utterance- Morpheme (MLUm) (Arif and Bol, 2008). For the purpose of the study, 50 sentences of the participants were collected through free discussion with them and divided by the words used in each utterance.

Additionally, to measure non-verbal intelligence, the Raven's Colored Progressive Matrices (CPM) (Raven et al., 1998) was used. Raven's Colored Progressive Matrices is addressed to children aged 4 to 12 years, is not influenced by cultural or linguistic factors, as no language responses are required and the verbal instructions given by the examiner are limited, and is standardized for the Greek population (Sideridis et al., 2015). In addition, Raven's Colored Progressive Matrices (Sideridis et al., 2015) showed high internal consistency (Cronbach's $\alpha = 0.90$). Reliability was measured by the test-retest method and showed high levels of shared variance between the two measurements ($R^2 = 73.4\%$).

Finally, CCC-2 (Bishop, 2003) is a 70-question questionnaire completed by parents or teachers who have known the child for at least 6 months. The questionnaire has been used in order to identify different communication profiles in children with DLD and ASD (Andrés-Roqueta et al., 2021; Creemers and Schaeffer, 2022; Gorman et al., 2016; Schaeffer, 2018) as it has been shown to effectively differentiate between structural language disorders and pragmatic difficulties (Norbury et al., 2004). It concerns children aged 4 to 16 years. The 70 questions of the questionnaire are grouped into 10 subscales concerning: (A) Speech, (B) Syntax, (C) Semantics, (D) Coherence, (E) Inappropriate onset, (F) Stereotyped language, (G) Use of context, (H) Non-verbal communication, (I) Social relationships and (J) Interests and assess General Communication Competence and Social-Interaction Deviance

Composite. Respondents are asked to respond about how often they observe various linguistic, pragmatic and social behaviors in children. On the General Communicative Composite, typically developing children receive a score >55 , while a score <55 probably indicates difficulties in structural language. Regarding, the Social-Interaction Deviance Composite, a negative score (<0) indicates pragmatic and social difficulties. In particular, according to Norbury et al. (2004), the performance of children with ASD does not exceed 8 points, while the performance of children with ASD on this scale is usually above 8. The internal consistency of the questionnaire is Cronbach's $\alpha = 0.80\text{--}0.87$, while the reliability is $r \sim 0.80$ (Norbury et al., 2004).

2.2.2 Measures of the main research

Regarding the main research, structural language was examined in all three groups by using standardized tests assessing their skills in phonological awareness, morphosyntax and expressive vocabulary. Phonological skills were assessed using subscales from the Test for the Detection and Investigation of Reading Difficulties (Porpodas, 2007). For the assessment of morphology and syntax, scales from the Diagnostic Test of Linguistic Intelligence (DTGL) for school-age children (Stavrakaki and Tsimpli, 2000) were administered, while expressive vocabulary was assessed using the lexical scale from WISC-V.

The Test for Detection and Investigation of Reading Difficulties (Porpodas, 2007) is a detective and investigative test that addresses reading difficulties during the most critical period of a child's age for the acquisition of reading. The purpose of this test is both to identify children who are likely to have difficulties in learning to read (when administered to kindergarten children) and to investigate the level of the individual main cognitive-linguistic factors of reading that are likely to be related to reading difficulties (when administered to children in the first two grades of primary school). The Test for Detection & Investigation of Diagnostic Difficulties (Porpodas, 2007) is standardized and it showed internal consistency (Cronbach's $\alpha = 0.60\text{--}0.79$). It consists of 9 scales, some of which are administered only to primary school students, some of which are administered only to kindergarten students and some of which are administered to both age groups. The test may be administered as a whole or partially, depending on the circumstances of the test and the skills that need to be assessed. For the purposes of this study, the two scales assessing phonological awareness (phoneme segmentation and phoneme deletion) were administered. Each of the two scales consists of 24 pseudowords of increasing difficulty. The pseudowords have been selected in such a way that they include the phonemes of the Greek language in various simple combinations at the syllabic level. In the phoneme segmentation scale, pseudowords of two to seven phonemes and pseudowords of one, two or three syllables are included. The examiner reads out each pseudoword and the candidate is asked to break it down into phonemes by tapping his/her pencil on the table. The phoneme deletion scale includes pseudowords of one syllable, each of which contains between 2 and 4 phonemes. The examiner reads a pseudoword and the candidate is asked to delete either the initial or the final phoneme and to pronounce the remaining part of the pseudoword (excluding the deleted phoneme).

The Diagnostic Test of Language Intelligence is a test that assesses the language skills of children in terms of levels of language development, determining their language age and identifying cases of deviations from normal language development. The test assesses three levels of language performance: production, comprehension and repetition. The test is designed for school-age children (6–12 years old), testing the production of clitic and productive morphology and syntax, the understanding of meta-linguistic concepts, syntactic structures and thematic roles, text comprehension and repetition of syntactic structures (Stavrakaki and Tsimpli, 2000). In the present study, scales related to morphology and syntax were administered. Specifically, the following were used: (a) The scale of clitic morphology; (b) the scale of productive morphology; (c) the scale of syntax; (d) the scale of understanding morphology/syntax; and (e) the scale of recalling syntactic structures. This test was chosen because it is standardized, it is intended for the age groups studied in the present research and provides a full assessment of the morphological and syntactic language development of the examinees. The internal consistency of the test, as calculated through Cronbach's α , was 0.78, while the Guttman split-half reliability coefficient was 0.75, indicating good consistency of the individual questions. In terms of validity, Spearman's correlation coefficient was used between the performance of the groups in the different sections of the test. A statistically significant positive correlation was found ($p < 0.001$), supporting the structural validity of the instrument.

Finally, the WISC-V lexical scale was chosen because it examines the depth and breadth of vocabulary, while it is standardized to the Greek population. WISC-V demonstrated high reliability (internal consistency: subtests 0.79–0.91) and validity through confirmatory factor analysis, supporting the factorial structure of the test. It is also important to note that Weschler's scales have a dominant role in assessing special populations, such as individuals with language disorders and pervasive developmental disorders (Vogindroukas and Zikopoulou, 2009).

2.3 Procedure

For the implementation of this research, a certificate of approval was granted by the Internal Ethics Committee of the Department of Special Education of the University of Thessaly (protocol number 937), as well as the required permission from the Institute of Educational Policy and from the Ministry of Education, Religious Affairs and Sports separately from each competent Department (Special and General Education) (protocol number: $\Phi 15/83926/EK/100881/\Delta 1$). Additionally, permission was secured from the school principals for the researcher's access to public schools and the administration of research measures to participants. Furthermore, written consent was obtained from parents, both for their children's participation in the study and for the publication of the research findings.

The evaluation process included three visits to schools and special education centers. At the first meeting, the school principal or the special education center manager was informed about the aims of the study, the tests to be administered and the duration of each evaluation. After obtaining the consent of the teachers'

association, parents were informed and, if they agreed to their children’s participation in the study, they signed a consent form and a form with their demographic data.

Then, the day and time of the next meeting was set, during which the Raven’s Colored Progressive Matrices (CPM) test (Sideridis et al., 2015) was administered individually and the MLU(w) was measured through free discussion with the participants. For those students who met the criteria set in terms of non-verbal intelligence and MLU(w), a third session was set, during which the main research tests were administered. An additional session was scheduled for the administration of the main research test for participants who were observed to exhibit signs of fatigue.

Participants were assessed individually in a silent classroom in one or two sessions. The total duration of the assessment was approximately 1 h for each participant. Prior to administration, clear instructions in simple words and examples were given to the participant so that they could understand what each test was asking for. No additional information or assistance was given during the administration. However, comments were made encouraging the participation of children, and at the end of each test, the participants were asked if they would like to take a short break. At the end of the assessment, the score that the participants obtained on each test was calculated and standard scores were calculated for the tests where this was possible.

Statistical analysis was carried out using the statistical analysis software Statistic Package for Social Sciences (SPSS v25). Initially, descriptive analyses of the quantitative data were conducted and the Mean Score (M), the Standard Deviation (SD) and the range of variables were calculated. Subsequently, a normality test (One Sample Kolmogorov Smirnov Test) was carried out separately for each group of children (TD, ASD, DLD) in order to check whether the variables met the conditions of normal distribution or not, in order to select the appropriate statistical test to determine the presence or absence of statistical significance in the research data. Specifically, as the variables did not meet the conditions of normal distribution, the non-parametric Kruskal-Wallis test was chosen to compare the performance of the three groups. In addition, pairwise comparisons of the groups were then made to check for statistical significance in each pair. For this purpose, variables that met normal distribution were subjected to the parametric *t*-test, while those that did not meet normal distribution were subjected to the non-parametric Mann-Whitney *U* test.

3 Results

The present study involved 75 children, divided into three groups; 25 children with ASD; 25 children with DLD; and 25 children of typical development. The groups were matched based on the age and sex of the participants. Each group consisted of 25 children aged 6–8 years (mean = 84.10 months), while 68% of the participants were boys (*N* = 17) and 32% were girls (*N* = 8).

The mean age of participants with TD was 84.09, the mean age of participants with DLD was 84.09 and the mean age of participants with ASD was 84.19. In terms of non-verbal intelligence, children with TD had a mean score of 89.40, children with DLD had a mean score of 88.20 and children with ASD had a mean score of 89.80. Finally, regarding MLU(w), children with TD

TABLE 2 Means and Standard Deviations of age, non-verbal intelligence and MLUw of the participants.

		TD ^a (<i>n</i> = 25)		ASD ^b (<i>n</i> = 25)		DLD ^c (<i>n</i> = 25)	
		M	SD	M	SD	M	SD
Age (months)		84.09	6.716	84.19	6.55	84.09	6.72
Non-verbal intelligence		89.40	3.905	89.80	4.20	88.20	4.54
MLU(w) ^d		6.56	0.25	5.79	0.82	4.37	0.10
CCC-2 ^e	GCC	77.08	4.85	37.52	11.38	35.40	3.81
	SIDC	6.36	9.35	−7.08	9.35	7.16	1.16

^aTD = typical development.
^bASD = autism spectrum disorder.
^cDLD = developmental language disorder.
^dMLUw = mean length of utterance (word).
^eCCC-2 = children’s communication checklist; GCC = general communication composite; SIDC = social-interaction deviance composite.

had higher mean score (*M* = 6.56) than children with DLD (*M* = 4.37) and children with ASD (*M* = 5.79) (Table 2).

Kruskal-Wallis’s analysis was performed to compare the three groups with each other. Table 3 presents the descriptive data on the performance of the children in the three groups on structural language, as well as the statistical significance between the groups on this measurement. Specifically, the results of the study as presented in Table 3, showed that there was a statistically significant difference in phonological awareness between the three groups (TD *M* = 20.80, *SD* = 3.12; DLD *M* = 12.32, *SD* = 3.86; ASD *M* = 18.20, *SD* = 4.01). Also, there was a statistically significant difference regarding morphosyntax between the three groups (TD *M* = 82.96, *SD* = 4.23; DLD *M* = 31.00, *SD* = 7.84; ASD *M* = 45.88, *SD* = 13.54). Finally, there was a statistically significant difference concerning expressive vocabulary (TD *M* = 11.24, *SD* = 1.67; DLD *M* = 6.52, *SD* = 1.78; ASD *M* = 7.84, *SD* = 2.84). As presented above analytically statistical analysis showed a statistically significant difference between the three groups on all measures related to structural language (*p* < 0.001) with the clinical groups exhibiting lower performance than the control group (TD children). A comparative representation of the scores of participants across the three measurements and between the groups is presented in Figure 1.

In addition, pairwise comparisons between groups were performed using independent samples *t*-tests and Mann-Whitney *U* tests, depending on the normality of the data.

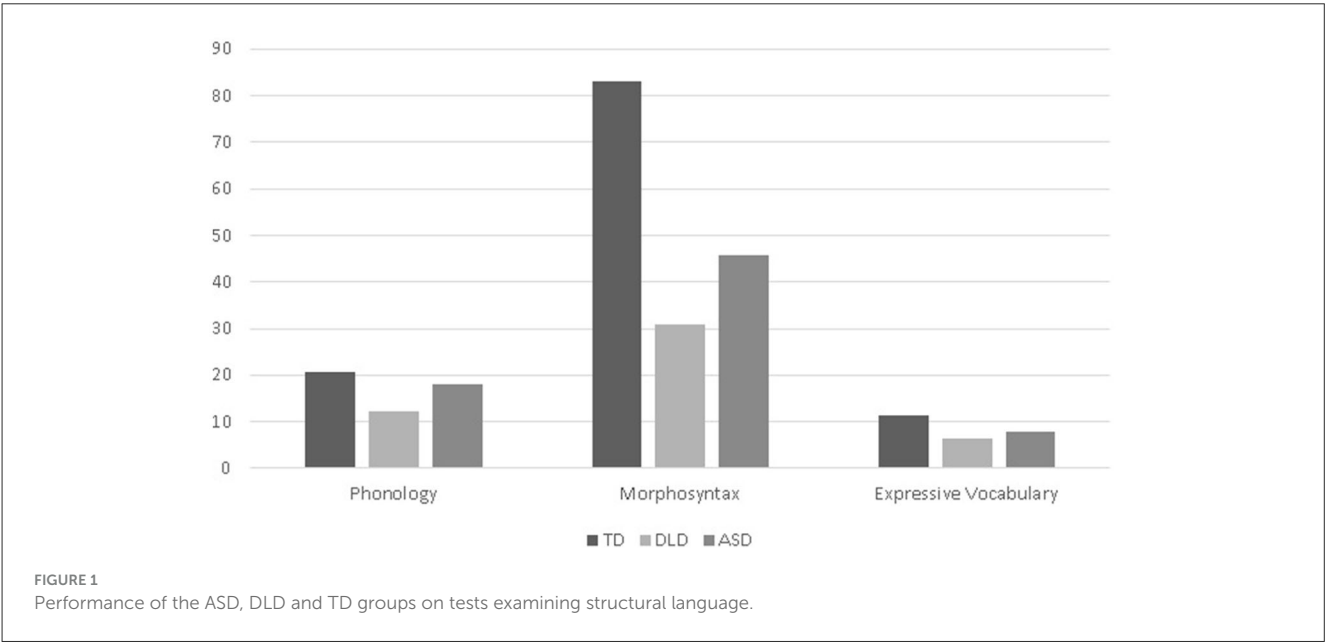
Regarding the first hypothesis, children with DLD are expected to perform lower on all tests that examine structural language than typically developing children. The results indicated lower performance for DLD group across all measurements. Specifically, statistically significant differences were observed regarding phonology (TD *M* = 20.80, *SD* = 3.12; DLD *M* = 12.32, *SD* = 3.86), morphosyntax (TD *M* = 82.96, *SD* = 4.23; DLD *M* = 31.00, *SD* = 7.84), and expressive vocabulary (TD *M* = 11.24, *SD* = 1.67; DLD *M* = 6.52, *SD* = 1.78) (Table 4).

Regarding the second hypothesis, children with ASD are expected to perform lower on all tests examining structural language than typically developing children. The comparison of the

TABLE 3 Performance of the TD, DLD and ASD groups in structural language.

	TD ^a (<i>n</i> = 25)		DLD ^b (<i>n</i> = 25)		ASD ^c (<i>n</i> = 25)		<i>p</i>	<i>H</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Phonology	20.80	3.12	12.32	3.86	18.20	4.01	<0.001***	37.63
Morphosyntax	82.96	4.23	31.00	7.84	45.88	13.54	<0.001***	57.07
Expressive vocabulary	11.24	1.67	6.52	1.78	7.84	2.84	<0.001***	39.52

^aTD = typical development.
^bDLD = Developmental language disorder.
^cASD = autism spectrum disorder.
*** *p* < 0.001.



TD group and the group with ASD revealed lower performance for children with ASD, while also showed statistically significant differences between the performance of the two groups, as shown in Table 5. Specifically, in the performance of Morphosyntax (TD *M* = 82.96, *SD* = 4.23; ASD *M* = 45.88, *SD* = 13.54) and expressive vocabulary (TD *M* = 11.24, *SD* = 1.67; ASD *M* = 7.84, *SD* = 2.84) the statistical significance was *p* < 0.001, while that of Phonological Awareness was *p* = 0.02 (TD *M* = 20.80, *SD* = 3.12; ASD *M* = 18.20, *SD* = 4.01).

According to the third hypothesis, children with ASD are expected to perform higher on tests examining phonology and morphosyntax than children with DLD. As shown in Table 6, the comparison of the two clinical groups also showed statistically significant differences in phonology and morphosyntax with the group with ASD performing higher than the group with DLD. More specifically, the measure for Phonological Awareness (DLD *M* = 12.32, *SD* = 3.86; ASD *M* = 18.20, *SD* = 4.01) and Morphosyntax (DLD *M* = 31.00, *SD* = 7.84; ASD *M* = 45.88, *SD* = 13.54) gave a statistical significance of *p* < 0.001.

Finally, as regards the fourth hypothesis, children with ASD are expected to perform similarly to children with DLD on the test examining expressive vocabulary. The results indicated that ASD group performed higher than the DLD group (DLD *M* = 6.52, *SD*

= 1.78; ASD *M* = 7.84, *SD* = 2.84) with a statistical significance of *p* = 0.03.

4 Discussion

The purpose of this study was to investigate and compare abilities and weaknesses in structural language of Greek-speaking children with ASD and DLD. The specific aims set were to identify the strengths and deficits of children with ASD and children with DLD in structural language (phonology, morphosyntax and expressive vocabulary) as compared to typically developing children in this area, and to compare the performance of the two clinical groups in structural language skills. The results of this study indicate that DLD population performed poorer in almost all measurements compared to ASD population. In addition, both children with ASD and children with DLD exhibited impairments in structural language as compared to TD children.

Our first research hypothesis states that children with DLD will present lower performance on all tests that examine structural language than typically developing children. The results of the study showed deficits for the DLD group as compared to their TD peers on phonology, morphosyntax and expressive vocabulary and

TABLE 4 Comparison of the DLD and TD groups regarding structural language.

	DLD ^a (n = 25)		TD ^b (n = 25)		p	U-test	t
	M	SD	M	SD			
Phonology	12.32	3.86	20.80	3.12	<0.001***	24.00	
Morphosyntax	31.00	7.84	82.96	4.23	<0.001***	0.000	
Expressive Vocabulary	6.52	1.78	11.24	1.67	<0.001***		9.68

^aDLD = developmental language disorder.
^bTD = typical development.
***p < 0.001.

TABLE 5 Comparison of the ASD and TD groups regarding structural language.

	ASD ^a (n = 25)		TD ^b (n = 25)		p	U-test
	M	SD	M	SD		
Phonology	18.20	4.01	20.80	3.12	0.02*	188.00
Morphosyntax	45.88	13.54	82.96	4.23	<0.001***	0.00
Expressive Vocabulary	7.84	2.84	11.24	1.67	<0.001***	92.50

^aASD = autism spectrum disorder.
^bTD = typical development.
*p ≤ 0.05
***p < 0.001.

TABLE 6 Comparison of the ASD and DLD groups regarding structural language.

	ASD ^a (n = 25)		DLD ^b (n = 25)		P	U-test
	M	SD	M	SD		
Phonology	18.20	4.01	12.32	3.86	<0.001***	88.00
Morphosyntax	45.88	13.54	31.00	7.84	<0.001***	99.50
Expressive Vocabulary	7.84	2.84	6.52	1.78	0.03*	19.50

^aASD = autism spectrum disorder.
^bDLD = developmental language disorder.
*p ≤ 0.05.
***p < 0.001.

are consistent with previous studies examining structural language in the DLD population. More specifically, Botting (2020) found that children with DLD have difficulties in structural language, while the development of structural language is slower in the DLD population as compared to typically developing children. Similarly, Andrés-Roqueta et al. (2021) found that children with DLD had more structural language difficulties than their TD peers. Regarding the phonological development of the DLD population, Georgiou and Theodorou (2023) investigating Greek-speaking children with DLD, concluded that children with DLD had significant difficulties in discriminating voicing contrasts, while Moraleda-Sepúlveda et al. (2022), who investigated the phonological awareness of children with DLD, found that they had difficulties in both phonemic and syllabic awareness. In a recent study in the Greek language, Georgiou and Theodorou (2025) presented evidence that young children with DLD exhibited more

phonological difficulties than children with TD, while Mengisidou and Marshall (2019) suggested that children with DLD show clear deficits in phonological processing skills, particularly in phonological processing and phonological representations.

In terms of morphological and syntactic development, Stanford and Delage (2020) concluded that children with DLD had more deficits in morphosyntactic skills than their TD peers, while Deevy and Leonard (2018) claimed that children with DLD exhibited weaker knowledge of tense/agreement forms in their speech. Our results also align with those of Abdalla and Mahfoudhi (2023) who found morphological deficits in children with DLD as compared to a language-matched TD group and a chronologically age-matched TD group, as children with DLD presented difficulties regarding the correct use of third-person verb agreement. In addition, Calder et al. (2022) revealed the presence of difficulties in morphosyntax in children with DLD, while Georgiou and Theodorou (2023) found that children with DLD exhibited deficits also in grammar.

Finally, concerning vocabulary of the DLD population, our findings agree with those of Pijnacker et al. (2017) who showed that the expressive vocabulary of children with DLD is deficient as compared to that of their TD peers. Similarly, Jackson et al. (2021) observed a clear deficit in expressive vocabulary and in word learning in children with DLD, a finding that has also been identified by Ghawi-Dakwar and Saiegh-Haddad (2024) who investigated word learning in Arabic-speaking children with DLD. Difficulties in the vocabulary of children with DLD were also noted by Sandgren et al. (2021) studying their lexical knowledge in comparison to typically developing peers. Therefore, the first research hypothesis was confirmed, reinforcing the findings of previous studies that documented deficits in phonology, morphology, syntax and vocabulary in the DLD population.

The second hypothesis states that children with ASD are expected to perform lower on all tests examining structural language than typically developing children. The results showed that children with ASD exhibited more deficits in structural language as compared to their TD peers and therefore are in line with previous research investigating the structural language of children with ASD. In particular, Boo et al. (2022) found that children with ASD demonstrated lower complexity in structural language as compared to children with typical development. Regarding phonological abilities, Zarokanellou et al. (2023) concluded that Greek-speaking children with ASD produced more errors in their speech than typically developing children, and deficits were observed in terms of phonological representations. In addition, Alnemr (2022) showed that children with ASD presented difficulties in phonological awareness, while Dynia et al. (2019)

also observed impaired phonological awareness skills in children with ASD.

Regarding morphosyntactic abilities of ASD population, our findings agree with those of [Meir and Novogrodsky \(2020\)](#) who found deficits in the syntactic skills of children with ASD and those of [Durrleman et al. \(2017b\)](#) who showed difficulties in morphosyntax for children with ASD. In addition, [Ramírez-Santana et al. \(2019\)](#) observed morphosyntactic deficits in children with ASD, while [Al-Hassan and Marinis \(2021\)](#) found that children with ASD exhibited deficits in grammatical abilities as compared to their TD peers.

In terms of vocabulary, our results align with those of [Liu et al. \(2025\)](#) who found that children with ASD exhibited lower overall language production and weaker expressive vocabulary than their TD peers. [Kover et al. \(2013\)](#) found that children with ASD showed deficits in terms of perceptual vocabulary as compared to their TD peers. Deficits in the semantic development of children with ASD were also highlighted by [Di Stefano et al. \(2019\)](#) in their research. In addition, [Hart and Curtin \(2023\)](#) observed that children with ASD exhibited slower developmental trajectories of vocabulary and showed significant differences as compared to children with typical development. Thus, the second research hypothesis was confirmed strengthening existing research on phonological, morphosyntactic and semantic difficulties of children with ASD.

Our third hypothesis was that children with ASD would perform higher on tests examining phonology and morphosyntax than children with DLD. The results showed that children with DLD exhibited more deficits in phonology and morphosyntax than children with ASD. The results of the present study are consistent with those of [Riches et al. \(2011\)](#) who found differences in the language skills between children with DLD and children with ASD and they claim that the two populations have different language profile, but do not exclude a small degree of overlap. Moreover, [de la Torre Carril et al. \(2021\)](#) found that the structural language of school-aged children with DLD was less developed than that of age-matched children with ASD. More specifically, the results are in agreement with previous research that studied the phonological developmental in children with ASD in comparison to children with DLD. [Ramírez-Santana et al. \(2019\)](#) concluded that children with DLD exhibited more profound phonological deficits. Same results were found by [Hill et al. \(2015\)](#), investigating phonological skills, as they observed differences between ASD and DLD in terms of verbal memory and pseudoword repetition, possibly indicating that different mechanisms are involved in language learning in the two disorders. Different cognitive profiles, which probably also affect language skills, are also suggested by [Taylor et al. \(2014\)](#). In addition, the review by [Wolk et al. \(2016\)](#) showed that findings on the phonological development of children with ASD are conflicting and they concluded that some children with ASD use typical phonological processes, while others do not show phonological deficits.

In terms of morphosyntactic abilities, the results of the present study are in line with [Craig and Trauner \(2017\)](#), who showed significant differences between the two groups, with individuals with DLD making more grammatical errors than children with ASD. Additionally, [Suknik and Friedmann \(2018\)](#) investigated the syntactic skills of children with ASD and DLD and, although

the results revealed similar performance in terms of overall scores for children in the two groups across all tests, however, when examined in terms of the type and form of incorrect responses made by participants, significant differences were found between the two groups. Specifically, the two groups differed in terms of the type of syntactic errors as well as in terms of consistency in performance. The errors of the children with DLD were observed in specific sentence types, whereas the errors of the children with ASD were not consistent in terms of sentence types. Furthermore, [Creemers and Schaeffer \(2022\)](#) found differences between children with ASD and children with DLD on tests that examined grammar, while [Schaeffer \(2018\)](#) did not find any similarities in the structural language of children with ASD and children with DLD and concluded that there is no overlap in the language profile of the two disorders.

On the other hand, the results of the present study are not in line with [Huang and Finestack \(2020\)](#), who investigated the morphosyntactic skills of children with DLD and children with ASD and did not find any differences between them. The differences in the findings between our study and those of the study of [Huang and Finestack \(2020\)](#) could be attributed to the fact that in their study they only included children with ASD and language difficulties. In addition, [Durrleman et al. \(2017a\)](#) concluded that there are similarities in morphosyntax between individuals with DLD and individuals with ASD. However, in the study by [Durrleman et al. \(2017a\)](#), participants also had similar performances on tests that examined Theory of Mind, a skill that, according to [Spanoudis \(2016\)](#), is related to morphosyntactic development. Therefore, the third research hypothesis was confirmed, reinforcing the existing research on the phonological and morphosyntactic skills of the two clinical populations.

According to the fourth hypothesis, children with ASD are expected to perform similarly to children with DLD on the test examining expressive vocabulary. According to the results, the performance of children with ASD was not similar to that of children with DLD. This finding contradicts findings from previous studies examining the semantic abilities of the two clinical groups. In particular, [Félix et al. \(2024\)](#) suggested that there is an overlap of language phenotypes in terms of lexical knowledge. Similar conclusions were reached by [Haebig et al. \(2015\)](#) who found similarities in the lexical-semantic knowledge of children with ASD and children with DLD. In addition, [McGregor et al. \(2012\)](#) suggested similarities in semantic development between the two populations. Furthermore, [de la Torre Carril et al. \(2021\)](#) found similar performance on semantics between children with ASD and children with DLD. [Whitehouse et al. \(2008\)](#) also found similar performance between the two populations in terms of semantic skills, as did [Georgiou and Spanoudis \(2021\)](#) in their study in the Greek language. Nevertheless, despite the observed similarities, it has been found that children with ASD showed stronger performance in lexical depth, word associations, and structures as compared to children with DLD ([Lloyd et al., 2006; Loucas et al., 2013; Manolitsi and Botting, 2011](#)), while [Bekmurat et al. \(2024\)](#) suggested that there is variation in the semantic skills of children with ASD. Specifically, some children with ASD indicated high proficiency and other children with ASD presented lower levels of vocabulary. In addition, [Auza-Benavides et al. \(2024\)](#)

confirm the variation observed across these populations, while simultaneously they found distinct vocabulary profiles across DLD and ASD. Therefore, the fourth research hypothesis regarding expressive vocabulary of children with DLD and children with ASD was not confirmed.

The different results between our study and previous research concerning expressive vocabulary of children with DLD and children with ASD are probably due to the heterogeneity in the language profiles of the children of the two populations in our study, especially in the ASD group. The groups were matched for age and non-verbal intelligence. MLU(w) was measured in all participants to prevent large variations within groups, however there was no matching of participants in terms of MLU(w). Consequently, the ASD group had a higher mean score on MLU(w) than the DLD group, which probably affected the ASD group's performance on verbal knowledge.

The findings of the present study revealed impairments in structural language for both clinical populations as compared to their typically developing peers. In addition, considerable differences in their deficits were observed between children with ASD and children with DLD. Both clinical groups indicated deficits in phonology, morphosyntax and expressive vocabulary as compared to the TD group. However, children with DLD appear to have more deficits than children with ASD in terms of structural language. Importantly, the deficits of children with DLD and children with ASD in the Greek language are in line with research that has been conducted in other languages in previous studies.

The differences in language skills between ASD and DLD can be attributed to the fact that children with DLD usually show broader structural language impairments, whereas some children with ASD, particularly those without a co-occurring language disorder, may show relatively preserved structural language skills despite pragmatic difficulties. In the present study, comorbidity with another disorder was an exclusion criterion for both clinical groups.

Furthermore, according to the findings, the present study does not support the hypothesis of a common etiology or overlap between the two clinical populations. On the other hand, previous research has observed a common biological basis and genetic overlap between the neurodevelopmental disorders (Nisiotou and Vlachos, 2014; van Wijngaarden et al., 2024; Vernes et al., 2008). Consequently, investigating the language phenotype of ASD and DLD through the assessment of language skills is probably not able by itself to provide a response to the hypothesis regarding a common etiology between the two clinical populations.

4.1 Implications

Through the present study, an effort was made to strengthen the findings on structural language in ASD and DLD. The investigation of structural language in Greek populations with neurodevelopmental disorders, specifically in children with ASD and DLD, as well as the comparison of the two clinical groups, provides important data that can contribute to a clearer understanding of their language profiles. Specifically, due to the particular characteristics of the Greek language, the investigation of language skills in phonology, morphosyntax

and expressive vocabulary offers a cross-linguistic perspective, allowing comparison with other languages and contributing to the understanding of the common and differentiated language difficulties faced by the ASD and DLD populations. This approach can enhance diagnosis and intervention, taking into account the linguistic specificities of each language.

More specifically, given that children with DLD performed significantly lower not only compared to typically developing peers, but also compared to children with ASD, assessment strategies aimed at detecting DLD should focus on key structural language domains, including phonological awareness, morphosyntactic abilities and expressive vocabulary. Hence, diagnostic protocols and measures for DLD should incorporate more accurate and sensitive tasks examining multiple levels of language structure, so that a detailed profiling of the children's language profile is possible for the early diagnosis of DLD and its differentiation from other neurodevelopmental disorders.

Additionally, given some common elements that ASD and DLD present in terms of language profile, their separation is often difficult, resulting in the diagnoses given being inaccurate and, thus, the interventions followed being inappropriate. Therefore, the findings of the present study can be used to create axes of observation or diagnostic tools for the assessment of language skills in the Greek language, while simultaneously suggesting guidelines for the differentiation of the two disorders, reducing the risk of diagnostic confusion.

In addition, the findings provide information which can be used for the design and implementation of interventions tailored to the language needs of each population. These interventions can enhance structural language, improving both comprehension and production of speech, while also contributing to the improvement of the communicative competence and social interaction of individuals with ASD and DLD.

4.2 Limitations and future research

There are some limitations in the present study that need to be considered. A limitation of the present study that the three groups of participants (ASD, DLD, and TD) were matched for chronological age and sex, but not matched for language abilities. In the study, participants' MLU(w) were measured to limit large language variations between groups and for both clinical groups, MLU(w) was defined as 4 or higher. However, no one-to-one matching of participants was applied, nor were children with ASD and language difficulties separated from those with ASD without language difficulties. Future research could include comparisons between four distinct groups: children with ASD and language difficulties, children with ASD without language difficulties, children with DLD, and typically developing children, allowing for a more detailed analysis of linguistic differences and similarities between them.

The small number and the limited age range of the participants in all three groups could also be considered as a limitation of the study. In general, small samples do not allow generalization of the findings which need to be replicated with larger samples in order to be confirmed. Further research on language development

in ASD and DLD populations could be conducted with a larger number of participants, so that the results are more reliable and generalizable. Also, a broadening of the age range of participants would allow the trajectory of language development to be observed at different developmental stages, providing valuable information on the differences between the two populations in language ability as they grow older. Finally, it would be useful to conduct comparative research with other neurodevelopmental disorders, in order to better understand the common and differentiated language difficulties observed in these populations.

Finally, a limitation of this research is the reliance on accuracy scores without qualitative analysis of error patterns. Qualitative differences in language behavior may reveal strategies or vulnerabilities of specific groups in structural language. Future research should incorporate qualitative analyses and, where feasible, dynamic assessment procedures to better capture underlying language profiles.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Ethics Committee of University of Thessaly. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

GA: Writing – review & editing, Writing – original draft, Supervision, Methodology. VL: Data curation, Methodology,

Formal analysis, Conceptualization, Project administration, Writing – original draft, Software, Writing – review & editing. VA: Formal analysis, Data curation, Writing – original draft, Software, Writing – review & editing.

Funding

The author(s) declare that no financial support was received for the research and/or publication of this article.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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