Review

Language Skills in Children with Attention Deficit Hyperactiv-Ity Disorder and Specific Language Impairment: A Systematic Review

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Review

Language Skills in Children with Attention Deficit Hyperactivity Disorder and Specific Language Impairment: A Systematic Review

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Abstract: (1) Background: Attention Deficit Hyperactivity Disorder (ADHD) and Developmental Language Disorder (DLD) are neurodevelopmental disorders that affect various areas of children's development, such as language. There is an emerging idea that ADHD is characterised by the presence of language difficulties, which could be explained by the high comorbidity between ADHD and DLD. The purpose of this study is to analyse the empirical evidence of language competence in children aged 6–17 years old, diagnosed with ADHD and/or DLD. (2) Method: Fifteen studies with experimental designs were identified from Scopus, PsycINFO and WoS databases, reporting on language skills in children diagnosed with ADHD and/or DLD. Studies relating executive functioning to language skills in this target population were also included. (3) Results: The literature is heterogeneous and different components of language are also examined. Even though the results are contradictory they convincingly demonstrate that there are overlapping symptoms between ADHD and DLD, such as language skills and executive functions. (4) Conclusions: the differences in the samples limit the generalisability of the results. Therefore, this review highlights the importance of considering language skills when designing individualised interventions for the population with ADHD and DLD, both in comorbidity and in isolation.

Keywords: ADHD; DLD; idiopathic language impairment; neurodevelopmental disorders; comorbidity; language skills

1. Introduction

Although idiopathic difficulties in language development without overt intellectual disability have been recognized since the early 19th century [1], different terminology has been used and the term developmental language disorder (DLD) has come into use in recent years.

DLD affects approximately 7% of the population and its prevalence varies between studies and countries [2]. DLD has a high prevalence: it is 7 times more common than autism spectrum disorder (ASD) and 46 times more common than childhood hearing loss, yet DLD has been understudied [2–4].

Attention Deficit Hyperactivity Disorder (ADHD) and DLD are two of the most common neurodevelopmental and comorbid disorders [5,6]. Children with comorbid DLD and ADHD may present with a range of symptoms that may overlap and affect different areas, such as language and executive function.

Symptoms of comorbid DLD and ADHD vary in severity and can affect academic and social functioning, increasing interest in understanding these conditions in order to provide appropriate support and intervention.

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1.1. Language Skills

Language skills enable an individual to use language at a level of accuracy that conveys meaning in production and comprehension. These skills include both productive and receptive language skills, such as speaking, listening, reading and writing, and their effective use in a variety of practical contexts [7]. The five basic areas of language (phonology, morphology, syntax, semantics, and pragmatics) are essential for understanding and using language effectively. They work together to form a dynamic, integrative whole that enables individuals to communicate and comprehend spoken and written language [7,8].

Language skills are essential for communication and are crucial for navigating personal and professional life. Limited language skills affect a range of areas, including behaviours, learning, future employment, social aspects and well-being [9].

Language development plays a crucial role in children's overall cognitive and social development. However, some children may face challenges in acquiring language skills, which can impact their academic performance and social interactions. Two common conditions that can affect language skills in children are ADHD and DLD [10].

1.2. Designations for Idiopathic Language Impairment

Idiopathic language impairment has been given a variety of names. Specific Language Impairment (SLI) was widely used in research studies to refer to the idiopathic subset of children with language disorders [11]. However, the term SLI was too restrictive, implying that the child had a relatively pure language problem with no other impairments. For this reason, the term SLI was rejected by the CATALISE panel in 2017. Instead of SLI, an alternative term, Developmental Language Disorder (DLD), was proposed by the international CATALISE consortium and endorsed for use when language impairment is not associated with a known biomedical aetiology [12].

The CATALISE consortium also agreed that (a) the presence of risk factors (neurobiological or environmental) does not preclude a diagnosis of DLD, (b) DLD may co-occur with other neurodevelopmental disorders (e.g., ADHD), and (c) DLD does not require a discrepancy between verbal and non-verbal abilities [12].

Prior to the CATALISE consortium, the American Psychiatric Association (APA) published the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition [13], which established new guidelines for the diagnosis of language disorders. Instead of the term DLD, the DSM-5 manual includes the term 'language disorder' within neurodevelopmental disorders to define persistent difficulties in using language.

The difference in terminology is a source of instability in establishing criteria for idiopathic language disorders. Following the CATALISE consortium, the term DLD will be used in this study.

DLD, which affects approximately 7.5% of the world's population, is a very heterogeneous condition that can affect language production and/or comprehension with varying degrees of severity in different language domains (e.g., semantic, morphosyntactic, pragmatic) [14,15], which may explain the paucity of evidence regarding the accuracy and precision with which DLD is diagnosed in children [16].

1.3. ADHD

According to the Fifth Edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), ADHD is one of the most common neurodevelopmental disorders, affecting approximately 5-7% of the school population [13].

It is characterized by a persistent pattern of inattention, hyperactivity and/or impulsivity that interferes with functioning or development. Symptoms of ADHD can vary, and individuals may have a predominance of inattention, hyperactivity-impulsivity, or a combination of the two. These can cause several difficulties such as emotional, behavioural, psychiatric and cognitive problems, and its severity will depend on the time of detection [13].

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Although language difficulties are not included as a core diagnostic criterion, children diagnosed with ADHD have large deficits in their language functioning across expressive, receptive and pragmatic language modalities, leading to general language problems [17,18].

1.4. Comorbidity

According to the DSM-5, both ADHD and Language Disorder (LD) are considered neurodevelopmental disorders. These disorders can cause various difficulties such as emotional, behavioural, psychiatric and cognitive problems, and their severity depends on the time of detection [13].

In addition to being two of the most common neurodevelopmental disorders, some empirical reports suggest that ADHD and DLD may also be common co-occurring conditions [5,6]. There is a complex relationship between DLD and ADHD, with overlapping and distinct features [4].

Scientific evidence supports the link between learning difficulties and executive functioning in neurodevelopmental disorders [19–21]. Children with comorbid DLD and ADHD may exhibit difficulties in executive functions, including working memory, cognitive flexibility, attention and inhibitory control [17,22]. In this regard, some studies have found that the co-occurrence of these conditions has further implications for children's educational trajectories [23,24]. In fact, children with DLD may have attention deficits that are not significant enough to warrant a diagnosis of ADHD, but still affect their learning in the classroom [25].

Besides executive deficits, language difficulties are another overlapping symptom in comorbid DLD and ADHD. DLD is a well-defined condition characterized by impairments in receptive and expressive language, as evidenced by difficulty following multi-step instructions, difficulty with coherent conversation and expression, and impairments in reading and writing [26,27]

Overall, language problems are also observed in children with ADHD, although it is unclear which component of language is most affected. Some studies show difficulties at the morphosyntactic level [17], while others show major deficits in language functioning in the expressive, receptive and pragmatic modalities of language [18,28].

Understanding the symptoms of comorbid DLD and ADHD, it is important to identify and address these difficulties to ensure appropriate diagnosis and treatment for affected children.

1.5. The Current Review

Research shows that children diagnosed with ADHD have language impairments [6,17,29]. In fact, ADHD and DLD are two of the most common neurodevelopmental disorders and are co-occurring disorders [5,6], which increases the interest in comparing them.

Given the high prevalence rates of both ADHD and DLD [30], it is important to understand how these conditions affect children's language skills. This systematic review aims to examine the existing literature on language skills in children with ADHD and/or DLD. By synthesising findings from different studies, we aim to identify the specific language difficulties experienced by these children and to explore potential overlaps or differences between the two conditions.

Understanding the language profiles of children with ADHD and/or DLD can have significant implications for diagnosis, intervention, and support. By identifying the specific language challenges these children face, clinicians and educators can tailor interventions to address their unique needs. Additionally, this review will contribute to the existing literature by highlighting gaps in knowledge and suggesting avenues for future research.

In summary, this systematic review aims to provide a comprehensive overview of language skills in children with ADHD and/or DLD. By summarising the available evidence, we hope to improve our understanding of the language difficulties these children experience and inform effective strategies for assessment and intervention.

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2. Materials and Methods

The current systematic review was performed using the PRISMA guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) [31]. The PRISMA guidelines provide a 27-item checklist which allows reviewers to report the relevant information and make an accurate analysis of all the studies found.

2.1. Search Strategy

The literature search was performed using three databases (Web of Science (WoS), PsycINFO and Scopus) in August 2023. The main objective was to analyse the empirical evidence of language competence in children and adolescents diagnosed with ADHD and/or DLD/SLI. The following key words were used: **("Specific Language Impairment" OR "Developmental Language Disorder" OR "DLD" or "SLI") AND ("ADHD" OR "attention deficit hyperactivity disorder" OR "attention deficit-hyperactivity disorder" OR "attention deficit disorder") AND ("language skills" OR "language" OR "language competence") AND ("comorbid*" OR "co-occurring" OR "coexisting").**

2.3. Selection Criteria

The articles produced by the search were selected according to various inclusion/exclusion criteria, as follows.

Articles were included if they met the following criteria:

a) Empirical studies written in English or Spanish.

b) Included samples aged between 6 and 18 years.

c) Empirical studies that included children and adolescents diagnosed with ADHD and/or DLD/SLI.

d) Published in the last ten years (2013-2023).

e) Studies focusing on language skills and/or executive functioning in individuals diagnosed with ADHD and/or DLD/SLI.

On the other hand, articles were excluded if they met the following criteria:

a) Conference papers, reviews, doctoral theses, meta-analyses, case reports or book chapters.

b) Studies with a sample age range other than 6 to 18 years.

c) Articles on neurodevelopmental disorders other than DLD/SLI and/or ADHD, such as cognitive delay, deafness, autism spectrum disorders, neurological deficits or dyslexia.

d) Studies focusing on biological variables, biomarkers, genetic variables, mental health, behavioural problems, clinical trials; studies focusing on parental reports.

2.4. Study Selection

A total of 260 studies were found in the databases used (219 from Scopus, 23 from WoS and 18 from PsycINFO). Duplicates (25 results) and results from book chapters, doctoral theses or conference papers (14 results) were removed. In total, 195 studies were excluded by title (n = 173) or by abstract (n = 22). Finally, 15 studies were selected as meeting the inclusion criteria. The whole process is illustrated in the following flowchart (Figure 1) in accordance with the PRISMA declaration [31].

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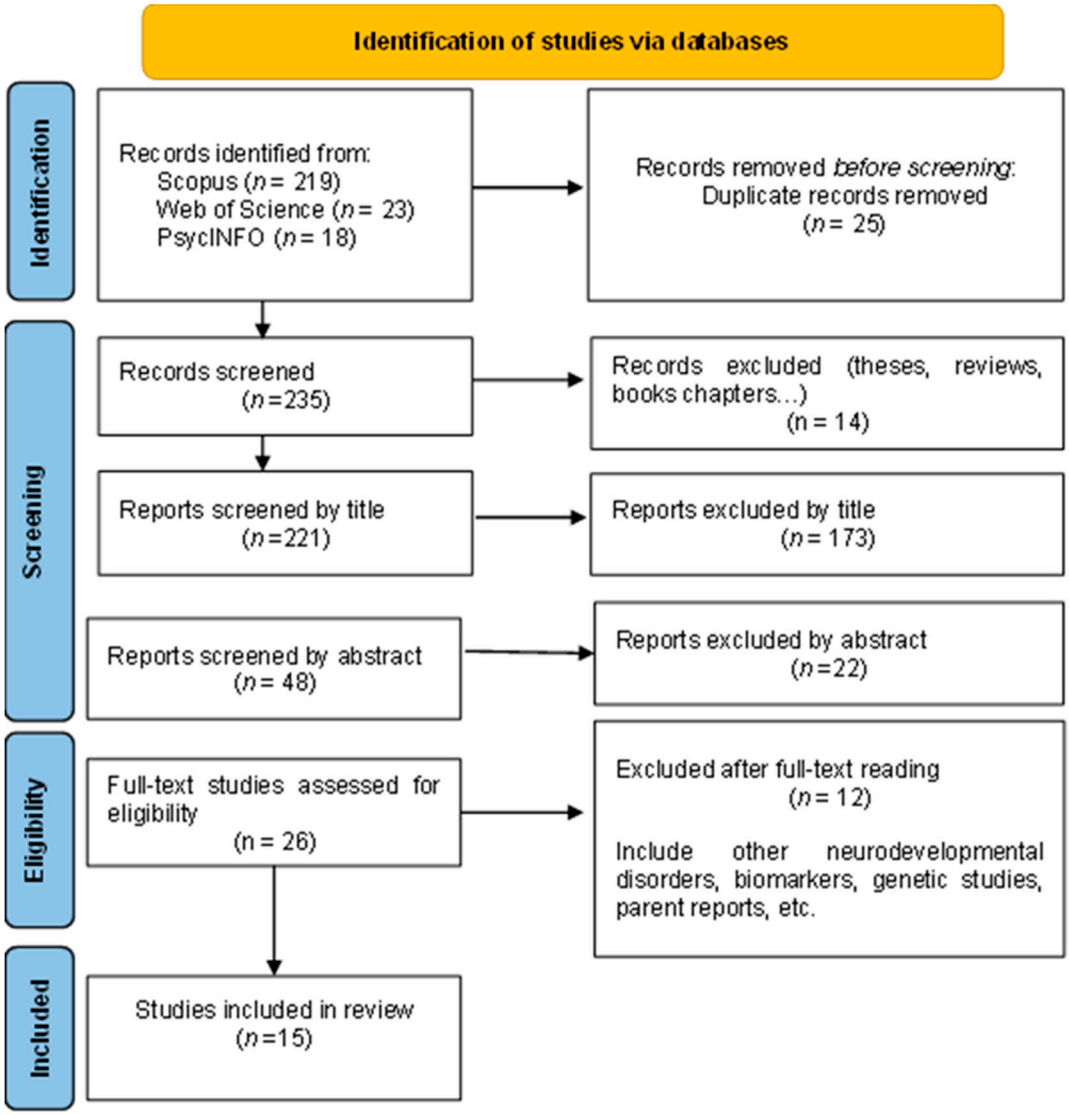

Figure 1. Flowchart of the article selection process.

3. Results

We first describe the general characteristics of the 15 selected studies (Table 1). Two-fifths (40%, n=6) of the studies investigated the language skills of English speakers. The 15 studies were published in 12 different journals and, as Table 1 shows, the most studies were published in 2021.

Table 1. General characteristics of selected studies.

Author	Year	Journal	Country	Language
Brinton et al. [32]	2018	Communication Disorders Quarterly	USA	English
Delgado et al. [33]	2018	Pragmalingüística	Chile	Spanish
El Sady et al. [34]	2013	The Egyptian Journal of Medical Human Genetics	Egypt	Arabic
Gooch et al. [35]	2019	Child Development	UK	English
Helland et al. [36]	2014	Journal of Attention Disorders	Norway	Norwegian
Kaganovich et al. [37]	2021	Brain Sciences	USA	English
O'Neil et al. [38]	2016	Neuropsychology	USA	English
Paredes-Cartes y Moreno-Garcia [29]	2021	Revista Española de Pedagogía	Spain	Spanish
Ralli et al. [39]	2021	Brain Sciences	Greece	Greek

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Redmond et al. [22]	2015	Language speech and hearing services in schools	USA	English
Staikova et al. [40]	2013	The Journal of Child Psychology and Psychiatry	USA	English
Stanford y Delage [6]	2021	Clinical Linguistics & Phonetics	Switzerland	French
Stanford y Delage [17]	2020	Frontiers in Psychology	Switzerland	French
Vassiliu et al. [41]	2022	Communication Disorders Quarterly	Greece	Greek
Zenaro et al. [42]	2019	Communication Disorders, Audiology and Swallowing	Brazil	Portuguese

Table 1 summarizes the demographic characteristics of the selected studies. The 15 studies report results from nine countries with sample sizes varying from 370 to 5 participants (Table 1). We selected studies with participants aged between 6 and 17 years, but in this case most studies (n =9) focused on childhood (7 - 12 years). Only 40% (n = 6) of the selected studies reported participants' gender.

Just under half (46%, n = 7) of the articles studied populations with both a diagnosis of DLD and a diagnosis of ADHD. Only two of the fifteen studies included participants with comorbid DLD and ADHD, despite DLD and ADHD having high rates of comorbidity [30].

Ten of the selected articles compared the performance of different groups (ADHD group, DLD group, typically developing (TD) group) in different language tasks and the remaining 5 articles included measures of executive function in addition to language skills. There was a great deal of variability in the study of language skills. Some studies focused on narrative skills, while others focused on morphology, syntax, ... (Table 2).

There was variation in the use of instruments, but the selected studies were consistent in using instruments such as the Children's Communicative Checklist, Second Edition (CCC-2), the Clinical Evaluation of Language Fundamentals (CELF-4) or the Peabody Picture Vocabulary Test (PPVT-III). In terms of executive function, the most frequent items measured were working memory and attention (Table 2).

The study of language skills involves the assessment of different language domains. In our selection of articles, we found studies that focused on examining language skills in a population diagnosed with DLD [31,35,37,39]. In these articles there was a great diversity as they focused on different language domains, notably syntax, semantics, and pragmatics. For example, Kagnovich and colleagues [37] measured general linguistic aptitude and working memory and the found that children with DLD had difficulties integrating visual information into long-term a-phonemic representations. However, it is important to note that none of the selected studies dealt with the study of phonology in isolation.

Brinton and colleagues [32] analysed the way in which five children with DLD related internal states when they spontaneously told a story from pictures and when they were asked directly about these states. Descriptions of the internal states of the story characters' emotions increased in response to prompts, but the children often produced emotion words that did not accurately reflect the content of the story.

It is well known that ADHD children have difficulties with language skills. In Vassiliu's study [41], the performance of the ADHD group demonstrated structural language difficulties, even though the ADHD group performed significantly higher than the DLD group. In the case of pragmatics, the ADHD group scored lower than any other group, but no statistical significance was found.

Similar results were found in Staikova's study [40], which investigated pragmatic language functioning in children with ADHD through different formal tests and questionnaires for parents. They found that children with ADHD had less developed skills in several aspects of pragmatic language compared to their typically developing peers, and that these problems were evident over and above general language functioning.

Zenaro and colleagues [42] compared the oral narrative skills of children with ADHD and children with TD. As in the studies mentioned above, they found that the ADHD group had lower

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levels of coherence than the TD group, with lower scores on the structural elements of theme/topic and outcome.

Narrative skills refer to the ability to tell a story or narrate an event in a coherent, organized way. The literature suggests that children with DLD may have difficulties with narrative skills due to their impaired language functioning, whereas children with ADHD may have better grammar, general core language skills, receptive and expressive language skills, but may still struggle with executive functions [10]. Narrative tasks engage not only language skills but also executive functions [43]. Stanford and Delage [6,17] examined syntactic and morphosyntactic aspects while measuring executive-function variables in French-speaking children. The EF and morphosyntactic profiles of children with ADHD and DLD are different [17]. Deficits in morphosyntax are not characteristic of ADHD, but performance in the ADHD group may mimic morphosyntactic impairment. This may explain the difference between the groups in the use of visual cues: children with DLD were more sensitive than children with ADHD to visual cues that may have required more attentional resources. In contrast, the DLD group were less sensitive to linguistic cues, as these cues required syntactic processing [6].

To determine which of the language areas is most affected in each of these disorders, and to understand the overlap of symptoms between the two, they need to be studied together. Our selection included six studies involving joint study of ADHD and DLD populations and a control group [6,17,29,32,36,41], while only two studies included samples with ADHD and DLD as comorbidity [22,34].

The results are contradictory. While Paredes-Cartes and Moreno-García [29] found significant differences in semantic and pragmatic language skills between the DLD and ADHD groups, indicating that children with DLD had more difficulties at the semantic level, the ADHD group had more difficulties at the pragmatic level. Helland and colleagues [36] aimed to investigate the linguistic profiles of children with DLD. Their results indicate that the DLD group was significantly more impaired than the ADHD group in the language and syntax scales. In the pragmatics scale, both groups exhibited equivalent difficulties, and in the semantic scale, they demonstrated the same level of impairment.

Conflicting results have also been found in articles examining populations with comorbid ADHD and DLD, particularly in relation to the symptom of hyperactivity and language skills. Redmond and colleagues [22] focused on morphosyntactic aspects in children with comorbid DLD and ADHD, typically developing children, and children with DLD. They found no significant differences between the DLD + ADHD and DLD groups. They also found that the severity of ADHD symptoms and sentence recall performance were moderately positively correlated. In contrast, El Sady and colleagues [34] concluded that hyperactivity was the most important factor affecting language in ADHD, as they found that children with DLD and comorbid ADHD had poorer language reception than children with DLD without ADHD.

Delgado and colleagues [33] compared the development of metapragmatic awareness in children with DLD, ADHD and a control group. They found that an age effect was evident for the ADHD group, but significant differences were found between the DLD and control groups, while children diagnosed with predominantly inattentive ADD were found to perform similarly to the control group.

Children with language impairment (LI) often perform below the level of typically developing peers in measures of both processing speed and working memory, and pro-cessing factors may contribute to the understanding of language disorders [44]. Ralli and colleagues [39] measured several EF variables such as verbal fluency and working memory, as well as measures of expressive vocabulary and sentence completion. Their results indicated that children with DLD were outperformed by their TD peers on measures of WM and verbal fluency (phonological and semantic).

Hyperactivity is also an important factor which affects language in ADHD [34]. However, O'Neil and colleagues [38] reported that there was no significant association between the severity of pre-schoolers' hyperactivity/impulsivity and their language skills at 4-6 years old.

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The scientific research suggests that processing speed is related to different aspects of language ability, including syntactic development, language impairment, social and language delays, and vocabulary/word learning. [44,45].

Gooch and colleagues [35] conducted a longitudinal study in a British population to investigate the relationship between speed of processing (SOP), language and inattention/hyperactivity. The results showed that the DLD group had increased symptoms of inattention/hyperactivity commonly associated with ADHD. Symptoms of inattention/hyperactivity moderate the effect of SOP on language, but SOP does not predict later language progress.

Table 2. Summary of studies selected (n=15).

Author(s)	Sample	Comorbidity Condition	Instrument(s)	Measures	Summary of Results
Brinton et al. (2018) [31]	Age range: 5-10 years Group(s): *n* =5 DLD Gender: 2 females/ 3 males	No	**Language skills:** Edmonton Narrative Norms Instrument (ENNI)	Narrative skills: internal response expressions in spontaneous and prompted condition.	Production and accuracy of internal plan Spontaneous condition: Expressions were appropriate. Prompted condition: high production but the accuracy decreased. Production and accuracy of emotion words: Spontaneous condition: children describe few emotions. Prompted condition: greater variety of emotion words.
Delgado et al. (2018) [33]	Age range: 7 -12 years Group(s): *n* = 6 DLD *n* = 6 ADHD *n* = 6 TD	No	**Language skills:** Metapragmatic Consciousness Assessment Test	Metapragmatic Awareness	TD group had the highest results. DLD group had the worst outcome. Age effect in the ADHD group Significant differences between the DLD group and the TD group.
El Sady et al. (2013) [34]	Age range: 3 – 6 years Group(s): *n* = 36 DLD + ADHD *n* = 25 DLD Gender: 9 females /27 males 9 females/ 16 males	Yes	**Language skills**: Language testing of Arabic speaking children	Receptive age Expressive age Semantic Syntax and phonology Pragmatics Receptive age quotient Expressive age quotient	Significant difference in the receptive age and the receptive age quotient: DLD + ADHD children had poorer reception than DLD + no ADHD children. Hyperactivity was the most important factor affecting language in ADHD.

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(*Continued*)

Author(s)	Sample	Comorbidity	Instrument(s)	Measures	Summary of Results
Gooch et al. (2019) [35]	Age range: 5 -8 years Group(s): *n* = 129 DLD *n* = 370 TD	No	**Language skills**: Expressive One Word Picture Vocabulary Test (EOWPVT) Receptive One Word Picture Vocabulary Test (ROWPVT) School-Age Sentence Imitation Test-English 32 (SASIT-E32) Test for Reception of Grammar (TROG) Assessment of Comprehension and Expression (ACE) **Executive functions**: Rapid Automatized Naming (RAN) Visual Search (Apples Task) Coding (WPPSI-III) Simple Reaction Time	Vocabulary Grammar Narrative recall and comprehension Speed of processing:	Children with DLD score lower on Speed of Processing (SOP) than their TD peers. The DLD group have elevated symptoms of inattention/hyperactivity commonly associated with ADHD. Symptoms of inattention/hyperactivity moderate the effect of SOP on language, but SOP does not predict later language in formal schooling
Helland et al. (2014) [36]	Age range: 6- 12 years Group(s): *n* = 19 DLD *n* = 21 ADHD *n* = 19 TD Gender: 2 females/17 males 3 females/ 21 males 2 females/17 males	No	**Language skills**: Children's Communication Checklist–Second Edition (CCC-2)	Speech, syntax, semantics, coherence, inappropriate initiation, stereotyped language, use of context, nonverbal communication, social relations, interests.	Communication impairments were as pronounced in the ADHD group as in the DLD group. The ADHD group was as impaired as the DLD group on the scale measuring semantics. Language structure was more impaired in the DLD group. The ADHD group was more impaired on the interest scale.

(*Continued*)

Author(s)	Sample	Comorbidity	Instrument(s)	Measures	Summary of Results
Kaganovich et al. (2021) [37]	Age range: 7-13 years Group(s): *n* = 18 DLD *n* = 18 TD Gender: 5 females/13 males 7 females/ 11 males	No	**Language skills**: Photographic Expressive Language Test—2nd Edition (SPELT-II) Photographic Expressive Language Test—Preschool 2 (SPELT-P2) Core Language Score (Concepts and Following Directions, Recalling	General linguistic aptitude Working memory	Children with TD, but not children with DLD, can incorporate visual information into long- term phonemic representations

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			Sentences, Formulated, Sentences, Word Structure and Word Classes-2 Total (WC-2, 9–12-year-olds only), and Word Definitions (WD, 13-year-olds only). **Executive Functions**: Verbal working memory and nonword repetition test. Number Memory Forward. Number Memory Reversed subtests of the Test of Auditory Processing. Skills—3rd edition (TAPS-3). Language domain of the NEPSY. Wechsler Individual Achievement Test, Second Edition (WIAT-II): Word Reading, Pseudoword, Decoding, Reading Comprehension, and Spelling subtest. Vanderbilt Assessment Scale, Teacher Informant: Reading and Written Expression performance in school.		
O'Neil et al. (2016) [38]	Age range: 4 – 8 years Group(s): *n* = 90 ADHD *n* = 60 TD	No		Language (NEPSY) Reading Writing	At 4-6 years of age, there was no significant association between the severity of pre-schoolers' hyperactivity/impulsivity and their language skills. at 4-6 years. At 8 years, language ability mediated the pathway from preschool inattention (but not hyperactivity/impulsivity).

(*Continued*)

Author(s)	Sample	Comorbidity	Instrument(s)	Measures	Summary of Results
Paredes-Cartes y Moreno-Garcia (2021) [29]	Age range: 7 – 12 years Group(s): *n* = 47 DLD *n* = 48 ADHD *n* = 47 TD Gender: 20 females/27 males 39 females/ 9 males 19 females/ 28 males	No	**Language skills**: The Objective and Criterion-referenced Language Suite (BLOC) The Peabody Picture Vocabulary Test (PPVT-III)	Language: morphology, syntax, semantics and pragmatics. Receptive vocabulary	Significant differences were found between the three groups in semantic and pragmatic language skills. Children with ADHD had fewer problems with semantic competence than children with DLD. Pragmatic competence: ADHD group had lower scores than the DLD group and the control group.
Ralli et al. (2021) [39]	Age range: 8 years Group(s): *n* = 29 DLD *n* = 29 TD Gender:	No	**Language skills**: Wechsler Intelligence Scale for Children-WISC III: vocabulary scale. Athena Test: the sentence completion subtest.	Expressive vocabulary Sentence completion Working memory	Children with DLD were outperformed by their TD peers on measures of WM capacity, updating, monitoring (mixing cost) and verbal

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14 females/ 15 males 17 females/ 12 males	**Executive functions:** - Working Memory Test Battery for Children. - n-back task. - Flanker task. - Borella's task. - "How many—What number task" - Semantic fluency test. - Phonological fluency test.	Updating Inhibition Switching Verbal fluency Phonological fluency	fluency (phonological and semantic).	

(*Continued*)

Author(s)	Sample	Comorbidity	Instrument(s)	Measures	Summary of Results
Redmond et al. (2015) [22]	Age range: 7 – 9 years Group(s): *n* = 19 DLD *n* = 19 ADHD+DLD *n* = 19 TD Gender: 10 females / 9 males	Yes	**Language skills**: English Nonword Repetition Task. Test of Early Grammatical Impairment (TEGI).	Nonword repetition Sentence recall Tense marking	No significant differences were found between the ADHD and DLD + ADHD groups. A modest positive correlation was found between the severity of ADHD symptoms and their sentence recall performance: children with higher levels of ADHD symptoms performed better than those with lower levels.
Staikova et al. (2013) [40]	Age range: 7 – 11 years Group(s): *n* = 28 ADHD *n* = 35 TD	No	**Language skills**: Children's Communicative Checklist, Second Edition (CCC-2). Comprehensive Assessment of Spoken Language (CASL). Test of Pragmatic Language, Second Edition (TOPL-2) Narrative Assessment Profile: Discourse Analysis (NAP) Clinical Evaluation of Language Fundamentals, Fourth Edition (CELF-4)	Pragmatic language General language	Children with ADHD had poorer pragmatic language skills relative to peers across all measures, even after controlling for general language abilities.
Stanford and Delage (2021) [6]	Age range: 8 years Group(s): *n* = 20 DLD *n* = 20 ADHD *n* = TD	No	**Language skills**: Bilan Informatisé du Langage Oral (BILO) Phonological loop. **Executive functions**: Conners CBRS: inattention, hyperactivity.	Syntax selective attention, central executive, processing speed,	Children with DLD were more sensitive than children with ADHD to visual cues (DLD > ADHD), which were more implicit than the linguistic cues and may have required more attentional resources.

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				attentional flexibility.	For linguistic cues, which required syntactic processing, the opposite pattern was true (ADHD > DLD).

(*Continued*)

Author(s)	Sample	Comorbidity	Instrument(s)	Measures	Summary of Results
Stanford and Delage (2020) [17]	Age range: 8 years Group(s): *n* = 20 DLD *n* = 20 ADHD *n* = 20 TD	No	**Language skills**: Bilan Informatisé du Langage Oral (BILO). Probe test. **Executive functions**: Sky Search task (TEA-ch) Digit recall task (WISC-IV) Opposite Worlds task (TEA-ch)	Morphosyntax Selective attention Working memory Attention shifting	Different EF and morphosyntactic profiles in children with ADHD and DLD. ADHD group: higher-order EF weakness and difficulty with the omnibus morphosyntax task. DLD group: lower- and higher-order limitations and struggled with both morphosyntax tasks. Deficits in morphosyntax are not characteristic of ADHD: their performance can mimic morphosyntactic impairment.
Vassiliu et al. (2022) [41]	Age range: 4 – 8 years Group(s): *n* = 25 DLD *n* =29 ADHD *n* = 29 TD Gender: 8 females /17 males 11 females / 18 males 10 females / 19 males	No	**Language skills**: Logometro tasks	Structural language Vocabulary: receptive and expressive Morphosyntax: expressive and receptive Pragmatic language	ADHD children face difficulties with language skills and especially with structural language: they performed significantly lower than their TD peers but significantly higher than the DLD group. In pragmatics, ADHD children performed numerically lower than any other group but no statistical significance was found.
Zenaro et al. (2019) [42]	Age range: 6 – 10 years Group(s): *n* = 20 ADHD *n* = 20 TD Gender: 6 females /14 males	No	**Language skills:** Frog, Where are you?	Narrative skills	The ADHD group presented lower scores on the structural elements of "theme/ topic" and "outcome" and a narrative with a lower degree of coherence than the TD group.

Note. DLD= Developmental Language Disorder; ADHD= Attentional Deficit Hyperactivity Disorder; TD= Typical Development.

4. Discussion

The purpose of this study was to investigate the specific language difficulties experienced by children with DLD and/or ADHD and to explore potential overlaps or differences between the two conditions.

First, the review showed that the symptoms of these two disorders overlap, including language difficulties and deficits in EF.

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There is a great deal of variability in language assessment research. Conflicting results are to be expected due to the complexity of conducting assessments in different language domains and because it is important to be aware of the variability of the tests used in our selection of studies.

Some studies focused on receptive language, others on expressive language. Most of the studies included in this review were concerned with examining grammar, semantics, and pragmatics, as these are the most impaired language areas in DLD and ADHD. However, the results are contradictory. Some research indicated that children with DLD have more morphological and semantic difficulties than children with ADHD [6,17,29]. While other research also identified morphological and semantic difficulties in children with ADHD [41].

The studies selected for the review also showed varied results in terms of the performance of children with ADHD in language tasks: studies in children with ADHD focusing on language use indicated difficulties in language use compared to the control group [40] although the differences between the groups were not always significant [29]. On the other hand, positive correlations were sometimes found between ADHD symptoms and sentence recall tasks [22].

The study of language skills is a complex field involving several different factors. For example, the assessment of pragmatic language is challenging. Firstly, the construct includes verbal and non-verbal skills, and secondly, as the definition of pragmatics is linked to social context, the assessment of pragmatic skills through standardised tests may not reflect a subject's true ability to use language in natural settings [40]. In relation to narrative skills, structural elements are responsible for narrative coherence. These factors are important to build meaning for thematic maintenance and to present a coherent outcome related to the story problem situation that shows the relationship between the events being narrated [42]. They are also important in the ability to relate internal states, which involve not only linguistic deficits, but also the limitations of social and emotional knowledge [32].

Another important aspect is to consider the relationship between EF and language skills, which are closely related and interact in different ways [46]. In our selection of articles, only 5 included measures of EF in addition to language measures, which is particularly striking given that the type of participants included in the studies (DLD and ADHD) would be expected to have deficits in EF.

It is generally interesting to consider socio-demographic variables, such as gender or age, as these may have an impact on the performance of the proposed tasks. Gender stereotypes may affect the diagnosis of girls with DLD and/or ADHD. There are gender differences in ADHD, with boys more likely to be diagnosed than girls. Despite similar symptomatology, evidence-based sex and gender differences (in prevalence, presentation, symptom expression, progression, and impairment) are emerging. Girls with ADHD may experience greater functional impairment and have different long-term outcomes than boys with ADHD [47].

Gender also plays a role in DLD, with boys being at higher risk of the disorder and more likely to receive speech and language therapy services. A strong gender effect has been consistently reported, with higher prevalence of language delay and DLD in males than in females [48,49]. All of this shows how important it is to consider gender.

Finally, the age of the sample needs to be considered, because it can influence children's language development. Children's language skills continue to develop throughout childhood, and gestational age at birth can also influence language development. In fact, children develop many of the oral language skills that help them to learn to read when they go to school, and their language skills continue to develop throughout childhood [50].

The 'age effect' also needs to be considered in the field of language impairment, especially at an early age. One example is the development of metapragmatic awareness happens recursively, in that as children get older, they are not only able to identify the error between the context of the communicative act and the context of the communicative act and the linguistic expression, but also to explain it, thus achieving a reflexive control of language [33].

These results suggest the need for a standardized assessment tool that covers the different language domains, along with the importance of assessing pupils' language skills in a general way that could allow early identification of children at risk of these disorders.

5. Conclusions

This study has important implications for the field of language competences in DLD and/or ADHD. The results contribute to the understanding of language difficulties in these neurodevelopmental disorders by highlighting gaps in knowledge that may be addressed to improve the identification and intervention.

However, it is also important to note the limitations of the study. The use of different terminology when talking about idiopathic speech problems makes it difficult to identify the research carried out. Similarly, the number of studies that included participants with comorbidity between DLD and ADHD was very small, even though they are two disorders that often co-occur. Additionally, the small number of studies and methodological heterogeneity reduce the precision and generalizability of the findings. Hence, this review underscores the fact that further research is needed to clarify the relationship between language competence and these two neurodevelopmental disorders.

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