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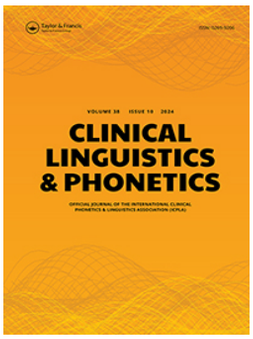

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Comprehension of verb morphology in Arabic-speaking children with and without developmental language disorder

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ABSTRACT

Children with developmental language disorder (DLD) experience difficulties with a range of morphosyntactic skills, particularly with tense and subject – verb agreement. Many studies have examined verb-morphology production in children with DLD. We extend this line of research by profiling verb-morphology comprehension in 67 monolingual Saudi Arabic-speaking children, comprising 33 with DLD ($M = 61$ months, $SD = 10.70$), and 34 age-matched typically developing (TD) children ($M = 63$ months, $SD = 8.94$). Children completed a novel picture selection task developed to assess their comprehension of verb tense, gender agreement, and number agreement. Children with DLD scored significantly lower than TD children on the verb morphology comprehension task. They showed greater difficulty identifying verb tense forms, particularly future tense. They also demonstrated lower accuracy in identifying subject-verb agreement in general, with specific difficulty in comprehending masculine verbs, and singular verbs. These findings were compared with production verb-morphology data from previous Arabic studies. Overall, this study highlights the challenges experienced by Arabic-speaking children with DLD in comprehending verb morphology, particularly tense and subject-verb agreement inflections. These findings can be used to tailor appropriate assessment designs and interventions for an Arabic-speaking DLD population.

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Developmental language disorder; verb morphology; Arabic; tense; subject–verb agreement

Introduction

Children with developmental language disorder (DLD) experience difficulties with a range of morphosyntactic skills, particularly with tense and subject – verb agreement (Leonard, 2014). Crosslinguistic variation exists in the morphosyntactic deficits of children with DLD. For instance, English-speaking children with DLD mostly experience difficulty with present-tense third-person singular *–s*, regular past-tense *–ed*, auxiliary *do* forms, and auxiliary and copula *be* forms (Gladfelter & Leonard, 2013). In Germanic languages such as Danish (Christensen & Hansson, 2012) and Dutch Rispens & De Bree, 2014), tense agreement is problematic for children with DLD, particularly past-tense inflection (Krok & Leonard, 2015). In contrast, children with DLD speaking morphologically rich languages such as

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Italian and Spanish exhibit different patterns of production difficulty; Italian-speaking children with DLD have difficulty using function words such as direct object pronouns and articles, whereas tense and agreement verbal inflections are not problematic (Leonard & Bortolini, 1998). This evidence of crosslinguistic variation demonstrates that DLD-linguistic-profiles differ according to language typology (Leonard, 2014), underlining the significance of studying a diverse range of languages to understand the nature of DLD.

Verb morphology comprehension in DLD

While deficits in verb morphology are well-documented in children with DLD through production data, these children also experience difficulties in comprehension of verb morphology. Grammaticality judgement tasks have been widely used in cross-linguistic studies to assess tense and agreement morphemes in children with DLD. Lower performance by children with DLD compared to their typically developing (TD) peers has been consistently reported (English: Rice et al., 1999; Calder et al., 2023; Greek Lalioti et al., 2016; Italian Moscati et al., 2020; Dutch Blom et al., 2014; J. Rispens & Been, 2007; French Maillart & Schelstraete, 2005).

Rice et al. (1999) suggested that grammatical judgement abilities in English-speaking children with DLD mirror their language production skills. These children demonstrated sensitivity to morphosyntactic violations, which they were less likely to produce, but they were less able to detect errors that were more common in their own language production. Specifically, Rice et al. (1999) reported that children with DLD showed greater difficulty in detecting tense violations compared to agreement violations. Leonard et al. (2000) further examined the comprehension abilities of English-speaking children with DLD using a picture-selection task. They found that the ability of these children to comprehend third-person singular, copula, and plural forms was significantly below that of their age-matched TD peers. Maillart and Schelstraete (2005) examined grammaticality judgement abilities among French-speaking children with DLD to detect various grammatical violations: (1) agreement errors, (2) tense marking violations, and (3) word order violations. They found that children detected significantly fewer violations related to verbal morphology compared with word-order violations. J. Rispens and Been (2007) investigated subject – verb agreement in Dutch children with DLD (mean age 8 years) to assess their ability to identify three types of errors: (1) the use of the bare verb form instead of the third-person singular form, (2) the use of the plural form instead of the third-person singular form, and (3) the use of the third-person singular form instead of the plural form. Only two children with DLD were able to detect all error types, while the remaining children scored at chance level. Expanding on these findings, Blom et al. (2014) investigated the production and comprehension of subject-verb agreement in Dutch-speaking children with DLD. Using a picture description task to assess production and a self-paced listening task to assess comprehension, they found that children with DLD frequently omitted the third-person singular *-t* suffix in production and had difficulty detecting these omissions in comprehension. However, the children were more successful at identifying substitution errors (using plural instead of singular forms), mirroring their infrequent use of incorrect plurals in production. These findings suggest a consistent pattern of difficulty with subject-verb agreement across both production and comprehension in Dutch -speaking children with DLD.

Christou, Andreu, et al. (2022; Christou, Coloma, et al., 2022) conducted two eye-tracking experiments to investigate verb morphology comprehension in bilingual Spanish-Catalan children with DLD (mean age 8 years). Performance was compared with three control groups: age-matched TD children, language-matched children, and adults. In both experiments, all participants (including those with DLD) showed better comprehension of past tense and plural forms compared with future tense and singular forms. The first experiment (Christou, Andreu, et al., 2022) focussed on Spanish verb tenses, revealed higher accuracy for past than future forms. The second experiment (Christou, Coloma, et al., 2022) examined singular and plural inflections, and participants performed better with plural inflections. Despite tense and number-specific difficulties observed across all groups, neither experiment revealed significant differences between children with DLD and control groups. This suggests that Spanish-Catalan speaking children with DLD exhibit a relatively preserved capacity to comprehend Spanish verbal morphology. Calder et al. (2023) examined the processing of regular past tense *(ed)*, third person singular *(3s)*, and possessive *('s)* using a grammaticality judgement task in English-speaking children with DLD. Performance of the DLD group was significantly lower on all measures, and showed a one-year delay compared with controls.

These studies reveal the complexity of morphosyntactic processing in children with DLD, showing that their sensitivity to grammatical violations varies with linguistic structure, task demands, and the language itself. Kidd and Garcia (2022), in a review of languages used in child-language-acquisition research between 1974 and 2020, reported a bias towards English and other Indo-European languages. We partly address this and focus on Arabic – the official spoken language of more than 26 Middle Eastern and North African countries (Al-Buainain et al., 2012). To our knowledge, this is the first study to examine the comprehension of verb morphology in Arabic-speaking children with DLD.

The Saudi Arabic verb paradigm

Arabic is a Semitic language with a rich inflectional morphological system, distinguishing it from widely studied Indo-European languages (Boudelaa et al., 2010). Unlike English, all Arabic varieties lack an infinitive form of the verb (Bulos, 1965). Each Arabic verb is formed of a consonantal root and vocalic infixes, which together form the verb stem. The root consists of three to four consonants and conveys the semantic meaning (Ryding, 2005), while vocalic infixes comprise discontinuous vowels inserted into the consonantal root and convey grammatical information (Tucker, 2011). For instance, the root */akl/* carries the meaning of 'eating'. By inserting various patterns and consonantal affixes into this root, different words are obtained such as */ʔakala/*,[1] meaning 'he ate', and */ʔakl/* meaning 'food'. Arabic is a 'pro-drop or null-subject' language, meaning the subject can be deleted from a finite clause and a morphological inflection marker used to infer the referent.

Arabic has two different forms: Modern Standard Arabic (MSA) and colloquial or dialectal Arabic. MSA is the formal variety of the language, used mainly in newspapers, television news broadcasts, in education, and on religious occasions, and it is understood by Arabs in all Arabic-speaking countries. MSA is not acquired in early life as a maternal language and is not used for everyday communication, but it is taught at school (Ibrahim, 1989). In contrast, colloquial Arabic is used for daily social interactions, and has various distinctive geographical dialects. These colloquial dialects often have simpler grammatical

rules. For example, in MSA, the plural feminine inflection differs from the masculine plural, whereas in the Saudi dialect of colloquial Arabic both the plural feminine and masculine have the same morphological inflection. For instance, in MSA the suffix *u:n* in the verb */ja?kul**un**/* 'they are eating' indicates a third-person feminine plural, whereas in Saudi Arabic the suffix *u:n* in the verb */jakl**u:n**/* 'they are eating' indicates a third-person plural form for both genders, feminine and masculine (without gender distinction).

In Arabic, the verb can be inflected according to six morphological categories: person, gender, number, tense, voice, and mood (Ryding, 2005). The first three are determined by the subject of the verb, with the verb agreeing with the subject in all aspects (Ryding, 2005). Verbs have two main morphological forms: imperfective and perfective (Benmamoun, 2000). Morphologically, the two forms differ primarily in their realisation of agreement features. The perfective form usually occurs in the past tense, and it is realised exclusively by a suffix (Benmamoun, 2000), while the imperfective form carries no tense (Benmamoun, 1999). However, two of the main imperfective forms are present-tense verbs (progressive and habitual) and future-tense verbs (Benmamoun, 2000). In the imperfective form, tense and agreement features are realised by prefixes or a circumfix, which is a prefix and suffix combination (see Appendix A for an overview of the verb paradigm in SA). In MSA, the future tense is realised by adding the particle */sawfa/* 'will' or the clitic *sa-*, which is considered by grammarians to be the abbreviation of the particle */sawfa/*, to the present-tense indicative verb (Ryding, 2005). In Saudi Arabic, futurity is expressed in a various way. One approach involves adding the prefix *bi-* to the imperfective verb form. For example, the verb */jɑkɪl/* 'he is eating' would be */bɪjɑkɪl/* in the future tense, 'he will eat'. The prefix *bɪ-* can occur in several morphological forms such as *bɪ-*, *ba-*, *or aba-*. The motion verb *raħ* is another common expression for futurity in Saudi Arabic, where it acts as the future particle */sawfa/*. To express a future event, the motion verb *raħ* would precede an imperfective verb form (Altamimi, 2021), as in */raħ jɑkɪl/* 'he will eat'.

Verb morphology in Arabic-speaking children

Few studies have investigated the acquisition of verb morphology in Arabic. Omar (1973) was the first to study the acquisition of Arabic as a native language, reporting that children start using verbal morphological inflections at approximately 2;03 years. Yet, not all verbs were morphologically inflected as required in typical adult language. Singular and masculine verbs emerged before plural and feminine verbs, and the default verb agreement category of Egyptian Arabic-speaking children was the masculine singular. Abdu and Abdu (1986) investigated the vocabulary acquisition of their son and daughter from ages 1–5 years. Consistent with Omar (1973), singular and masculine verbs emerged before plural and feminine verbs. Furthermore, in the past tense, third-person verbs emerged before first-person ones, while second-person verbs emerged last. Comparatively, for present-tense verbs, no specific order was observed. Aljenaie (2010) investigated the development of verbal inflection in three Kuwaiti Arabic-speaking children aged between 1;8 and 3;1 year, analysing their spontaneous speech samples over a period of six months. Only present and past tenses were analysed because future forms rarely appeared during the study. Correct verbal inflection among Kuwaiti Arabic-speaking children was observed from an early age (2;0 to 2;06), suggesting that languages with rich morphological systems foster more rapid development of inflectional morphology in children's speech (Xanthos

et al., 2011). Instead of using fully inflected verbs, children used the imperfective bare stem, which is a non-finite form (Aljenaie, 2010).

While research on DLD in Arabic-speaking children is growing, it has primarily focused on their production of verb morphology, leaving a gap in our understanding of their comprehension abilities in this area. This review examines current research on the production of verb morphology in Arabic-speaking children with DLD. Abdalla and Crago (2008) investigated tense and agreement inflections in the spontaneous speech of 10 Saudi Arabic-speaking children (aged 4;0–5;3 years). These children performed significantly lower in their use of these verbal inflections compared to age- and language-matched peers, particularly scored lower on present-tense, feminine, and third-person forms. This pattern aligns with the typical developmental trajectory of Arabic verbs, where first-person verbs and masculine singular forms emerge before more complex forms such as third-person and feminine verbs (Abdu & Abdu, 1986; Aljenaie, 2001; Omar, 1973). This suggests that children with DLD may follow a similar, but delayed, path of verb acquisition. Shaalan (2010) reported that Qatari Arabic-speaking children with DLD (aged 4;6–9;4 years) had greater difficulty producing past-tense verbs than present-tense verbs. However, these findings were based on a limited number of test items, with most verb markers tested using a single stimulus only. Fahim (2017) analysed spontaneous speech samples of three Egyptian Arabic-speaking children with DLD (aged 3;1–4;6 years) and found they had greater difficulty marking subject – verb agreement than tense marking. These children exhibited three main patterns of verb morphology errors: using a default verb form that resembled the subjunctive or imperative as a replacement of tensed verbs, producing verbs with the correct tense but incorrect agreement, and using nonadult target forms (pseudo-words) instead of target verbs.

Taha et al. (2021a) investigated tense and agreement production in 14 Palestinian Arabic-speaking children with DLD (aged 4;0–7;10) using a verb-elicitation task. They found lower accuracy in marking tense (particularly present tense) and agreement (particularly feminine forms) compared to TD children. However, the DLD group still scored above mastery level in both tense and agreement, potentially due to their higher average age compared to participants in other studies. In a recent study, Abdalla and Mahfoudhi (2023) used an elicitation task to examine gender and number agreement in Kuwaiti Arabic-speaking children with DLD (mean age 4 years). The findings revealed that these children demonstrated significantly lower accuracy compared to their TD peers matched for age and language level. Additionally, the children with DLD showed greater proficiency in producing masculine forms compared to feminine forms, and singular forms compared to plural forms.

Previous studies indicate that the production of verb morphology poses a significant challenge for Arabic-speaking children with DLD. However, inconsistencies in error patterns across studies suggest that methodological variations and age differences between participants may be influential factors. Some studies included older children (Shaalan, 2010; Taha et al., 2021a), while others focused on young preschoolers (Abdalla & Crago, 2008; Abdalla & Mahfoudhi, 2023; Fahim, 2017). Variations in linguistic structures of the various Arabic dialects examined in these studies may also contribute to these inconsistent results. This study aims to profile the comprehension of verb morphology in children with DLD to determine whether previously reported difficulties in the production of verb morphology

extend to comprehension. Our analysis contributes to the assessment, diagnostic processes, and intervention for children with DLD in Saudi Arabia. We achieve this by comparing the comprehension abilities of children with DLD to those of chronologically age-matched TD children. Specifically, we examine the following in Saudi Arabic-speaking children with DLD, aged 4;0–6;11 (years; months):

(1) How do children with DLD compare to TD children in terms of overall performance accuracy on a verb morphology comprehension task?
(2) How do children with DLD differ from TD peers in their ability to identify verb tenses, gender agreement, and number agreement on a verb morphology comprehension task?

Methods

Participants

Initially, a total of 68 monolingual Saudi Arabic-speaking children participated in the study. One participant with DLD was excluded due to difficulty following instructions in the verb morphology comprehension task. The final sample comprised 33 children with DLD (14 females, 19 males), aged range between 48 to 83 months ($M = 61$ months, $SD = 10.70$), and 34 TD children (16 females, 18 males), aged range between 48 to 80 months ($M = 63$ months, $SD = 8.94$).

Children with DLD were recruited from two private speech and language therapy clinics and two governmental hospitals in Riyadh, Saudi Arabia. All DLD children were independently diagnosed by certified speech-language therapists (SLTs), and were receiving language-intervention sessions. Because DLD diagnosis in Arabic is mainly informally assessed, we verified that children fulfilled the criteria for DLD as defined by Bishop et al. (2017). Each child's SLT filled in a questionnaire to ensure the following: (a) language skills were below the expected level for their age based on an extensive assessment process; (b) language difficulties were not limited to phonology but also affected other language domains such as morphosyntax and semantics; and (c) there was an absence of other medical and developmental disorders such as autism spectrum disorder. The TD children were recruited from four private and public schools in Riyadh, Saudi Arabia. Inclusion criteria for TD participants required parents to complete a background questionnaire, in which they confirmed there were no concerns regarding their child's current language skills, and that there was no history of language delay or intervention.

There was no significant difference in age between DLD and TD groups (Mann – Whitney $U = 483$, $p = 0.331$). A Fisher's Exact Test revealed a statistically significant difference in socio-economic status (SES) distributions between DLD and TD groups ($p = 0.040$). SES levels included very high, high, medium, and low, with DLD individuals showing a greater prevalence of low SES (DLD, $n = 10$; TD, $n = 2$) compared with TD individuals. This suggests a socio-economic disadvantage in the DLD group relative to TD. Demographic information for participants is provided in Table 1.

Table 1. Detailed demographic information for each group.

	TD n = 34		DLD n = 33		
	Mean (SD) Range	Median	Mean (SD) Range	Median	Group differences
Age (months)	63.38 (8.94) 48–80	64	61.42 (10.70) 48–83	59	Mann – Whitney: U = 483, $p = 0.331$, $r = 0.11$
Gender	16 females; 18 males		14 females; 19 males		χ^2 (1, 67) = 0.018, $p = 0.892$
Mother's education		–		–	Fisher's Exact Test: $p = 0.277$
Elementary/ Secondary	0		2		
High School	4		5		
Bachelor's degree	17		19		
Postgraduate	13		7		
Family Income		–		–	Fisher's Exact Test: **$p = 0.040$**
Low	2		10		
Medium	22		13		
High	7		6		
Very high	2		2		
MPU raw scores	4.63 (1.07) 2.86–7.52	4.49	3.16 (1.22) 1.20–5.82	2.90	t-test: t (63.48) = −5.19, **$p < .001$**, d = −1.27
SR raw scores	28.17 (10.38) 4–42	30.50	5.93 (8.02) 0–32	3	Mann – Whitney U = 62.5, ***$p < 0.001$***, $r = 0.76$

TD: Typically developing, DLD: Developmental language disorder, SD: Standard deviation, MPU: Mean length of utterance, SR: Sentence repetition task.
Values in bold are significant at the $p < .05$ level.

Determining developmental language status

Background measures

The lack of a standardised and criterion-referenced test for assessing Arabic-speaking children with DLD necessitated the use of the following non-standardised measures to verify DLD diagnoses, and confirm if a child with DLD had significantly lower language skills than expected for their age.

Spontaneous language sample

Using the wordless picture book *Frog, Where Are You?* (Mayer, 1969), a 50-utterance language sample was collected from each child. This wordless picture book has been used in Arabic-speaking studies on children with no documented cultural challenge (Alsiddiqi et al., 2022; Taha et al., 2021a). The morpheme-per-utterance (MPU) score, a linguistic measurement of grammatical development that accounts for the richly inflected nature of Semitic languages (Dromi & Berman, 1982), was calculated following Shaalan and Khater (2006). This measure has been used to verify the presence of DLD in Arabic (Abdalla & Crago, 2008; Taha et al., 2021a). Average MPU raw scores of the DLD group were significantly below those of the TD group (t (63.48) = −5.20, $p < 0.001$, $d = -1.27$).

Sentence repetition (SR)

Studies in Arabic-speaking populations have confirmed the efficacy of the sentence repetition (SR) task as a clinical tool for distinguishing children with DLD from TD children (Shaalan, 2010; Taha et al., 2021b; Wallan, 2018). We used a Saudi Arabic SR test (comprising 14 sentences of varying structures and grammatical markers) (Wallan, 2018) to verify DLD diagnoses and confirm the language status of TD children by comparing total sentence

accuracy scores. Average SR raw scores of DLD children were significantly lower than those of TD children ($U = 62.5$, $p < 0.001$, $z = -6.25$ $r = 0.76$). See Table 1 for background measures for both groups of participants.

Comprehension of verb morphology task

Grammaticality judgement tasks, commonly used for comprehension assessment, rely on metalinguistic awareness – the ability to explicitly reflect on the grammatical structures of the spoken language (Tunmer & Herriman, 1984) – and working memory. Because both areas can challenge children with DLD and potentially impact their performance on grammaticality judgement tasks, we use a picture-selection task, which is considered more appropriate for preschool-aged children (Leonard et al., 2000). This task was used to assess children's ability to identify (1) verb tense (past, present, future), and subject – verb agreement for (2) gender (masculine and feminine), and (3) number (singular and plural).

Task materials were specifically developed by the first author for this study. Target verbs were selected based on two criteria. All verbs had to be: 1) early acquired according to the Jeddah Institute for Speech and Hearing Arabic Communicative Development Inventory (Dashash & Alsafi, 2014), which is a tool normed on the Saudi population; and 2) concrete verbs that could be demonstrated in photographs. Consideration was given to the relevance of photographs (actions, appearance, clothing, and materials) to Saudi culture.

The 110 comprehension items were divided into two blocks: block A included gender and number inflection items in present and past tenses, while block B included only verb-tense items. Target verbs were arranged in a semi-randomised fashion within the block, varying their locations to prevent any consistent pattern, such as always appearing at the top left or bottom right, thus controlling for potential picture preference effects. However, the same order of presentation was maintained for all children within each block. To avoid potential confounding effects of intonation, the researcher pre-recorded all auditory stimuli and embedded them into a Microsoft PowerPoint presentation. Audio stimuli were recorded by an Arabic-speaking female blinded to the purpose of the research.

Verb tenses

A total of 30 items were used to assess past, present, and future verb tenses. Three main lists were created, each containing 10 tested items and covering only two verb tenses. Thus, the first list included present vs. past tenses, the second featured present vs. future tenses, and the third included past vs. future tenses. For each target verb, the child had to select one of four presented photographs, each depicting a different action or tense. For each trial, which included four photographs, number and gender were controlled across the images. Within each list, half of the trials featured photographs of male children and masculine verbs, while the other half featured photographs of female children and feminine verbs (See Appendix B for the list of target verbs).

Gender agreement

Gender inflection markers were assessed in singular verbs only, as the suffix plural morpheme *(–u)* is used irrespective of the subject's gender in Saudi Arabic. A total of 40 items were used, with 10 items for each of the following verb forms: present singular masculine, past singular masculine, present singular feminine, and past singular

feminine. The subject was omitted and the only cue for interpretation was the gender inflection on the verbs. Verbs were inflected for gender using prefixes *(j-)* for masculine verbs and *(t-)* for feminine verbs to indicate gender variation in present-tense forms. In past-tense forms, masculine verbs are not realised by overt inflections (null morpheme), while feminine verbs were marked by the suffix (*-t*) (See Appendix C for the list of target verbs)

Number agreement

A total of 40 items were used to assess number inflection markers, with 10 items assigned to each of the following verb forms: third-person singular present-tense, third-person plural present-tense, third-person singular past-tense, and third-person plural past-tense. Gender was controlled within each trial, with all four photographs featuring the same gender. Two photographs depicted a singular subject performing an action (e.g. *a boy eating*), and two depicted plural subjects performing the same action (e.g. *boys are eating*). For present-tense verbs, number variation was realised through specific inflectional morphemes: the prefix (*y-*) for third-person singular masculine, the prefix (*ta-*) for third-person singular feminine, and the suffix (*-lun*) for third-person plural. For past-tense verbs: third-person singular masculine verbs are not realised by overt inflections (null morpheme), the suffix (*-at*) marker third-person singular feminine, and the suffix (*-u:*) marked the third-person plural (See Appendix D for the list of target verbs).

Procedure

After obtaining written parental informed consent, each child was tested by the first author in a quiet room either at their school for the TD children, or speech and language therapy clinic for DLD children. The verb morphology comprehension task was administered with other tasks as part of a larger PhD study. All language samples were audio-recorded on an Olympus WS-852 voice recorder for later transcription and analysis. Language samples were collected before the SR test and the verb morphology comprehension task. The number of tasks performed in a session varied depending on a child's motivation, although the task order was constant for all children. Before administering the verb morphology comprehension task, each child was given three practice items to ensure they understood the instructions and to familiarise themselves with the task. Photographs were displayed on a laptop monitor, and the child was required to point to the appropriate image. All children were instructed by the researcher to point to a specific photograph on the screen while being told 'Let's play a game! Each time you hear a word, point to the photograph that matches the word you hear'. All children completed every task. However, one participant did not understand the concept of the task and was excluded from the analysis. All children were rewarded with stickers throughout the session, regardless of the responses produced.

Scoring

Scores were collected during the session and were later converted into a digital format.

Binary scoring

Responses were correct when a child pointed to the target photograph and incorrect otherwise. A correct response was scored 1 point, whereas an incorrect response was scored 0. The maximum overall score on the verb morphology comprehension task was 110.

Error scoring

Below is a brief description of the error scoring system with examples:

(1) Overall accuracy. The child's selection was scored as correct (1 point) if it matched both the target verb inflection and the specific verb. An example:

Target verb	/bɪjkanɪs/(sweep-FUT-3 MS, 'He will sweep')	
Response options	A. rasam draw-PAST-3 MS He drew	B. bɪjrsim draw-FUT-3 MS He will draw
	C. kanas sweep-PAST-3 MS He swept	D. bɪjkanɪs sweep-FUT-3 MS He will sweep
Correct response	The child chooses option D.	
Incorrect response	The child chooses option A, B, or option C.	

(2) Tense accuracy. The child's selection was scored as correct (1 point) if it matched the target tense, regardless of the specific verb chosen. The maximum overall scores the child could achieve on tense trials was 30. An example:

Target verb	/bɪjkanɪs/(sweep-FUT-3MS, "He will sweep")	
Response options	A. rasam draw-PAST-3MS He drew	B. bɪjrsim draw-FUT-3MS He will draw
	C. kanas sweep-PAST-3MS He swept	D. bɪjkanɪs sweep–FUT-3MS He will sweep
Correct response	The child chooses either option D, as it matches both the tense and the specific target verb, or option B, as the tense inflection matches the target tense, even though the verb is incorrect.	
Incorrect response	The child chooses option A or C.	

(3) Gender agreement accuracy. The child's selection was scored as correct (1 point) if it matched the target gender inflection, regardless of the specific verb chosen. An example:

Target verb	/jakɪl/(Eat-PRES-3 MS, 'He eats')	
Response options	A. jɪnfax blow-PRES-3 MS He blows	B. takɪl eat–PRES-3FS She eats
	C. tɪnfax blow-PRES-3FS She blows	D. jakɪl eat–PRES-3 MS He eats
Correct response	The child chooses either option D, as it matches both the gender and the specific target verb, or option A, as the gender inflection matches the target gender, even though the verb is incorrect.	
Incorrect response	The child chooses option B or C.	

(4) Number agreement accuracy. The child's selection was scored as correct (1 point) if it matched the target number, regardless of the specific verb chosen. An example:

Target verb	/maʃatˁ au/(comb-PAST-3P, 'They combed')	
Response options	A. maʃatˁ ɑt	B. ʔakalau
	comb-PAST-3FS	eat-PAST-3P
	She combed	They ate
	C. maʃatˁ au	D. ʔakalat
	comb–PAST-3P	eat–PAST-3FS
	They combed	She ate
Correct response	The child chooses either option C, as it matches both the number and the specific verb, or option B, as the number inflection matches the target number, even though the verb is incorrect.	
Incorrect response	The child chooses option A or D	

Reliability

A Saudi Arabic-speaking SLT, blinded to the study, re-scored the transcribed responses from 22% of the sample (seven DLD and eight TD) to assess inter-rater reliability. The intraclass correlation coefficient (ICC; absolute) indicated a high interrater reliability for the overall binary scoring, with an ICC value of 0.999, tense scoring (ICC = 0.998), number scoring (ICC = 0.999), and gender score (ICC = 1). The internal consistency of the test was assessed using a split-half reliability analysis with random assignment of items to each half (the traditional odd – even split method was not feasible). To minimise potential bias, random assignment ensured that both halves of the test contained a representative sample of the test's content domain. The Spearman – Brown coefficient yielded a reliability estimate of 0.94. Further, Cronbach's alpha for all test items was 0.938. Both values indicate that the receptive verb morphology test demonstrated satisfactory level of internal consistency and reliability.

Statistical analysis

All analyses were carried out in R software (version 4.3.0; R Core Team, 2023). To address the first research question, the non-parametric Mann-Whitney U test was employed due to the non-normal distribution of the data (Shapiro – Wilk statistic $p < 0.05$). Effect size was then calculated using the z-score, with r determined by dividing the absolute value of the z-score by the square root of the total sample size. The second research question was addressed by running a series of mixed-effects logistic regression models using the lme4 package (Bates et al., 2015). For the tense model, the dependent variable was the accuracy of verb tense identification. This was a binomial, categorical variable (1 = correct, 0 = incorrect). To control for significant differences in SES between the two groups, we included SES as a covariate; age was also included as a covariate. The fixed effects (predictors) are group (TD and DLD), and target tense (past, present, and future). Because target tense was tested in both gender inflection markers, we also included target gender (masculine and feminine) as a predictor in the model, along with the interactions between these predictors. Subjects and Items were entered as random effects to account for the non-independence of data (repeated measures; Baayen et al., 2008). In the gender model, the dependent variable was the accuracy of gender inflection identification. The predictors included group (TD and

DLD) and target gender (masculine and feminine). Additionally, because we tested target gender in two verb tenses, target tense (present and past) was also included as a predictor, along with the interactions between these predictors. Similarly, in the number model, the dependent variable was the accuracy of number inflection identification. The predictors included group (TD and DLD) and target number (singular and plural). Because we tested target number in different verb tenses and genders, we also included target tense (present and past) and target gender (masculine and feminine) as predictors in the model along with the interactions between these predictors. An analysis of variance was performed using the *Anova* function to determine the significance levels of the main fixed effects and their interactions. Residuals of the fitted models were checked using *simulateResiduals* and *plot* functions in the *DHARMa* package (Hartig, 2022). Post hoc contrasts were performed using the *emmeans* package (Lenth, 2023) with all pairwise comparisons corrected using Bonferroni corrected *p* values to account for multiple comparisons (Field, 2009).

Results

Descriptive statistics for both groups on the verb morphology comprehension task are summarised in Table 2. Overall, in the verb morphology comprehension task, the DLD group (median = 67, range = 46–95) scored significantly lower than their TD peers (median = 83.50, range = 61–110), as indicated by performance scores ($U = 201$, $z = -4.51$, $p < 0.001$, $r = 0.55$). See Figure 1.

Table 2. Mean percentages correct and raw scores of TD and DLD children for the target morphemes.

	TD $n = 34$				DLD $n = 33$			
	Raw Scores		Percentage Correct %		Raw Scores		Percentage Correct %	
Measures	Mean (SD) Range	Median	Mean (SD) Range	Median	Mean (SD) Range	Median	Mean (SD) Range	Median
Overall accuracy	87.11 (16.11) 61–110	83.50	79.19 (14.64) 55.45–100	75.90	67.84 (11.93) 46–95	67.00	61.68 (10.84) 41.81–86.36	60.90
Tense accuracy	22.58 (5.46) 12–30	22.50	75.29 (18.22) 75–100	75.00	17.87 (3.73) 11–27	17.00	59.59 (12.46) 36.66–90.00	56.66
Past	8.41 (1.76) 4–10	9	84.11 (17.60) 40–100	90	7.09 (1.84) 3–10	7	70.90 (18.43) 30–100	70
Present	8.55 (1.65) 4–10	9	85.58 (16.54) 40–100	90	7.09 (2.30) 1–10	7	70.90 (23.09) 10–100	70
Future	5.61 (3.20) 0–10	5	56.17 (32.09) 0–100	50	3.69 (2.24) 0–9	3	36.96 (22.42) 0–90	30
Gender agreement	33.41 (5.82) 22–40	34	83.52 (14.55) 55–100	85	26.09 (6.19) 13–38	26	65.22 (15.47) 32.50–95	65
Masculine agreement	15.47 (3.87) 7–20	15.50	77.35 (19.39) 35–100	77.50	11.78 (4.34) 0–19	11	58.93 (21.71) 0–95	55
Feminine agreement	17.94 (2.76) 11–20	19	89.70 (13.81) 55–100	95	14.30 (4.08) 3–20	15	71.51 (20.40) 15–100	75
Number agreement	31.11 (7.10) 19–40	30	77.79 (17.76) 47.50–100	75	23.87 (4.92) 13–37	24	59.69(12.32) 32.50 -92.50	60
Singular agreement	13.58 (5.17) 5–20	13	67.94 (25.88) 25–100	65	9.18 (3.55) 3–17	10	45.90 (17.78) 15–85	50
Plural agreement	17.52 (2.89) 7–20	18	87.64 (14.47) 35–100	90	14.69 (3.71) 7–20	15	73.48 (18.56) 35–100	75

TD: Typically developing, DLD: Developmental language disorder, SD: Standard deviation.

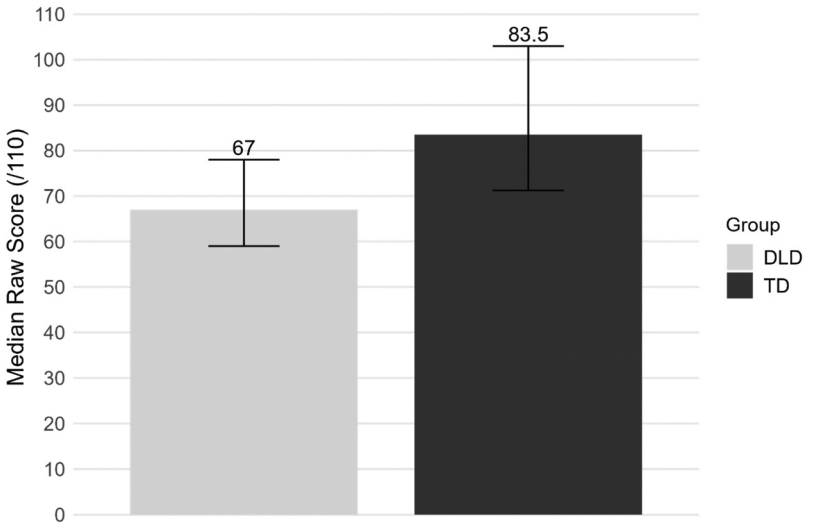

Figure 1. Overall group performance on the comprehension verb morphology task in typically developing (TD) children and children with developmental language disorder (DLD).

Tense analysis

Analysis was based on the set of tense items ($n = 30$). Model fit was significantly better than the intercept-only baseline model, Akaike information criterion (AIC) = 2109.1, $\chi^2(15) = 61.84$, $p < 0.001$. Model results are presented in Table 3. The analysis revealed a significant effect of

Table 3. Parameter estimates of the tense marker logistic mixed-effects model.

Predictors	Odds Ratios	CI	*p*
(Intercept)	1.38	0.21–8.92	0.734
Age	1.03	1.00–1.05	0.059
Income [Low]	0.66	0.28–1.57	0.348
Income [Medium]0	0.90	0.45–1.80	0.767
Income [Very High]	0.56	0.17–1.88	0.351
Group [DLD]	0.39	0.19–0.81	**0.012**
Target tense [present tense]	1.65	0.70–3.86	0.249
Target tense [future tense]	0.35	0.16–0.77	**0.009**
Target gender [masculine]	2.11	0.88–5.06	0.092
Group [DLD] × target tense [present tense]	0.84	0.38–1.85	0.662
Group [DLD] × target tense [future tense]	1.32	0.64–2.70	0.453
Group [DLD] × target gender [masculine]	0.82	0.36–1.85	0.626
Target tense [present tense] × target gender [masculine]	0.41	0.12–1.42	0.161
Target tense [future tense] × target gender [masculine]	0.21	0.07–0.67	**0.008**
(Group [DLD] × target tense [present tense]) × target gender [masculine]	1.17	0.37–3.72	0.785
(Group [DLD] × target tense [future tense]) × target gender [masculine]	0.77	0.26–2.26	0.634
Random Effects			
σ^2		3.29	
$\tau_{00\ ID}$		0.95	
$\tau_{00\ Item}$		0.22	
ICC		0.26	
$N_{\ ID}$		67	
$N_{\ Item}$		30	
Observations		2010	
Marginal R^2/Conditional R^2		0.221/0.425	

Values in bold are significant at the $p < .05$ level.

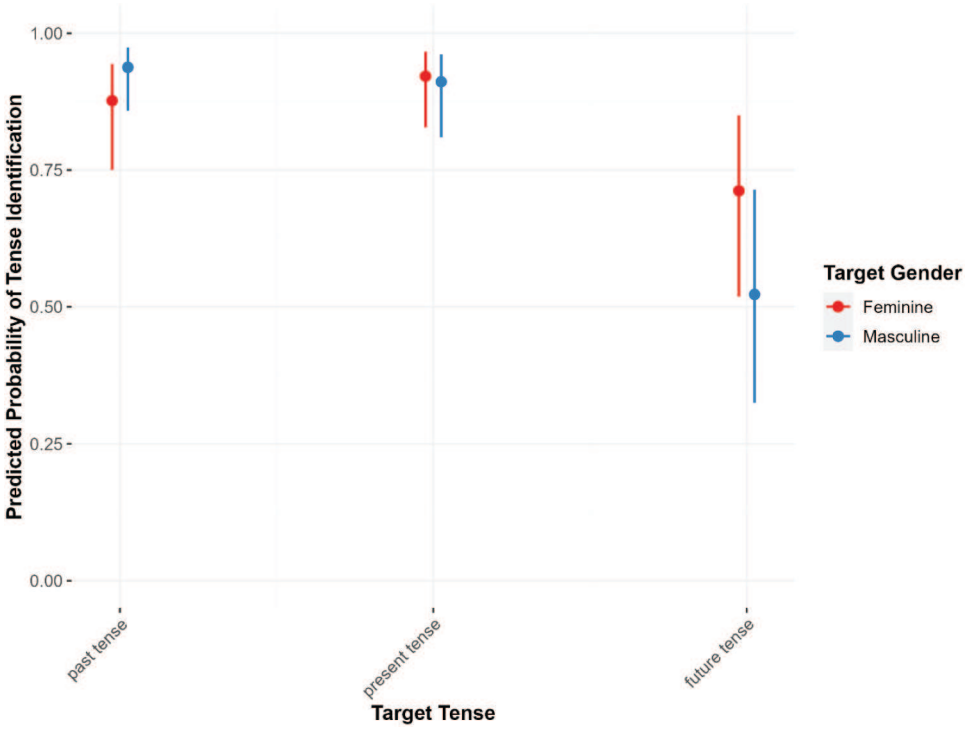

Figure 2. Predicted probabilities of tense identification accuracy by target gender and target tense.

group $\chi^2(1) = 6.29$, $p < 0.05$, indicating that children with DLD were less likely to correctly identify verb tense (odds ratio (OR) 0.39, $p < 0.05$) compared to TD peers. The effect of age on tense comprehension performance was not significant, $\chi^2(1) = 3.57$, $p = 0.058$. Further, the effect of target tense on tense identification accuracy was significant, $\chi^2(2) = 14.77$, $p < 0.001$. Children with and without DLD were less likely to identify future tense verbs (OR = 0.35, $p < 0.01$) than past tense verbs. There was no significant difference in children's ability to identify present tense verbs compared to past tense verbs (OR = 1.65, $p = 0.249$). The only significant interaction observed was between target tense and target gender, $\chi^2(2) = 6.98$, $p < 0.05$. The proportion of correctly identified verbs across different tenses and gender markings is depicted in Figure 2. Accuracy generally increases from future to past tense for both genders, with the distinction between genders being more pronounced in the future tense.

To unpack the two-way interaction, a post-hoc analysis with Bonferroni correction was applied. We first examined performance differences between masculine and feminine verbs within each verb tense. Children showed lower accuracy in identifying future tense masculine verbs (estimated marginal mean [EMM] = −0.74, SE = 0.29) compared to future tense feminine verbs (EMM = 0.29, SE = 0.29, $p < 0.05$). However, no significant differences were found between masculine and feminine verbs in identifying present or past tense verbs (all $p = 1.0$). Subsequently, we examined the effect of target gender across verb tenses. For feminine verbs, children were significantly less likely to identify future tense verbs (EMM = 0.29, SE 0.29, $p < 0.01$) compared to present tense verbs (EMM = 1.62, SE 0.30). No significant differences in accuracy were observed between future and past tenses ($p =$

Table 4. Parameter estimates of the gender marker logistic mixed-effects model.

Predictors	Odds Ratios	CI	*p*
(Intercept)	14.65	1.89–113.43	**0.010**
Age	1.01	0.98–1.04	0.451
Income [Low]	1.23	0.47–3.22	0.666
Income [Medium]	0.84	0.39–1.79	0.652
Income [Very High]	0.79	0.21–2.94	0.730
Group [DLD]	0.13	0.06–0.29	**< 0.001**
Target gender [masculine]	0.26	0.12–0.55	**< 0.001**
Target tense [present tense]	0.43	0.20–0.92	**0.031**
Group [DLD] × target gender [masculine]	1.54	0.81–2.90	0.185
Group [DLD] × target tense [present tense]	1.55	0.81–3.00	0.188
Target gender [masculine] × target tense [present tense]	1.46	0.53–3.99	0.466
(Group [DLD] × target gender [masculine]) × target tense [present tense]	1.10	0.48–2.56	0.818
Random Effects			
σ^2		3.29	
$\tau_{00\ ID}$		1.19	
$\tau_{00\ Item}$		0.36	
ICC		0.32	
$N_{\ ID}$		67	
$N_{\ Item}$		40	
Observations		2680	
Marginal R^2/Conditional R^2		0.155/0.425	

Values in bold are significant at the $p < .05$ level.

0.12), or between present and past tenses ($p = 1.0$). For masculine verbs, children were less likely to identify future tense verbs present (EMM = −0.74, SE = 0.29) compared to both present tense verbs (EMM = 1.47, SE = 0.30, $p < 0.001$) and past tense verbs (EMM = 1.86, SE = 0.31, $p < 0.001$). No significant difference in accuracy observed between present and past tense verbs ($p = 1.0$). No other factor or interaction significantly predicted the likelihood of tense identification accuracy.

Gender analysis

Analysis was based on the set of gender items ($n = 40$). The model fit was significantly better than the intercept-only baseline model (AIC = 2605.8, $\chi^2(11) = 48.24$, $p < 0.001$). Model results are presented in Table 4. A significant main effect of group was found, $\chi^2(1) = 26.57$, $p < 0.001$, indicating that children with DLD were less likely (OR = 0.13, $p < 0.001$) to correctly identify gender verb inflections compared to the TD group. The effect of age on gender comprehension performance was not significant, $\chi^2(1) = 0.56$, p =0.45. There was a significant effect of target gender, $\chi^2(1) = 12.52$, $p < 0.001$), revealing that children with and without DLD were less likely to identify masculine verbs (OR = 0.26, $p < 0.01$) compared to feminine verbs. A significant effect of target tense was found, $\chi^2(1) = 4.67$, $p < 0.05$. Children in both groups were less likely to identify gender inflections in present tense verbs (OR = 0.43, $p < 0.05$) compared to past tense verbs.

Number analysis

Analysis was based on the set of number items ($n = 40$). The model fit was significantly better than the intercept-only baseline model (AIC = 2773.6, $\chi^2(15) = 67.76$, $p < 0.001$). Model results are presented in Table 5. A significant main effect of age was found, $\chi^2(1)$

Table 5. Parameter estimates of the number marker logistic mixed-effects model.

Predictors	Odds Ratios	CI	*p*
(Intercept)	0.52	0.07–3.92	0.525
Age	1.03	1.00–1.07	**0.023**
Income [Low]	1.01	0.39–2.61	0.979
Income [Medium]	0.78	0.37–1.67	0.530
Income [Very High]	0.74	0.20–2.70	0.644
Group [DLD]	0.20	0.10–0.44	**< 0.001**
Target number [plural]	2.74	1.29–5.81	**0.009**
Target tense [present tense]	0.66	0.28–1.51	0.321
Target gender [masculine]	0.66	0.29–1.53	0.335
Group [DLD] × target number [plural]	1.16	0.61–2.22	0.648
Group [DLD] × target tense [present tense]	1.82	0.90–3.66	0.093
Target number [plural] × target tense [present tense]	2.91	0.99–8.57	0.052
Group [DLD] × target gender [masculine]	1.03	0.50–2.09	0.943
Target tense [present tense] × target gender [masculine]	2.58	0.79–8.43	0.116
(Group [DLD] × target number [plural]) × target tense [present tense]	0.52	0.20–1.33	0.172
(Group [DLD] × target tense [present tense]) × target gender [masculine]	0.80	0.29–2.15	0.651
Random Effects			
σ^2		3.29	
$\tau_{00\ ID}$		1.19	
$\tau_{00\ Item}$		0.28	
ICC		0.31	
N_{ID}		67	
N_{Item}		40	
Observations		2680	
Marginal R^2/Conditional R^2		0.206/0.450	

Values in bold are significant at the $p < .05$ level.

= 5.18, $p < 0.05$, indicating that older children were more likely than younger children to accurately comprehend number inflections. There was also a significant main effect of group, $\chi^2(1) = 16.92$, $p < 0.001$, revealing that with children with DLD were less likely (OR = 0.20, $p < 0.001$) to identify number inflections compared to TD peers. Further, a main effect of target number was found, $\chi^2(1) = 6.89$, $p < 0.01$, indicating that children with and without DLD were more likely to identify plural verbs than singular verbs (OR = 2.74, $p < 0.01$).

Discussion

To our knowledge, this study is the first to profile verb morphology comprehension abilities in Arabic-speaking children with and without DLD. We examined how children with DLD compare to their TD peers in understanding verb tense, gender, and number agreement. Our results revealed significant group differences, with the DLD group exhibiting lower overall performance on the verb morphology comprehension task. This aligns with previous crosslinguistic evidence (e.g. Blom et al., 2014; Leonard et al., 2000; Stegenwallner-Schütz & Adani, 2021; Yarbay Duman & Topbaş, 2016), suggesting that verb morphology comprehension may be an area of particular difficulty for Arabic-speaking children with DLD.

Children with DLD demonstrated a 59.59% accuracy rate in identifying verb tense, while their TD peers achieved a higher accuracy rate of 75.29%. This suggests that although tense comprehension ability in children with DLD, aged 4 to 6 years, is developing, it has not yet been fully mastered. Children with DLD had difficulty identifying future, present, and past tense forms. While previous research has reported that Arabic-speaking children with DLD have difficulty producing present and past

tense forms (Abdalla & Crago, 2008; Abdalla & Mahfoudhi, 2023; Fahim, 2017; Taha et al., 2021a), our findings extend these results to include comprehension deficits in these verb tenses. This study is also the first to examine and report difficulties with future tense comprehension among Arabic-speaking children with DLD, an area that has not been explored in previous Arabic production research.

Our findings align with Christou, Andreu, et al. (2022), who reported similar challenges with future tense verbs in Spanish-Catalan children with DLD. In our study, both TD and DLD groups exhibited greater difficulty identifying future tense verbs compared to present and past tenses. This is consistent with Herriot's (1969), which found that English-speaking TD children up to the age of 6 years may struggle to comprehend the future tense, especially when paired with present-tense verbs. These results can be explained from cognitive and structural perspectives. Cognitively, verb tenses indicate when events occur relative to the speaker's present moment. The future is inherently uncertain and unfolds on a timeline ahead of the speaker. Conversely, past events are definite and recede backward. Understanding tense morphology relies on the ability to locate actions relative to 'now' (Radden & Dirven, 2007). The future's speculative nature, compared with the concreteness of the past and present, makes it cognitively demanding for children to grasp, potentially explaining the observed difficulty with future tense. Structurally, future tense verbs in Arabic are often more complex than past and present verb forms. For instance, the verb /*bɪjɑkɪl*/ 'he will eat' is formed by adding the prefix *bɪ*- to the present verb form /*jɑkɪl*/ 'he is eating', whereas the past /*ʔakal*/ 'he ate' form is not marked by any inflections.

Children with DLD demonstrated significantly lower accuracy than their TD peers in identifying gender and number agreement inflections. Both TD and DLD children demonstrated greater difficulty in identifying masculine verbs compared to feminine verbs for gender agreement. Furthermore, both groups exhibited more challenges in identifying singular verbs than plural verbs for number agreement. This observed pattern may reflect the way children process agreement inflections. Plural verbs (e.g., /*jɑklu:n*/ for 'they eat') have more pronounced markings than singular verbs (e.g., /*jɑkɪl*/ for 'he eats'), making them acoustically more distinct and easier to recognise. These findings support the 'surface hypothesis' proposed by Leonard (1989), which suggests that children with DLD struggle more with grammatical elements that are phonologically less salient and shorter in duration. In Arabic, the feminine (e.g., /*ʔakɑlat*/ 'she ate') and plural (e.g., /*ʔakɑlu:*/ 'they ate') verb forms are morphologically more complex (marked by more morphemes) than masculine and singular forms (e.g., /*ʔakɑl*/ 'he ate'). This increased complexity enhances their acoustic salience, making them easier to distinguish in speech. This finding is consistent with Kouider et al. (2006) and Miller and Schmitt (2014), who suggested that that multiple inflections on verbs can aid children's comprehension. Such morphological cues provide more explicit signals to aid decoding verb forms, potentially explaining the better understanding of feminine and plural verbs compared to masculine and singular forms among Arabic-speaking children. Children may find it more challenging to comprehend verb forms without overt morphological marking, but they understand explicitly marked forms earlier (Johnson et al., 2005).

Our preliminary findings indicate that Arabic-speaking children with DLD experience difficulties comprehending verb tenses (future, present, and past) and agreement (gender and number). These results mirror previous research documenting similar challenges in verb morphology production among children with DLD (Abdalla & Crago, 2008; Abdalla &

Mahfoudhi, 2023; Taha et al., 2021a). This suggests that verb morphology is a persistent area of weakness for Arabic-speaking children with DLD, affecting both comprehension and production. These findings align with studies in other languages, such as Dutch (Blom et al., 2014) and English (Rice et al., 1999).

Our results demonstrate that difficulties in comprehending verb morphology extend to both tense and agreement, consistent with findings in French-speaking children with DLD (Maillart & Schelstraete, 2005). Their findings showed that DLD children detected fewer verb morphology violations (tense and agreement errors) than word order violations. This suggests specific difficulties with certain types of grammatical errors, potentially challenging the applicability of Rice's Extended Optional Infinitive (EOI) account in French. In contrast, Rice et al. (1999) found that English-speaking children with DLD had more difficulty detecting tense violations than agreement violations. They were more likely to accept tense violations but consistently rejected agreement violations. This suggests that their grammatical judgement mirrors their production ability, supporting the EOI account, which posits morphosyntactic limitations rather than input processing or production constraints in DLD. Blom et al. (2014) identified parallel production and comprehension errors in subject-verb agreement among Dutch-speaking children with DLD. However, their study did not investigate verb tense. They explained these agreement difficulties based on Clahsen's (2008) account, which suggests that DLD involves incomplete or disrupted representations of verb inflection. Furthermore, the study indicated that phonological constraints, specifically those related to verb phonology, influenced the production and processing of subject-verb agreement in Dutch-speaking children with DLD. These findings reveal that children with DLD experience difficulties with verb morphology comprehension across languages. However, the specific nature of these difficulties varies depending on the unique linguistic characteristics of each language and differences in research methodologies employed across studies.

Our study reveals potential differences in the difficulty patterns of verb tenses and agreement based on our comprehension task (picture selection) compared to production findings from previous studies. In our comprehension task, children exhibited more difficulty with masculine and singular verbs, contrasting with existing research on production, which found greater difficulty with feminine and plural verbs (Abdalla & Crago, 2008; Abdalla & Mahfoudhi, 2023; Taha et al., 2021a). This suggests that while Arabic-speaking children with DLD experience difficulties with verb morphology in both comprehension and production, the specific types of difficulties differ between the two domains. The greater difficulty with masculine and singular forms, compared to feminine and plural forms, found in this study was evident in both children with and without DLD. This suggests that these challenges may be influenced by the linguistic characteristics of Arabic rather than being solely attributed to DLD. Furthermore, the controlled nature of the picture selection task may not fully capture the complexity of verb morphology comprehension in naturalistic language contexts, potentially influencing the findings. Future research employing a variety of assessment tasks could provide a more comprehensive understanding of verb morphology comprehension difficulties in Arabic-speaking children.

Limitations

The findings of this study should be considered in light of the following limitations. While the total sample size of 67 is comparable to many studies, the relatively small group sizes (DLD = 31, TD = 36) may limit the generalisability of the results. The observed differences in error patterns – more errors for masculine and singular verbs in our comprehension task, compared to more errors for feminine and plural verbs in previous production studies – could be due to the specific design of our picture selection task or other factors unique to this participant group, such as age or linguistic background. The absence of production data in our study prevents a direct comparison of comprehension and production performance in these children. Moreover, the current study relied on static photographs to represent dynamic actions. This approach that may have inadvertently reduced overall performance and potentially influenced results (Ambridge & Rowland, 2013). Using live-action videos could potentially be more effective at conveying actions, leading to improved understanding (Ambridge & Rowland, 2013). Finally, potential unintentional bias may have been introduced during testing, as the first author, who was aware of the participants' language groups (DLD vs. TD), administered the task.

Clinical implications

This study offers valuable insights for SLTs working with Arabic-speaking children with DLD. The findings reveal specific challenges these children encounter in comprehending verb morphology, including difficulties with identifying verb tenses (future, present, and past), subject-verb number agreement (singular and plural), and gender agreement (masculine and feminine). These results highlight the importance of including verb morphology comprehension assessment into the evaluation of morphosyntax skills in Arabic-speaking children with DLD.

Conclusions

This study has identified that Saudi Arabic-speaking children with DLD experience significant comprehension deficits in verb tenses and subject-verb agreement, particularly with verbs in the future tense, masculine gender, and singular number. These findings contrast with previous research on the production of verb morphology in Arabic-speaking children with DLD, which, despite variations in dialect, reported minimal difficulties with these forms. This discrepancy between comprehension and production abilities warrants further research to explore potential factors contributing to this difference. Future studies should systematically examine both comprehension and production within the same sample and across different Arabic dialects. Employing longitudinal designs to track developmental changes over time and including both comprehension and production measures will provide a more comprehensive understanding of verb morphology difficulties in Arabic-speaking children with DLD.

Notes

1. All Arabic words in this article are represented using Arabic IPA transcription.

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Data availability statement

The data set reported on in this study can be made available upon reasonable request to the corresponding author.

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Appendices

Appendix A. Verb paradigm in Saudi Arabic for the root a–k–l (eating).

Tense	Person	Number	Gender	Affixes	Verb + suffix	Gloss
Past	First	Singular	Neutral	–t	/ʔakalt/	I ate
		Plural	Neutral	–na	/ʔaklna/	We ate
	Second	Singular	Male	–t	/ʔakalt/	You ate
			Female	–ti	/ʔaklti/	
		Plural	Neutral	–tu	/ʔakltu/	
	Third	Singular	Male	∅	/ʔakal/	He ate
			Female	–at	/ʔakalat/	She ate
		Plural	Neutral	–u	/ʔakalau/	They ate
Present	First	Singular	Neutral	a-	/akɪl/	I eat
		Plural	Neutral	na	/nakɪl/	We eat
	Second	Singular	Male	ta	/takɪl/	You eat
			Female	ta, i:n	/takli:n/	
		Plural	Neutral	ta, u:n	/taklu:n/	
	Third	Singular	Male	ja-	/jakɪl/	He eats
			Female	ta-	/takɪl/	She eats
		Plural	Neutral	ja, u:n	/jaklu:n/	They eat
Future	First	Singular	Neutral	ba-	/bakɪl/	I will eat
		Plural	Neutral	b+na	/bnakɪl/	We will eat
	Second	Singular	Male	b+ta	/btakɪl/	You will eat
			Female	b+ta, i:n	/btakli:n/	
		Plural	Neutral	b+ ta, u:n	/btaklu:n/	
	Third	Singular	Male	bɪ+ja	/bɪjakɪl/	He will eat
			Female	b+ta	/btakɪl/	She will eat
		Plural	Neutral	bɪ+ja, u:n	/bɪjaklu:n/	They will eat

Note: The gender category 'Neutral' denotes that gender is not distinguished by the affix attached to the verb.
Verb paradigm in Saudi Arabic for the root a – k – l (eating).

Appendix B. List of verbs used in verb tense comprehension trials.

		Gender	
Target variable	Tense Type	Masculine	Feminine
Tense	Past	/lɪ.bas/ wear-PAST-3MS	/fta.ħat/ open-PAST-3FS
		/rak.kab/ assemble-PAST-3MS	/ɡaʃ.ʃa.rat/ peel-PAST-3FS
		/ra.sam/ draw-PAST-3MS	/kas.sa.rat/ crush-PAST-3FS
		/kan.nas/ sweep-PAST-3MS	/ɡɑsˁ.sˁ ɑt/ cut-PAST-3FS
		/na.fax/ blow-PAST-3MS	/maʃ. ʃa.tˁ ɑt/ comb-PAST-3FS
	Present	/jɪ.sˁ ʊb/ pour- PRES-3MS	/tɡatˁ.tˁ ɪʕ/ chop-PRES-3FS
		/jɪ.rak.kɪb/ assemble-PRES-3MS	/tɪn.fax/ blow- PRES-3FS
		/jɪf.taħ/ open-PRES-3MS	/tɡɪsˁ/ cut- PRES-3FS
		/jɪ.ɡaʃ.ʃɪr/ peel- PRES-3MS	/tɪl.bas/ wear-PAST-3FS
		/jɪ.ɣas.sɪl/ wash-PAST-3MS	/tkan.nɪs/ sweep-PRES-3FS
	Future	/bɪ.sˁ ʊb/ pour-FUT-3MS	/btɪf.taħ/ open-FUT-3FS
		/bɪ.ʃi:l/ carry-FUT-3MS	/bɪt.maʃ.ʃɪtˁ/ comb-FUT-3FS
		/bɪ.ɡaʃ.ʃɪr/ peel- FUT −3MS	/bɪt.kan.nɪs/ sweep-FUT-3FS
		/bjɪn.fax/ blow-FUT-3MS	/bɪt.kas.sir/ crush-FUT-3FS
		/bja.kɪl/ eat-FUT-3MS	/bɪt.ɣas.sɪl/ wash-FUT-3FS

Note. Each dot (.) in the phonetic transcription indicates a syllable boundary. For example, "lɪ.bas" is divided into two syllables: "lɪ" and "bas". PAST-3MS = past third-person masculine singular; PAST-3FS = past third-person feminine singular; PRES-3MS = present third- person masculine singular; PRES-3FS = present third-person feminine singular; FUT-3MS = future third-person masculine singular; FUT-3FS = future third-person feminine singular.

Appendix C. List of verbs used in gender agreement comprehension trials

		Tense	
Target variable	Gender	Past	Present
Gender agreement	Masculine	/ʔa.kal/ eat-PAST-3 MS	/jɪf.taħ/ open-PRES-3 MS
		/ʃa.rab/ drink-PAST-3 MS	/jɪm.saħ/ wipe-PRES-3 MS
		/rak.kab/ assemeble-past-3 MS	/jmaʃ. ʃɪtˁ/ comb-PRES-3 MS
		/kɪ.tab/ write-PAST-3 MS	/jɪk.tɪb/ write-PRES-3 MS
		/maʃ. ʃɑtˁ/ comb-PAST-3 MS	/jɪ.kas.sɪr/ crush-PRES-3 MS
		/mɪ.saħ/ wipe-PAST-3 MS	/jɪ.rak.kɪb/ assessbmel- PRES-3 MS
		/kas.sar/ crush-PAST-3 MS	/jɪk.nɪs/ sweep-PRES-3 MS
		/fɪ.taħ/ open-PAST-3 MS	/jɪʃ.rab/ drink-PRES-3 MS
		/kan.nas/ sweep-PAST-3 MS	/jlaw.wɪn/ colour-PRES-3 MS
		/law.wan/ colour-PAST-3 MS	/ja:.kɪl/ eat-PRES-3 MS
	Feminine	/ɡɑtˁ. tˁ ɑ.ʕat/ chop-PAST-3FS	/tɡɑtˁ.tˁ ɪʕ/ chop-PRES-3FS
		/far.ra.ʃat/ brush-PAST-3FS	/tfar.rɪʃ/ brush -PRES-3FS
		/ɡaʃ.ʃa. ʀat/ peel-PAST-3FS	/tɡaʃ. ʃɪr/ peel- PRES-3FS
		/ɪn.fa.xat/ blow-PAST-3FS	/tɪn.fax/ blow- PRES-3FS
		/sˁ ɑb.bɑt/ pour-PAST-3FS	/tsˁ ʊb/ pour- PRES-3FS
		/naʃ.ʃa.fat/ dry-PAST-3FS	/tnaʃ.ʃɪf/ dry- PRES-3FS
		/ɣas.sa.lat/ wash-PAST-3FS	/tʃi:l/ carry- PRES-3FS
		/ɛr.sɪ.mat/ draw-PAST-3FS	/tɡɪsˁ/ cut- PRES-3FS
		/ʃa:.lat/ carry-PAST-FS	/tɪr.sɪm/ draw-PRES-3FS
		/ɡɑsˁ.sˁ ɑt/ cut-PAST-3FS	/tɣas.sɪl/ wash- PRES-3FS

Each dot (.) in the phonetic transcription indicates a syllable boundary. For example, ʔa.kal is divided into two syllables: ʔa "and 'kal'. PAST-3 MS = past third-person masculine singular; PAST-3FS = past third-person feminine singular; PRES-3 MS = present third- person masculine singular; PRES-3FS = present third-person feminine singular.

Appendix D. List of verbs used in number agreement comprehension trials.

			Verb Tense	
Target Variable	Number	Gender	Past	Present
Number agreement	Singular	Masculine	/ʃa.rab/ drink-PAST-3 MS	/jgaʃ. ʃɪr/ peel-PRES-3 MS
			/far.raʃ/ brush-PAST-3 MS	/jɪn.fax/ blow- PRES-3 MS
			/gɑsˁ sˁ/ cut-PAST-3 MS	/jfar.rɪʃ/ brush -PRES-3 MS
			/nɪ.fax/ blow-PAST-3 MS	/jɪʃ. rab/ drink-PRES-3 MS
			/gaʃ.ʃar/ peel-PAST-3 MS	/jɪ.gɪsˁ/ cut- PRES-3 MS
		Feminine	/ʔa.ka.lat/ eat-PAST-3FS	/tmaʃ. ʃɪtˁ/ comb-PRES-3FS
			/maʃ.ʃa.tˁ ɑt/ comb-PAST-3FS	/tɪl.bas/ wear-PAST-3FS
			/ɛr.sɪ.mat/ draw-PAST-3FS	/tɪk.tɪb/ write-PRES-3FS
			/ka.ta.bat/ write-PAST-3FS	/ta.kɪl/ eat-PRES-3FS
			/lbɪ.sat/ wear-PAST-3FS	/tɪr.sɪm/ draw-PRES-3FS
	Plural	Neutral	/maʃ.ʃa.tˁ au/ comb-PAST-3P	/ʔɪ.sˁ ɪb.bu:n/ pour-PRES-3P
			/far.ra.ʃau/ brush-PAST-3P	/ja:.klu:n/ eat-PRES-3P
			/gaʃ.ʃa.rau/ peel-PAST-3P	/jɪʃ.ra.bu:n/ drink-PRES-3P
			/ɪn.fa.xau/ blow-PAST-3P	/jɪ.gatˁ .ʕu:n/ chop-PRES-3P
			/sˁ ab.bau/ pour-PAST-3P	/jɪ.far.ʃu:n/ brush-PRES-3P
			/law.wa.nu/ colour-PAST-3P	/jɪn.fa.xu:n/ blow-PRES-3P
			/ʃra.bau/ drink-PAST-3P	/ʔɪ.maʃ.tˁ u:n/ comb-PRES-3P
			/naʃ.ʃa.fau/ dry-PAST-3P	/ʔɪ.gaʃ.ru:n/ peel-PRES-3P
			/gɑtˁ.tˁ ɑ.ʕau/ chop-PAST-3P	/ʔɪ.naʃ.fu:n/ dry- PRES-3P
			/ʔa.ka.lau/ eat-PAST-3P	/ʔɪ.law.nu:n/ colour-PRES-3P

Each dot (.) in the phonetic transcription indicates a syllable boundary. For example, ' ʃa.rab' is divided into two syllables: 'ʃa' and 'rab'. PAST-3 MS = past third-person masculine singular; PAST-3FS = past third-person feminine singular; PRES-3 MS = present third- person masculine singular; PRES-3FS = present third-person feminine singular; PRES-3P= present third-person plural; PAST-3P= past third- person plural.