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Later lexical development in Hebrew peer talk

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This study examines later lexical development in Hebrew, focusing on the spoken discourse of school-aged participants. A new corpus was recorded and transcribed for this research, consisting of triadic peer conversations among children and adolescents. The study included 72 native Hebrew speakers, divided into four age/grade-level groups: 1st−2nd graders, 3rd−4th graders, 5th−6th graders, and 7th−8th graders. Two categories of lexical items were analyzed in the corpus, which contained nearly 100,000 words: content words (nouns, verbs, adjectives, and lexical adverbials) and discourse words (discourse markers, social words, and address forms). The study explores the distributional changes of these lexical categories across development, providing insights into language development and socio-cognitive growth during the school years.

Introduction

From the early stages of systematic psycholinguistic research, much of the literature on language acquisition has focused on the preschool years. This emphasis reflects a general consensus among researchers that typically developing children have acquired the core lexicon and most morphological and syntactic structures of their mother tongue(s) by the time they reach school age (Brown, 1973; Clark, 2016; Kidd and Garcia, 2022; Ravid, 2019a; Slobin, 1985). However, language development is far from complete at age five. In fact, it continues throughout the school years and into early adulthood, with ongoing growth in all areas of language and communication (Ameel et al., 2014; Ayala et al., 2023; Blything et al., 2022; Dawson et al., 2018; Evorato and Cacciari, 2002; Vainio et al., 2019).

The aim of the current article is to explore Later Lexical Development in Hebrew, as evidenced in the spoken discourse of school-aged children, with a focus on the implications for socio-cognitive growth. Our analysis draws on a novel database of Hebrew peer talk from school-going (pre)adolescents aged 8–14 years, and compares it with a younger group of children aged 6–8 years. This entire age range spans a significant portion of the Israeli educational system, from the early elementary years through to the end of middle school.[1]

Cognitive and socio-affective development during the school years

Later language development, typically occurring between the ages of 9 and adulthood, plays a critical role in preparing individuals for active participation as communicators in

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1   Most (but not all) Israeli children graduate Elementary School at the end of the 6th grade and start Middle School by 7th grade. For a large minority in several areas, Extended Elementary School goes up to 8th grade. Highschool starts at 10th grade for graduates of Middle School and at 9th grade for those attending Extended Elementary School.

the adult speech community, ultimately leading to mature native language proficiency (Berman, 2004, 2017; Berman and Ravid, 2009; Nippold, 2016). This period is also characterized by significant brain reorganization, with changes in brain structures and functions that are particularly pronounced during adolescence (Fuhrmann et al., 2015; Kadosh et al., 2013; Paus, 2005; Simmonds et al., 2014). Multi-modal brain areas undergo both structural and functional transformations, which enhance brain connectivity and activation. These changes support the integration of areas responsible for higher cognitive functions (Kilford et al., 2016; Larsen and Luna, 2018). As a result, these neural developments have significant socio-cognitive effects which improve attention, cognitive flexibility, executive functions, goal management, memory, and processing abilities in older children, adolescents and young adults (Gooch et al., 2016; Lecce et al., 2017; Osterhaus et al., 2017; Tolchinsky and Berman, 2023). Due to these structural changes, adolescent brains are especially sensitive to environmental influences, such as peer pressure.

One key cognitive outcome of adolescent brain development is a dramatic improvement in processing abilities. While younger children rely on limited cognitive resources (Elman, 1993), focusing on frequent, salient, and predictable language categories (Dattner et al., 2023; De Ruiter et al., 2018), older learners have enhanced cognitive capacities—particularly in attention, memory, processing, and literacy skills—that allow them to process more linguistic complexity (Kilford et al., 2016; Larsen and Luna, 2018). As a result, older children and adolescents are better able to focus on less frequent or prominent linguistic features (Ramscar et al., 2018) and adapt to the changing structure of language input, particularly in the shift from spoken to written language (Berman, 2008; Onnis and Thiessen, 2013). These cognitive developments allow older learners to extract information from larger and more diverse data sets, enabling them to learn less prominent language categories and items.

Many of the changes in adolescent brains are associated with areas involved in social cognition (Best and Ban, 2021; Blakemore, 2012; Padilla-Walker and Van der Graaff, 2023), making socio-affective contexts—particularly peer interactions—crucial in shaping development. Notably, these changes contribute to the maturation of Theory of Mind (ToM), including a growing understanding of one's own and others' emotions and behaviors, which facilitates cooperation and interaction with peers. Adolescents also undergo significant psychological changes, including developments in self-awareness and identity, which influence how they engage with others. Compared to younger children, adolescents are more sociable and form more complex, hierarchical peer relationships (Giletta et al., 2021; Meeus, 2016).

Given these developmental shifts, the current study focused on peer talk as a key arena for examining language as reflecting social-cognitive development during later childhood and adolescence.

Later lexical development

The neural and socio-cognitive changes that occur during adolescence culminate in the emergence of mature, complex language abilities during the phase known as Later Language Development (Berman, 2017; Clark, 2004; Kuhn, 2011; Proverbio and Zani, 2005). Language skills continue to evolve through

the school years into young adulthood and beyond (Berman, 2007; Berninger et al., 2017; Gooch et al., 2016; Nippold, 2016). These developments support the acquisition of automatic, flexible, and abstract language use capabilities, alongside enhanced metalinguistic abilities and the capacity for higher-order, non-literal language (Berman and Ravid, 2010; Ravid, 2006a; Karmiloff-Smith, 1994; Nippold and Duthie, 2003). In parallel, adolescents gain access to a broader range of new lexical items and linguistic constructions (Ravid and Tolchinsky, 2002; Tolchinsky, 2022).

A key aspect of language proficiency during this period is lexical development, particularly within the content and referential domains (Strömqvist et al., 2002), with a focus on nouns, adjectives, and verbs (Beitchman et al., 2008). As cognitive, social, and linguistic skills mature, individuals develop greater abstract reasoning and analytical abilities (Hollarek and Lee, 2022). These advancements are reflected in their use of more complex vocabulary, which is often characteristic of academic language (Anglin et al., 1993; Nagy and Townsend, 2012). Recent research by Atanasova et al. (2020) further highlights significant differences in lexical knowledge between children and adults, both in terms of accuracy and processing speed. Their findings suggest that, regarding the Age of Acquisition (AoA) of words in production, adolescents (ages 14–16) exhibit an intermediate pattern between younger children and adults, indicating ongoing brain maturation.

Studies of Hebrew, where the lexicon is organized by and around morphological systems, further illustrate these developments. In Hebrew, command of derivational morphology and morpho-lexical abilities increases exponentially throughout adolescence. This includes the acquisition of morphologically structured mental words, abstract and derived nouns (Ravid, 2006a; Ravid and Avidor, 1998), denominal adjectives (Cutillas and Tolchinsky, 2017; Ravid et al., 2016), and specialized vocabulary across all lexical classes (Ben-Zvi and Levie, 2016; Berman and Nir-Sagiv, 2010).

Later lexical development in the spoken mode

Most prior studies investigating language development during the school years have focused on the written mode (Anglin et al., 1993; Berman et al., 2011; Dabrowska, 2018; Larsen and Nippold, 2007; Ravid and Levie, 2010), regarding written texts as "optimal hunting grounds" for unveiling later linguistic abilities (Haim and Ravid, 2022), especially in the context of genre-specific text types (Jisa and Tolchinsky, 2009). The idea is that the written mode, occupying a privileged cognitive position for literate individuals, imposes cognitive demands on memory, executive functions, and top-down processing, promoting the retrieval of high-register lexical items and the creation of complex syntactic units (Chafe, 1992; Kärkkäinen et al., 2007; White, 2014). Indeed, there is ample evidence regarding the lexical and syntactic density and complexity of the written mode in the later development of text production abilities (Nippold and Sun, 2008; Ravid and Berman, 2010; Tolchinsky et al., 2010). In contrast, little work has been done on the lexical characteristics of spoken interaction in school-aged children and adolescents. It makes sense to assume that Later Language conversation might be constrained by the characteristics

of online discourse (Ravid and Chen-Djemal, 2015), with lesser density and diversity of lexical items than the written mode; however there can be no doubt that participants' age and schooling experience must drive lexical acquisition in ways that can be discerned even in the contexts of spoken interaction (Levie et al., 2020).

Against this background, the current study focuses on conversation as the core of inter-personal linguistic communication, the most natural and immediate implementation of language abilities (Casillas and Frank, 2017; Levinson, 2019)—a shared, timed communicative activity requiring attention, memory and ToM resources (Hari and Kujala, 2009). It is an established fact that early language learning directly derives from the wiring of brain social interaction pathways (Baldwin, 1995; Brooks and Meltzoff, 2005; Conboy et al., 2008; Kuhl, 2007). Specifically, turntaking and communication repairs provide rich socio-cognitive experience which drives linguistic acquisition (Dingemanse et al., 2015; Kendrick et al., 2023). As these social interaction pathways continue to develop with age and schooling, constituting an important socio-cognitive achievement at teenage, they provide another venue for investigating the development later lexical abilities.

Peer talk

The current study investigates lexical distributions in children and adolescents in peer talk—i.e., spontaneous spoken interactions with their close friends (see Methods Section below). Peer interactions (Ellis and Zarbatany, 2017) are characterized by several properties that can be taken to reflect children's foundational abilities, unassisted by teachers or parents, and may also benefit and enhance lexical expression. First, peer talk among children reflects self-management with no external intervention or support by adults (Forrester and Cherrington, 2009; Veneziano, 2018). Second, this communicative context provides the most motivation for participants to talk to each other and carry out transactional interactions (Veneziano, 2010). Third, peer talk enables spontaneous play, which is critical in constructing social interactions (Blum-Kulka et al., 2010). Fourth, this is a non-scripted, speedy exchange of speech and activities, requiring constant monitoring and mutual attention to interlocutors' needs, urge management and control – necessitating the usage of ToM vocabulary (Clark and Krych, 2004; Rendle-Short et al., 2014). And finally, this context enables meaningful learning by children from children, which may involve more advanced linguistic resources in expository-like explanations, persuasion and discussion (Zadunaisky Ehrlich, 2011; Zadunaisky Ehrlich and Blum-Kulka, 2010).

Lexical development: concepts, study goals, and hypotheses

This study investigates the characteristics and development of lexical production in children and adolescents aged 6–14 during peer interactions. Lexical acquisition is a key component of mastering mother-tongue proficiency (Berman and Ravid, 2009;

Dockrell and Messer, 2004; Nippold, 2002; Ravid and Ginat-Heimann, 2014), encompassing aspects such as lemma frequency, token use, and lexical categories (Ambridge et al., 2015), as well as lexical depth and associations (Caro and Mendinueta, 2017; Schmitt, 2014; Wolter, 2001). In this context, we focused on token analyses of two primary lexical components: the content lexicon and the discourse lexicon.

The content lexicon

We categorized content words into two main groups: core content words and extended content words, which we define and explain below, along with their implications for our lexical analyses.

Core content words

The *core content words* group includes nouns (e.g., *kir* "wall", *mila* "word"), verbs (e.g., *zuz* "move, Imp", *hevénu* "we brought"), and adjectives (e.g., *zariz* "nimble", *mara* "bitter, Fm"). These three lexical classes are considered "core" for two key reasons. First, they provide essential referential, predicative, and modifying information about the external and cognitive world—covering entities, concepts, events, actions, and their properties (Croft, 2010; Kemmerer, 2014)—and are therefore termed "open class" lexical items (Halliday, 1985). Second, in Hebrew, these categories are morphologically rich, both inflectionally and derivationally, and are governed by structured systems such as root-pattern or word-suffix constructions (Ravid, 1995, 2019b). Research has shown that morphology, morpho-phonology, and morpho-syntax play a critical role in the processing, learning, and use of core content words in many languages (Diependaele et al., 2012; Jarmulowicz and Taran, 2013; Perfetti, 2007)—particularly in Hebrew, a synthetic Semitic language (Frost, 2012; Ravid, 2004). From toddlerhood through adulthood, morphology influences lexical acquisition in Hebrew, encompassing speech, reading, and writing (Bar-On and Ravid, 2011; Levie et al., 2020; Ravid, 2012). Therefore, the expanding core content word lexicon in adolescence reflects an increasing command of morpho-phonology, morpho-syntax, and the internal organization of the Hebrew lexicon by derivational systems (Bar-On et al., 2017; Ravid, 2006a,b; Ravid and Schiff, 2006; Schiff et al., 2011). Core content words thus serve as a key intersection of lexical and morphological development.

Extended content words

In addition to nouns, verbs, and adjectives, we extended the content words category to include adverbials, forming the *extended content words* group. Hebrew adverbials differ from core content words in several ways. They form a heterogeneous class in both semantics and form (Fagard and Sarda, 2014), expressed through a variety of lexical, morphological, and syntactic structures (Ravid, 2019b; Ravid and Shlesinger, 1999). Unlike core content words, adverbials are typically not inflected, and most of them lack systematic derivational structures. However, they play a critical role in modifying predicates, particularly in terms of event or situation circumstances (Comrie and Thompson, 2007; Timberlake, 2007), and are thus essential in spontaneous verbal interactions. For this study, we focused on Hebrew adverbs expressed as single words

(rather than periphrastically), which modify verbs and adjectives within **three** major semantic categories: manner, time, and location (e.g., *maher* "quickly", *telefónit* "by telephone", *axshav* "now").

Content words are considered referential, meaning they convey conceptual information. The proportion of content words in a text—either as a ratio of all words or relative to the number of clauses—has been proposed as an indicator of text readability for comprehension (Halliday, 1985; To et al., 2013) and as a measure of linguistic richness in production (Ravid and Levie, 2010). But no study to date has investigated these distributions developmentally in spoken interactions. Thus, analyzing the frequencies of the Hebrew core and extended content lexicon at any age level is foundational to understanding psycholinguistic development and capturing the expression of conceptual content in spontaneous conversations of peers. We hypothesized that, in general, the number and diversity of content words across all categories would increase with participants' age and level of schooling, reflecting socio-cognitive growth. Regarding the internal structure of the content lexicon, we anticipated that nouns would consistently represent the largest category in usage (Bornstein and Haynes, 1998), while verbs would constitute a smaller but stable proportion of content words across participants (Levie et al., 2020). Modifiers—namely adjectives and adverbs—were expected to account for the smallest proportion of the content lexicon. We further hypothesized that, with age and schooling, the use of modifiers would increase at the expense of nouns and verbs (Ravid and Levie, 2010).

The discourse lexicon

The discourse lexicon plays a crucial role in lexical development, complementing the content lexicon and highlighting the flexible, dynamic cognitive abilities humans use to convey and interpret meaningful intentions (Heintz and Scott-Phillips, 2023). From a linguistic perspective, the discourse lexicon refers to words that are not directly referential or lexical but serve essential communicative, discursive, and social-pragmatic functions (Dickey, 1997). This includes discourse markers, address forms, and various social words expressing affect and stance (Da Costa and Bond, 2016). These discourse elements are critical in interaction throughout all stages of language development (Choi, 2007; Lieven et al., 1992) and continue to play a key role in adults' social and linguistic understanding during communication (Oyetade, 1995). In this framework, we categorized discourse words into three groups: discourse markers, social words, and address forms.

Discourse markers

Discourse markers often arise from adverbials through grammaticalization processes (Dik et al., 1990; Ho-Dac and Péry-Woodley, 2009; Keizer, 2020). They serve to signal relationships between discourse units and express stance by emphasizing, hedging, or intensifying the content of discourse (Choi, 2007; Fagard and Sarda, 2014). Discourse markers help organize discourse structure, capture interlocutors' attention, underscore thematic progression, and facilitate turn-taking (Fagard, 2010, p. 247). For example, an 11-year-old girl says about a classmate,

hu **ma-ze** *batúax she-kulam mekan'ïm bo*—"he['s] **what-that** = so much sure that everyone envies him." According to Chafe (1976), the use of discourse markers in spoken interaction reflects underlying cognitive processes during speech production.

Social words and address forms

Beyond discourse markers, peer interactions are rich with a wide range of social words, including interjections and onomatopoeic expressions (e.g., *boom*, *wow!*), address forms (such as personal names, nicknames, or name-calling, e.g., *ya metumtémet* "you moron"), and various expressions that convey emotion, surprise, and goading (e.g., *yalla*, *ma?* "come on, what?"). These interactions feature terms that reflect augmentation, affirmation, denial, encouragement, and discouragement, among others. All of these elements are crucial for the co-construction of discourse, shaping participant roles and positioning within the conversation, creating joint rhythm and turn-taking synchronization, and constantly addressing the internal mental states of interlocutors (Da Costa and Bond, 2016; Dickey, 1997; Hamilton and Holler, 2023).

Given the lack of comparable prior research, we had no specific expectations regarding the overall frequency or internal distribution of discourse words, nor about their evolving distributions across the age/grade level groups.

Methods

This is one part of the doctoral work of the first author.[2] In the current framework we present the frequencies and distributions of the content and discourse word classes delineated above in a corpus of spontaneous speech interactions of Hebrew-speaking schoolgoing participants in developmental perspective.

Participants and materials

For the current study, a new corpus of children and adolescents engaged in peer conversations was collected, recorded, and transcribed. This age range was chosen for the study based on prior research about age cut-off points that mark significant changes in Later Language Development (Berman, 2005, 2008; Berman and Verhoeven, 2002; Ravid and Hershkovitz, 2017; Ravid, 2006a; Ravid and Levie, 2010). The total research population consisted of 72 participants, 34 boys and 38 girls, from middle- high socio-economic background in central Israel, all native Hebrew speakers with no diagnosed developmental disorders in language or communication, and no history of hearing, vision, attention, learning, or emotional difficulties.

In dividing the participants into age/schooling groups, we relied on the general psycholinguistic and developmental literature, as well as literature on the acquisition of Hebrew, reviewed in the Introduction section (Berman, 2005; Nippold, 2016; Ravid,

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2   Zwilling, R. (In preparation). *The Development of Language and Socio-Cognitive Skills in Spoken Peer Interaction* (Doctoral dissertation). Tel Aviv University, Tel Aviv, Israel.

1995). This review indicated that language development during elementary and middle school years progresses more slowly compared to early childhood acquisition. Therefore, we combined every two consecutive schooling levels into a single age/grade level group, such that the research participants were divided into four age/grade-level groups based on adjacent two-year age ranges as follows:

1. 1st and 2nd grades (age range: 5;8–7;0, mean age: 6;9).
2. 3rd and 4th grades (age range: 8;10–10;0, mean age: 9;8).
3. 5th and 6th grades (age range: 10;11–12;3, mean age: 11;6).
4. 7th and 8th grades (age range: 12;3–14;0, mean age: 13;4).

From this point onward, our reference framework for the participants is the educational systems that host the four research groups: early elementary school (1st—2nd grades), middle elementary school (3rd—4th grades), late elementary school (5th—6th grades), and middle school (7th—8th grades). Triadic conversation was selected for this study as requiring complex turn-taking, the usage of pronominal reference, and the comprehension of the role of a third person in conversation (Dattner et al., 2019; Salazar Orvig et al., 2010). Each age/grade level group thus contained 6 triads (groups of three), i.e., 18 children, and the total number of triads in the study was 24. The triads were formed with a variety of gender combinations, based on the participants' expressed preferences, to ensure a smooth and natural flow of conversation. Each triad conversed for 35 min (a total of 3 h for each age/grade level group), and the total amount of recording time was 12 h.

Data collection and procedures

The recruitment of participants was done through direct contact with their parents. In each triad, the children recruited their close friends, who were likely to be at a similar developmental level and accustomed to close, shared interaction. Each triad was recorded on both video and audio for a total of 35 min, during which they interacted naturally with their peers in their homes. They were instructed to talk about anything that came to their minds, to play with anything they chose, to engage in any activity, or to have a conversation. The only restriction was not to use any screen devices such as computers, phones, iPads and the like. No intervention was made by the researcher, who sat outside the children's field of vision. Before the recordings began, participants were told about the importance of participating in the study and the potential benefits that could result from this research in the field of language acquisition, conversation, and language instruction. The explanation to the children emphasized how their participation could contribute to understanding the development of conversation and communication skills. This explanation helped motivate children to engage in conversation in the same location for the entire recording and to actively participate.

Transcription

The video and audio files were transcribed into Hebrew by three communication disorders students, under the full supervision and guidance of both authors. The reliability of the transcription was ensured by having the first author transcribe 20% of the recordings herself and comparing these transcriptions with those made by the students, with emphasis on accurately conveying the phonetic information in context and clarifying overlapping speech. Since the transcription was in unvowelized Hebrew, disambiguation of homographs was carried out when needed using vowelization or phonetic writing (e.g., ראית could be ra'íta "you, Masc. saw" or ra'it "you, Fm. saw"). The transcription was done while watching the video, with notes and clarifications added about what was happening in the room, participants' body and facial gestures, and physical activity observed, such as wrestling between the children. As part of the transcription process, the text was segmented into utterances, with particular attention given to prosodic intonation patterns that highlight text content (Hill et al., 2021; Wynn et al., 2023). An utterance (in peer talk) is defined as a segment of speech by one speaker. Prosodically it has a distinct melodic pattern, including pauses, rhythm, and loudness changes. Content-wisean utterance is defined as conveying a relatively complete thought or serving a specific communicative function within the interaction, often constituting a turn or part of a turn. This pragmatic unit is highly relevant to samples of spoken language; whereas clauses, which are a syntactic unit, are more relevant to studies of written language (Berman, 2008; Berman and Slobin, 1994).

Coding

Lexical frequencies are typically considered from two perspectives: lexical tokens and lexical types. Lexical tokens refer to the inflected forms of words as they appear in the transcription (e.g., hevánti "I've understood", or macxikot "funny, Fm.Pl"). Token frequency counts the total number of occurrences of these lexical tokens in a given category within the corpus, reflecting their actual usage by participants. Type frequency, on the other hand, is a more abstract measure. It involves extracting the lemma from each token (e.g., the root b-y-n and the verb pattern hif'il, yielding the abstract verb lemma "understand"), and counting each lemma only once. This measure reflects both the size of the category and its diversity within the participants' mental lexicon.

While both measures are important in the developmental psycholinguistic literature (Ambridge et al., 2015), the current study focuses on token frequencies, which are directly influenced by and reflect the syntactic and pragmatic structure of discourse. Accordingly, all content word tokens—nouns, verbs, adjectives, and adverbs—along with all discourse-related tokens, including discourse markers, social words, and address forms, were identified based on their syntactic and discursive contexts. The first author performed the identification and coding, while the second author reviewed 50% of the texts to ensure consistency in lexical classification. For challenging cases, such as determining whether a beynoni present-tense form was a verb, noun, or adjective (Ravid, 1995, 2019b; Ravid and Levie, 2010; Ravid et al., 2016), decisions were made using the syntactic context as well as through discussion and reference to the literature.

TABLE 1 Lexical frequency in the corpus: means, SDs, and ranges of token frequencies for all triads in the study.

Variables	Frequency in the corpus	Descriptive statistics		
		M	SD	Range
Number of words	99,707	4,154.46	1,171.28	2,712–6,797
Number of utterances	30,568	1,273.67	313.09	814–2,068
Number of nouns	13,810	575.42	225.24	249–1,005
Number of verbs	13,387	557.79	148.81	363–945
Number of adjectives	4,721	196.71	65.63	94–326
Number of core content words	31,918	1,329.92	423.45	735–2,259
Number of adverbials	5,587	232.79	69.54	156–416
Number of extended content words	37,505	1,562.71	482.09	921–2,675
Number of discourse markers	3,124	130.17	78.71	34–337
Number of social words	7,918	329.92	88.37	158–513
Number of address forms	1,266	52.75	34.28	11–153
Number of discourse words—general measure	12,308	512.83	137.78	232–801

FIGURE 1
Lexical density in the entire database: nouns, verbs, adjectives, and adverbials ($N = 99,707$).

FIGURE 2
The Content, Discourse, and Function word in the entire database: nouns, verbs, adjectives, and adverbials; discourse markers, social words, and address forms ($N = 99,707$). Note that the remaining non-analyzed words are Function Words.

Results

We start by presenting the general token frequencies in the corpus, followed by developmental analyses of each content and discourse class.

General text frequencies

Table 1 presents the general distributions of the study categories in our database, as against two counts: the number of word tokens and the number of utterances in the corpus.

Table 1 shows the general information regarding lexical frequencies in the study database, consisting of 12 h of triadic conversation transcribed into 24 transcripts, as described in the Participants and Materials section above. The meanings and implications of these lexical characteristics of peer talk are explored in the Discussion section. Figures 1, 2 illustrate these findings.

Figure 1 shows the lexical density of the text in terms of the number of nouns, verbs, adjectives, and adverbials out of all word tokens.

Figure 2 shows the distributions of three lexicons in the database: the extended content lexicon (nouns, verbs, adjectives, and adverbials); the discourse lexicon (discourse markers, social words, and address forms); and the rest of the word
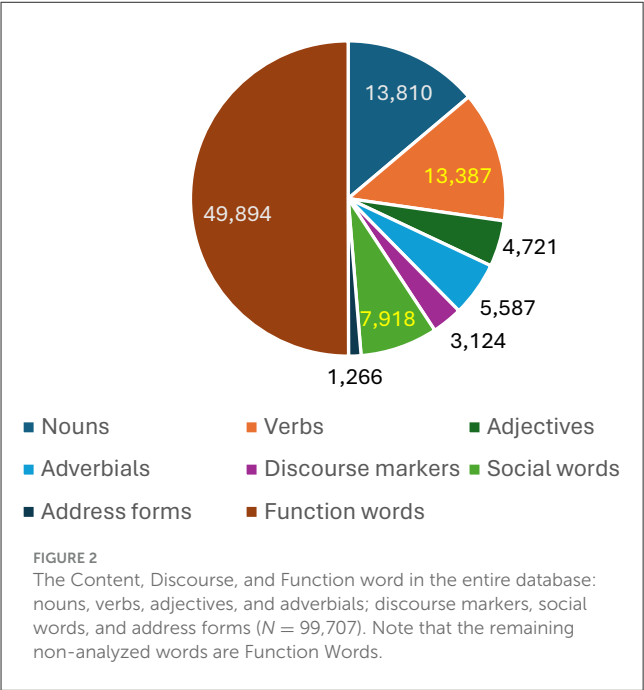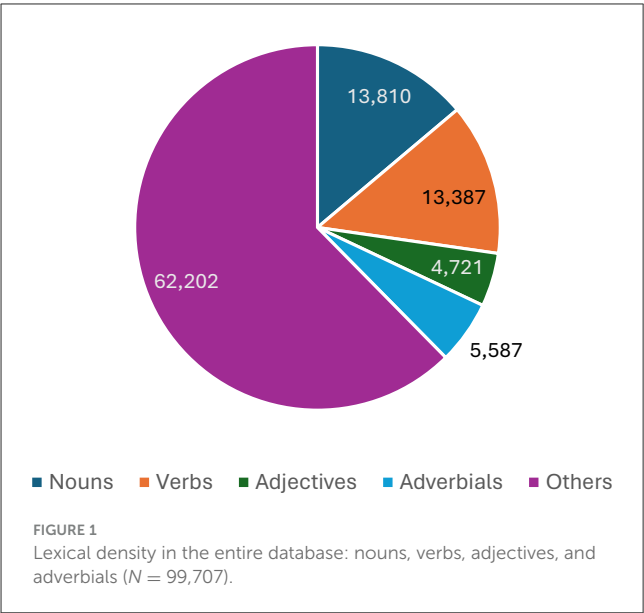
tokens, which constitute the function word lexicon—out of all word tokens.

Developmental analyses

Given the study's focus on lexical development between ages 6 and 14 years, we conducted developmental statistical analyses on the data in Table 1. Tables 2–4 present the results of the parametric and nonparametric tests regarding the distributions of words of different classes, utterances, and MLU by the four age/grade level study groups. Please note that each triad was recorded for the same amount of time—35 min.

TABLE 2 Text productivity—means, SDs, F and Mann-Whitney values for number of word tokens, number of utterances, and average words per utterance according to age groups.

Age group								Parametric results				Nonparametric
Grade 1−2 (1)		Grade 3−4 (2)		Grade 5−6 (3)		Grade 7−8 (4)		F-values				
M	SD	M	SD	M	SD	M	SD	F	p	η_p^2	Scheffe	Mann-Whitney
Number of words												
3,060.17	211.97	3,932.00	514.49	4,291.00	1,076.49	5,334.67	1,285.31	6.82**	0.002	0.51	4 > 1	2,3,4 > 1
Number of utterances												
952.67	161.79	1,390.00	127.01	1,266.33	270.01	1,485.67	376.59	5.03**	0.009	0.43	4 > 1	4 > 1 2 > 1
Number of words per utterance												
3.27	0.45	2.83	0.29	3.37	0.18	3.63	0.52	4.52*	0.014	0.40	4 > 2	4 > 2

*$p < 0.05$, **$p < 0.01$; The average number of words per utterance is calculated as: number of words/number of utterances.

Words and utterances

According to Table 2, the number of words and utterances rises significantly with age and schooling, with the youngest group of 1st−2nd graders producing the least number of words and the smallest number of utterances. MLU rises too significantly with age and schooling, with the oldest group producing the longest utterances.

Content words

As shown in Table 3 and illustrated in Figure 3, the number of both core and extended content words increased significantly with age and schooling, with 7th−8th graders producing more content words than 1st−2nd graders. In terms of proportions, content words maintained consistent percentages across all age groups—~32% for core content words and 37% for extended content words. The number of nouns and verbs also increased significantly with age and schooling. For nouns, there was also a notable increase in their proportion, with a clear distinction between the youngest group and the older groups. For verbs, however, the proportional pattern was less clear and did not indicate any significant developmental changes. The numbers and proportions of adjectives and adverbials generally remained stable across age groups, although non-parametric tests revealed a significant increase in the number of adjectives, particularly from the youngest group to the older groups.

Discourse words

Table 4 shows that the discourse words class increases significantly in number with age and schooling, with the youngest group producing fewer discourse words than the rest of the groups. The numbers of discourse markers and of social words rise significantly with age and schooling, with the oldest group producing the highest number of these words; whereas the number and proportions of address forms stay constant across the age/grade level groups. These results are illustrated in Figure 4.

Figure 5 illustrates the distributions of the content word classes and the discourse word class across the different age/grade level groups, as against the distributions of all word tokens.

Discussion

Much of the psycholinguistic literature investigates the frequencies and linguistic features of specific words in texts to explain phenomena related to processing, usage, and comprehension in reading, writing, and speech (Baroni, 2005; Heitmeier et al., 2024). We adopted a different goal, taking a developmental perspective on the evolving characteristics of word classes (rather than individual words) in the conversations of native Hebrew-speaking children and adolescents during the period of Later Language Development. We anchored our aims in the importance of examining the frequencies of content, function, and discourse word classes in discourse due to their distinct roles in cognition, communication, and development (Ambridge et al., 2015; Chafe, 1992; Croucher, 2004; Evans, 2010).

Overall, our hypotheses were largely supported: with age and schooling, most categories showed increases in number and/or proportion. In the following sections, we will discuss our findings in relation to text size, as well as examine each of the content and discourse categories, drawing comparisons with previous studies on Hebrew and other languages.

Text size across development

General

First, let us review the key details of the database that served as the foundation for our analysis, as presented in Table 1, focusing on the units traditionally used to measure its size: words and utterances. The New Zwilling Corpus consists of a total of nearly 100,000 word tokens across more than 30,000 utterances. The overall Mean Length of Utterance in Words (MLUW) in the corpus, calculated as the total number of word tokens divided by the number of utterances, is 3.26. This value, averaged across all age groups from 6 to 14 years, aligns with the findings reported by Ravid and Levie (2010)

TABLE 3 Text productivity—means, SDs, F and Mann-Whitney values for number of words by class, number of utterances, and average words per utterance according to age groups.
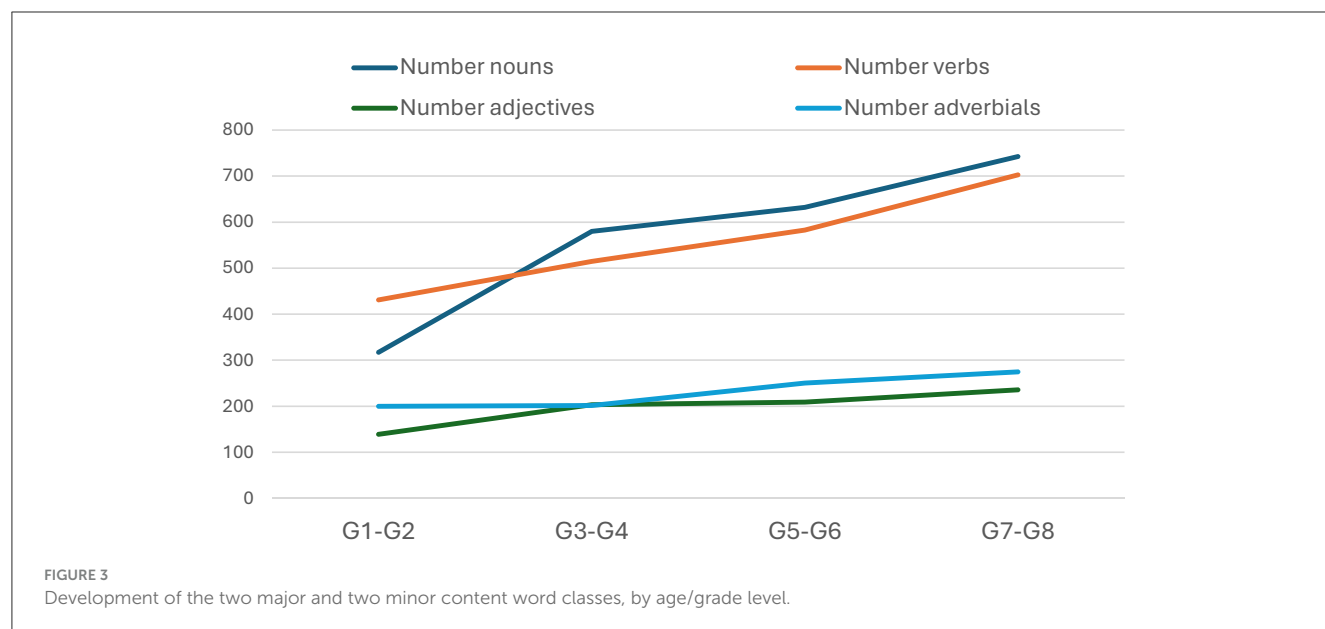
Age group								Parametric results				Nonparametric
Grade 1−2 (1)		Grade 3−4 (2)		Grade 5−6 (3)		Grade 7−8 (4)		F-values				
M	SD	M	SD	M	SD	M	SD	F	p	η_p^2	Scheffe	Mann-Whitney
Number of nouns												
317.17	54.11	579.83	160.01	632.17	222.53	742.50	235.42	4.99**	0.010	0.43	4 > 1	2,3,4 > 1
Average number of nouns per utterance (number of nouns/number of utterances)												
0.37	0.07	0.42	0.10	0.49	0.07	0.50	0.11	2.86	0.063	0.30	–	3,4 > 1
Percentage of nouns out of total words (number of nouns/number of words * 100)												
11.33%	1.53	14.56%	2.28	14.49%	1.77	13.71%	1.97	3.78*	0.027	0.36	2 > 1	2,3,4 > 1
Number of verbs												
431.00	45.27	514.50	49.76	583.00	141.75	702.67	172.52	5.82**	0.005	0.47	4 > 1	2,3,4 > 1
Average number of verbs per utterance (number of verbs/number of utterances)												
0.46	0.06	0.37	0.04	0.46	0.03	0.48	0.05	6.19**	0.004	0.48	1=3=4 > 2	1=3=4 > 2
Percentage of verbs out of total words (number of verbs/number of words * 100)												
14.13%	1.65	13.16%	1.12	13.62%	0.51	13.18%	0.94	0.98	0.424	0.13	–	–
Number of adjectives												
139.00	46.79	203.33	62.54	208.83	43.42	235.67	76.04	2.93	0.059	0.31	–	2,3,4 > 1
Average number of adjectives per utterance (number of adjectives/number of utterances)												
0.14	0.03	0.15	0.04	0.17	0.02	0.16	0.03	0.77	0.522	0.10	–	–
Percentage of adjectives out of total words (number of adjectives/number of words * 100)												
4.50%	1.31	5.09%	0.95	4.92%	0.56	4.39%	0.87	0.73	0.549	0.10	–	–
Total core content words (number of nouns + number of verbs + number of adjectives)												
917.17	113.28	1,297.67	256.75	1,424.00	398.89	1,680.83	472.09	5.27**	0.008	0.44	4 > 1	2,3,4 > 1
Average number of core content words per utterance (number of core content words /number of utterances)												
0.97	0.11	0.93	0.16	1.11	0.09	1.13	0.18	3.18*	0.046	0.32	4 > 2	1=3=4 > 2
Percentage of core content words out of total words (number of core content words /number of words * 100)												
29.96%	2.98	32.81%	2.68	33.02%	1.76	31.28%	3.31	1.64	0.212	0.20	–	–
Number of adverbials												
199.83	41.14	201.50	31.65	250.17	86.85	279.67	80.81	2.18	0.122	0.25	–	–
Average number of adverbials per utterance (number of adverbials/number of utterances)												
0.21	0.04	0.15	0.03	0.19	0.03	0.19	0.01	5.69**	0.006	0.46	1 > 2	1,3,4 > 2
Percentage of adverbials out of total words (number of adverbials/number of words * 100)												
6.54%	1.32	5.16%	0.83	5.75%	0.66	5.25%	0.75	2.82	0.065	0.30	–	–
Total extended content words (number of nouns + number of verbs + number of adjectives + number of adverbials)												
1,117.00	140.49	1,499.17	267.99	1,674.17	484.40	1,960.50	543.02	4.81*	0.011	0.42	4 > 1	2,3,4 > 1
Average number of extended content words per utterance (number of extended content words/number of words * 100)												
1.18	0.13	1.08	0.16	1.31	0.12	1.32	0.18	3.49*	0.035	0.34	–	–
Percentage of extended content words out of total words (number of extended content words/number of utterances)												
36.50%	3.81	37.97%	2.40	38.77%	2.32	36.53%	3.56	0.78	0.518	0.10	–	–

*$p < 0.05$, **$p < 0.01$.

TABLE 4 Discourse words—mean, SD, F and Mann-Whitney values for discourse markers, social words, and address forms according to age groups.

Age group								Parametric results				Nonparametric
Grade 1−2 (1)		Grade 3−4 (2)		Grade 5−6 (3)		Grade 7−8 (4)		F-values				
M	SD	M	SD	M	SD	M	SD	F	p	η_p^2	Scheffe	Mann-Whitney
Number of discourse markers												
68.33	29.70	84.33	12.96	158.33	92.04	209.67	57.73	8.11***	<0.001	0.55	4 > 1,2	3 > 1,2 4 > 1,2
Average number of discourse markers per utterance (number of discourse markers/number of utterances)												
0.07	0.02	0.06	0.01	0.12	0.04	0.14	0.02	12.45***	<0.001	0.65	3=4 > 1=2	3=4 > 1=2
Number of social words												
263.67	52.59	360.67	71.29	299.00	79.20	396.33	94.65	3.71*	0.029	0.36	4 > 1	4 > 1
Average number of social words per utterance (number of social words/number of utterances)												
0.28	0.05	0.26	0.04	0.24	0.06	0.27	0.07	0.61	0.617	0.08	–	–
Number of address forms												
48.83	27.02	77.50	45.77	49.00	28.54	35.67	25.37	1.74	0.190	0.22	–	–
Average number of address forms per utterance (number of address forms/number of utterances)												
0.05	0.04	0.06	0.03	0.04	0.03	0.03	0.02	1.35	0.287	0.17	–	–
Total discourse words—general measure (number of discourse markers + number of social words + number of address forms)												
280.83	88.04	522.50	72.09	506.33	126.21	641.67	132.15	5.90**	0.005	0.47	4 > 2	2,3,4 > 1
Average discourse words—general measure per utterance (total discourse words/number of utterances)												
0.40	0.09	0.38	0.04	0.40	0.07	0.44	0.07	0.84	0.487	0.11	–	–

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

FIGURE 3
Development of the two major and two minor content word classes, by age/grade level.

for the combined mean clause length (MCL) in spoken Hebrew narratives and expositories, which averaged 4.45 words per clause for 9–13 year olds. This similarity is consistent with the two following differences: (1) the conversational, interactive, often meandering nature of speech vs. the more structured format of monologica narratives and expositions; and (2) the distinction between utterances, which are pragmatic-prosodic units, and clauses, which are syntactic units[3] (Sanada, 2018). The comparison between MLU and MCL is further explored in the following paragraphs, which discuss the developmental trajectories of text size.

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3   The clause is defined as "a unified predicate describing a single situation (activity, state, or event)" (Berman and Slobin, 1994, p. 660–663).
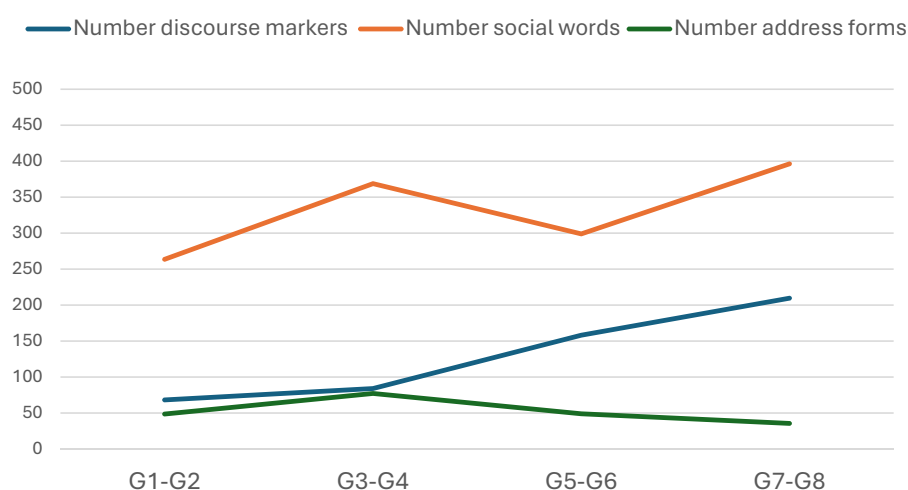
FIGURE 4
Development of the three discourse classes investigated—discourse markers, social words, and address forms, by age/grade level.
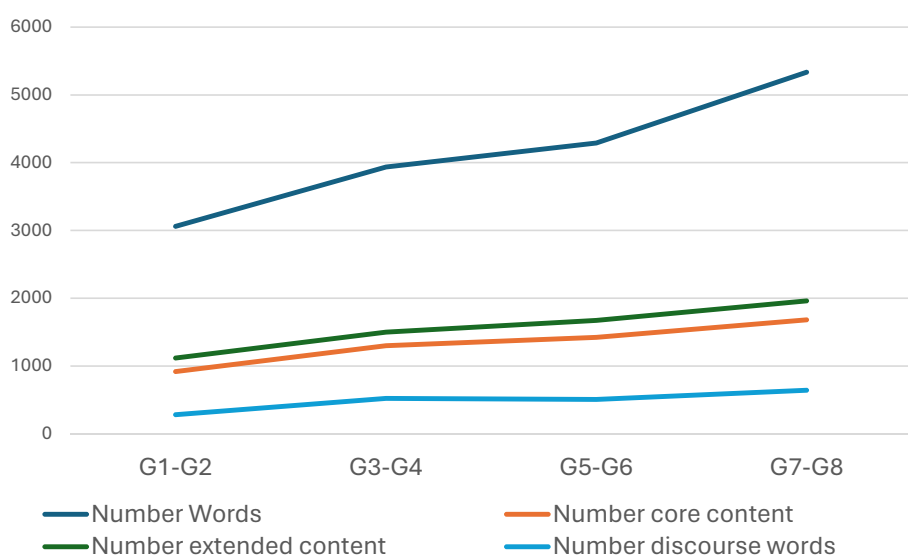

FIGURE 5
Text frequencies in word tokens: all words, core content words, extended content words, and discourse words, by age/grade level.

Development

The changes in the frequencies of three key units of text size measurement—words, utterances, and Mean Length of Utterance in Words (MLUW)—offer valuable insights from a developmental perspective. The increase in the number of words produced in discourse has long been recognized almost as a proxy of age and schooling level, across different languages, text types, modalities, and genres (Berman and Verhoeven, 2002; Berman et al., 2011; Haim and Ravid, 2022). Similarly, in this underexplored arena of spoken language samples from children in elementary and middle school, the text size in transcriptions also increased in terms of both words and utterances, with the most notable growth observed in the oldest group. This finding is particularly significant given that the recording time (35 min) remained consistent across all

triads, regardless of age/grade level. This suggests that adolescents were able to participate in longer triadic conversations about their chosen discourse topics within the same amount of time allocated to each triad – a capability likely driven by the development of socio-cognitive and executive function skills.

The growth in mean length of utterance in Words (MLUW) across age and grade level groups warrants particular attention, as there has been limited research on this important measure in school-age language users. Brown (1973), who explored early language acquisition in English-speaking toddlers and children, argued that MLU serves as an excellent and simple index of grammatical development, noting that "almost every new kind of knowledge increases length" (p. 53). Longer MLUs are not only strongly correlated with age and grammatical development (Rice

et al., 2006), but also play a critical role in later lexical development: They indicate more words per clause, with these words organized into an increasing number of phrases which are also longer, reflecting the integration of more conceptual information per clause (Berman and Ravid, 2008).

In this study too, MLU served as a solid indicator of general language and cognitive development across the research groups (Rice et al., 2010), despite being calculated for triads and age/grade level groups rather than individuals. The developmental progression in terms of MLUW reached its peak at 3.63 words per utterance in the oldest group of 13–14-year-old 7th–8th graders. While there are no directly comparable studies of spoken language, comparisons can be made with the development of MCL in spoken narrative and expository texts across childhood and adolescence. Thus, Ravid and Berman (2010) report an average MCL of 5.93 in spoken texts produced by 9–10-year-olds (4th graders) and 5.76 in 12–13-year-olds (7th graders). Similarly, Ravid and Levie (2010) report MCLs of 4.31 and 4.59, respectively, for spoken texts produced by two groups of the same age/grade levels. Given the structured nature of syntactic units in monologic texts compared to pragmatic/prosodic units in interactional dialogue, this comparison provides meaningful insight into the developmental trends observed.

To demonstrate the implications of the changing frequencies of words, utterances, and MLU across different age/grade level groups, consider the following segments of triadic conversations from the youngest and oldest groups. In both cases, the triads consisted of one boy and two girls.[4]

(1) Pretend family play, 6–7 year olds (1st–2nd graders)

> G(g): Let's play family.
> I(b): I'm the big kid.
> I(b): I'm an older brother.
> H(g): I'll close.
> H(g): Can I be a boy?
> G(g): No.
> G(g): Not a family from here (points to the dollhouse).
> G(g): A pretend family …
> G(g): With us.
> G(g): I'm just hmm like...
> It(b): Let's say you're playing...
> It(b): She's playing her.
> It(b): And I'm playing me.
> It(b): So I'm the dad.
> G(g): Understood?
> G(g): Like...
> I(b): Would you like to be my daughters and I would be the dad?
> G(g): No.
> G(g): Here, there's some like a pretend kitchen.
> I(b): Okay, let's go, I'm operating this.
> H(g): What's allowed in the family?
> G(g): You know... umm...

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4 Please note that this is a loose translation intended to convey the content and tone of the conversations rather than their precise linguistic properties.

> I(b): Do you want me to be the dad...? (yells, overlapping with G)
> I(b): And you would be my daughters?
> G(g): What?!
> H(g): That he'll be the dad and we'll be his daughters.
> G(g): Okay!
> G(g): Okay, so you're the dad and we're your daughters.
> H(g): You...

(2) The little blind cat, 13–14 year olds (7th–8th graders)

> Y(b): Sometimes cats just come to us, regular cats.
> Y(b): Street cats.
> Y(b): There are also lost cats.
> Y(b): Some of them die.
> N(g): (...)
> R(g): Some of them die? (overlapping with N)
> Y(b): Yeah, like Shchori, he died.
> Y(b): Levana died.
> R(g): Since when?
> Y(b): Tiger, though.
> R(g): I liked Shchori.
> Y(b): Tiger, my mom thought he was dead.
> Y(b): And then the next day,
> Y(b): he came after a few years of not being at home (N laughs).
> Y(b): And he waited for us outside the door.
> N(g): Amazing.
> Y(b): Good for him.
> N(g):: Yeah (laughs).
> R(g): He said "Ding dong,
> R(g):: I'm alive."
> Y(b): So, um...
> Y(b): Suddenly,
> Y(b): umm, we saw at the neighbor's place, over there (points).
> Y(b): Umm, she always has cats living in her yard, she has quite a big yard.
> Y(b): So we saw a mom
> Y(b): and a little blind cat.
> Y(b): We had...
> N(g): Wait (in astonishment).
> Y(b): His eyes (overlapping with N).
> N(g): Sean is blind?
> Y(b): Don't look him in the eyes.
> Y(b): Really.
> N(g): Wow, stop.
> Y(b): It will gross you out.
> Y(b): He doesn't have any.
> R(g): I saw his eyes.
> Y(b):: He has a hole (overlapping with R).

While no single segment can fully represent any group, these two excerpts highlight changes in the foci of conversation and their implications for information processing and socio-cognitive load. The 1st–2nd graders participate in pretend play centered around the familiar context of family, assigning well-known roles to each other and using predominantly 1st and 2nd person deictic expression to refer to themselves and their immediate

surroundings. This exchange is typical of younger children as they co-construct socio-cognitive understanding of shared intentions through self-directed, reciprocal interactions (Moore and Barresi, 2017). In contrast, the 7th−8th graders engage in a narrative about cats and people, with one child (Y) narrating a story, followed by his interlocutors R and N. This narrative focuses on absent entities represented in detail in memory and cognition, accompanied by emotional engagement. This cognitively distanced, third-person perspective in personal-experience narrative construction reflects the development of Theory of Mind and emotional regulation typical of this period of development (Best and Ban, 2021; Carlo and Padilla-Walker, 2020; Giletta et al., 2021; Wallace-Hadrill and Kamboj, 2016).

Lexical development in peer talk conversations

Turning to the core of our study, the following sections outline the evolving distributions of content and discourse words and discuss their implications for Later Lexical Development. To date, we have not identified any directly comparable studies that examine word classes from a developmental psycholinguistic perspective in Hebrew or any other language. However, for several of the phenomena analyzed, we did find relevant comparisons that help to illuminate and enrich our findings.

The development of the content words lexicon

General

The present study examined four classes of content (or open-class) words to assess "lexical density," which refers to the extent of lexical reference to entities, events, situations, and their modifiers (Halliday, 1985) in our participants' triadic interactions. Overall, the three core content classes—nouns, verbs, and adjectives—constituted nearly one-third of the word tokens, or approximately one content word per utterance. When adverbials are included, the extended content word class accounts for over one-third of the tokens in the corpus (as shown in Figure 1), or about 1.2 extended content words per utterance. This finding aligns with Chafe's (1976) observation that spoken language typically contains one content word per utterance, indicating the introduction of a new concept, with the remainder consisting of discourse and function elements.

The two largest content word classes, nouns and verbs, each comprise more than 13% of the word tokens, together accounting for over a quarter of the total. In contrast, the modifying classes—adjectives and adverbials—represent a smaller proportion of the lexical volume, a little under and somewhat over 5%, respectively. These proportions reflect the fact that nouns and verbs are fundamental word classes, found in the vast majority of the world's languages, while adjectives and adverbs are secondary morpho-lexical categories that modify primary lexical classes and are absent in many languages (Dixon and Aikhenvald, 2007; Ravid and Shlesinger, 1999). For example, despite its synthetic nature, Biblical Hebrew lacked a dedicated morpho-lexical class for adjectives, and

Modern Hebrew does not have a dedicated morpho-lexical class for adverbs (Nir and Berman, 2010; Ravid et al., 2016).

Development

In our study, the measure that proved most diagnostic across the different age groups was the actual number of content word tokens, rather than their proportion out of all words or the number of content words per utterance. As noted, because our participants engaged in spontaneous conversations, we focused on word tokens and utterances rather than investigating category size based on lemmas as against syntactic units, which might provide different perspectives (see a detailed explanation in Ravid, 2006a). Additionally, recall that the increase in content word tokens is constrained by the same 35-min time frame allocated to each triad of participants across all age/grade level groups. Therefore, we argue that these findings reflect developmental changes in both the mental lexicons and socio-cognitive abilities of our participants.

We found that the number of content words (both core and extended) increased with age and schooling, with the oldest age group of 7th−8th graders producing more content words than the youngest group of 1st−2nd graders. Since the number of content words reflects the expression of referential content, this suggests that children just starting elementary school do not express as much referential content in conversation as adolescents in middle school. This finding highlights differences in conceptual knowledge acquired through school experiences and related social activities, as discussed in Ravid and Cahana-Amitay (2005). It also points to an increase in executive functions, as content words serve as informational anchors around which conversations are organized and move forward. Furthermore, our results align with Ravid and Levie (2010), who found that the proportion of content words per clause significantly increased between middle school and high school (beyond the scope of our oldest group), indicating that the growth in referential content is more pronounced in older adolescents, especially in monologic text production.

Excerpt (3) is taken from a triadic conversation among three girls in the oldest age/grade-level group. This translation accurately reflects the original number of content words (22, including adverbials) in relation to the number of utterances (13) and the total word count (71). Specifically, over 30% of the word tokens are content words, averaging about 1.7 content words per utterance. In conjunction with the relatively abstract topic of "content activities," this segment highlights the significance of the extended content lexicon in the study of peer interactions during the school years.

(3) Content activities, 13−14 year olds (7th−8th graders)

> N(g): He did two **really good content activities** for us.
> N(g): Do you **know** what **content activities** are?
> O(g): Yeah, we have them too.
> N(g): Because I'm **talking** about it with…
> N(g):: What's a **content activity**?
> L(g):: Because he was here this **year**, they haven't **done content activities** for us yet.
> N(g):: Oh…
> N(g):: Did they **do personal conversations** with you?
> L(g):: Yes.

N(g): m: Oh, cool (laughs).
N(g):: **Youth movement**, you're **managing** to **understand**.
O(g): Okay.
N(g):: It's **part** of who I am.

While the current investigation did not center on syntax, it is important to underscore the syntactic functions of the three core content word classes: nouns, verbs, and adjectives. These word classes occupy the positions of arguments, adjuncts, and predicates in clauses, and they head the noun phrases, prepositional phrases, adjectival phrases, and finite and non-finite verb constructions that fill these roles. As an illustration, 9 out of 13 utterances in (3) are syntactic clauses where the bolded content words operate as heads and modifiers within their phrase structure. Therefore, the observed growth in the proportion of content words in the children's transcripts provides a compelling indication of both lexical development and the increasing elaboration and complexity of their clausal syntax.

Nouns and verbs in development

A clear distinction emerged in the developmental trajectories of the two main content classes—nouns and verbs—compared to the modifying classes of adjectives and adverbs, as depicted in Figure 4. Our participants increasingly used more nouns and verbs as they got older, with this trend being especially pronounced for nouns, which showed a steeper growth trajectory than verbs. This suggests a more significant expansion of the nominal lexicon, which refers to entities and concepts, compared to the predicative lexicon, which conveys activities, events, and situations. The findings in Ravid (2006a) also revealed a notable increase in nominality with age, particularly in written expository texts, with a sharp division between high schoolers and adults, accompanied by a rise in abstract nominal terms. Our population, being younger and engaged in interactive conversations rather than monologic text production, appears to be on the cusp of this shift. As for verbs, our results align with those in Levie et al. (2020), which found that across a broad range of ages (from toddlers to adults), text types (interactive and monologic), and modalities (speech vs. writing), the proportion of verb tokens remained remarkably consistent at around 18% of all words, except at the very beginning of language acquisition (around age 2 years), on the one hand, and in expert-level texts, on the other. This suggests that predicative content, referring to actions and experiences, remains relatively stable across development, while the nominal lexicon, which refers to a larger and more diverse range of entities, shows more significant growth.

The predominance of nouns over verbs may have both general conceptual foundations in early language acquisition and more specific cognitive underpinnings in later language development. Research consistently shows that across all developing lexicons, nouns are acquired earlier than other lexical categories (Bornstein et al., 2004). Nouns are also notably easier for preschool-aged children to retrieve (Kambanaros et al., 2013) and are learned more rapidly under controlled laboratory conditions (Childers and Tomasello, 2002). A key cognitive explanation for this advantage is that canonical nouns typically refer to entities that are highly

imageable, representing stable objects in space and time, and are thus less transient and variable than verbs (Golinkoff et al., 1992; McDonough et al., 2011). As a result, children tend to focus initially on objects and only subsequently on the actions associated with them (Echols and Marti, 2004). Even in Asian languages—where a verbal bias is often noted—nouns still outnumber verbs in parental input (Fernald and Morikawa, 1993).

Given that the developmental range examined in the current study spans from 6 to 14 years, encompassing much of the school-age period, two further, distinct, later-language explanations for the increasing dominance of nouns over verbs emerge. These explanations are rooted in (1) the expansion of syntactic structures and (2) in cognitive developments associated with abstract conceptualization. In terms of syntactic growth, older children and adolescents tend to expand NPs by constructing multi-nominal structures such as compounds, prepositional phrase (PP) and relative clause modifiers, requiring increasingly more numerous nouns that create complex nominal structures with complex semantics (Ravid and Berman, 2010; Ravid and Zilberbuch, 2003). Furthermore, consistent evidence shows that older children and adolescents shift from verb-based to abstract nominal expression of predicative content in order to tone down their emotional involvement and emphasize a non-dynamic, withdrawn stance. Thus, older speakers tend to express actions, events and processes as abstract nominals rather than verbs, e.g., using the abstract nouns *theft* and *destruction* instead of the verbs *steal* or *destroy*, respectively (Ravid, 2006a; Ravid and Cahana-Amitay, 2005).

Excerpt (4) of a triadic conversation of two boys and a girl shows that even in the youngest age group, children used cognitive, perception and dicendi verbs (underlined, e.g., *say, explain, understand, listen*), indicating attention to the mental states of their interlocutors; side by side with various nouns such as *game, owl, snack*, and the compound noun *color card*.

(4) Rules of the game, 6–7 year olds (1st—2nd graders)

R(g): <u>Explain</u> the **game** to G, he didn't <u>understand</u> anything.
O(b): G.
O(b): <u>Listen</u>.
O(b):: This is the tastiest **snack**.
O(b): Did you <u>understand</u>?
G(b):: Yes.
O(b): So just <u>eat</u> it (laughs).
R(g):: <u>Explain</u> it to him, come on.
R(g):: He's slow.
O(b): Okay, G, look (overlapping with R).
O(b): If you get a **color card**,
O(b): G.
G(b): What?
O(b): If you <u>get</u> a **color card**, you <u>move</u> the **owl** forward.
O(b): Here, for example, if I <u>get</u>...
O(b): Um, let's <u>say</u>, not worth <u>saying</u>...
O(b): Blue.
O(b):?
O(b): I move my **owl** to the closest blue.
R(g): No (overlapping with O).
R(g): To the **blue**.

O(b): To the closest **blue**.
O(b): Did you <u>understand</u>?
G(b): Yes (shouts).

These initial instances of semantically and morphologically complex lexical items foreshadow continued development throughout adolescence. Preliminary analyses of nominals in this corpus reveal an increase in compound nouns among older participants, reflecting the labeling of nuanced sub-categorization in Hebrew, alongside a parallel rise in abstract nouns—both established indicators of conceptual growth (Dawson et al., 2023; Ravid, 2006b; Reggin et al., 2021). Within the verb category, despite a stable overall frequency, internal changes align with existing research: the two oldest groups show a decrease in *Qal* conjugations and a corresponding increase in others, suggesting improved ability to express transitivity and diverse perspectives on events (Levie et al., 2020). Moreover, the increasing proportion of mental verbs from the youngest to oldest participants (Orr and Gilead, 2023; Schroeder et al., 2021) indicates a developing capacity for understanding others' thoughts. While these preliminary findings are not the central focus of this study, they highlight the rich potential for future investigations into the morphological, semantic, and conceptual development within various lexical categories.

Adjectives and adverbials in development

The modifying classes—adjectives and adverbials—showed much less developmental change, although adjectives did increase significantly after the early elementary school grades. As relational terms that describe the properties of nouns, adjectives typically emerge later in child speech than nouns and verbs (Salerni et al., 2007), and they remain a low-frequency class in children's early lexicons (Tribushinina et al., 2014). For Hebrew Ravid and Levie (2010) found that adjectives were more prominent in the monologic texts of adolescents and adults, particularly in written expository language. Our study thus suggests that the increased use of adjectives in middle school is an early indicator of more advanced language skills, reflecting a broader range of expression and more linguistic sophistication than in younger ages, but far from reaching the quantity and diversity adjectives in mature language users.

Regarding adverbials, we are treading on less-researched ground here, as to the best our knowledge, this is the first study to examine the distribution of Hebrew adverbials in conversations. Also recall that we are only looking here at single-word adverbials of three important semantics—manner, time, and location/direction, rather than at all adverb usage including the productive syntactic preposition plus NP constructions with all of their semantic complexities, which are typical of narration in older adolescence (Brandes and Ravid, 2016, 2019). Given this reservation, what we have found is that adverbials of the type analyzed here maintain a steady number and proportion across all age groups, testifying to their role in spoken peer interaction.

Excerpt (5) is taken from an all-boys conversation in the second age/grade-level group. In this segment, the boys repeatedly refer to a present member of the triad using the single adjective "fat" (underlined in the text), but their conversation actually explores various aspects of being *fat* in a metalinguistic and good-humored manner. Not only do they use the morphologically derived adverbials *physically* and *mentally* (bolded in the text) to describe different dimensions of being fat, but they also discuss and clarify the meaning of the adverb mentally. This example highlights the sophisticated use of modifiers in interactive discourse among children in the middle of elementary school.

(5) Being fat, 8–10 year olds (3rd—4th graders)

> **I: K is fat, but he's not f**at **physically** or **mentally**.
> **Y**: Funny (overlapping with I).
> **Y**: By voting! (?)
> **Y**: And you're still doing... (?) (laughs).
> **I**: Quiet! (laughs).
> **O**: You know, **mentally** means... like, in terms of thinking... (overlapping with I).
> **O**: **Mentally** means in terms of thinking.
> **I**: **Exactly**.
> **Y**: No... **mentally**...
> **I**: He's fat **mentally**, but he's not fat **physically** (overlapping with Y).
> **Y**: But he is fat...
> **I**: But he's fat.
> **I**: Like, fat like this! (laughs).
> **Y**: Right (laughs).

Discourse words

This section presents entirely new analyses, focusing on the results of an exhaustive examination of three types of discourse words in the database: discourse markers, social words, and address forms. Discourse words enhance the pragmatic dimension of language, revealing speakers' attitudes, intentions, and their understanding of the social dynamics at play. In the current study, these three categories accounted for ~12% of the word tokens in the text, or about 0.4 discourse words per utterance. Among these, social words made up the largest proportion, close to 8% of the word tokens in the corpus, followed by discourse markers at around 3% and address forms at over 1%. These words, which convey discourse stance, affect, interactional relationships, and textual structure, are part of the very early emerging lexicon (Gopnik, 1988). Our analysis of schoolgoing children and adolescents revealed that the total discourse lexicon expands with age and schooling, with the oldest age group using the most discourse words and the youngest group using the fewest. Specifically, discourse markers increased with age, with the two older groups using more than the two younger groups. In the same way, the number of social words was highest in the 7th—8th grade group (ages 13–14), compared to the 1st—2nd grade group (ages 6–7). These findings clearly indicate the growing social motivation and conversational abilities of our participants, reflecting their increasing capacity to attend to, initiate, and sustain conversational topics, as well as to respond to and engage with the mental and positional states expressed in their interlocutors' linguistic productions.

These numbers reflect communicatively accurate use of socially oriented discourse items that facilitate and advance triadic

interactions. For instance, 1st—2nd graders frequently used the discourse marker *bo* "literally, come", which is meant to encourage interlocutors to take action, as well as enhancing discourse markers like *récax* ("literally, murder"), as in *xazaka récax* "extremely strong", and the complimentary *máshehu máshehu* ("literally, something something"), as in *ata máshehu máshehu* "you're something else". Examples of discourse items used by 3rd—4th graders include the discourse markers *ke'ilu* "like" and *háyush* "[informal and intimate} hi", along with interjections like *íma'le* "[literally, mommy] oh my goodness!" and *yummy*.

5th—6th graders employed the discourse marker *be'emet* "[literally, in-truth] = really" in three distinct ways: *ma'aréxet xisunit be'emet al ha-panim* "an immune system really [literally, on-the-face] in horrible condition"; the derogatory *nu be'emet* "come on, seriously?"; and the pretend-horror interjection *lo be'emet* "not really". These nuanced uses are difficult to translate with full communicative accuracy, but they hopefully convey the pragmatics of the interaction.

Finally, the oldest group, 7th—8th graders, also used the discourse marker *bo* "literally, come", however, unlike its more concrete function in the younger group, the oldest participants used *bo* to invite their interlocutors to engage in shared contemplation – a clearly mental activity. Moreover, this group demonstrated expert use of hedges and fillers in the utterance involving the academic term *questionnaires*: *hu asa ka'éle pá'am stam she'elonim ve-ze* "he did like-these once just like that [random] questionnaires and-stuff"; and in the following description: *sabába, aval yesh lo kéta kaze she-hu mashmin ve-marze, mashmin ve-marze* "alright, but he has this thing where he keeps gaining weight and losing weight, gaining weight and losing weight". This last utterance uses discourse markers to express satisfaction (*sabába*), followed by a roundabout way of getting to the issue of the fluctuating weight of their friend. Hopefully, this translation succeeds in capturing the nuances of the original discourse while maintaining the intended pragmatic meaning.

The increasing use of discourse words closely reflects the demands of spoken interaction, where they function as vital tools for creating coherence and adding subtle layers of meaning and perspectives. Therefore, the rise in discourse word frequency within our data may reflect our participants' developing skill in navigating a three-way conversation. This involves strategies such as soliciting agreement, expressing alignment or opposition, sustaining conversational threads or introducing new ones, and highlighting their individual viewpoints on occurrences, personal stance, and how they believe others perceive them.

Conclusion

Figure 2 provides an edifying picture of the lexical structure of our database, which contains about 100,000 words. Half of the database comprises lexical and discourse words. This means that half of the tokens in the triads' speech are words indicating reference to concrete and abstract people, objects, places, states, concepts, events, situations, properties and qualities in participants' immediate vicinity as well as in the more remote arenas that they talk about; and words that link together the various segments of

conversation that they engage and indicate their emotions and thoughts re their interlocutors. The other half of the database consists of function or grammatical words that did not comprise part of our analysis but are certainly important for any study of the growth of language and conversation abilities in later language development.

Across the elementary and middle school years, the interwoven development of language, cognition, and schooling significantly shapes a child's conversational abilities. Building upon early language foundations, students rapidly expand their vocabulary and grammatical complexity, enabling them to articulate abstract ideas and emotions with increasing nuance. This linguistic growth is fueled by parallel advancements in cognitive skills like logical thinking, memory, and attention, which directly enhance their capacity for sophisticated verbal interaction. They become better equipped to grasp multiple meanings, understand diverse viewpoints, and engage with increasingly abstract and specialized vocabulary encountered in both academic and social contexts. As schooling shifts from basic literacy to learning through reading and discussion, students' enhanced cognitive maturity allows them to utilize more complex language for expressing their thoughts, negotiating ideas, and building relationships—even in conversations, which differ greatly from academic discourse. The conversations analyzed in our study reflect milestones such as improved focus, independent comprehension, advanced vocabulary use, logical reasoning, and growing empathy, all of which contribute to more effective and nuanced conversational skills. Thus, the interplay of language, cognition, and schooling during these formative years is crucial for fostering the sophisticated communication abilities essential for academic success and meaningful social engagement.

These integrated developments are illustrated in an excerpt from a triad of 7th—8th graders (one boy, two girls) as they draw on their shared academic, socio-cognitive, and emotional resources to resolve a communication breakdown caused by homophony.

The conversation begins with the slang verb *koré'a* "[literally, tearing apart] = funny", which we have translated as "tear-worthy." This verb is phonetically identical to the name of the country Korea in Hebrew. This trialogue highlights the central role of lexical and meta-lexical knowledge in relation to socio-cognitive abilities, demonstrating how the group amicably resolves the communication failure by explaining the homophony.

(6) North Korea, 13–14 year olds (7th—8th graders)

> S: What was *koré'a* "tear-worthy"?
> S: What did he say was tear-worthy?
> N: North Korea (S laughs).
> S: What?
> S: Korea, like...
> S: What?!
> S: Never mind.
> N: I said North Korea (overlapping with S).
> N: I mean...
> N: A country.
> N: North Korea.
> N: You need to understand.

S: What's a country, North Korea?
N: A country.
N: There's a country called Korea.
S: Oh, right (laughs).

Study strengths and limitations

The current study offers a novel and comprehensive analysis of two key components of the lexicon as reflected in the spontaneous speech interactions of older children and adolescents: four categories of content words and three categories of discourse words. To the best of our knowledge, this is the first psycholinguistic study of its kind to examine the evolution of these lexicons in Modern Hebrew.

However, there are (at least) two limitations to this study. First, we focused on tokens rather than lemmas in our analysis. This means we included all instances of the lexical categories under investigation that appeared in the text, rather than examining abstracted types (e.g., different nouns, adverbials, etc.). This token-based approach to lexical development may provide a different perspective on the distribution of content and discourse words compared to analyses based on lexical density and diversity in terms of lemmas.

A second limitation is the absence of in-depth semantic and morphological analyses of relevant age- and grade-level lexical sub-classes in development, such as abstract nominals, mental verbs, roots and patterns, denominal adjectives, and others—all beyond the scope of the current article. These analyses, which we intend to publish in the future, will hopefully complement, expand, refine, and deepen our understanding of later stages of lexical development during the school years.

Data availability statement

The datasets presented in this article are not readily available because this is a database that is still under investigation for the doctoral dissertation of RZ. Requests to access the datasets should be directed to doritr@tauex.tau.ac.il.

Ethics statement

The studies involving humans were approved by Tel Aviv University Ethics Committee. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin in accordance with the national legislation and institutional requirements.

Author contributions

RZ: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Writing – original draft, Writing – review & editing. DR: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Writing – original draft, Writing – review & editing.

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Conflict of interest

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

Generative AI statement

The author(s) declare that no Gen AI was used in the creation of this manuscript.

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