frontiers | Frontiers in Communication

TYPE Original Research
PUBLISHED 19 December 2024
DOI 10.3389/fcomm.2024.1473075

OPEN ACCESS

EDITED BY
Antonio Benítez-Burraco,
University of Seville, Spain

REVIEWED BY
Weifeng Han,
Flinders University, Australia
Pirko Tõugu,
University of Tartu, Estonia
Carren J. Stika,
San Diego State University, United States

*CORRESPONDENCE
Lara Hardebeck
✉ lara.hardebeck@uni-oldenburg.de

RECEIVED 30 July 2024
ACCEPTED 03 December 2024
PUBLISHED 19 December 2024

CITATION
Hardebeck L, Ruigendijk E, Grandon B and Licandro U (2024) Narrative and related spoken language skills—a comparison between German-speaking children who are hard of hearing and children with typical hearing.
Front. Commun. 9:1473075.
doi: 10.3389/fcomm.2024.1473075

Narrative and related spoken language skills—a comparison between German-speaking children who are hard of hearing and children with typical hearing

Lara Hardebeck[1]*, Esther Ruigendijk[2], Bénédicte Grandon[2,3] and Ulla Licandro[1]

[1]Department of Special Needs Education and Rehabilitation, Carl von Ossietzky Universität Oldenburg and Cluster of Excellence Hearing4all, Oldenburg, Germany, [2]Department of Dutch Studies, Carl von Ossietzky Universität Oldenburg and Cluster of Excellence Hearing4all, Oldenburg, Germany, [3]Nantes Université, CNRS, Laboratoire de linguistique de Nantes, UMR 6310, Nantes, France

Introduction: Narrative skills are crucial for academic success and social interaction. To date, few studies have looked at the specific impact of hearing loss on higher-level language skills, like narrative skills, especially in German-speaking children. This study is the first to analyze the narrative skills of German-speaking children who are hard of hearing.

Method: Specifically, we assessed and compared the narrative skills of two groups of school-aged children – children who are hard of hearing (n = 22; M_{age} = 10;5) and children with typical hearing (n = 28; M_{age} = 9;0) – at the macro- and microstructural level using a standardized storytelling task. In addition, the relationship between spoken narrative skills, receptive vocabulary, and phonological working memory was investigated to determine which factors best predict oral narrative performance.

Results: Children who are hard of hearing produced adequate narratives at the macrostructural level, but used less diverse vocabulary than their peers without hearing loss. Furthermore, children who are hard of hearing demonstrated lower receptive vocabulary and phonological working memory skills than children with typical hearing. Receptive vocabulary emerged as the most important factor in predicting narrative skills at the microstructural level.

Discussion: The heterogeneity observed in the narratives of children who are hard of hearing emphasizes the need to investigate additional factors that may influence the development and expression of spoken narrative skills in this group.

KEYWORDS

narrative skills, children who are hard of hearing, receptive vocabulary, phonological working memory, school-age

1 Introduction

An estimated one to three in 1,000 children are born with hearing loss or will develop it in the neonatal period (Morton and Nance, 2006). By the age of 18, about one out of every five children in the United States is diagnosed with hearing loss (Lieu et al., 2020). Due to newborn hearing screening, it is now possible in many countries to initiate hearing care and support from a very early age on Lieu et al. (2020) and Matthews and Kelly (2022). However, despite this fact and further advancements in hearing technology (e.g., hearing aids or cochlear implants), children who are hard of hearing due to sensorineural hearing loss still experience challenges in acquiring spoken language and communication skills. Particularly in complex auditory environments such as noisy group situations or classrooms, they face disadvantages compared to their peers with typical hearing, and thus do not have equal access to spoken linguistic information (Krijger et al., 2020; Levesque et al., 2023).

Access to spoken linguistic information is important for spoken language development which, in turn, is essential for academic participation and success in mainstream classrooms. Children who have had limited access to spoken language input are especially challenged to advance their spoken language proficiency and academic knowledge (Riad et al., 2023; Schoon et al., 2010) in comparison to children without hearing loss (Levesque et al., 2023; Tomblin et al., 2015). Therefore, it is essential to understand how hearing loss affects linguistic abilities. Previous studies of language development in children who are hard of hearing have focused on lower-level language skills such as vocabulary and morphosyntax (e.g., Lund, 2016; Werfel et al., 2021), while little is known about more complex oral language skills. One of the more complex oral language skills is the ability to produce a narrative, which represents an essential element of human communication (Bishop and Edmundson, 1987). Previous studies indicate that the ability to produce a coherent and cohesive narrative is not only a prerequisite but also a predictor of academic success (e.g., Dickinson and Snow, 1987; Paul et al., 2020). This holds true for reading comprehension, literacy acquisition (e.g., Gutiérrez-Clellen, 2002), but also for mathematical achievement (O'Neill et al., 2004). Because of the high importance of narrative skills, the main aim of the present study was to assess narrative skills of children who are hard of hearing who use spoken language and to compare them with children with typical hearing. The ability to tell stories plays a central role in how people understand, use and develop language. Narrative competence encompasses the ability to present events or information in a coherent, structured and understandable way. Those who are skilled in storytelling demonstrate not only mastery of language and literacy but also a profound understanding of linguistic structure and usage, which enhances their ability to access and apply language effectively across various contexts (Griffin et al., 2004).

Previous studies on narrative skills have focused on English-speaking children who are hard of hearing (e.g., Jones et al., 2016; Walker et al., 2023). To date, no studies have investigated the spoken narrative skills of German-speaking children who are hard of hearing in comparison with children with typical hearing. Since narratives are influenced by the linguistic and cultural context in which they are told, studies on different languages provide a more comprehensive understanding of narrative abilities. German, for example, has different syntactic structures and narrative conventions than English, and it is so far unclear whether this affects narrative skills. Studies from children with different language backgrounds will contribute to the overall generalizability of results on these skills. Also, for this exploratory study we decided to include a relatively heterogeneous group of children who are hard of hearing. This means that we included children with different types of hearing loss, coming from different backgrounds, as we aimed to understand the effects of hearing loss on narrative skills regardless of individual factors like degree of hearing loss or age of diagnosis and focus on specific language abilities.

1.1 Language skills in children who are hard of hearing

Due to the delayed and reduced access to auditory and spoken language input, children who are hard of hearing may exhibit delays and/or challenges in all areas of spoken language development as well as their phonological working memory (Haukedal et al., 2022; McCreery and Walker, 2021). These challenges persist into school-age (Tomblin et al., 2015). The language development of children who are hard of hearing is influenced by factors such as age of diagnosis, degree of hearing loss, hearing device fitting, and hearing age (i.e., the onset of hearing, corresponding to the time of fitting with hearing devices) (Cupples et al., 2018). Children who are hard of hearing demonstrate lower phonological working memory skills than their peers with typical hearing, even though there is interindividual variability in this respect (McCreery and Walker, 2021; Tomblin et al., 2015). Phonological working memory requires skills in phonological perception and short-term memory. These skills are important for the acquisition of vocabulary and morphosyntax. Thus, difficulties in the area of phonological working memory affect the acquisition of lexical and morphosyntactic representations in children (Chiat, 2015). In addition, substantial vocabulary deficits in receptive as well as expressive vocabulary have been reported for children who are hard of hearing (Davidson et al., 2019; Lund, 2016; McCreery and Walker, 2021; Walker et al., 2019). Together with a reduced vocabulary size and slower acquisition of new word forms (Lederberg and Spencer, 2001), children who are hard of hearing also frequently demonstrate difficulties in the areas of morphology and syntax (Boons et al., 2013). They may produce less complex syntax (Klieve et al., 2023; Werfel et al., 2021) with fewer correct coordinated clauses, subordinate clauses, and simple infinitives compared to their peers with typical hearing (Werfel et al., 2021) and they show delayed processing of complex syntax (Schouwenaars et al., 2019). Furthermore, studies have reported pronounced difficulties in children who are hard of hearing in terms of pragmatic skills, which include the ability to initiate and keep conversations going, respond appropriately, understand the perspectives of others and use appropriate language strategies in different situations (Crowe and Dammeyer, 2021; Duncan and O'Neill, 2022; Matthews and Kelly, 2022).

The production of a complete and coherent narrative draws on linguistic skills at the lexical, morphological, syntactic, semantic, and pragmatic level (Botting, 2002; Vandewalle et al., 2012), as described in the following sections.

1.2 Narratives

Narratives can be defined as a description of one or more events or experiences, that are organized in a temporal sequence of at least two connected sentences (Labov, 1972). Thus, narrative skills involve both the comprehension and production of at least two related utterances at the discourse level (De Fina and Georgakopoulou, 2011). Narratives involve a single event or a sequence of events (Abbott, 2008) and refer to either real or fictional events or actions (Berman and Slobin, 1994).

Narratives include the use of so-called decontextualized language (Curenton and Justice, 2004; Dickinson and Snow, 1987) which is characterized by communication that is not related to a specific situation or action (Dickinson and Porche, 2011; Pearson, 2002; Snow et al., 1995). Finally, a comprehensive knowledge of language is necessary to establish decontextualization in a narrative and provide detailed descriptions of characters, events and their sequential progression, for instance to explain situation-dependent actions to other people. This includes lexical-semantic and morphological knowledge, as well as the ability to construct complex sentences (McCabe and Rollins, 1994; Melzi and Caspe, 2017).

1.3 Analysis of narrative skills

The analysis of narrative skills enables the identification of specific language strengths and weaknesses in an ecological and valid manner (see Botting, 2002; Cleave et al., 2010; Heilmann et al., 2010; Justice et al., 2006). Narrative skills can be examined through the analysis of the macrostructure and the microstructure. The macrostructure refers to the global organization and content structure of a narrative, while the microstructure refers to the linguistic expression of this macrostructure (Liles et al., 1995; McCabe and Rollins, 1994). The macrostructure can be analyzed using the multidimensional theory of narrative organization (see Lindgren et al., 2023). This theory operationalizes the macrostructure of narratives in production and comprehension in terms of qualitative and quantitative as well as factual and inferential dimensions. The macrostructure consists of single elements, such as goals (G), attempts (A), outcomes (O), and internal states (IS), which are organized in episodes. In terms of the quantity dimension, the number (or sum) of these produced components is the structure of the story. The qualitative dimension reflects the complexity of a narrative. To assess the degree of complexity of the narrative, the extent to which the core episodic components (attempt, outcome, goal and internal states) are combined is investigated. The factual and inferred components are another dimension of the multidimensional theory. Both inferred dimensions represent the goals and internal states, while the two factual dimensions relate to attempts and outcomes. The factual dimensions are visualized directly, e.g., in picture stories, which makes them easier to understand and produce (Lindgren et al., 2023). Meanwhile, the microstructure refers the linguistic organization and production of a coherent story on the lexical, morphological, and syntactic level (Justice et al., 2006; Kawar et al., 2019). Common assessments of a narrative's microstructure include productivity (total number of words and utterances), lexical diversity (number of different words), and syntactic complexity (mean length of utterances; MLU) (e.g., Licandro, 2016; Rodina, 2017).

Microstructural and macrostructural skills are also interrelated, as the expression of the macrostructure is supported by the development of microstructural skills (e.g., Berman and Slobin, 1994). Lexical proficiency is an important precursor for narrative production, as vocabulary knowledge is related to macrostructural skills. Having a good lexical proficiency can help organize narratives, especially for children who do not yet have fully developed syntactic skills (Heilmann et al., 2010; Norbury and Bishop, 2003). In turn, weak morphosyntactic skills may hinder the ability to express complex relationships within the story structure (Kaderavek and Sulzby, 2000), since syntactic knowledge, such as the ability to use temporal conjunctions, supports story cohesion (Norbury and Bishop, 2003). Initial evidence suggests that phonological working memory serves as an underlying capacity for narrative skills in children who are hard of hearing, particularly for macrostructural skills (Walker et al., 2023).

1.4 Narrative skills in children who are hard of hearing

Only a limited number of studies have examined the narrative skills of children who are hard of hearing and they reported varying results. Boons et al. (2013) found that school-age children with cochlear implants (CI) produced a similar number of utterances as their age-matched peers with typical hearing. However, from a macrostructural perspective, they produced significantly fewer complete settings in the story, initiating and episodic elements. Despite producing a similar number of utterances, the children who are hard of hearing demonstrated a higher percentage of utterances with errors and produced a shorter MLU (Boons et al., 2013). Jones et al. (2016) also compared the narrative skills of children who were hard of hearing (fitted with either hearing aids (HA) or CI) to those of children with typical hearing. They found that on the macrostructural level, both groups (6–11-year-old children) exhibited comparable results and were able to produce key elements of narrative structure and content. However, on the microstructural level, children who are hard of hearing displayed difficulties in using grammatical expressions that rely on finer pragmatic and linguistic skills. The authors also identified strong correlations between expressive vocabulary and microstructural skills as well as weak correlations between expressive vocabulary and macrostructural skills. Furthermore, an Italian study by Zanchi et al. (2021) compared three- to seven-year-old children with CI to groups of children matched for chronological or hearing age. They found no significant differences in macrostructural abilities, such as quantity of information, structure, and cohesion between children with CI and those matched for chronological age. However, children with CI produced a higher number of events than children with typical hearing matched in hearing age. Regarding the microstructure, the group of children with CI produced stories that were lexically less diverse than their age-matched peers, while no significant differences emerged in story length, MLU in words or syntactic complexity. Finally, Walker et al. (2023) analyzed factors influencing narrative performance in story generation and narrative retells in seven-year-old children who are hard of hearing and their age-matched peers with typical hearing from the United States. Vocabulary as well as phonological working memory skills were among determining factors for the link between hearing status and narrative skills in story generation.

In sum, children who are hard of hearing may display challenges at both, the macro- and microstructural level. However, macrostructural skills appear less affected than microstructural skills in children with CI (Boons et al., 2013; Jones et al., 2016; Zanchi et al., 2021). Study findings were less conclusive with respect to microstructural abilities (e.g., Boons et al., 2013; Jones et al., 2016).

Note that many studies have used retelling tasks to analyze narrative skills in children who are hard of hearing (e.g., Boons et al., 2013). While this is a valid approach, retelling tasks require children to simultaneously listen to and comprehend the sample story presented in spoken language, which is especially challenging for children who are hard of hearing. In our study, we used a story generation task which allows for children to construct their story independently. In addition, we wanted to investigate how children who are hard of hearing create stories rather than reproduce them. Finally, there is a research gap with regard to the narrative skills of children who are hard of hearing in German-speaking environments, as most previous studies have primarily focused on English-speaking children, which may limit the generalizability of the findings to other linguistic and cultural groups.

1.5 The current study

Given the importance of narrative skills for child development and the current limited and heterogeneous nature of existing studies, there is a clear need for further research on the narrative skills of children who are hard of hearing. To explore the relationship between spoken narrative skills of German-speaking children who are hard of hearing and their peers with typical hearing, we posed the following question:

> *How do school-aged children who are hard of hearing produce macro- and microstructural elements in oral picture-based narratives, as compared to their peers with typical hearing?*

Based on the current state of knowledge, we expect macrostructural narrative skills of children who are hard of hearing to be similar to those of children with typical hearing, and microstructural narrative elements to be less well developed in comparison to their peers with typical hearing.

Also, further research is needed to understand the relations between receptive vocabulary, phonological working memory, and narrative skills in children who are hard of hearing. Therefore, our second aim was to investigate how lower-level language skills correlate with narrative skills in children who are hard of hearing and children with typical hearing. Specifically, we asked:

> *What are the relationships between narrative skills at the level of macro- and microstructure, receptive vocabulary and phonological working memory and which factors predict children's narrative skills best?*

We decided to focus on two lower-level language skills, namely phonological working memory and receptive vocabulary. We chose receptive vocabulary over expressive vocabulary, because the comprehension of words gives an indication of children's vocabulary development without depending on a production task, which may be difficult for children with hearing loss, even if they know the corresponding words. It also provides a well-established estimate of language comprehension and it is closely related to literacy development (Taylor et al., 2013). For example, a strong receptive vocabulary enables children to understand and use a variety of words in their stories. Although children who are hard of hearing may experience delays in the development of these lower-level language skills due to delayed and/or reduced auditory input, the relationships between these skills and narrative skills should follow similar patterns to those seen in children with typical hearing. For both groups, we expected that better developed lower-level language skills support the expression of more advanced narrative skills. We predict vocabulary size to be positively correlated with measures of narrative micro- and macrostructure based on previous studies. Predictions for a relationship between narrative skills and phonological working memory are harder to derive due to the lack of research on narrative development in children who are hard of hearing. Walker et al. (2023) provided preliminary evidence that phonological working memory may emerge as a determining factor for the relationship between hearing status and narrative abilities. This will be further investigated in the present study.

2 Methods

2.1 Participants

This study included a total of 50 German-speaking children: 22 children who are hard of hearing (CHH) and 28 children with typical hearing (CTH) who were matched for hearing age [$t(48) = 0.480$, $p = 0.627$, $d = 1.39$] (Table 1). We define hearing age as the age of initial intervention (i.e., receiving the first hearing device, which was on average at the age of 2;6 years). We chose to match the two groups for hearing age as well as possible instead of chronological age, since this allows us to better understand the effects of hearing impairment after the fitting of hearing devices. Furthermore, since age of diagnosis and aiding can vary, this choice makes the group of children who are hard of hearing slightly more homogeneous. Due to partial information obtained in the data collection process, we were not able to compute hearing age for five children. We therefore used chronological age for the children with missing data for the matching process. One child from the CHH group was a simultaneous learner of Kurdish in addition to German and one child from the group of CTH was a simultaneous learner of Dutch. The group of CHH (8 female, 14 male) was between 6;5 and 14;0 years old ($M_{age} = 10;5$ years). We recruited a heterogeneous group of children who are hard of hearing, as this was an exploratory study and our aim was to analyze the range of their narrative abilities as well as the relation of these abilities with receptive vocabulary and phonological working memory. Our focus was on investigating language processing skills of children with known delayed or partial access to auditory input without requiring detailed audiological testing, as we did not aim to examine specific effects of auditory processing associated with hearing loss.

Individual hearing loss was diagnosed on average at the age of 1;3 years, with initial intervention starting on average at the age of 2;6 years. According to parental report (based on questionnaires) as well as school records, children had varying degrees of hearing loss, ranging from mild to profound. Children were fitted with CIs and/or hearing aids, either unilaterally or bilaterally, depending on the type and degree of their hearing loss. Thirteen children were fitted bilaterally and five children unilaterally. One child had a unilateral hearing loss, but did not use any hearing device, and we were not able to obtain information for three children (see Supplementary Appendix 1 for details). All participating children primarily communicated using spoken language and the majority of CHH ($n = 16$) attended a special needs school for children with hearing loss. As per parental report, 18 out of the 22 children had been diagnosed with attention, reading, learning, and/ or language difficulties. These diagnoses were not exclusion criteria for our study. Language difficulties as a result of hearing loss are expected, as for the other difficulties, we cannot know if these diagnoses were consequences of their hearing loss or if these

TABLE 1 Characteristics of participant groups.

	CHH	CTH
Background information		
Gender	Male: n = 14 Female: n = 8	Male: n = 18 Female: n = 10
Chronological age at testing	n = 22 Mean: 10 yr. 5mo Min: 6 yr. 6mo Max: 14 yr. 0mo	n = 28 Mean: 9 yr. 0mo Min: 6 yr. 2mo Max: 12 yr. 11mo
Hearing age at testing	n = 17 Mean: 8 yr. 2mo Min: 5 yr. 1mo Max: 12 yr. 4mo	n = 28 Mean: 9 yr. 0mo Min: 6 yr. 2mo Max:12 yr. 11mo
Care giver 1 education	n = 21 Elementary school: 1 Technical education: 15 High school diploma: 2 Bachelor degree: 2 Master degree: 0 Doctoral degree: 1	n = 28 Elementary school: 0 Technical education: 7 High school diploma: 2 Bachelor degree: 5 Master degree: 10 Doctoral degree: 4
Care giver 2 education	n = 18 Elementary school: 3 Technical education: 12 High school diploma: 1 Bachelor degree: 1 Master degree: 0 Doctoral degree: 1	n = 28 Elementary school: 0 Technical education: 11 High school diploma: 1 Bachelor degree: 8 Master degree: 5 Doctoral degree: 3
Auditory factors		
Age at diagnosis	n = 18 Mean: 1 yr. 3mo Min: 0 yr. 1mo Max: 5 yr. 4mo	
Age at initial intervention	n = 14 Mean: 2 yr. 6mo Min: 0 yr. 1mo Max: 5 yr. 1mo	

CHH, children who are hard of hearing; CTH, children with typical hearing; PPVT-4, T-score of the Peabody Picture Vocabulary Test (Lenhard et al., 2015); Hearing age, Time period in which learning to hear takes place in the context of a hearing device (CI or HA); Age at diagnosis, age at which hearing loss was diagnosed; Age at initial intervention, age at which the child first received a hearing device.

were additional unrelated difficulties. CHH were recruited through their school as well as an announcement in the regional newspaper. Five families did not return a complete questionnaire and some data points on demographic information are therefore missing. We still decided to include all children in our study.

The age of the CTH (10 female and 18 male) ranged from 6;2 to 12;11 years (M_{age} = 9;0 years). All children in this group were screened for hearing loss by means of an audiogram. This was performed at the time of testing as part of the protocol: they all had PTA4 values within normal limits. As per parental report, one child had been diagnosed with developmental verbal dyspraxia, one child with attention difficulties and one child with attention and learning difficulties. We decided to not exclude these children because we had no further information about the diagnosis and no indication how these diagnoses had affected their language development. For the remaining children, no diagnoses were reported. We recruited CTH through an announcement in the regional newspaper and through flyer distribution.

2.2 Materials and general procedure

Ethics approval for data collection was granted by the central ethics committee of the Carl von Ossietzky Universität Oldenburg. Testing took place in a one-on-one setting, either in a quiet room of their school or in the Speech and Music Lab of the Carl von Ossietzky Universität Oldenburg. A testing session lasted about half an hour for CHH and about 1 h for CTH, since we additionally performed an audiogram with these children. All children also completed a second session (approx. 1 h) for an additional study. They received a small present to thank them for their participation.

Receptive vocabulary was assessed using the German version of the Peabody Picture Vocabulary Test (PPVT-4) (Lenhard et al., 2015) where the child is asked to select the most fitting picture from four options corresponding to a spoken word. The PPVT-4 comprises 228 items divided into 19 sets with 12 items each and arranged in ascending order of difficulty. T-scores were used for further analysis, to control the PPVT-4 score for effects of age. Phonological working memory was assessed with the Crosslinguistic Nonword Repetition Test (CL-NWR; Chiat, 2015; see Hinnerichs, 2016 for the German version) in which children are asked to repeat nonwords consisting of two to five consonant-vowel sequences. A maximum of 16 points could be reached.

Children's production of oral narratives was evaluated using the standardized Multilingual Assessment Instrument for Narratives (MAIN) (Gagarina et al., 2019). MAIN consists of four comparable stories with six full-color pictures. Each story consists of three episodes with an introduction of a setting (place and time), a main story structure (goals, attempts and outcomes) and internal state terms as initiating events and reactions. The chosen story for this study was the "Baby Bird-Story." Following the testing protocol, participants were instructed to carefully look at the pictures and to generate their own story without direct support from the examiner. Afterwards, children were asked 10 questions about the story included in the MAIN protocol to assess story comprehension. Children's narratives and answers were recorded using an Olympus linear PCM recorder.

Data collection was completed by three student assistants of the lab. They all had received training in collecting experimental data with children and the protocols (i.e., language tasks, audiogram) used in this study. They were overseen by the first author (LH) who is a doctoral student with a master's degree in special needs education (incl. Standardized diagnostics) and practical diagnostic experience. The audiological tests on the TH children were performed by the same student assistants.

The audio recordings were transcribed by the article's first author (LH) following the Codes for the Human Analysis of Transcripts (CHAT) conventions of the Child Language Data Exchange System (CHILDES) (MacWhinney, 2000). Utterances from both the child and the examiner that were unrelated to the narrative were transcribed, but excluded from the analysis (e.g., questions about word meanings; comments on events outside the room). All utterances were divided into communication units (C-units) (Loban, 1976), that is syntactic units that include a main clause as well as all dependent components, such as phrases or subordinate clauses (Retherford, 2000). Additionally, one-word and multi-word utterances without a complete sentence structure (e.g., "birds"; "is back") were considered in the analysis as a C-unit. Conversely, repetitions that added no further meaning to the story (e.g., "And then…and then the cat comes") and filler words (e.g., "mhmm"; "uh"s) were excluded from the analysis. If a child self-corrected, only the corrected form was evaluated. Unintelligible productions were also excluded from further analyses.

2.3 Coding and measure

Transcriptions of the full dataset and analyzes of the narrative macro- and microstructure were made by the first author (LH). To establish interrater reliability, 80 % of the corpus was independently transcribed by a student assistant trained on our protocol and on the CHILDES conventions. We used Spearman rank correlations to calculate inter-rater agreements. For the macrostructural parameters, the values were $r = 0.902^{**}$, $p < 0.001$ for story structure and $r = 0.880^{**}$, $p < 0.001$ for structural complexity. With regard to microstructural parameters, the correlation values were $r = 0.987^{**}$, $p < 0.001$ for the total number of words, $r = 0.982^{**}$, $p < 0.001$ for lexical diversity, $r = 0.851^{**}$, $p < 0.001$ for number of C-units, and $r = 0.894^{**}$, $p < 0.001$ for syntactic complexity. As displayed in Table 2, the macrostructure was assessed using the MAIN protocol (Gagarina et al., 2019). Points were assigned for story structure with one or two points if the child introduced a place and/or time (setting). In addition, one point for each initiating event (goal, attempt and outcome), as well as internal state terms were awarded. A total of 17 points could be obtained, with five points allocated for each of the three episodes and 2 points for the setting. Regarding structural complexity, children could achieve a maximum of 12 points, with a cap of four points for each of the three episodes. More detailed information on the assessment of structural complexity can be found in Table 2. Additionally, for every correctly answered comprehension question, the child received one point allowing for a total of 10 points (see Table 2).

The microstructural parameters included productivity, lexical diversity, and syntactic complexity, which are all sensitive indicators of children's linguistic abilities (e.g., Justice et al., 2006; Uccelli and Páez, 2007). Calculations were performed using the software Computerized Language ANalysis (CLAN) (MacWhinney, 2000). For productivity measures, we used the CLAN command *freq* to calculate both the total number of words and C-units. Regarding lexical diversity, two measures were computed. Firstly, the number of different words was determined through lemmatization, a lexicographic reduction of inflectional forms of a word to their basic form, preventing inflation due to grammatical variations (Bedore et al., 2010). Lemmatization involved transferring the CLAN word list obtained via the *freq* command to an Excel worksheet. The lemmas were then manually sorted into the respective base form of a word, considering grammatical variations (e.g., *have*, *has*, *had* as variants of *have*). Composites were divided into their respective root words. Secondly, lexical diversity was calculated by dividing the determined lemmas by the total number of words. To assess syntactic complexity, we calculated the MLU, which represents the average C-unit length in words, using the *mlu* command. A higher MLU value indicates more complex C-units.

TABLE 2 Description of the macrostructural analyses.

Analysis	Description	
Story structure	Setting: introduction of a place and/ or time: 0–2 points, e. g: Once upon a time there were 3 birds in a nest	
	Initiating event, one point for each:	
	Goal e. g.: "*The mother bird wanted to get the babies a worm*"	
	Attempt e. g.: "*The mother bird flew away*"	
	Outcome e. g.: "*The mother bird brought a worm*"	
	Internal state terms e.g.: "*The baby birds were hungry*"	
Structural complexity	1 point	Attempt and outcome e.g.: "*The mother bird flew away and brought a worm*"
	2 points	Goal e. g.: "*The mother bird wanted to get the babies a worm*"
	3 points	Goal and attempt or outcome e. g.: "*The mother bird wanted to get the babies a worm and flew away*"
	4 points	Attempt and outcome and goal e. g.: "*The mother bird wanted to get the babies a worm and flew away and brought a worm*"
Comprehension (see MAIN protocol)	Goal of the episode: e.g., Why does the cat jump up the tree?	
	Internal state terms: e.g., How do the baby birds feel?	
	Consequences of the episode: e.g., How does the cat feel?	

2.4 Data analysis

To address the research questions, we performed descriptive and inferential statistical analyses, including t-tests. Accounting for high interindividual variability, we ran Spearman rank correlations to examine relations between narrative skills, receptive vocabulary, and phonological working memory. Effect sizes were determined according to Cohen (1988), where $r = 0.10$ indicated a small effect, $r = 0.30$ a medium effect, and $r = 0.50$ a large effect. We conducted t-test to assess differences between the groups across all narrative parameters, receptive vocabulary, and phonological working memory. The homogeneity of variance was checked prior to the analyses using Levene's test. Cohen's d (Cohen, 1988) was employed to interpret the effect sizes of the group differences, considering a small effect at $d = 0.2$, a medium effect at $d = 0.5$ and large effect at $d \geq 0.8$. Statistical significance was determined at $p < 0.05$. Due to the relatively small sample size and hence an increased risk of a type II error, the Bonferroni correction was not applied. A multiple linear regression analysis was conducted to test the strength of the relationship between narrative skills and lower-level language skills.

3 Results

This cross-sectional study investigated differences in oral narrative skills of children who are hard of hearing and children with typical hearing. Table 3 displays the descriptive statistics and t-test results regarding the macro- and microstructure in story generation.

High inter-individual variability was found for all parameters in both groups. With regard to lower-level language skills, the parameters differed more in the group of CHH than in the group of CTH. To further determine the descriptive differences statistically, t-tests were used to test for group differences (CHH or CTH) for all narrative parameters. With regard to the macrostructure, no statistically significant between-group differences were found for the story structure [$t(48) = 0.14$, $p = 0.44$, $d = 0.04$], structural complexity [$t(48) = 1.70$, $p = 0.10$, $d = 0.48$], and the comprehension of the story [$t(48) = -0.39$, $p = 0.35$, $d = -0.11$]. Regarding the microstructure, the narratives of the groups did not differ in total number of words produced. Also, no between-group difference with respect to syntactic complexity was detected. However, significant between-group differences were observed for lexical diversity [$t(48) = 2.31$, $p = 0.01$, $d = 0.66$] and the number of C-units produced [$t(48) = -1.82$, $p = 0.04$, $d = -0.52$]. The narratives of CTH had a significantly higher lexical diversity, but the CHH produced significantly more C-units in their narratives. There were no significant between-group differences with regard to the other microstructural parameters. There were significant between-group differences for lower-level language skills, both for receptive vocabulary [$t(34) = 8.36$, $p < 0.001$, $d = 2.51$] and for phonological working memory [$t(45) = 4.88$, $p < 0.001$, $d = 1.40$], where the CTH outperformed the CHH.

As part of the second research question, we used Spearman rank correlations to investigate the relations between narrative skills and lower-level language skills. Results are summarized in Supplementary Appendix 2. Significant and positive correlations between both macrostructural parameters (i.e., story structure and structural complexity), and phonological working memory (story structure: $r = 0.317^*$, $p = 0.028$; structural complexity: $r = 0.347^*$, $p = 0.016$) suggest that better phonological working memory skills are related to the ability to verbally construct a more advanced story structure and structural complexity. Additionally, both macrostructural parameters were highly intercorrelated ($r = 0.707^{**}$, $p < 0.001$), indicating that a higher story structure score goes along with a higher structural complexity. Finally, a well-structured story was associated with better performance on comprehension questions (story structure: $r = 0.298^*$, $p = 0.035$).

On the microstructural level, a higher receptive vocabulary was associated with a higher lexical diversity ($r = 0.436^{**}$, $p = 0.002$) and fewer produced C-units ($r = -0.288^*$, $p < 0.042$). However, no significant correlations were found between the microstructural parameters and the phonological working memory score. Several microstructural parameters are interrelated: A higher total number of words was correlated to a higher number of C-units ($r = 0.715^{**}$, $p < 0.001$), and a higher syntactic complexity ($r = 0.561^{**}$, $p < 0.001$). In contrast, a lower lexical diversity was linked to a higher total number of words ($r = -0.532^{**}$, $p < 0.001$) and the number of C-units ($r = -0.559^{**}$, $p < 0.001$).

There were further relations between the macro- and microstructural parameters. A good story structure, a high structural complexity and better results in the comprehension questions were

TABLE 3 Macro- and microstructure scores and between-group comparison.

Test variable	Group	N	M	SD	*t*	df	*p*	*d*
Macrostructure								
Story structure	CHH	22	7.64	1.941	0.14	48	0.44	0.04
	CTH	28	7.71	1.941				
Structural complexity	CHH	22	3.95	2.497	1.70	48	0.10	0.48
	CTH	28	5.29	2.930				
Comprehension question	CHH	22	7.32	2.079	−0.39	48	0.34	−0.11
	CTH	28	7.11	1.792				
Microstructure								
Total number of words	CHH	22	73.82	20.800	−0.19	48	0.85	−0.05
	CTH	28	72.54	25.580				
C-units	CHH	22	10.91	2.022	−1.82	48	0.04	−0.52
	CTH	28	9.75	2.382				
Lexical diversity	CHH	22	0.527	0.084	2.31	48	0.01	0.66
	CTH	28	0.582	0.081				
Syntactic complexity	CHH	22	6.925	1.285	1.14	48	0.26	0.33
	CTH	28	7.426	1.711				
Lower-level language skills								
PPVT-4	CHH	22	40.73	10.855	8.36	34	0.001	2.51
	CTH	28	62.96	6.947				
CL-NWR	CHH	21	9.71	3.875	4.88	45	0.001	1.40
	CTH	27	13.70	1.564				

CHH, children who are hard of hearing; CTH, children with typical hearing; PPVT-4, T-score of the Peabody Picture Vocabulary Test (Lenhard et al., 2015); CL-NWR, Crosslinguistic Nonword Repetition Test (Chiat, 2015).

TABLE 4 Summary of multiple linear regression analyses.

	Lexical diversity			
Predictors	*b*	*SE*	*β*	*p*
PPVT-4	0.003	0.001	0.520	0.003
NWR	−0.002	0.004	−0.076	0.653
R^2	0.227 (p = 0.003)			

PPVT-4, T-score of the Peabody Picture Vocabulary Test (Lenhard et al., 2015); CL-NWR, Crosslinguistic Nonword Repetition Test (Chiat, 2015).

associated with a higher total number of words (story structure: $r = 0.693^{**}$, $p < 0.001$; story complexity: $r = 0.370^{**}$, $p = 0.008$; comprehension questions: $r = 0.314^{*}$, $p = 0.026$). In addition, a better and more complex structure was found for children with a higher number of C-Units (story structure: $r = 0.535^{**}$; $p < 0.001$; structural complexity: $r = 0.328^{*}$, $p = 0.020$).

Before conducting the regression analyses, the assumptions were checked to ensure that the models were appropriate and robust. The criteria were only met for lexical diversity. Therefore, the analysis (Table 4) was conducted with lexical diversity as the dependent variable and receptive vocabulary and phonological working memory as independent variables. The overall model was significant [$F(2, 45) = 6.623$, $p = 0.003$], accounting for 22.7% of the variance of the dependent variable lexical diversity ($R^2 = 0.227$). Receptive vocabulary was the only significant predictor of lexical diversity [$\beta = 0.520$, $t(45) = 3.116$, $p = 0.003$]. Phonological working memory, in contrast, was not a significant predictor of lexical diversity [$\beta = -0.076$, $t(45) = -0.435$, $p = 0.653$].

4 Discussion

This cross-sectional study was the first to examine the narrative skills of German-speaking children who are hard of hearing on a macro- and microstructural level compared to a group of children with typical hearing as well as the impact of lower-language skills on narratives in these groups. Note that this is an exploratory study with a relatively heterogeneous group of children with hearing loss and the results are therefore preliminary. It is well-known that children who are hard of hearing face challenges in lower-level language skills (e.g., Klieve et al., 2023; McCreery and Walker, 2021). However, less is known about the impact of hearing loss on higher level language skills, such as the ability to produce a narrative, and about how lower-level language skills relate to these narrative skills in these children. Therefore, our first aim was to investigate group differences between children who are hard of hearing and children with typical hearing of a comparable hearing age, based on spontaneously produced oral narratives. More specifically, we examined whether macro- and microstructure parameters differed between the two groups and whether these were related to vocabulary and phonological working memory.

4.1 Group comparison on macrostructural level

In line with Jones et al. (2016), we found no significant difference between the children who are hard of hearing and the children with typical hearing with regard to the story structure and structural complexity. Zanchi et al. (2021) reported similar findings when comparing children who are hard of hearing and children with typical hearing matched for chronological age. However, the authors reported that children who are hard of hearing outperformed younger children matched in hearing age in terms of the quantity of information (e.g., agents, events) in the narratives told. The lack of between-group differences at the macrostructural level in our study may be due to the fact that those skills are more dependent on cognitive skills, age, and the children's overall development than on language skills and auditory experience (Bitetti et al., 2020; Jones et al., 2016; Zanchi et al., 2021). Especially cognitive skills play a particularly important role in the construction and understanding of narratives, as these skills include the understanding of narrative structure, and organizing information coherently. Thus, children with delays in certain language areas may still have the cognitive skills to effectively comprehend and create narratives. Macrostructural skills therefore appear to be less affected. Our results also suggest that the children who are hard of hearing comprehended the story equally well as the children with typical hearing. This finding contrasts with Jones et al. (2016) who found that children who are hard of hearing gave less detailed and/or relevant responses to comprehension questions related to characters intentions or feelings. Note, however, that Jones et al. (2016) only asked two comprehension questions, while the protocol (MAIN) used in the current study includes 10 comprehension questions. Lindgren et al. (2023) pointed out that due to the conception of the narrative task and the related comprehension questions in MAIN, children may generally perform better in the area of comprehension questions than, for example, in story generation. This would fall in line with our results.

4.2 Group comparison on microstructural level

With regard to the microstructure, significant between-group differences were found. On average, children who are hard of hearing produced more C-units than the group of children with typical hearing. In contrast to our finding, Boons et al. (2013) did not find differences in the number of produced C-units. It is possible that these differing findings result from procedural and evaluation-related factors. In our study, the children told a story independently, whereas Boons et al. (2013) collected narratives via story retell. Perhaps the children who are hard of hearing in our study needed more utterances to implement the macrostructural organization of the story than children with typical hearing. However, the increased number of C-units did not affect the length of the story. The total number of words produced and the syntactic complexity (MLU in words) did not differ significantly between the two groups. Meanwhile, another significant group difference was found for lexical diversity. The narratives of the children with typical hearing showed a higher lexical diversity than the narratives of the children who are hard of hearing. Similarly, Zanchi et al. (2021) found a group difference for lexical diversity, but not in the length of narratives. The higher lexical diversity suggests that the children with typical hearing used a more extensive vocabulary, while children who are hard of hearing were more likely to use the same expressions when generating their story.

4.3 Group differences in terms of lower-level language skills

The group differences in the PPVT-4 and in the NWR task indicate that children who are hard of hearing not only exhibit difficulties in their vocabulary development, but also in phonological working memory. All in all, the children who are hard of hearing in our study showed better narrative skills than reported in previous studies. We argue that differences in methods and data collection can account for these differences. For example, other studies used different stories and different types of narratives (retell vs. story generation). Furthermore, differences may result from different profiles of children who are hard of hearing and a limited number of participants as well as from the heterogeneity of the group of children who are hard of hearing. Finally, German differs from English in several aspects, among them morphology and word order, and therefore comparability with studies from English-speaking children may be limited.

4.4 Individual profiles of children who are hard of hearing

Since the group of children who are hard of hearing is highly heterogenous, we also looked at their individual profiles to gain first insights into whether or not their history with hearing loss could help explain the heterogeneity of their narrative abilities. The following remarks extend our previous analyses from a qualitative perspective. In our study, the children with unilateral hearing loss and/or mild hearing loss showed better macrostructural (e.g., story structure and structural complexity) and microstructural skills (especially lexical diversity and syntactic complexity). These children also had better lower-level language skills. The type of device they use did not seem to influence the results, as the children with CIs performed just as well as the children with bilateral HAs and those with both a CI and a HA. Children who had an early diagnosis but a delayed initial intervention (after the age of 2;3 years) were more likely to have poorer narrative skills and lower-level language skills. This pattern was particularly evident in children who were fitted with bilateral CIs. It appears that a younger age at diagnosis of hearing loss, earlier onset of intervention, and unilateral and/or mild hearing loss, might support the development of narrative skills. The matching procedure is another important point to consider when comparing the language skills of children who are hard of hearing and children with typical hearing. Some studies matched groups of children based on chronological age (e.g., Boons et al., 2013), while others match them based on hearing age (e.g., Huttunen and Ryder, 2012). Matching based on hearing age provides a more appropriate basis for developmental comparisons regarding auditory input received by the children. This approach allows differences in language skills to be more accurately linked to the quality and duration of hearing exposure, while chronological age comparisons are better suited for assessing overall developmental differences. Since our aim was to investigate the occurrence of hearing loss and the associated effects on language abilities and how these are related to narrative skills, we matched the children based on their hearing age.

4.5 Relationships between narrative skills and related spoken language skills

The second aim of our study was to investigate relations between narrative skills at the macro- and microstructural-level, and to examine the role of receptive vocabulary and phonological working memory along with an investigation of which factors predict narrative skills on both groups best. Receptive vocabulary and lexical diversity were positively correlated, whereas receptive vocabulary and the number of C-units were negatively related. This suggests that children with a better receptive vocabulary tell more lexically diverse stories and require fewer utterances. For all other microstructural parameters, no correlation with receptive vocabulary or phonological working memory emerged. There were no correlations with receptive vocabulary at the macrostructural level. To further examine the relations between receptive vocabulary and narrative skills and to analyze whether receptive vocabulary is a predictor for narrative skills, multiple regression analyses were conducted for lexical diversity. The results show that receptive vocabulary contributes to the explanation of narrative skills on a microstructural level, which is in line with Walker et al.'s findings (Walker et al., 2023). The results are partially consistent with Jones et al.'s findings (Jones et al., 2016), possibly because they examined expressive rather than receptive vocabulary. Further evidence for a more advanced language development is provided by the strong positive relationships between the microstructural parameters, which are based on expressive language skills. Our study adds to existing studies (e.g., Jones et al., 2016), as we found that not only expressive but also receptive vocabulary significantly explains narrative microstructure. Moreover, some microstructural parameters correlate with each other. The number of words correlated highly and positively with the number of C-units on the one hand and with the syntactic complexity on the other. There were strong negative relationships between the total number of words produced and the lexical diversity and between the lexical diversity and produced C-units. This suggests a trade-off between lexical diversity and C-units: children who use many different words to create their narrative make less use of complex sentence structures (and vice versa). However, it should be noted that although children with typical hearing reached higher scores of lexical diversity in their narratives, this does not mean that on the content level they tell more complex and complete stories than children who are hard of hearing.

Finally, the present study shows that phonological working memory only correlates with macrostructural skills, i.e., story structure and story complexity. A stronger phonological working memory may help with sentences/ utterances planning which contributes to a better realization of the structure of the story. This improved skill of sentence planning enables the children to consider the overall structure of the story and ensure that their contributions fit coherently into the narrative. As a result, these children are more able to organize the structural elements of the story, such as the development of the plot and thematic coherence. This finding could indicate that well-developed short-term memory skills are an important prerequisite for structuring narratives. Despite the potential benefits of a strong phonological working memory, our analysis revealed no correlations between phonological working memory and microstructural parameters. This may suggest that while phonological working memory can facilitate broader aspects of narrative structuring, such as sentence planning and overall story coherence, it does not exert a significant influence on microstructural features, such as syntactic complexity or lexical diversity. These results are supported by the multiple regression analysis, which indicates that phonological working memory is not a strong predictor of lexical diversity. This finding is in contrast to Walker et al. (2023) who found that not only vocabulary but also phonological working memory skills explained the relationship between hearing status and narrative skills in story generation. The differences in our results could be due to different methods of story generation tasks and therefore different demands on the children.

4.6 Limitations and future directions

Our study extends the current understanding of the narrative skills of German-speaking children who are hard of hearing, as it is the first study to examine these skills at both macrostructural and microstructural level in comparison to children with typical hearing. The study provides further insight into how hearing loss affects higher-level language skills, namely narrative production, and how these skills relate to lower-level language skills. When interpreting the results, it should be noted that this is an exploratory study and that the sample may not be representative of the general population of children who are hard of hearing due to its size and the limited background information on some of the children who are hard of hearing. We chose to include all participating children in our analyses, even though we lacked some demographic information for some of the children. The results should therefore be considered as preliminary. Future research could also include a more targeted investigation with additional aspects such as cognitive skills. This could provide valuable information on whether and to what extent cognitive development affects the ability to tell stories, especially in children who are hard of hearing. As the aim of this study was to understand the effects of hearing loss on language skills regardless of individual factors such as severity or age of diagnosis and to focus on specific language skills, more research is needed to specifically address the role of type and degree of hearing loss, age of diagnosis and initial intervention and the role of cognitive development for instance. Additionally, future studies could examine potential differences between story generation tasks and retelling tasks and possible effects of the approach on the assessment of narrative skills in children who are hard of hearing.

5 Conclusion

To conclude, when compared to a group of children with comparable hearing age, the children who are hard of hearing in the present study were able to construct a narrative of similar content complexity, but they showed a relative weakness at the microstructural level in terms of lexical diversity. Between-group differences were also found for lower-level language skills like receptive vocabulary and phonological working memory, which appear to be affected in children who are hard of hearing. Finally, receptive vocabulary was the factor that best explained narrative skills at the macro- and microstructural level. The observed weakness in lexical diversity at the microstructural level suggests that children who are hard of hearing could benefit from targeted interventions focusing on vocabulary enhancement. These could include activities that promote the use of a wider range of words in everyday communication, such as story retelling exercises. The differences in lower language skills such as receptive vocabulary and phonological working memory underline the need for early and continuous support in these areas. Educators and therapists might consider including specific exercises to strengthen phonological working memory, such as repetition and sequencing tasks, as well as strategies to improve receptive vocabulary, such as structured vocabulary building programs.

Data availability statement

The datasets presented in this article are not readily available because further analyses are still being conducted. The dataset used and/or analyzed in the current study is available upon reasonable request to the corresponding author. Requests to access the datasets should be directed to Lara Hardebeck, lara.hardebeck@uni-oldenburg.de.

Ethics statement

The studies involving humans were approved by Kommission für Forschungsfolgenabschätzung und Ethik, Carl von Ossietzky Universität Oldenburg. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

LH: Formal analysis, Investigation, Writing – original draft. ER: Conceptualization, Project administration, Writing – review & editing. BG: Formal analysis, Investigation, Methodology, Writing – review & editing. UL: Conceptualization, Project administration, Writing – review & editing.

Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. This work was funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under Germany's Excellence Strategy – EXC 2177 /1 – Project ID 390895286.

Acknowledgments

We would like to thank all participants and their families as well as the Landesbildungszentrum für Hörgeschädigte Oldenburg. We would also like to thank our student assistants Selma Goebel and Doreen Schneider for their help with recruitment and testing.

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.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcomm.2024.1473075/full#supplementary-material

References

Abbott, H. P. (2008). The Cambridge introduction to narrative. *2nd* Edn. Cambridge, UK: Cambridge University Press.

Bedore, L. M., Peña, E. D., Gillam, R. B., and Ho, T.-H. (2010). Language sample measures and language ability in Spanish-English bilingual kindergarteners. *J. Commun. Disord.* 43, 498–510. doi: 10.1016/j.jcomdis.2010.05.002

Berman, R., and Slobin, D. (1994). Relating events in narrative: a crosslinguistic developmental study. Hillsdale, NJ: Lawrence Erlbaum.

Bishop, D. V. M., and Edmundson, A. (1987). Language-impaired 4-year-olds: distinguishing transient from persistent impairment. *J. Speech Hear. Disord.* 52, 156–173. doi: 10.1044/jshd.5202.156

Bitetti, D., Hammer, C. S., and López, L. M. (2020). The narrative macrostructure production of Spanish-English bilingual preschoolers: within-and cross-language relations. *Appl. Psycholinguist.* 41, 79–106. doi: 10.1017/S0142716419000419

Boons, T., De Raeve, L., Langereis, M., Peeraer, L., Wouters, J., and van Wieringen, A. (2013). Narrative spoken language skills in severely hearing impaired school-aged children with cochlea implants. *Res. Dev. Disabil.* 34, 3833–3846. doi: 10.1016/j.ridd.2013.07.033

Botting, N. (2002). Narrative as a tool for the assessment of linguistic and pragmatic impairments. *Child Lang. Teach. Ther.* 18, 1–21. doi: 10.1191/0265659002ct224oa

Chiat, S. (2015). "Non-word repetition," in Assessing multilingual children: disentangling bilingualism from language impairment, eds. S. Armon-Lotem, JongJ. de and N. Meir (Bristol, UK: Multilingual Matters), 125–150.

Cleave, P. L., Girolametto, L. E., Chen, X., and Johnson, C. J. (2010). Narrative abilities in monolingual and dual language learning children with specific language impairment. *J. Commun. Disord.* 43, 511–522. doi: 10.1016/j.jcomdis.2010.05.005

Cohen, J. (1988). Statistical power analysis for the behavioral sciences. *2nd* Edn. New York: Erlbaum.

Crowe, K., and Dammeyer, J. (2021). A review of the conversational pragmatic skills of children with cochlear implants. *J. Deaf. Stud. Deaf. Educ.* 26, 171–186. doi: 10.1093/deafed/enab001

Cupples, L., Ching, T. Y.-C., Button, L., Seeto, M., Zhang, V., Whitfield, J., et al. (2018). Spoken language and everyday functioning in 5-year-old children using hearing aids or cochlear implants. *Int. J. Audiol.* 57, S55–S69. doi: 10.1080/14992027.2017.1370140

Curenton, S. M., and Justice, L. M. (2004). African American and Caucasian preschoolers' use of decontextualized language: literate language features in oral narratives. *Lang. Speech Hear. Serv. Sch.* 35, 240–253. doi: 10.1044/0161-1461(2004/023)

Davidson, L. S., Geers, A. E., Hale, S., Sommers, M. M., Brenner, C., and Spehar, B. (2019). Effects of early auditory deprivation on working memory and reasoning abilities in verbal and visuo-spatial domains for pediatric CI recipients. *Ear Hear.* 40, 517–528. doi: 10.1097/AUD.0000000000000629

De Fina, A., and Georgakopoulou, A. (2011). Analyzing narrative: discourse and sociolinguistic perspectives. Cambridge, UK: Cambridge University Press.

Dickinson, D. K., and Porche, M. V. (2011). Relation between language experiences in preschool classrooms and children's kindergarten and fourth-grade language and reading abilities. *Child Dev.* 82, 870–886. doi: 10.1111/j.1467-8624.2011.01576.x

Dickinson, D. K., and Snow, C. E. (1987). Interrelationships among prereading and oral language skills in kindergartners from two social classes. *Early Child. Res. Q.* 2, 1–25. doi: 10.1016/0885-2006(87)90010-X

Duncan, J., and O'Neill, R. (2022). Prioritising pragmatics and social communication for deaf children and young people. *Deafness Educ. Int.* 24, 293–295. doi: 10.1080/14643154.2022.2139496

Gagarina, N., Klop, D., Kunnari, S., Tantele, K., Välimaa, T., Bohnacker, U., et al. (2019). "MAIN: multilingual assessment instrument for narratives – revised" in ZAS papers in linguistics 63, vol. *63* (Berlin: ZAS).

Griffin, T. M., Hemphill, L., Camp, L., and Wolf, D. P. (2004). Oral discourse in the pre-school years and later literacy skills. *First Lang.* 24, 123–147. doi: 10.1177/0142723704042369

Gutiérrez-Clellen, V. F. (2002). Narratives in two languages: assessing performance of bilingual children. *Lang. Educ.* 13, 175–197. doi: 10.1016/S0898-5898(01)00061-4

Haukedal, C. L., Wie, O. B., Schauber, S. K., Lyxell, B., Fitzpatrick, E. M., and von Koss Torkildsen, J. (2022). Social communication and quality of life in children using hearing aids. *Int. J. Pediatr. Otorhinolaryngol.* 152, 111000–111011. doi: 10.1016/j.ijporl.2021.111000

Heilmann, J., Miller, J., Nockerts, A., and Dunaway, C. (2010). Properties of the narrative scoring scheme using narrative retells in young school-age children. *Am. J. Speech Lang. Pathol.* 19, 154–166. doi: 10.1044/1058-0360(2009/08-0024)

Hinnerichs, J. (2016). "Spezifische Sprachentwicklungsstörungen bei Kindern mit Deutsch als Zweitsprache: Zur Eignung des Nachsprechens von quasi-universalen Nichtwörtern als Differentialdiagnostik". [Master's thesis].: Universität Heidelberg.

Huttunen, K., and Ryder, N. (2012). How children with normal hearing and children with a cochlear implant use mentalizing vocabulary and other evaluative expressions in their narratives. *Clin. Linguist. Phon.* 26, 823–844. doi: 10.3109/02699206.2012.682836

Jones, A. C., Toscano, E., Botting, N., Marshall, C. R., Atkinson, J. R., Denmark, T., et al. (2016). Narrative skills in deaf children who use spoken English: dissociations between macro- und microstructural devices. *Res. Dev. Disabil.* 59, 268–282. doi: 10.1016/j.ridd.2016.09.010

Justice, L. M., Bowles, R. P., Kaderavek, J. N., Ukrainetz, T. A., Eisenberg, S. L., and Gillam, R. B. (2006). The index of narrative microstructure: a clinical tool for analyzing school-age children's narrative performances. *Am. J. Speech Lang. Pathol.* 15, 177–191. doi: 10.1044/1058-0360(2006/017)

Kaderavek, J. N., and Sulzby, E. (2000). Narrative production by children with and without specific language impairment: Oral narratives and emergent readings. *J. Speech Lang. Hear. Res.* 43, 34–49. doi: 10.1044/jslhr.4301.34

Kawar, K., Walters, J., and Fine, J. (2019). Narrative production in Arabic-speaking adolescents with and without hearing loss. *J. Deaf. Stud. Deaf. Educ.* 24, 255–269. doi: 10.1093/deafed/eny048

Klieve, S., Eadie, P., Graham, L., and Leitão, S. (2023). Complex language use in children with hearing loss: a scoping review. *J. Speech Lang. Hear. Res.* 66, 688–719. doi: 10.1044/2022_JSLHR-22-00270

Krijger, S., Coene, M., Govaert, P. J., and Dhooge, I. (2020). Listening difficulties of children with cochlear implants in mainstream secondary education. *Ear Hear.* 41, 1172–1186. doi: 10.1097/AUD.0000000000000835

Labov, W. (1972). Language in the inner city. Philadelphia, PA: University of Pennsylvania Press.

Lederberg, A. R., and Spencer, P. E. (2001). "Vocabulary development of deaf and hard of hearing children" in Context, cognition, and deafness. eds. M. D. Clark, M. Marschark and M. Karchmer (Washington, DC: Gallaudet University Press), 88–112.

Lenhard, A., Lenhard, W., Segerer, R., and Suggate, S. (2015). Peabody picture vocabulary test. *4th* Edn. Frankfurt: Pearson Assessment.

Levesque, E., Duncan, J., and Snoddon, K. (2023). Rethinking the language development of deaf and hard of hearing children. *Deafness Educ. Int.* 25, 1–3. doi: 10.1080/14643154.2023.2165003

Licandro, U. (2016). Narrative skills of young dual language learners. Acquisition and peer-mediated support in early childhood education and care. Wiesbaden: Springer VS.

Lieu, J. E. C., Kenna, M., Anne, S., and Davidson, L. (2020). Hearing loss in children: a review. *JAMA* 324, 2195–2205. doi: 10.1001/jama.2020.17647

Liles, B. Z., Duffy, R. J., Merritt, D. D., and Purcell, S. L. (1995). Measurement of narrative discourse ability in children with language disorders. *J. Speech Lang. Hear. Res.* 38, 415–425. doi: 10.1044/jshr.3802.415

Lindgren, J., Tselekidou, F., and Gagarina, N. (2023). "Acquisition of narrative macrostructure: a comprehensive overview of results from the multilingual assessment instrument for narratives" in Multilingual assessment instrument for narratives: recent developments and new language adaptions. eds. J. Lindgren, F. Tselekidou and N. Gagarina (Berlin: ZAS), 111–132.

Loban, W. (1976). Language development: Kindergarten through grade twelve. Urbana, IL: National Council of Teachers of English.

Lund, E. (2016). Vocabulary knowledge of children with cochlear implants: a meta-analysis. *J. Deaf. Stud. Deaf. Educ.* 21, 107–121. doi: 10.1093/deafed/env060

MacWhinney, B. (2000). The CHILDES project: tools for analyzing talk. *3rd* Edn. Mahwah, NJ: Lawrence Erlbaum Associates.

Matthews, D., and Kelly, C. (2022). Pragmatic development in deaf and hard of hearing children: a review. *Deafness Educ. Int.* 24, 296–313. doi: 10.1080/14643154.2022.2140251

McCabe, A., and Rollins, P. R. (1994). Assessment of preschool narrative skills. *Am. Speech Lang. Hear. Assoc.* 3, 45–56. doi: 10.1044/1058-0360.0301.45

McCreery, R. W., and Walker, E. A. (2021). Variation in auditory experience affects language and executive function skills in children who are hard of hearing. *Ear Hear.* 43, 347–360. doi: 10.1097/AUD.0000000000001098

Melzi, G., and Caspe, M. (2017). "Research approaches to narrative, literacy, and education" in Research methods in language and education. eds. K. A. King, Y.-L. Lai and S. May (Cham: Springer International Publishing), 241–253.

Morton, C. C., and Nance, W. E. (2006). Newborn hearing screening –a silent revolution. *N. Engl. J. Med.* 354, 2151–2164. doi: 10.1056/NEJMra050700

Norbury, C. F., and Bishop, D. V. M. (2003). Narrative skills of children with communication impairments. *Int. J. Lang. Commun. Disord.* 38, 287–313. doi: 10.1080/136820310000108133

O'Neill, D. K., Pearce, M. J., and Pick, J. L. (2004). Preschool children's narratives and performance on the Peabody Indivdualized achievement test – revised: evidence of a relation between early narrative and later mathematical ability. *First Lang.* 24, 149–183. doi: 10.1177/0142723704043529

Paul, R., Paatsch, L., Caselli, N., Garberoglio, C. L., Goldin-Meadow, S., and Lederberg, A. (2020). Current research in pragmatic language use among deaf and hard of hearing children. *Pediatrics* 146, S237–S245. doi: 10.1542/peds.2020-0242C

Pearson, B. Z. (2002). "Narrative competence among monolingual and bilingual school children in Miami" in Language and literacy in bilingual children. eds. D. K. Oller and R. E. Eilers (Buffalo, NY: Multilingual Matters), 135–174.

Retherford, K. (2000). Guide to analysis of language transcripts. *3rd* Edn. Eau Claire, WI: Thinking Publications.

Riad, R., Westling Allodi, M., Siljehag, E., and Bölte, S. (2023). Language skills and well-being in early childhood education and care: a cross-sectional exploration in a Swedish context. *Front. Educ.* 8:963180. doi: 10.3389/feduc.2023.963180

Rodina, Y. (2017). Narrative abilities of preschool bilingual Norwegian-Russian children. *Int. J. Biling.* 21, 617–635. doi: 10.1177/1367006916643528

Schoon, I., Parsons, S., Rush, R., and Law, J. (2010). Children's language ability and psychosocial development: a 29-year follow-up study. *Pediatrics* 126, e73–e80. doi: 10.1542/peds.2009-3282

Schouwenaars, A., Finke, M., Hendriks, P., and Ruigendijk, E. (2019). Which questions do children with cochlear implants understand? An eye-tracking study. *J. Speech Lang. Hear. Res.* 62, 387–409. doi: 10.1044/2018_JSLHR-H-17-0310

Snow, C. E., Tabors, P. O., Nicholson, P. A., and Kurland, B. F. (1995). SHELL: Oral language and early literacy skills in kindergarten and first-grade children. *J. Res. Child. Educ.* 10, 37–48. doi: 10.1080/02568549509594686

Taylor, C. L., Christensen, D., Lawrence, D., Mitrou, F., and Zubrick, S. R. (2013). Risk factors for children's receptive vocabulary development from four to eight years in the longitudinal study of Australian children. *PLoS One* 8:e73046. doi: 10.1371/journal.pone.0073046

Tomblin, J. B., Harrison, M., Ambrose, S. E., Walker, E. A., Oleson, J. J., and Moeller, M. P. (2015). Language outcomes in young children with mild to severe hearing loss. *Ear Hear.* 36, 76S–91S. doi: 10.1097/AUD.0000000000000219

Uccelli, P., and Páez, M. M. (2007). Narrative and vocabulary development of bilingual children from kindergarten to first grade: developmental changes and associations among English and Spanish skills. *Lang. Speech Hear. Serv. Sch.* 38, 225–236. doi: 10.1044/0161-1461(2007/024)

Vandewalle, E., Boets, B., Boons, T., Ghesquière, P., and Zink, I. (2012). Oral language and narrative skills in children with specific language impairment with and with-out literacy delay: a three-year longitudinal study. *Res. Dev. Disabil.* 33, 1857–1870. doi: 10.1016/j.ridd.2012.05.004

Walker, E. A., Harrison, M., Baumann, R., Moeller, M. P., Sorenson, E., Oleson, J. J., et al. (2023). Story generation and narrative retells in children who are hard of hearing and hearing children. *J. Speech Lang. Hear. Res.* 66, 3550–3573. doi: 10.1044/2023_JSLHR-23-00084

Walker, E. A., Redfern, A., and Oleson, J. J. (2019). Linear mixed-model analysis to examine longitudinal trajectories in vocabulary depth and breadth in children who are hard of hearing. *J. Speech Lang. Hear. Res.* 62, 525–542. doi: 10.1044/2018_JSLHR-L-ASTM-18-0250

Werfel, K. L., Reynolds, G., Hudgins, S., Castaldo, M., and Lund, E. A. (2021). The production of complex syntax in spontaneous language by 4-year-old children with hearing loss. *Am. J. Speech Lang. Pathol.* 30, 609–621. doi: 10.1044/2020_AJSLP-20-00178

Zanchi, P., Zampini, L., and Berici, R. (2021). Narrative competence in Italian children with cochlear implants: a comparison with children matched by chronological or hearing age. *Clin. Linguist. Phon.* 35, 277–292. doi: 10.1080/02699206.2020.1781264