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Narrative Skills in School-Age Children who are Hard of Hearing

Kathryn Gabel

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A thesis submitted in partial fulfillment of the requirements
for graduation with Honors in the Speech Pathology and Audiology

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Elizabeth Walker
Thesis Mentor

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All requirements for graduation with Honors in the
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Speech Pathology and Audiology Honors Advisor

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ABSTRACT

The ability to effectively tell a story is a central component of language and a considerable predictor of academic success for children. Due to their reduced access to auditory input, children with hearing loss (CHL) are at risk for delays in language development. Previous research suggests that CHL lag behind their peers with normal hearing (children with normal hearing; CNH) in narrative language development; however few studies focus specifically on children with mild-to-severe hearing loss (children who are hard of hearing; CHH). The current study examined multiple aspects of narrative ability and its underlying mechanisms in second-grade CHH compared to same-age CNH. Results indicated that 1) CHH performed significantly worse on narrative comprehension than CNH, 2) children with severe hearing loss performed worse than CNH on both narrative comprehension and production, and children with moderate hearing loss performed significantly better than children with severe hearing loss on production tasks, 3) grammar and vocabulary contributed uniquely to narrative ability in CHH, while only vocabulary contributed in CNH, and 4) CHH omitted a higher percentage of high-frequency morphemes in their stories than CNH. Overall, CHH demonstrated delays in narrative performance compared to CNH. Narrative language skills should be targeted in intervention to promote literacy development and optimize potential academic success of CHH.

INTRODUCTION

Narratives are arguably one of the most central components of language. Not only do narratives require the ability to present and connect ideas in an organized fashion (narrative macrostructure), but they also necessitate use and understanding of complex linguistic structures to share those ideas with another person (narrative microstructure). Additionally, telling a story requires pragmatic skills that are involved in a conversation with a more formal structure and less support from a conversational partner (Botting, 2002).

An abundance of research supports that early narrative skills are predictive of a child's later academic success, specifically in their literacy development. Most of the material in a school setting, whether teacher instruction or written assignments, will be conveyed in language that goes beyond the sentence-level. As narratives are the first form of extended language discourse to which young children are exposed and bridge the transition from oral to written language, they are crucial in building a strong academic foundation in a child's early elementary school years (Crosson & Geers, 2001). In fact, many of the Common Core's Anchor Standards for Reading (2010) involve the ability to comprehend, interpret, and integrate both the content and linguistic components of discourse presented in diverse formats.

Children with language disorders have difficulties with multiple aspects of narratives, putting their ability to succeed in school at risk (Reuterskiöld, Ibertsson, & Sahlén, 2010). Narrative abilities are an ecologically valid way to assess language in children of multiple populations, allowing for early identification and treatment for children who are at-risk for delays in language and reading development (Botting, 2002; Klein & Wie, 2014). The primary aim of this thesis is to explore the narrative skills of children with mild-to-severe hearing loss

when compared to their typically hearing peers, including identifying the impact of degree of hearing loss and other underlying factors on narrative ability.

Narrative Skills in Typically Developing Children

Narrative discourse typically begins to emerge at preschool age in the form of pre-episodic narratives, or stories that lack a goal-directed attempt to resolve an issue. At first, preschoolers require heavy peer and adult support when producing narratives, relying on questioning from their communication partner and prompting to continue their stories. Preschoolers will gradually become more independent in their narrative productions, moving from strings of descriptive statements with no dependent order to action sequences that rely on certain temporal relations. In kindergarten, causal relations (the effect that one event has on another) are typically introduced in children's stories. Beginning in elementary school, children's stories shift from pre-episodic to episodic narratives, which include a problem, internal response, goal-directed attempts to solve the problem, and a consequence. A child's ability to tell these episodic narratives clearly and stylistically will typically continue developing until about 14 years of age (Ukrainetz, 2006).

Narrative Skills in Children with Hearing Loss

Terminology used to refer to hearing loss is often muddled, leading to ambiguity when interpreting research on the impact of hearing loss on children's functional outcomes. "Hearing loss" is a broad term that encompasses children with any level of reduced auditory capacity (children with hearing loss; CHL). Children who are deaf have severe-to-profound hearing loss (>80 dB HL). Without cochlear implants to electrically stimulate the auditory nerve, children who are deaf have essentially no access to an auditory signal. On the other hand, children with mild-to-severe hearing loss (20-80 dB HL) are considered hard of hearing (children who are hard

of hearing; CHH). Hearing aids, which amplify the acoustic signal, are the primary means of intervention.

Multiple studies have found that CHL, as a group, perform more poorly on narrative tasks than their typically hearing peers (Boons et al., 2013; Crosson & Geers, 2001; Jones et al., 2016; Reuterskiöld et al. 2010; Soares, Garcia de Goulart, & Chiari, 2010). Auditory access is essential to the development of spoken language skills; restricted access to verbal information provides CHL with fewer opportunities for incidental language learning through exposure to multiple story forms (Crosson & Geers, 2001). Previous research has found that higher speech intelligibility and speech perception scores relate to stronger narrative skills in school-age cochlear implant users, suggesting that favorable auditory access can help CHL develop narrative skills comparable to children with normal hearing (CNH; Boons et al., 2013; Crosson & Geers, 2001; Klein & Wie, 2014). However, Jones et al. (2016) found no relationship between children's storytelling abilities and pure-tone average scores, suggesting that any level of hearing loss, even in the mild range, may affect narrative skill development in CHL.

Various studies of narrative ability have suggested that CHL lag behind CNH in story comprehension and generation, in both microstructural and macrostructural aspects of the task (Boons et al., 2013; Crosson & Geers, 2001; Jones et al., 2016; Reuterskiöld et al., 2010; Soares et al., 2010). The results of these studies, however, are not all consistent, as each explores different aspects of the narrative task with children who have varied levels of hearing loss. Some studies also include CHL who have confounding factors, such as lower nonverbal cognition or use of sign language as a primary mode of communication (Botting, 2010). Further research that controls for communication mode and comorbid factors would complement and clarify current knowledge on narrative skills in CHL.

Narrative Skills in Children with Mild-to-Moderate Hearing Loss

Generally, higher-level language skills in CHH who have a mild-to-moderate hearing loss have not been extensively studied (Reuterskiöld et al., 2010). Few studies have examined narrative skills in particular with children from this population. The studies that have been conducted have clear limitations. Reuterskiöld et al. (2010) examined story productions in a group of school-age CHH with mild-moderate hearing loss. Participants were presented with a sequence of pictures and asked to tell a story about the pictures after being prompted by the examiner with a starting sentence. The only significant difference that the researchers found was that the CHH shared less-relevant information in their narratives compared to the CNH; the groups performed similarly on all other measures of story content, structure, and grammar. Their findings suggest that hearing loss affects only a component of narrative production. The CNH in this study, however, were younger than the CHH by one year, on average. Comparing the narrative productions of CHH to narratives of younger CNH may have masked any delays in the CHH. Furthermore, a conservative choice of statistical analysis may have reduced the likelihood of finding significant differences between the CNH and CHH. Overall, the current lack of research on storytelling abilities in children who have mild-to-moderate hearing loss combined with the assertion that any level of hearing loss will impact narrative skill development indicates a need for a more thorough investigation of storytelling abilities within this population.

Underlying Mechanisms of Narrative Production

Previous research suggests that, in general, CHL have weaker storytelling abilities than CNH (Jones et al., 2016). Botting (2010) proposed that future studies should focus on examining which underlying mechanisms play a role in narrative skill development in this population. Exploring the relationships between factors such as working memory, grammar, and vocabulary

in narrative production and comprehension is key to understanding the most effective ways to support strong narrative skill formation in CHL (Botting, 2010).

Working memory. Narrative production and comprehension requires working memory skills to integrate linguistic information while actively recalling a series of events (Dodwell & Bavin, 2008). Few studies to date have examined the role of working memory in narrative abilities of CHL. Blom and Boerma (2016) investigated the factors that influence narrative macrostructure in children with specific language impairment (SLI), finding significant correlations between verbal working memory and performance on various narrative tasks. Similarly, Dodwell and Bavin (2008) found that children with SLI who scored well on measures of working memory performed better on narrative recall and comprehension tasks. While working memory plays an important role in the narrative task as a whole, it seems to be particularly crucial to narrative comprehension (Dodwell & Bavin, 2008). Further research regarding the role of working memory in the narrative abilities of CHL is warranted.

Grammar. While CHL have reduced auditory access in a variety of areas, their high-frequency input is notably affected. Because many English grammatical morphemes consist of high-frequency acoustic information, the morphosyntactic development of CHL is especially vulnerable (Worsfold, Mahon, Yuen, & Kennedy, 2010). In analyzing language samples of 3- and 6 year-old CHH and CNH, Koehlinger, Owen Van Horne, and Moeller (2013) found that the CHH in both age groups produced fewer obligatory verb morphemes than their hearing peers. Similarly, McGuckian and Henry (2007) found that 7 year-old CHH struggled with producing possessive -*'s* and plural -*s* morphological endings. Previous studies have found that CHL have lower scores on correct grammatical morpheme production in their narratives (Jones et al., 2016). Worsfold et al. (2010) compared the narratives of children with late-confirmed and early-

confirmed hearing loss to CNH. They found the fewest correct high-frequency morpheme productions in the late-confirmed hearing loss group, with the early-confirmed hearing loss group performing slightly better, and the CNH producing the largest number of accurate high-frequency morphemes in their narratives. Poor morphosyntactic development in CHH could affect their ability to produce narratives with correct grammatical morphemes.

Vocabulary. Previous research has found that CHL generally have smaller receptive vocabularies than their hearing peers (Spencer, 2004). It has been suggested that strong vocabulary development is important to narrative language (Jones et al., 2016). Jones et al. (2016) studied narrative skills in CHL and CNH, finding that vocabulary scores were strongly correlated with use of grammatical markers and narrative devices scores. CHL had lower vocabulary scores, on average, compared to the CNH (Jones et al., 2016).

Clinical Implications of Narrative Research in CHL

Narratives have been proposed as a more ecologically valid and sensitive assessment than other standardized measures in identifying children who are at-risk for delays in their language development (Botting, 2010; Klein & Wie, 2014). Research to date is consistent in that CHL generally lag behind their hearing peers on multiple components of the narrative task (Boons et al., 2013; Crosson & Geers, 2001; Jones et al., 2016; Reuterskiöld et al., 2010; Soares et al., 2010). Understanding the specific attributes in narrative skills of CHL is key to early identification and treatment of language deficits in this population. Additionally, exploring the underlying mechanisms of narrative skill development is central to providing therapy that effectively and efficiently improves narrative performance in CHL (Botting, 2010).

Current Study

The current study aims to examine multiple aspects of narrative skills and their underlying mechanisms in second-grade CHH compared to same-age CNH. The following research questions will be addressed:

1. Are second grade CHH delayed in their narrative comprehension or production skills compared to CNH? *We predict that CHH will demonstrate lower scores on measures of narrative comprehension and production than CNH, and that narrative comprehension scores will particularly be lower in CHH.*

2. Does degree of hearing loss have an impact on narrative production skills? *We predict that as degree of hearing loss increases, narrative production scores will decrease. Alternatively, studies suggesting that any level of reduced auditory input impacts narrative development (Jones et al., 2016) support the hypothesis that even children with mild hearing loss will demonstrate deficits in narrative production compared to CNH.*

3. Does performance in areas of working memory, grammar, or vocabulary differ in CHH compared to CNH? How do these factors impact narrative skills in CHH? *We predict that CHH will have lower working memory, grammar, and vocabulary scores than CNH. We also predict that working memory, grammar, and vocabulary will all be associated with narrative performance in CHH.*

4. Do CHH differ on measures of mean length of utterance (MLU), total number of utterances, and production of high-frequency morphemes (possessive -*'s*, third person singular -*s*, plural -*s*, regular past tense -*ed*, contracted copulas/auxiliaries -*'s*) in their narratives when compared to CNH? *We predict that CHH will have smaller MLUs, fewer total utterances, and will have a higher percentage of omitted high-frequency morphemes in their narratives than CNH.*

METHOD

Participants

Children in the current study were part of a larger longitudinal study, the Outcomes of School-Age Children who are Hard of Hearing (OSACHH) project. Participants included 88 CHH and 37 CNH who were all tested after they had completed second grade. All children who participated in the study had at least one primary caregiver who spoke English in the home, normal-to-corrected vision, no major motor/cognitive impairments, and nonverbal cognition that was within normal limits when tested at 4 and 5 years old. CHH who participated met the following criteria: 1) had a mild-to-severe hearing loss, with a better-ear pure-tone average (BEPTA) of 25 to 75 dB HL, 2) used spoken language as their primary mode of communication, and 3) no cochlear implant.

Procedures

Audiologic assessment. A pediatric audiologist obtained air-conduction and bone-conduction thresholds at 500, 1000, 2000, and 4000 Hz for CNH. Full audiograms were obtained for CHH.

Narrative measures. Trained examiners from the University of Iowa, Boys Town National Research Hospital, and the University of North Carolina at Chapel Hill administered the Test of Narrative Language (TNL; Gillam & Pearson, 2004) to each participant while they were in second grade. The TNL assesses children's narrative comprehension and production skills, with multiple sections that require children to listen and answer questions about a story, retell a story after listening to an examiner tell it, and generate their own story with varied levels of picture support. Each child's composite TNL standard score was calculated, as well as separate Narrative comprehension and Oral Narration scaled scores.

Research assistants from the University of Iowa and the University of North Carolina at Chapel Hill transcribed and coded participants' narrative productions on three subtests of the TNL: the "McDonald's" story retell, "Late for School" story generation with five supporting pictures, and "Alien" story generation with one supporting picture. One research assistant from the University of Iowa was trained to achieve over 85% reliability with a second research assistant on three consecutive language samples before transcribing the narrative data. The trained research assistant then transcribed and coded all participants' narrative productions on the three subtests, including checking over transcripts that had been completed by other research assistants. The second research assistant from the University of Iowa then separately transcribed 18% of participants' narrative productions, achieving 98% overall reliability with the first research assistant (98.2% at the sentence level, 99.3% at the word level, and 96.5% at the morpheme level). With the three narrations transcribed as one language sample for each child, transcripts contained 43 utterances, on average (*SD* = 18.6). Though traditional language sample guidelines recommend a minimum of 50 utterances for transcript reliability, research supports that narrative retell and generation tasks can provide reliable linguistic data in shorter samples (Heilmann, 2010; Heilmann et al., 2008; Tilstra & McMaster, 2007). These transcripts were used to calculate each participant's average mean length of utterance (MLU), total number of utterances, and percentage of omitted high-frequency morphemes (possessive -*'s*, third person singular -*s*, plural -*s*, regular past tense -*ed*, contracted copulas/auxiliaries -*'s*).

Language assessment. Participants were administered multiple language assessments, including the Woodcock-Johnson Tests of Achievement III (WJTA III; Woodcock, McGrew, & Mather, 2001; 2007) Picture Vocabulary subtest to measure receptive vocabulary, and the Clinical Evaluation of Language Fundamentals-4 (CELF-4; Semel, Wiig, & Secord, 2003) Word

Structure subtest as a measure of expressive grammar. Scores from these assessments were used to calculate children's vocabulary and grammar scores.

Cognitive assessments. Participants were administered a backwards digit span task from the Automated Working Memory Assessment (AWMA; Alloway, 2007) to measure complex working memory. Scores from this assessment was used to calculate the verbal working memory capacity of each child.

Statistical Analyses

Comparing CHH to CNH. Narrative Comprehension and Oral Narration scaled scores on the TNL were calculated and averaged for both the CHH and CNH. Independent-sample *t* tests were used to compare performance between groups. When variances were unequal, we performed a Satterwaithe adjustment.

Effect of degree of hearing loss. Narrative Comprehension and Oral Narration scaled scores on the TNL were calculated and averaged for the normal hearing, mild, moderate, and severe hearing loss groups. An analysis of variance (ANOVA) was used to compare performance between groups.

Underlying mechanisms. Cognitive and language assessment scores were used to calculate working memory, grammar, and vocabulary scores for both CNH and CHH. A regression analysis was used to compare performance between groups on each measure and determine any correlations between the three different factors and narrative performance scores.

Transcript analysis. Three oral narrations from the TNL were transcribed using the Systematic Analysis of Language Transcripts (SALT; Miller & Chapman, 2000) transcription software. In order to evaluate the microstructure of participants' narratives, transcripts were analyzed for MLU, total number of utterances, and percentage of omitted high-frequency

morphemes. Independent-sample *t* tests were used to compare performance between CHH and CNH.

RESULTS

Research Question 1: Narrative Skills in Children who are Hard of Hearing Compared to Children with Normal Hearing

Mean scores on the Narrative Comprehension subscale of the TNL were 10.66 for CHH (*SD* = 3.00) and 12.11 for CNH (*SD* = 2.25). The difference between groups was significant, $t(88.94) = -2.65$, $p = .004$, $d = .547$. Mean scores on the Oral Narration subscale of the TNL were 9.52 for CHH (*SD* = 3.00) and 10.57 for CNH (*SD* = 3.12). The difference between groups approached significance, $t(70.57) = -1.73$, $p = .09$, $d = .343$. Figure 1 displays comparisons between TNL scaled scores for Narrative Comprehension and Oral Narration subscales.

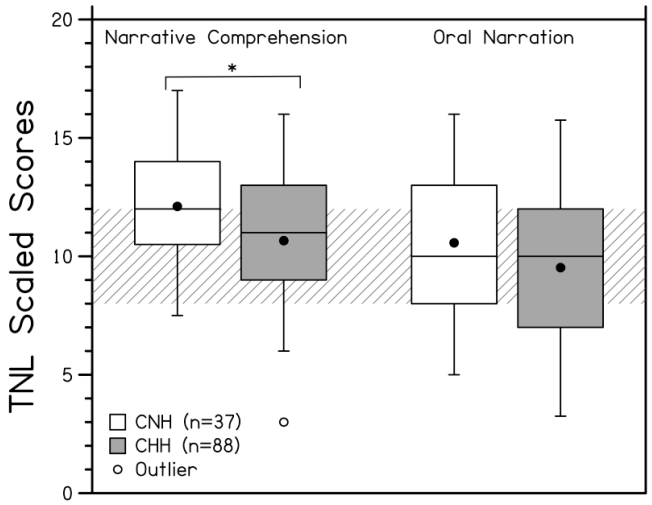

Figure 1. Box plot of Test of Narrative Language (TNL) Narrative Comprehension and Oral Narration scaled scores as a function of children with normal hearing (CNH) and children who are hard of hearing (CHH). The central lines represent the median values, the filled circles represent the mean values, and the box limits are the 25th and 75th percentiles. The lower fence is 1.5*(IQR) below the 25th percentile and the upper fence is 1.5*(IQR) above the 75th percentile (IQR = 75th percentile - 25th percentile). The unfilled circles represent outliers. The hatched area represents the average range for the normative sample.

Research Question 2: Impact of Degree of Hearing Loss on Narrative Skills

Mean scores on TNL comprehension tasks were compared between CNH (*M* = 12.11, *SD* = 2.25), children with mild hearing loss (*M* = 10.59, *SD* = 2.61), children with moderate hearing loss (*M* = 11.22, *SD* = 2.86), and children with severe hearing loss (*M* = 9.74, *SD* = 3.62).

Between-group differences were significant, $F(3, 120) = 3.72$, $p = .01$, $\eta_p^2 = .085$. Follow-up pairwise comparisons using a Bonferroni correction indicated that CNH performed significantly better than children with severe hearing loss ($p = .02$). The difference in Narrative Comprehension scaled scores between CNH and children with mild hearing loss approached significance ($p = .09$). Figure 2 displays scaled scores on TNL Narrative Comprehension compared between groups.

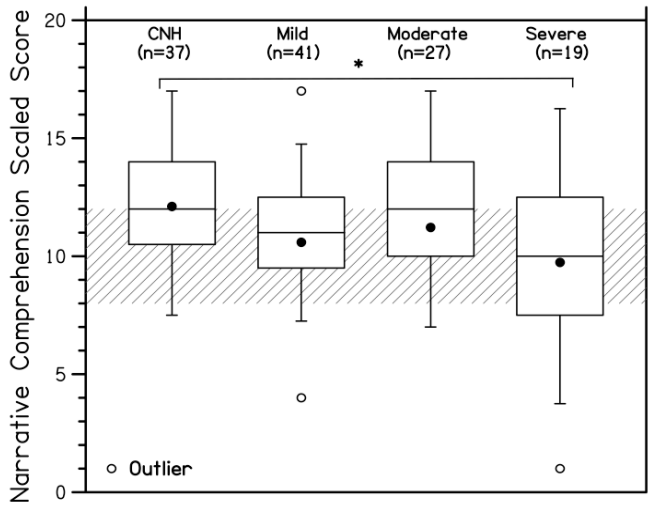

Figure 2. Box plot of Test of Narrative Language (TNL) Narrative Comprehension scaled scores as a function of hearing loss group. The central lines represent the median values, the filled circles represent the mean values, and the box limits are the 25th and 75th percentiles. The lower fence is 1.5*(IQR) below the 25th percentile and the upper fence is 1.5*(IQR) above the 75th percentile (IQR = 75th percentile - 25th percentile). The unfilled circles represent outliers. The hatched area represents the average range for the normative sample.

Mean scores on the TNL production tasks were also compared between CNH ($M = 10.57$, $SD = 2.98$), children with mild hearing loss ($M = 9.61$, $SD = 3.19$), children with moderate hearing loss ($M = 10.56$, $SD = 3.02$), and children with severe hearing loss ($M = 7.79$, $SD = 2.51$). Between-group differences were significant, $F(3, 120) = 4.30$, $p = .006$, $\eta_p^2 = .097$. Follow-up pairwise comparisons indicated that CNH performed significantly better than children with severe hearing loss ($p = .008$). Children with moderate hearing loss also performed significantly better than children with severe hearing loss ($p = .015$). Figure 3 displays scaled scores on TNL Oral Narration compared between groups.

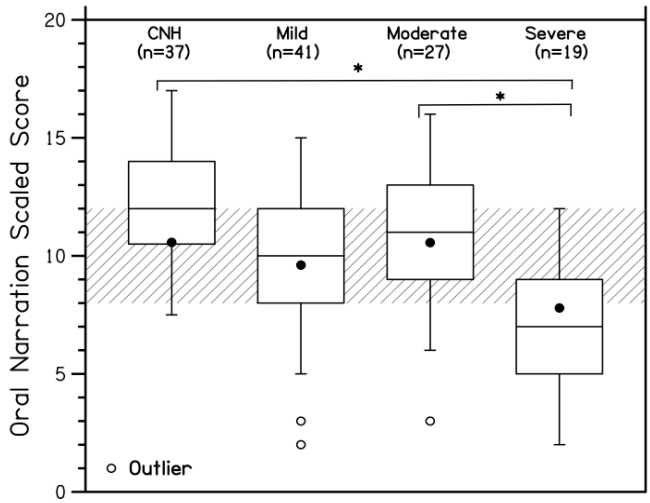

Figure 3. Box plot of Test of Narrative Language (TNL) Oral Narration scaled scores as a function of hearing loss group. The central lines represent the median values, the filled circles represent the mean values, and the box limits are the 25th and 75th percentiles. The lower fence is 1.5*(IQR) below the 25th percentile and the upper fence is 1.5*(IQR) above the 75th percentile (IQR = 75th percentile - 25th percentile). The unfilled circles represent outliers. The hatched area represents the average range for the normative sample.

Research Question 3: Influence of Working Memory, Grammar, and Vocabulary Skills on Narrative Performance

Mean scores from the AWMA Backwards Digit Span, CELF-4 Word Structure subtest, and WJTA III Picture Vocabulary subtest were used to compare groups on working memory, grammar, and vocabulary skills, respectively. CNH performed significantly better than CHH on the measure of grammar (p = .05). Table 1 displays descriptive statistics on measures of working memory, grammar, and vocabulary for CNH and CHH.

Table 1. Data for group performance on measures of working memory, grammar, and vocabulary.

Assessment	**CNH** (n = 37)		**CHH** (n=87)		
	Mean	**SD**	**Mean**	**SD**	***p* value**
Automated Working Memory Assessment (AWMA) Backwards Digit Span	104.97	13.88	101.55	15.62	.21
Clinical Evaluation of Language Fundamentals-4 (CELF-4) Word Structure subtest	110.14	8.94	106.03	14.08	**.05***
Woodcock-Johnson III Tests of Achievement (WJTA III) Picture Vocabulary subtest	103.14	10.04	100.79	9.72	.20

Children who are Hard of Hearing. We conducted a multiple regression analysis to determine whether the AWMA Backwards Digit Span (working memory), CELF-4 Word Structure (grammar), and WJTA III Picture Vocabulary (vocabulary) scores accounted for a

significant proportion of the variance in TNL scores. The overall regression models accounted for 44% and 46% of the variance in Narrative Comprehension and Oral Narration scaled scores, respectively (Narrative Comprehension, $F(3, 83) = 23.44$, $p < .001$; Oral Narrative, $F(3, 83) = 25.36$, $p < .001$). After adjusting for collinearity, grammar and vocabulary accounted for unique variance in narrative comprehension and oral narration in CHH, $p < .05$. Table 2 displays data on correlations between working memory, vocabulary, and grammar for CHH.

Table 3. Data for correlations on measures of working memory, grammar, and vocabulary in CHH.

Variable	1	2	3	4	5
1. Automated Working Memory Assessment (AWMA) Backwards Digit Span	--	**.233***	**.347****	**.221***	**.329****
2. Clinical Evaluation of Language Fundamentals-4 (CELF-4) Word Structure subtest		--	**.547****	**.649****	**.603****
3. Woodcock-Johnson III Tests of Achievement (WJTA III) Picture Vocabulary subtest			--	**.529****	**.612****
4. Test of Narrative Language (TNL) Narrative Comprehension subscale				--	--
5. Test of Narrative Language (TNL) Oral Narration subscale				--	--

Children with Normal Hearing. In CNH, the overall regression models accounted for 12% and 26% of the variance in Narrative Comprehension and Oral Narration scaled scores, respectively (Narrative Comprehension, $F(2, 34) = 3.61$, $p = .04$; Oral Narratives, $F(2, 34) = 7.25$, $p = .002$). After adjusting for collinearity, only vocabulary accounted for unique variance in narrative comprehension and oral narration in CNH, $p < .05$. Table 3 displays data on correlations between working memory, vocabulary, and grammar for CNH.

Table 3. Data for correlations on measures of working memory, grammar, and vocabulary in CNH.

Variable	1	2	3	4	5
1. Automated Working Memory Assessment (AWMA) Backwards Digit Span	--	.202	.322	.086	.252
2. Clinical Evaluation of Language Fundamentals-4 (CELF-4) Word Structure subtest		--	.230	.290	**.357***
3. Woodcock-Johnson III Tests of Achievement (WJTA III) Picture Vocabulary subtest			--	**.360***	**.485****

4. Test of Narrative Language (TNL) Narrative Comprehension subscale	--	--
5. Test of Narrative Language (TNL) Oral Narration subscale	--	--

Research Question 4: Narrative Microstructure Measures

MLU and Total Number of Utterances. Combining three transcribed narrations from each participant, MLU in morphemes was calculated for CHH (M = 8.37, SD = 1.37) and CNH (M = 8.29, SD = 1.22). Similarly, the average total number of utterances for three stories was calculated for CHH (M = 41.58, SD = 17.01) and CNH (M = 46.25, SD = 20.56). No significant difference was found between groups on measures of MLU or total number of utterances.

High-Frequency Morpheme Performance. Narrative transcripts were analyzed to calculate the percentage of high-frequency morphemes that were omitted in obligatory contexts. Only high-frequency morpheme omissions, and not incorrect morpheme productions, were included in the analysis. CHH had a significantly higher percentage of omitted high-frequency morphemes in their stories than CNH, $t(167.3) = 2.45$, $p = .02$, $d = .276$.

DISCUSSION

Previous research has found that CHL as a whole lag behind their NH peers in narrative ability. The current study aimed to examine narrative ability and its underlying mechanisms specifically in children with mild-to-moderate hearing loss. The ability to effectively comprehend and produce a story is one of the most common forms of language discourse, and is highly predictive of a child's literacy development. Identifying that CHH struggle with aspects of the narrative task will lead to more prompt speech and language services that supplement narrative skill development and, in turn, fortify their path to academic success.

Research Question 1: Narrative Skills in Children who are Hard of Hearing Compared to Children with Normal Hearing

Our first research question examined narrative comprehension and production skills in CHH. We found that CNH performed significantly better on narrative comprehension tasks than CHH. This difference was consistent with our prediction that CHH would have more difficulty on receptive aspects of the narrative task than CNH. Our finding was also consistent with Jones et al. (2016), who found that CHL scored more poorly on a narrative comprehension task than their NH peers. We also found the difference between CNH and CHH on narrative production tasks to be marginally significant.

Most of the current literature on narrative ability in CHL focuses on either narrative skills as a whole, or just production aspects of the task (Boons et al., 2013; Reuterskiöld et al., 2010; Soares et al., 2010). Our findings suggest that receptive abilities involved in the narrative task may be more vulnerable in CHH than narrative production skills. Narrative comprehension requires the ability to make inferences about characters, their motives, and their perceptions of events that happen in a story. This understanding that each person has their own thoughts, beliefs, and motives, and the ability to make inferences about those attributes in others, is referred to as theory of mind (Premack & Woodruff, 1978). One major component of theory of mind is false belief understanding, which involves the ability to hold separate representations in one's mind about what another person *thinks* about an event versus the reality of the event (Walker, Ambrose, Oleson, & Moeller, 2017). In a study examining false belief understanding in CHH, Walker et al. (2017) found that preschool-age CHH demonstrated delays in false belief compared to their NH peers, and these delays were not resolved in all CHH by second grade. As adequate narrative comprehension requires many cognitive abilities encompassed by theory of

mind, weaker false belief development would explain why CHH struggle on aspects of narrative comprehension compared to CNH. In order to support strong narrative skill formation, and therefore steady literacy development and academic achievement, clinicians should take measures to ensure that CHH not only produce narratives that are comparable to their NH peers, but also sufficiently understand the events in a story and their implications for each character.

Research Question 2: Impact of Degree of Hearing Loss on Narrative Skills

The second research question aimed to explore the impact of degree of hearing loss on narrative skills. We found that CNH performed significantly better than children with severe hearing loss on both comprehension and production tasks, and children with moderate hearing loss performed significantly better than children with severe hearing loss on production tasks. Little research exists on narrative performance as a product of degree of hearing loss. Those studies that have examined the impact of auditory access on narrative ability provide mixed results. While some studies have found that auditory skills and speech perception scores correlate with narrative ability scores (Klein & Wie, 2014; Crosson & Geers, 2001), Jones et al. (2016) found no relationship between pure-tone average and narrative performance. In the current study, there was a clear decline in narrative performance between the children with the best auditory access (CNH) and those with the poorest auditory access (children with severe hearing loss) which was consistent with our prediction, but this decline was not necessarily linear.

As a group, children with moderate hearing loss performed more closely to CNH than children with mild hearing loss. Though the difference between CNH, children with mild hearing loss, and children with moderate hearing loss did not reach significance in this study, a trend of children with mild hearing loss performing more poorly than children with moderate hearing loss emerged. We speculate that children with mild hearing loss may be less likely to receive

sufficient audiologic and speech/language services due to the reduced severity of their hearing loss. Children who have a moderate hearing loss may be more readily prioritized for services, therefore outperforming their peers who have more residual hearing because of the extra support they receive.

Research Question 3: Influence of Working Memory, Grammar, and Vocabulary Skills on Narrative Performance

Our third research question explored the underlying mechanisms that could be involved in narrative skill development. We found that working memory, grammar, and vocabulary were all associated with narrative performance, accounting for a significant proportion of the variance in comprehension and production. Grammar and vocabulary independently contributed to narrative skills in CHH, while only vocabulary contributed to narrative skills in CNH. Our findings suggest that different underlying mechanisms may influence narrative performance differently for CHH than CNH.

Research Question 4: Narrative Microstructure Measures

In addition to examining narrative macrostructure, we also examined measures of narrative microstructure between groups. There was no significant difference on measures of MLU or total number of utterances for CHH and CNH. CHH omitted a significantly higher percentage of high-frequency morphemes in their narratives than CNH. This finding parallels with previous research that suggests that CHH are at-risk for poor morphosyntactic development due to limited auditory access to high-frequency information (Stelmachowichz, Pittman, Hoover, & Lewis, 2002; Worsfold et al., 2010). Clinicians should keep this limited morphological access in mind and work to make morphological markers salient to CHH. In order to maximize CHH's potential for morphosyntactic development, audiologists should program hearing aids to give

CHH the best possible access to high-frequency input. Additionally, speech-language pathologists should keep high-frequency morphemes in mind as they work with CHH. Speaking with extra emphasis on the ends of words with high-frequency morphemes, and even using visual cues, will help to make these morphological markers more salient to CHH.

Limitations and Implications for Future Research

It is worth noting that the majority of participants from the current study were from higher socioeconomic backgrounds than the average U.S. population. Standardized measures such as the TNL, however, are typically created with a more deliberate approach to provide normative data that is representative of the general population, including socioeconomic status. This is important to keep in mind when interpreting the data represented in Figures 1, 2, and 3. It is well established that children from higher socioeconomic backgrounds can be expected to have higher language outcomes (Calvo & Bialystok, 2013). While CHH from the current study generally scored within the average range on TNL subscales, their potential for narrative language performance may be higher, as reflected by the performance of their NH peers who were matched on socioeconomic status.

Though we found no statistically significant differences between narrative performance in CNH, children with mild hearing loss, and children with severe hearing loss, a non-linear trend emerged in relation to degree of hearing loss and narrative ability. We hypothesize that the amount of speech, language, and audiology services that each hearing loss group receives, on average, could influence their narrative language outcomes. Future research should investigate the amount of services received compared to language outcomes in children with varied degrees of hearing loss.

The current study found that working memory, grammar, and vocabulary may play different roles in narrative development of CHH and CNH. These mechanisms all certainly play a role in higher-level language discourse such as narratives, though a better understanding of which factors uniquely contribute to narrative skill development will guide clinicians in creating effective and efficient interventions for narratives (Botting, 2010). Future research should further investigate the role of working memory, grammar, and vocabulary in narrative development.

In examining measures of narrative microstructure, the current study utilized MLU and total number of utterances. Previous research suggests that MLU is a reliable measure of linguistic complexity up until age 4, after which children's sentence length relies more heavily on the nature of their interactions than their knowledge of grammatical structures (Rice, Redmond, & Hoffman, 2006). Similarly, Rice (2006) suggests that when comparing groups, sample sizes of at least 175 utterances should be used in order to preserve the integrity of the group match. Future research examining narrative microstructure performance in CHH should utilize more sensitive indices of language performance.

Conclusion

As a group, CHH demonstrated delays in narrative ability compared to their NH peers, specifically in narrative comprehension. When working with CHH, clinicians should target narrative language skills during intervention. In particular, clinicians should focus on developing narrative comprehension ability and making high-frequency morphological markers accessible and salient. Additionally, narrative ability may be strengthened by targeting related skills, such as grammar and vocabulary. Improving narrative language outcomes in CHH will not only improve their quality of storytelling, but will also promote literacy development and optimize their potential for academic success.

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